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July 11, 2019

Via Electronic Filing

OREGON PUBLIC UTILITY COMMISSION
ATTENTION: FILING CENTER
PO BOX: 1088
SALEM OR 97308-1088

RE: Docket No. UG 366 – In the Matter of AVISTA CORPORATION, dba AVISTA UTILITIES, Request for a General Rate Revision.

Enclosed for electronic filing are Staff Testimony in Support of partial Stipulation, Certificate of Service and UG 366 Service List.

Exhibits 1100 to Exhibits 1113:

Exhibits 1100, Confidential pages are from 49 to 52
Exhibits 1103, Exhibits 1111 and Exhibits 1112 are confidential.
Confidential exhibits will be mailed to parties who have signed Protective Order No. 19-091.

Exhibits 1104, 1105, 1107, 1108, and 1109 are Excel spreadsheets and are filed as electronic version. A printed copy is included for viewing.

With Avista's approval, this voluminous filing of both confidential and non-confidential will be uploaded to Huddle by close of business today.

/s/ Kay Barnes

Kay Barnes
PUC- Utility Program
(503) 378-5763
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CERTIFICATE OF SERVICE

UG 366

I certify that I have, this day, served the foregoing document upon all parties of record in this proceeding by delivering a copy in person or by mailing a copy properly addressed with first class postage prepaid, or by electronic mail pursuant to OAR 860-001-0180, to the following parties or attorneys of parties.

Dated this 11th day of July, 2019 at Salem, Oregon

Kay Barnes

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UG 366
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CASE: UG 366
WITNESSES: MATT MULDOON & MOYA ENRIGHT

PUBLIC UTILITY COMMISSION OF OREGON

STAFF EXHIBIT 1100
Cost of Capital and Financial Hedging

Staff Testimony in Support of Partial Settlement Stipulation

REDACTED
July 11, 2019

Q. Please each state your name and occupation.

A1. My name is Matt Muldoon. I am a Senior Economist for the Public Utility Commission of Oregon (Commission or OPUC).

A2. My name is Moya Enright. I am an analyst for the OPUC.

Q. What is your common business address?

A. 201 High Street SE, Suite 100, Salem, OR 97301.

Q. Please describe your educational background and work experience.

A. Our educational background and work experience are set forth in our respective Witness Qualification Statements, provided as Exhibits Staff/1101 and Staff/1102.

Q. What is the purpose of this testimony?

A. We are responsible for the analysis of four Cost of Capital (CoC) issues in Docket No. UG 366 Avista Corporation (Avista, AVA or Company):

1. Capital Structure;
2. Cost of Common Equity, also known as Return on Equity (ROE);
3. Cost of Long-Term (LT) Debt; and
4. Independent Third Party Review of Avista's Financial Hedging Program.

Q. What is your summary recommendation?

A. Staff concurs with All Parties[1] in the partial settlement as shown herein in recommending a balanced capital structure of 50.0 percent equity and 50.0 percent LT Debt, a point ROE of 9.40 percent, and a 5.07 percent cost of LT

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1 Parties to the Partial Stipulation are Avista, Staff, the Oregon Citizens' Utility Board (CUB), and the Alliance of Western Energy Consumers (AWEC), collectively (Parties).

Debt. Parties differed on best range of reasonable ROEs but converge to recommend said point ROE. When Staff discusses a range of reasonable ROEs hereafter, it only illustrates how Staff's modeling supports the Parties' compromise agreement.

Q. Did you prepare tables showing Avista's current, Avista's-earlier proposed and the Staff calculated CoC?

A. Yes, the following three tables provide that information.

Table 1

AVA Current OPUC Authorized (UG 325 Order No. 17-344)			AVA
Component	**Percent of Total**	**Stipulated or Implied Cost**	**Weighted Average**
Long Term Debt	50.00%	5.300%	2.650%
Preferred Stock	0.00%	0.00%	0.000%
Common Stock	50.00%	9.40%	4.700%
	100.00%		**7.350%**

Table 2

AVA Requested – UG 366		AVA Direct Testimony		
Component	**Percent of Total**	**Cost**	**Weighted Average**	**ROR vs. Current**
Long Term Debt	**50.00%**	**5.20%**	2.600%	**0.200%**
Preferred Stock	0.00%		0.000%	
Common Stock	**50.00%**	**9.90%**	4.950%	
	100.00%		**7.55%**	

Table 3

Staff Settlement – UG 366		**Settlement**		
Component	**Percent of Total**	**Cost**	**Weighted Average**	**ROR vs. Current**
Long Term Debt	**50.0%**	**5.070%**	2.535%	**-0.115%**
Preferred Stock	0.00%		0.000%	
Common Stock	**50.0%**	**9.40%**	4.700%	
	100.00%		**7.235%**	

Q. Have you issued data requests (DRs) in this rate case?

A. Yes. Our CoC analysis is informed by Company responses to 63 multipart DRs.

Q. How is your testimony organized?

A. Our testimony is organized as follows:

Q. Did you prepare exhibits in support of your opening testimony?

A. Yes. Staff prepared the following exhibits:

Staff/1103 .... **CONFIDENTIAL** Capital Structure
Staff/1104 .... Staff Three-Stage DCF Peer Screening
Staff/1105 .... Staff Three-Stage DCF ROE Modeling
Staff/1106 .... Long Run 10-30 Year Gross Domestic Product (GDP) Growth

Q. Does Staff support the Stipulated Terms on CoC?

A. Yes. The Stipulated Terms mirror Staff's analysis, other than rounding. Therefore, Staff recommends that the Commission adopt the Stipulated Terms on CoC.

ISSUE 1 – CAPITAL STRUCTURE

Q. What is the basis for your recommendation for a capital structure of 50.0 percent Common Equity and 50.0 percent LT Debt?

A. Staff has examined actual and projected information provided by Avista in Exhibit Staff/1103 in response to Staff DR 38 in addition to Staff analysis and review of Bank of America Merrill Lynch (BAML) and Avista's Annual Shareholder's Meeting of May 9, 2019 data. Staff finds that the stipulated 50 percent common equity capital structure is consistent with a Commission Preferred balanced capital structure.[2]

Q. How has the Commission viewed capital structure?

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2 *See* as an example Commission discussion of equity structure in the floatation of PGE Stock after the Enron Bankruptcy.

A. The Commission has generally accepted that a capital structure with 50 percent common equity and 50 percent LT Debt balances the lower cost of borrowing against the credit enhancement represented by equity.[3]

Given that the actual and projected values for capital structure are consistent with Commission precedent, Staff recommends that the Commission find a 50 percent common equity capital structure reasonable.

ISSUE 2 – COST OF COMMON EQUITY (ROE)

Q. What point ROE within what range of reasonable ROEs does Staff recommend?

A. Staff recommends, as do the other Parties, a point ROE of 9.40 percent at the top of a range of reasonable ROEs of 8.80 to 9.35 percent. Although the ROE of 9.40 represents the upper limit rounded up, in the broader context of this rate case, especially considering other factors addressed simultaneously, Staff finds this settlement to be reasonable.

Q. Does your recommended ROE meet appropriate standards?

A. Yes. The 9.40 percent ROE Staff recommends meets the *Hope* and *Bluefield* standards, as well as the requirements of Oregon Revised Statute (ORS) 756.040.[4] Staff recommendations are consistent with establishing "fair

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[3] Moody's announced this sweeping change of Outlooks to Negative from Stable for 25 utilities on January 19, 2018. See "For Spire Missouri, State Regulator's Rate Case Order is Credit Positive" by Jeffrey Casella, VP and Senior Analyst of Moody's released by Moody's on March 1, 2018, explaining how Moody's expects the effect from the recent changes in US tax laws will reduce the ratio of cash flow from operations pre-working capital to debt.

[4] *See Federal Power Commission v. Hope Natural Gas Co*., 320 U.S. 591 (1944) and *Bluefield* Water *Works & Improvement Co. v. Public Service Commission of West Virginia*, 262 U.S. 679 (1923).

and reasonable rates" that are both "commensurate with the return on investments in other enterprises having corresponding risks" and "sufficient to ensure confidence in the financial integrity of the utility, allowing the utility to maintain its credit and attract capital."[5]

Q. Do Staff and the Company agree in this regard?

A. Yes. Staff and the Company apply the same legal standards. While the Company and Staff may disagree on what range of ROEs is reasonable, all Parties agree that the 9.40 percent point ROE is appropriate. Staff finds this ROE commensurate with that of other peer utilities and other investment opportunities with risk exposure similar to Avista's. When investors' expected rate of return is measured using a reasonable expectation of long-term growth and when risk is measured using an appropriate peer group of utilities, the resulting 9.40 percent ROE can be supported.

Q. What is the primary contributing modeling that supports Staff's recommended 9.40 percent point ROE?

A. Staff's two different three-stage discounted cash flow (DCF) models are the primary foundation for Staff's recommended point ROE.

Q. Did you perform indicator modeling as a general check on this recommendation?

A. Yes. Staff used Single-Stage DCF Modeling, Capital Asset Pricing Modeling (CAPM), and Risk Premium Modeling (RPM) analysis as general indicators

[5] *See* ORS 756.040(1)(a) and (b).

that the proposed 9.40 percent ROE is neither excessively generous nor impairing of the Company's access to financial markets. To keep this testimony in support fairly concise, Staff testimony in support will show how Staff's two primary comprehensive models support the Parties recommended 9.40 percent point ROE for Avista, are further corroborated through use of a Risk Premium Model reasonableness check on the results of Staff's more robust model outputs.

WHAT IS NEW IN THIS RATE CASE

Q. What is new in the financial landscape since the Company's last general rate case?

A. Exhibit Staff/1113 will illustrate the dramatic changes in financial market perspectives over the last year. Highlights include:

Tax Reform Stimulus to Growth Was Muted: The Tax Cuts and Jobs Act (Tax Reform) passed into law at the end of 2017 had the potential to dramatically boost American Gross Domestic Product (GDP) growth for perhaps five years before tapering off. Had tax savings and international earnings returning to the U.S. been invested in research and development, new plant and equipment, deployment of updated technologies and worker training, there was the potential for development of significant American competitive advantage in global markets going forward.

Unfortunately the primary use of windfall cash flows by corporations was stock buybacks at near all-time high stock prices. Further given expectation of slowing global growth and trade uncertainties, many companies were more cautious than earlier expected in making new business investments. The result was a short period of moderately high GDP growth that is now expected to slow over the next two years.[6]

Aging Population, Families, and Immigration: There is still considerable worry about families deciding to delay having children as working people age. That trend has been possibly exacerbated by uncertain immigration policies. Over the next 20 years, those children and immigrants not now present will not be working. The U.S. has also not made significant progress in creating immigration policy that is supportive of long-run U.S. GDP growth.

Productivity: Companies did not fully use the tax break to invest in new plant, equipment, software, and processes making each U.S. worker more productive and more competitive globally. The aging of America and cautious decisions of individual families and companies are depressing future potential GDP growth rates over the next 20 to 30 years.

U.S. Federal Reserve (Fed) Rate <u>Decreases</u>: Central banks of the world reversed policy in the last year and are now supporting easy-to-borrow money at historically low interest rates and continuing to rollover maturing securities on central bank balance sheets into more purchases of treasuries, bonds, and other securities. The Fed has decided that the neutral or natural equilibrium rate to target for a balanced economy should now be lower than targeted by

[6] *See* Exhibit Staff/1113 for news elaborating on these topics.

the Fed before the 2009 financial crisis. And central banks are now discussing cutting rather than raising, interest rates.

Q. What are the implications of recent market trends for utilities?

A. Contrary to what one might expect, the biggest risk to utility prosperity comes not from global uncertainties, but rather from other parts of the economy (that carry greater risks but offer greater returns) starting to do better and appearing to have sustainable momentum toward higher returns. Global uncertainties see investors rush back into safe havens like UST and their (in many ways more attractive) proxy U.S. Investor Owned Utility (IOU) stocks with dividend yields higher than UST. While sectors of the S&P 500 Stock Index most associated with growth have seen falling stock prices, utilities without extraordinary company specific challenges have market leading returns for 2019.

Q. Are interest rates, dividends and ROE's certain to rise?

A. No. Market consensus can change with any new information. Fortunately U.S. utilities fare quite well in times of modest global uncertainties.

Q. What is the implication for the Commission?

A. Since about 1990, the Commission has seen a long decline to authorized ROEs with substantial lag both due to some utilities delaying coming in for a rate case and a possible preference by regulatory commissions for a gradual and smooth process. Nationally that downward trend will continue until most utilities have come in for rate cases.[7] There may also be a downward pressure on ROEs while incremental new LT Debt issuances lower the overall Cost of LT Debt. That latter pattern could be broken when issuing new debt at prevailing market rates increases the overall Cost of LT Debt. In this context, the All Parties' proposed 9.40 percent point ROE is consistent with national trends.

OVERVIEW OF STAFF ROE POSITION

Q. Describe the analysis underlying Staff's ROE recommendation.

A. Staff continues to rely primarily on two different three-stage DCF models[8] applied using a cohort group of peer utilities to estimate the expected return on common equity required by the Company's investors. We compare the results of our three-stage DCF analysis with national recently-decided gas utilities' authorized ROE values as a check on the reasonableness of our ROE estimates. We rely on Simple DCF and CAPM models as directional vectors for a rough check (acknowledging their shortcomings) on the results from our two separate three-stage DCF models.

Q. What are the results of your multistage DCF models?

A. Please see Table 4 below drawn from Exhibit Staff/1304 Muldoon, Enright/1

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7 See news in Exhibit Staff/1113 illustrating this trend.

8 *See* the Commission's discussion of multistage versus single-stage DCF models in Order No. 01-777 at page 27.

Table 4[9]
Results of Staff's 3-Stage DCF Modeling
(See Exhibit No. Staff/1304 for more detail)

Common Stock Flotation Costs Adjustment Shifts Range of Reasonable ROE's Upward by :					12.5	bps
Range of Modeled Results		8.26%	to	9.35%	ROE	
		Midpoint	8.80%			
Best Fit Range of Reasonable ROEs		8.80%	to	9.35%	ROE	
(Best fit is Staff's Hamada adjusted screened gas utilities that have most similar characteristics to AVA regulated gas operations in Oregon)						
		Midpoint	9.1%	ROE		
Staff Point ROE Recommendation:						
Settlement		Top	9.4%	ROE		
Risk Premium Model (RPM) separetely discussed - used as a control points to the top of Staff's modeling results.						

Q. How do these estimated ROE values compare with gas utilities' national ROE values for 2018 General Rate Cases?

A. These estimated ROEs are consistent across the northwest, but low compared with average 9.59 percent median ROE for U.S. regulated natural gas utilities' authorized return on equity capital decided in 2018 as reported by Regulatory Research Associates (RRA) an affiliate of S&P Global Market Intelligence (SPG).[10] S&P Global Market Intelligence notes that Local (Natural Gas) Distribution Companies (LDC) tend to track the electrics, but at a 10 basis points (BPS) lower ROE level.

Much of the country including all of the Greater Northwest, including Oregon, Washington, Idaho, Montana, Utah, and Wyoming, is in line with Staff's recommended 9.40 percent point ROE for Avista.[11]

Q. Did your analysis reflect a synthetic forward curve?

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9 U.S. Treasury Inflation-Protected Securities is abbreviated as "TIPS".

10 *See* Average Electric, Gas ROE Authorizations Continue Downward Trend, dated March 28, 2019 in Exhibit Staff/1313.

11 *See* Exhibit Staff/205 in Docket No. UG 344 Northwest Natural general rate case.

A. Yes, Staff utilized synthetic forward curve using UST Treasury Inflation Protected Securities (TIPS) break-even points.[12] This reflects implied market-based inflationary expectations. Staff's recommendations are consistent with market activity indicating investor expectations of future inflation.

Staff assumes for purposes of its three-stage DCF modeling that LDC utility growth is bounded by the growth of the U.S. economy and more specifically impacted by challenges regarding U.S. population and productivity in the long-run (20-year) modeling period.

Q. Assume one presumed that future U.S. GDP growth would look like the past 30 years. Would a ROE based on that assumption still fall within Staff's recommended range?

A. Yes, Staff extracted and ran regression on data from U.S. Bureau of Economic Analysis (BEA) to generate the annual real historical GDP growth rate shown in Table 4 above. Staff recommended range of ROEs includes values that presume GDP growth over the next 30 years would look like that of the past 30 years informed by other federal projections.

Q. Do you show this analysis in your exhibits?

A. Yes. Exhibit Staff/1307 shows our analysis in support of this finding.

Q. How do your methods employed in this case differ from those utilized by Staff in recent general rate cases?

[12] See Exhibit Staff/1108.

A. Staff's methods and modeling parallel those employed by Staff in recent general rate cases, with the exception that we spent more time in this case working with a Risk Premium Model to check Staff's results from three-stage Discounted Cash Flow (DCF) models.

Q. Describe the two three-stage DCF models on which you primarily rely.

A. Staff's first model is a conventional three-stage discounted dividend model, which Staff denotes as a "30-year Three-stage Discounted Dividend Model with Terminal Valuation based on Growing Perpetuity" (referred to as "Model X"). This model captures the thinking of a money manager at a pension fund or insurance company, or other institutional investor, who expects to keep the Company's stock indefinitely and use the dividend cash flow to meet future obligations.

Staff's second model is the "30-year Three-stage Discounted Dividend Model with Terminal Valuation Based on P/E Ratio" (referred to as "Model Y"). This model best fits the investor who has a goal they are working towards. In addition to the income stream from dividends, this investor intends to sell the stock as the goal is reached.

Both models require, for each proxy company analyzed by Staff, a "current" market price per share of common stock, estimates of dividends per share to be received over the next five years calculated from information provided by Value Line, and a long-term growth rate applicable to dividends 10- to 30-years out. On this last point, Staff always recommends the Commission be particularly vigilant for any substitution of a short-term growth rate for a long-term 20- to 30-year growth rate. Some growth rates labeled "long" may be supported by information looking at the next ten years or less into the future.

For a smooth transition, Staff steps the rate of dividend growth between the near-term (the next five years) and that of long-run expectations.

Q. How does Model X calculate the terminal value of dividends as a perpetual cash flow into the future?

A. Model X includes a terminal value calculation, in which Staff assumes dividends per share grow indefinitely at the rate of growth in Stage 3 ("growing perpetuity"). In contrast, Model Y terminates in a sale of stock where the price is determined by our escalated price/earnings (P/E) ratio.

Q. Why is thirty years the primary horizon for financial decision-making?

A. Investors focus on the 30-year U.S. Treasury (UST) Bond against alternate investment opportunities. Thirty years is a generally accepted period for economists to ascribe to one generation. It is a common length of time for mortgages of plants, equipment, and homes. Many institutional holders of utility securities match the cash flows from utility dividends to future obligations such as the payout of life insurance, preparing to meet future pension and post-retirement obligations, and interest service for borrowing. Individuals plan for the education of their children, ownership of their home, and provision for their retirement on this same multi-decade timeframe.

Staff uses five years for Stage One as that is the timeframe for which Value Line estimates of future dividends are available. This is as far as Value

Line projects near-future trends. We use five years for Stage Two as a reasonable length of time for individual companies' dividend growth rates that are materially different from the growth rate used in Stage Three (and common to all companies) to converge to a LT dividend growth rate more representative of all gas utilities.

Q. How do you address dividend timing?

A. Each model uses two sets of calculations that differ in the assumed timing of dividend receipt. One set of calculations is based on the standard assumption that the investor receives dividends at the end of each period.

The second set of calculations assumes the investor receives dividends at the beginning of each period. Each model averages the unadjusted ROE values to generate an Internal Rate of Return (IRR) produced with each set of calculations for each peer utility. This approach accounts for the time value of money, closely replicating actual quarterly receipt of dividends by investors.

Q. What accounts for differences in peer capital structures?

A. Each model employs the Hamada equation[13] to calculate an adjustment for differences in capital structure between each peer utility and the Avista-proposed and Staff-assumed capital structure for the Company.[14] When few

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[13] Dr. Robert Hamada's Equation as used in Staff/1304 separates the financial risk of a levered firm, represented by its mix of common stock, preferred stock, and debt, from its fundamental business risk. Staff corrects its ROE modeling for divergent amounts of debt, also referred to as leverage, between the Company and its peers.

[14] Staff has described this adjustment in recent cost of capital testimony. *See*, as an example, Staff's description in the Matter of Idaho Power Company, Request for General Rate Revision Docket UE 233 Exhibit Staff/800, Storm/54-57 (December 7, 2011).

peer utilities are available, the Hamada equation ensures Staff's analysis addresses differences in peer utility capital structures.[15]

Q. Did recent tax changes impact Hamada adjustments?

A. Yes. Staff relies on the 2018 prevailing 21 percent corporate tax rate, except where Value Line (VL) has more specific forward looking information, causing our point ROE recommendation of 9.4 percent to roll-in slightly upward pressure from tax reform effects.[16]

Q. What price do you use for each peer utility's stock?

A. Staff used the average of closing prices for each utility from the first trading day in January, February, and March 2019, to represent a reasonable snapshot of utility stock prices.

Q. How do Staff's two DCF models differ?

A. Model X uses the calculation of a growing perpetuity as part of the terminal valuation. This may be the most common approach used in multistage DCF models.

Model Y uses the current price-earnings (P/E) ratio[17] multiplied by the estimated "earnings per share" (EPS), which establishes the stock's "selling price" for terminal valuation. Staff estimates the terminal EPS analogously with methods used to estimate the final dividend in both models; i.e., based

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15 See Exhibit Staff/1104.

16 See Value Line data sheets in Exhibit Staff/1110.

17 "Current" in this context means the price obtained, as previously described, divided by VL's estimated EPS; i.e., it is a forward P/E, not an historical P/E.

on Value Line (VL) estimates to which multiple growth rates are sequentially applied.

Q. What is the purpose of Model Y?

A. Staff includes this model as a method by which to incorporate the fact that most companies have estimates of future EPS and future dividends growing at different rates. Utilizing EPS that grows on a separate trajectory than dividends is the foundation for an alternative means of terminal valuation.[18]

Q. To recap, do you capture both the perspective of a buy and hold investor and an investor who plans to sell in the future?

A. Yes. The stipulated 9.40 percent point ROE is consistent with findings modeling the perspectives of both types of investors through Staff's two different three-stage DCF models.

GROWTH RATES

Q. Please explain the use of growth rates in the estimation of ROE.

A. The estimated rate of growth of future dividends is a very important input. Staff refer specifically to the singular growth rate for constant growth DCF models and the long-term growth rate for multistage DCF models such as Staff's two types of three-stage DCF modeling.

Q. What long-term growth rates did you use in Staff's two three-stage DCF models?[19]

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18 Please note that the approach used in this second model is not the same as using a singular estimate of the growth rate in EPS as the growth rate in dividends.

19 Methods used here related to GDP-based growth rates are similar, if not identical to methods Staff has used in past proceedings. *See*, as an example, Staff's discussion of these methods

A. Staff used three different long-term growth rates, with different methods employed in developing each.

The first method uses the U.S. Congressional Budget Office's (CBO) 4.0 percent nominal 20-year GDP growth rate estimate.[20]

Staff's second Composite Growth Rate applies a 50 percent weight to the average annual growth rate resulting from estimates of long-term GDP by the U.S. Energy Information Administration (EIA), the U.S. Social Security Administration, PricewaterhouseCoopers estimate for long-run (10- to 30-years from now), and the CBO, with each receiving one-quarter of that 50 percent weight.[21] The remaining 50 percent is the average annual historical real GDP growth rate, established using regression analysis, for the period 1980 through 2017 calculated as shown in Staff/1308, Muldoon Watson/1, to which we apply the TIPS inflation forecast discussed above.

Staff's third "Near Historical" Stage 3 annual growth rate, is an equal weighted average of the earlier described U.S. Bureau of Economic Analysis (BEA) derived projection which presumes the future will look much like the past. Table 5 below captures LT GDP growth rates Staff used.

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and, to a limited extent, their conceptual underpinnings in Docket. UE 233, Exhibit Staff/800, Storm/46 – 52.

20 *See* Staff/1304 for these growth rates.

21 The EIA is the Energy Information Administration within the U.S. Department of Energy (DOE), OMB is the Office of Management and Budget, and CBO is the Congressional Budget Office. EIA and OMB's estimates are of nominal GDP. We applied to CBO's estimate of real GDP as an inflation rate for the relevant timeframe developed using the Treasury Inflation-Protected Securities (TIPS) method described by Staff in testimony in multiple recent general rate case proceedings.

Table 5 – Long-Run GDP Growth Rates Used in Staff's ROE Modeling

Stage 3 – Long-Term Annual Dividend and EPS Growth Rates					
Component	Real Rate	TIPS Inflation Forecast	20-Yr Nominal Rate	Weight	Weighted Rate
Energy Information Administration	2.00%	1.99%	4.03%	12.50%	0.50%
PricewaterhouseCooper	1.80%	1.99%	3.83%	12.50%	0.48%
Social Security Administration	2.20%	1.99%	4.23%	12.50%	0.53%
Congressional Budget Office			4.00%	12.50%	0.50%
BEA Nominal Historical,1980 Q1 – 2018 Q4	2.76%	1.99%	4.80%	50.0%	2.40%
Composite				100%	4.41%
Congressional Budget Office Long-Term 20-Year Budget Outlook			4.00%	100.0%	4.00%
BEA Nominal Historical,1980 Q1 – 2018 Q4	2.76%	1.99%	4.80%	100.0%	4.80%

Q. Does this approach capture a reasonable set of investor expectations similar to Staff's analysis in other recent general rate cases?

A. Yes, Staff modeling captures the expectations of investors who think that: A) the non-partisan CBO is reliable, B) blended federal agency expert analysis also informs the historical track record, and C) one should be optimistic about the economy's long-run growth, provided there are still enough non-retired adult Americans to make it happen 20 years from now.

Q. Is it appropriate to use estimates of long-term GDP growth rates to estimate future dividends for gas utilities?

A. Yes. In many of the Company's prior rate cases, Staff has shared plots of U.S. gas demand growth since 1950 on a three-year moving average. This downward trending consumption curve allows GDP growth to be a conservative proxy for both gas sales and dividend growth rates.

Q. Can relying on a long-term GDP growth rate overstate required ROE?

A. Yes. It is possible that Staff modeling anticipates greater growth than may be realized and so overstates required ROE to attract investors. Our highest growth rate presumes return to near historical U.S. GDP growth rates.

Q. Is it important to distinguish between long-run 20- to 30-year rates and rates over the next five years?

A. Yes. Over-extrapolating a snapshot of short-term data undermines confidence in modeling results. For example, Value Line, Blue Chip, and a variety of other financial resources focus most on the next five years. The next five years may be affected by recent events. We have had a tax cut, rising interest rates that prompted many companies to raise dividends more than usual, and we are coming out of a market downturn wherein one might expect a bit of a jump. But that jump or boost does not happen every year forever. Over the long run, <u>people and productivity</u> are the key drivers of economic growth.

Q. Is Avista growing faster or slower than the rate of the overall economy?

A. Nationally, there is a persistent increase in energy efficiency and a durable downward slope or decline in usage of both electricity and natural gas per residential customer. Giving the Company benefit of doubt, Staff presumes that Avista may be growing as fast as, but no faster than the U.S. economy.

Q. In Staff's two different three-stage DCF models, Staff is looking for growth rates for a period between 10 and 30 years in the future, or an

average of 20-years out. Why can't Staff just use a 5- or 10-year projection?

A. Staff could, but there is better information available. If a primary concern is whether enough Americans are both working and highly productive 20 years from now to support a robustly growing economy, 10-year data is not yet impacted by retirement of persons born in 1960 or persons not immigrating and not being born to U.S. families now. A better solution is to use data that is projected with those difficulties in mind.

<u>PEER SCREEN</u>

Q. How did you select comparable companies (peers) to estimate NW Natural's ROE?

A. Staff used companies that met the following criteria as peer utilities to the regulated gas utility activities of Avista:

1. Covered by Value Line (VL) as a gas utility;
2. Forecasted by VL to have positive dividend growth;
3. LT Issuer Credit Rating equal to or better than BBB- from S&P, or Baa3 from Moody's;
4. No decline in annual dividend in last four years based on VL;
5. Has heavily regulated gas LDC revenue;
6. Has LT Debt under 56 percent in VL Capital Structure; and
7. Has no recent merger and acquisition activity.

Q. What cohort of companies resulted from your screens?

A. Please see Exhibit Staff/1104 for detailed Staff screens and also for a table that shows the list of peer utilities obtained from Staff screens.

Q. Why do you eliminate companies that are not forecasted to have positive dividend growth?

A. Our screening is consistent with Staff past practice. There is evidence that investors find common stock of dividend-cutting utilities much less attractive. General Electric Co. (GE) is the latest example of why a company does not cut long standing gradually growing quarterly dividends.[22] GE lost more than half of its stock value while the Standard and Poor's 500 rose sharply.

Q. Why does Staff exclude utilities engaged in merger activities?

A. Mergers can mean great change in both the acquiring and the acquired companies over time. Before the merger, both the target and the purchasing companies may have had regular patterns of management and performance, in part reflective of employees, executives, and board members acting consistent with a given corporate culture and identity. A merger can be a break from those prior patterns.

Merger uncertainties can involve changes to computer systems, changes in management focus, changes in staffing, different attitudes about risk, and many new initiatives that may or may not succeed. Even when the acquiring company announces it intends to preserve continuity, mergers can bring material changes as different corporate cultures collide.

Staff excludes from its sample of peer utilities those engaged in merger activities for which the current and near-term (five-year) Value Line

[22] *See* Avista General Rate Case UG 347, Exhibit Staff/1310 Muldoon Watson/60 for more about the precipitous GE stock plunge after cutting dividends.

projections are possibly reflective of the potential for merger rather than typical utility operations. Staff also excludes utilities whose operations are substantially unregulated as they are not representative of Avista's LDC operations.

Q. Did Staff's peer group for three-stage DCF modeling reasonably address peer utility capitalization size?

A. Yes. Most of Staff's peer group is the small to mid-cap market capitalization size like Avista.[23] Staff therefore makes no adjustments for capitalization size in its three-stage DCF modeling.

HAMADA EQUATION

Q. Your application of the Hamada Equation to un-lever peer utility capital structures and to re-lever at Avista's target capital structure increases required ROE. Why is this adjustment reasonable?

A. Staff employs the Hamada Equation as a check on the reasonableness of its modeling results. This allows Staff to better compare companies with different capital structures driven by differing amounts of outstanding debt. As earlier discussed, our screening criteria already identify peers that have a very close capital structure to the Company. Use of the Hamada adjusted results helps ensure that Staff has captured all material risk in our analysis because it captures additional risk associated with varying capital structure.

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[23] *See* Exhibit Staff/1304.

Within the confines of Staff's testimony, one can see the steps to un-lever and re-lever a peer company's capital structure as the equivalent of removing debt of peer companies with varying capital structures, and then adding enough debt back to equal Avista's balanced target capital structure in this general rate case.

INFORMED STAFF ANALYSIS

Q. Did Staff take into account information from other models?

A. Yes. Staff performed CAPM modeling and Simple DCF modeling, and reviewed the Company's testimony, which informed Staff's recommendations. However, the primary check on Staff's three-stage DCF modeling in this testimony is Staff's use of a Risk Premium Model (RPM) described in more detail later in this testimony.

Q. Do you monitor and analyze current and projected market conditions?

A. Yes. Staff's analysis includes analysis of the current economic climate and its impact on our estimates of long-term growth. We also rely heavily on feeds from SNL Financial LC (SNL), Bloomberg, Moody's, S&P, WSJ, and other sources to make sure that our financial understandings are reflective of investor expectations. Please see a cross section of recent financial market news in Exhibit Staff/1313.

Q. Did you develop your recommendations while informed by authorized ROEs in other parts of the country?

A. Yes. Staff examined 2018 authorized utility ROE decisions across the U.S. as published by Regulated Research Associates (RRA), an offering of S&P Global Market Intelligence.

Q. Did you use robust and proven analytical methodologies?

A. Yes. Staff's methods are robust, proven, and parallel Staff's work over the last decade.

Q. Describe how you performed your analysis.

A. Using the cohort of proxy companies that met our screens, Staff ran each of Staff's two three-stage DCF models three times, each time using a different long-term growth rate.

<u>ALTERNATIVE MODELS EXAMINED</u>

Q. What control modeling did you perform to support your three-Stage DCF results?

A. Staff performed Simple DCF and CAPM modeling that supports Staff three-stage Model X and Model Y DCF modeling. But for this testimony, Staff concentrates on its Risk Premium Model used to perform a check on Staff's primary findings derived from its three-stage DCF models. While Staff does not recommend that any alternate approach should replace the Commission's reliance on three-stage DCF modeling, such alternate models may offer a check on the reasonableness of our recommendation or provide a directional vector that helps the Commission select a point within Staff's range of reasonable ROEs as best point ROE.

RISK PREMIUM MODEL

Q. Why has Staff chosen to offer testimony on the Risk Premium Model (RPM)?

A. Staff intends to present a series of informational modules through testimony, in this case and future rate cases, to inform readers about the various financial models used to estimate cost of equity. Staff selected the RPM as the third module of this series because: (1) it was used by Avista to estimate cost of equity in the current rate case, and (2) although expressly rejected by the Commission as a standalone model, the RPM has been used by parties in previous rate cases as a check on reasonableness.

Q. Please describe the RPM.

A. The RPM is based on the assumption that investors require a higher return when investing in riskier assets. Common stock equity (common stock or common equity) investments are riskier than bond investments. This is due to the fact that in bankruptcy, a bond investor's right to be made whole takes priority over the rights of a common stock investor. In other words, the investor in common stocks is less likely to recoup their investment, and consequently demands a higher return. There is also greater variability in common equity returns than bond returns.

The RPM can measure the difference between returns to a risk-free asset, e.g. U.S. Treasuries (UST), and a riskier asset like common stock.[24] The difference represents excess return demanded by the common equity investor over the risk-free rate. The RPM can also be used to approximate the difference between utility bond returns and required utility return on common equity (ROE).

Q. Can analysts directly observe the required ROE on Avista stock?

A. No, required ROE is a concept based on the presumed expectations of a well-informed, rational investor, so this notional value cannot be directly observed for a target stock. Rather, financial analysts rely on models to approximate the ROE for like-situated peer utilities as a proxy for the target stock. In this case Staff selects peer utilities of a similar size, credit rating and market history to Avista.

Q. How is the RPM useful when more powerful modeling is available?

A. The RPM is still a quick, easy calculation that requires no expensive proprietary data. An investor might prefer to rely on detailed analysis run on a powerful computer. But just as one may still use a simple hand-held calculator to ground expectations regarding the output of a large computer program, the RPM may be used as a quick check on reasonableness, and to

[24] While investing in UST is not 100 percent risk free, UST are one of the lowest risk investments one can make. Therefore, variously 10- and 30-year maturity UST are regularly used by investors and market analysts as a good proxy for a conceptual Risk Free Rate of Return. The 20-year UST is more thinly traded and seldom used as a primary benchmark by investors, analysts and finance academics.

consider what part of an output range from more comprehensive modeling is a best fit.

Q. How has Staff used this model?

A. Staff uses the RPM as a check on reasonableness of two different more-comprehensive three-stage Discounted Cash Flow (DCF) models. Used as a vector, the RPM points Staff, in this instance, to the upper part of the range of reasonable ROEs generated by Staff's aggregated three-stage DCF models.

Q. Are there risks in over reliance on Risk Premium Models?

A. Yes. A number of biases affect RPM results:

- *Survivor Bias*. This occurs because the model uses the ROE data of successful companies. Failed companies are excluded, and this has the consequence of overstating the expected return.[25]
- *Taxation Bias.* The RPM does not account for different taxation rates on debt and common equity investments[26], e.g., this model poorly captures effects of the Tax Cuts and Jobs Act, which cut top corporate tax rates from 35 percent to 21 percent.
- *Period Bias.* The choice of study period can double the Risk Premium.[27] Depending on the start date of the analysis, the RPM may imply that either stocks are riskier than bonds or bonds are riskier than stocks.

[25] Siegel, J., & Thaler, R., 1997. The Equity Premium Puzzle. *Journal of Economic Perspectives*, 191 – 200.

[26] Welch, I., 2000. Views of Financial Economists on the Equity Premium and on Professional Controversies. *The Journal of Business, University of Chicago Press*, 501-537.

[27] Carleton, W., & Lakonishok, J., 1985. Risk and Return on Equity: The Use and Misuse of Historical Estimates. *Financial Analysts Journal*, 38 – 47.

- *Method Bias.* Alternative approaches to measuring expected returns, e.g., by survey, historic analysis, or ex ante analysis, provide distinct results.[28] [29]
- *Measurement Bias.* When measured as a geometric mean, the model reflects a buy-and-hold investment strategy; however, as an arithmetic mean, it reflects a strategy that rebalances to a fixed amount each year. Studies have found significant differences in the model's results according to the measurement used,[30] with the arithmetic mean displaying an upward bias,[31] likely overstating the Risk Premium.[32] Because Staff focuses on a 30-year timeframe, commensurate with 30-year bonds and best practice,[33] Staff's forward looking analysis uses the geometric mean.

Q. Does the RPM have other shortcomings?

A. Yes. Additional concerns regarding the RPM include:

- *Misleading Results.* Academics conducting long range studies have raised concerns about the value of the Risk Premium model. It has been

[28] Brigham, E., Shome, K., & Vinson, S., Spring 1985. The Risk Premium Approach to Measuring a Utility's Cost of Equity. Financial Management, 33 - 45.
[29] Arnott, R., & Bernstein, P., 2002. What Risk Premium is "Normal"?. *Financial Analysts Journal, 64 – 85.*
[30] Dimson, E., Marsh, P., & Staunton, M., 2006. Global Evidence on the Equity Risk Premium. *Journal of Applied Corporate Finance*, 27 – 38.
[31] Welch, I., 2000. The Equity Premium. *Research* Roundtable *Yale School of Management.*
[32] Damodaran, A., 2011. Equity Risk Premiums: Determinants, Estimation and Implications. *Stern School of Business*.
[33] Pratt, S., 2014. Cost of Capital: Applications and Examples. *John Wiley & Sons*.

shown to be difficult to measure due to excessive variation in returns,[34] [35] with one study of utility company Risk Premiums claiming that the volatility of Risk Premiums render the model useless.[36] This is combined with further studies which found the Risk Premium to be "excessive and unlikely to continue",[37] and likely to be lower going forward.[38] [39]

- *Dual Utility.* The model does not account for utilities operating in both the Natural Gas and Electric industries. Approved ROEs for Natural Gas utilities have averaged 0.23 percent below approved ROEs for Electric utilities in the past 10 years as shown in Figure 1 below.[40]

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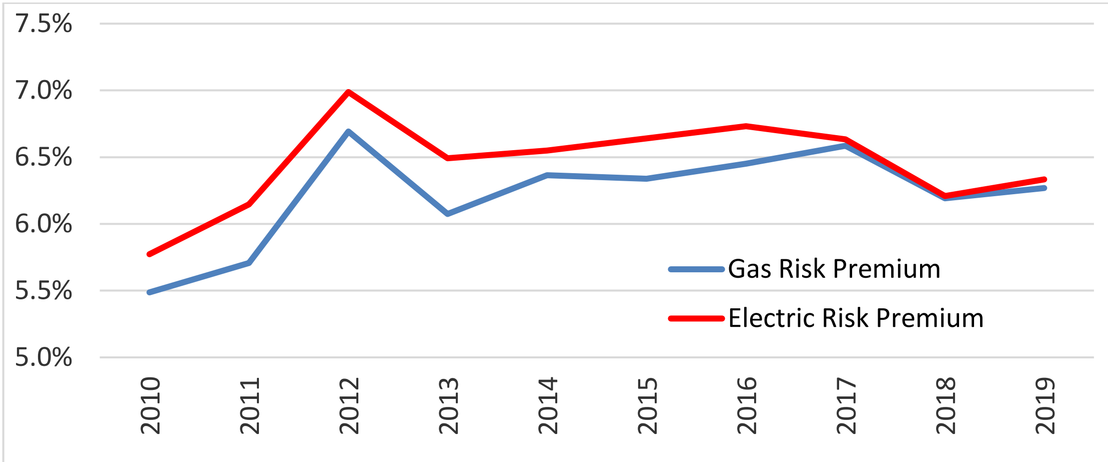
[34] Derrig, R. & Orr, E., 2004. Equity Risk Premium: Expectations Great and Small. *North American Actuarial Journal*.
[35] Damodaran, A., 2011. Equity Risk Premiums: Determinants, Estimation and Implications. *Stern School of Business*.
[36] Brigham, E., Shome, K., & Vinson, S., Spring 1985. The Risk Premium Approach to Measuring a Utility's Cost of Equity. Financial Management, 33 – 45.
[37] Siegel, J., 1992. The Equity Premium: Stock and Bond Returns since 1802. *Financial Analysts Journal, 28-38.*
[38] Arnott, R., & Bernstein, P., 2002. What Risk Premium is "Normal"?. *Financial Analysts Journal, 64 – 85.*
[39] Faugère, C., & Van Erlach, J., 2006. The Equity Premium: Consistent with GDP Growth and Portfolio Insurance. *The Financial Review,* 547 – 564.
[40] *Source: Regulatory* Research *Associates (RRA) and* affiliate of S&P Global Market Intelligence.

Figure 1



Q. What is the Commission's historical treatment of RPM results?

A. In previous general rate cases, the Commission has rejected the RPM for a number of reasons, which echo the issues raised by Staff in this testimony module:

- *1999, Northwest Natural Gas GRC*. The Commission found the RPM "inappropriate," and rejected it for two reasons: that "financial markets, not regulatory decisions, set a utility's cost of equity," and "the ROE authorized by a commission is just one component in setting rates and is commonly tied to other, unknown elements in a rate case ... [The Commission is] … reluctant to base an ROE … on unknowable parameters from other cases, set in other jurisdictions and different capital market conditions."[41]
- *2001, Portland General Electric Restructure & Repricing per SB1149/GRC.* The Commission rejected the RPM "because the

[41] Order No. 99-697, page 19.

methodology is not based on accepted regulatory principles."[42] Further, The Commission expressed its intentions regarding such methodologies going forward: "[W]e will continue to review ROEs authorized in other jurisdictions to help gauge the reasonableness of the cost of equity estimates derived from independent methodologies. We will not, however, rely on such decisions to base an ROE award for a utility."[43]

- *2001, PacifiCorp Restructure & Repricing per SB1149/GRC. The* Commission did not support the Company's RPM.[44]
- *2007, Portland General Electric GRC*. The Commission once again rejected the RPM.[45]

Q. Has Commission guidance caused the model to stop appearing in Oregon general rate cases?

A. No, variants of the model appear in every rate case. Therefore, Staff must address the model in each rate case. In some past instances, Staff has not constructed this model, and merely referred to the above Commission precedence. However, in this testimony module, Staff discusses the model in greater depth in order to provide a reference that can be directly cited in future rate cases. To clarify, the RPM *cannot* be used as a stand-alone ROE justification and should not be weighted as heavily as other modeling in

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42 The Commission did not support a Risk Positioning Model, which is synonymous with Risk Premium Model.
43 Order No. 01-777, page 33 - 34.
44 Order No. 01-787, page 34.
45 Order No. 07-015, page 47.

Oregon. However, Oregon precedent is less clear on whether the RPM can be used as a check on other modeling results.

Q. What formula represents the Risk Premium Model?

A. The RPM can be represented by the following formula:

$$\text{Risk Premium (RP)} = \text{Return (R)} - \text{Risk-free Return } (R_F)$$

Q. How does Staff derive the terms Return and Risk-free Return used in RPM calculations?

A. Staff uses the following RPM parameters in following calculations:

R = Expected Market Return is represented by approved ROEs for Natural Gas utilities.[46]

RF = Risk-Free Rate is represented by 30-year utility bonds.[47]

Period = Data from 1980 to 2019 is used, because business school academics find there is a change of risk premium from 1980 looking forward as shown in Figure 2.[48] [49]

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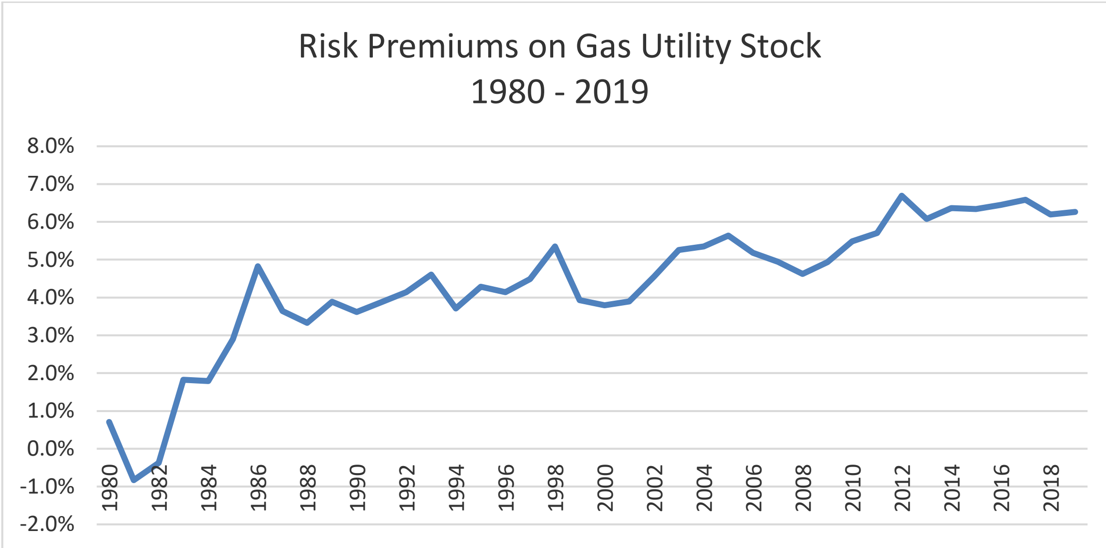
46 Gas utility authorized ROE data, compiled by Regulatory Research Associates.

47 Index of coupon rates on utility bonds with 30 year average maturities, compiled by Moody's.

48 See Yale School of Management, Robert G. Ibbotson, Professor of Finance publication at: https://som.yale.edu/faculty/roger-g-ibbotson. His findings mirror those of the University of Chicago.

49 Figure 3 is calculated by Staff. Please see Exhibit Staff/1109 for this analysis.

Figure 2



Q. What required ROE does Staff calculate from the RPM in this rate case?

A. Staff estimated a synthetic[50] required ROE of 9.34 percent for Avista, which lays within a range of reasonable ROEs of 7.65 percent (unadjusted) to 9.33 percent (adjusted). Staff interprets this as guidance toward an upper range of ROEs of 9.3 percent to 9.4 percent. Figure 3 presents this calculation in detail.

[50] The term "synthetic" flags this calculation as aggregated from multiple data sources and methods or approaches, in this case – derived as described in Figure 3.

Figure 3 – RPM Calculations

Step One	Return on natural gas utility stock[26]	11.54%	*A*
	Return on A-Rated utility bonds[27]	7.87%	*B*
	Risk premium	3.67%	*C = [A- B]*
Step Two	Forecasted 2020 return on A-Rated utility bonds[28]	3.98%	*D*
	Average Return on A-Rated utility bonds	7.87%	*E = B*
	Difference	-3.89%	*F = [D - E]*
	Adjustment per -1% difference[29]	-0.434	*G*
	Staff adjustment to Risk Premium	1.69%	*H = [F * G]*
Step Three	Risk premium	3.67%	*I = H*
	Staff adjustment to Risk Premium	1.69%	*J = C*
	Forecasted 2020 return on A-Rated utility bonds	3.98%	*K = D*
	Calculated ROE	9.34%	*L = [I + J + K]*

Q. Please explain each step in the modeling above in detail.

A. Staff followed three steps to calculate a synthetic ROE for Avista using the RPM:

- *Step One*. The Risk Premium is calculated by subtracting the return on A-Rated utility bonds from authorized ROEs to Natural Gas utilities. It is measured as a geometric average.[55]

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51 Authorized ROEs for US Natural Gas utilities. Source: Regulatory Research Associates through SNL.

52 Yields on A-Rated utility bonds, with 30 year average maturity. Source: Bloomberg.

53 Forecast calculated by Staff. Sources: Bloomberg forward UST interest rates, and spreads between A-Rated utility bonds and USTs.

54 Adjustment calculated by Staff.

55 The geometric average or geometric mean is used to calculate the average rate per period on an investment that is compounded over multiple periods. This average return of an investment over time is used to evaluate the performance of an investment portfolio.
Geometric Mean = [Product of (1 + Rn)] ^ (1/n) -1. Rn = growth rate for year n.

- *Step Two*. Staff identified an inverse relationship between the Risk Premium and returns to bonds, whereby the Risk Premium tended to be higher when bond returns were lower. Staff used a linear regression to estimate the relationship between these two variables, and found that the Risk Premium increases by 0.434 percent for every 1 percent the interest rate is below the long run interest rate used in the model. This resulted in an adjustment of 1.69 percent to the Risk Premium.
- *Step Three*. The ROE is calculated as the sum of the calculated Risk Premium, Staff's adjustment to the Risk Premium, and the forecasted 2020 return on A-Rated utility bonds. This calculation suggests a synthetic point ROE of 9.34 percent in a reasonable range of ROEs between 7.65 percent (unadjusted) and 9.34 percent (adjusted as shown in Figure 3).

Q. Did Staff apply judgment in reaching this result?

A. Yes, Staff's judgement was used on the following matters:

- *Geometric average.* Staff calculated the Risk Premium as a geometric average, rather than as an arithmetic average[56].
- *Risk-free rate.* Staff used A-Rated utility bonds to represent the risk-free rate, as opposed to USTs.

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[56] As an example if an investor had returns of 20 percent, 10 percent, minus 50 percent, 5 percent, and 20 percent, over five years, adding annual returns and diving by 5 can be very misleading. The investor should not conclude they made 5 percent over 5 years or an average of 1 percent return / year. Rather the investor has lost money on an unprofitable investment.

- *Adjusted Risk Premium*. Staff calculated an adjustment of 1.69 percent to the Risk Premium to account for differences between the forecasted 2020 interest rate and the long run interest rate used in the model.

Q. Is Staff's approach the only method for using the RPM?

A. No, Staff's approach is one of many, and each alternative approach will produce alternative results.[57] The RPM cannot be considered a highly accurate model because it does not predict consistent results. That is one of the reasons for Commission concern about the RPM and perhaps also why it appears in each rate case nevertheless as it relies heavily on the analyst's judgment.

Moreover, due to the many variations of the model, and the substantial amount of judgement required, its results are not as robust or reliable as other financial models used to estimate ROE. For these reasons, it is not appropriate to average the results of the RPM with other financial models, but instead it should be used as a gauge of an approximate range of appropriate ROEs.

Q. Has the model provided useful information for approximating an ROE for Avista?

A. Consistent with guidance from prior Commission orders earlier discussed, Staff did not rely on RPM calculations as a stand-alone methodology. However, the RPM can be useful as a check on the reasonableness of ROEs

[57] See UG 288, NWIGU-CUB/100, Gorman/37 for an alternative approach to calculating a synthetic ROE using the RPM.

returned by Staff's two different three-stage DCF models. In this case, the RPM pointed to the higher end of Staff's three-stage DCF modeling results. Subject to analyst judgement, the RPM in this instance offered a reasonably approximate solution. In summary, Staff's use of the RPM is supportive of Staff's three-stage DCF model results, which match the All-Party recommended 9.40 percent ROE for Avista.

Q. Inclusive of Staff's use of a RPM, what recommendation does Staff make regarding most appropriate ROE?

A. All Parties including Staff recommend a point ROE for Avista of 9.40 percent. This value is supported by Staff's usual three-stage DCF modeling results and consistent with Staff's RPM findings, which were used as a check on Staff's more robust modeling.

ISSUE 3 – COST OF LT DEBT

Q. Briefly summarize Staff's recommendation for Avista's Cost of LT Debt.

A. Staff recommends a Cost of LT Debt of 5.07 percent. This represents the cost of all outstanding and forecasted debt, as of the 2020 test year. See Confidential Exhibit Muldoon-Enright/1111 for a summary table which displays the LT Debt instruments included in Staff's calculation of LT Debt, along with Staff's calculation thereof.

Q. How has Staff calculated Avista's Cost of LT Debt?

A. Staff compiled a comprehensive table of Avista's outstanding and forecasted LT Debt as of the 2020 test year. This table was compiled using independent data sources including Bloomberg, SNL, and the Company's SEC filings.

Staff first identified outstanding debt using Bloomberg, and tracked individual debt issuances using their unique CUSIP numbers.[58] The details of each issuance, including issuance and maturity dates, yields, issued and outstanding debt amounts, and credit ratings, were downloaded from the Bloomberg database. This information was cross-referenced against the Company's latest SEC filing and the records available through SNL. As a final step, the data included in the table was confirmed by Avista through discovery as being fully accurate.[59]

Staff used this information to compile a fully comprehensive table of Avista's LT Debt, to calculate the yield to maturity of each debt issuance, and finally, to calculate the Company's carrying cost of long term debt.

Q. Avista provided a table of LT Debt in its initial filing. Why not use that?

A. Staff's approach of independently compiling a table of LT Debt is beneficial because it ensures that a clear and impartial record is created. Publicly available information can provide valuable insight and aid with the verification process. For example, the Company's SEC filing includes standardized information, in contrast to a General Rate Case for which no such standardized model exists, and some information may be missed.

Staff's thorough research ensures that when the cost of LT debt is calculated, it fully encapsulates the Company's debt issuances, permitting

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[58] A CUSIP number is a nine-character alphanumeric code which identifies financial securities. The acronym *CUSIP* derives from the Committee on Uniform Security Identification Procedures, a committee of the American Bankers Association.

[59] See Exhibit Staff/1111 for Avista's response to DR 129.

Staff and the Commission to place their full confidence in the integrity of the data therein.

Q. Is this table updated to reflect the anticipated composition of Avista's LT debt in the 2020 test year?

A. Yes. Staff has made specific adjustments to Avista's current LT Debt holdings to reflect the Company's anticipated debt structure come 2020. These changes include:

- Planned debt issuances in 2019 and 2020 have been incorporated.[60]
- The interest rate on variable rate debt was updated to reflect forecasted debt costs in 2010.[61]
- Maturing debt has been excluded.[62]

Q. Does the table reflect hedging losses and gains, discounts or premiums, and debt issuance costs?

A. Yes. The table fully encompasses hedging losses and gains, discounts or premiums, debt issuance costs and debt insurance costs. Staff has tied each individual cost back to the associated issuance, and calculated the net proceeds of each debt issuance. The net proceeds of each debt issuance is used to calculate the Yield to Maturity of that issuance, which feeds into Staff's calculation of LT Debt carrying costs.

In the case of Avista's forecasted debt, hedging losses on the forecasted issuances were included by Staff. Furthermore, Staff has estimated issuance

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60 Avista/204, Thies/1, 2 & 3.
61 See Exhibit 1111, Avista's response to DR 236, including attachment.
62 See Exhibit 1111, Avista's response to DR 130.

costs of 1 percent of the total debt issuance. This value is in-line with the Company's estimate, and reflects the Company's historic issuance costs.[63]

Q. How has Staff forecasted interest rates for forecasted debt issuances?

A. Staff has forecasted a synthetic forward interest rate for Avista's forecasted debt issuances. This is shown in Exhibit 1111.

Staff began this process by surveying forward US Treasury interest rates[64] over a five-week period, and calculating the average forecasted rate during that period. By taking this approach, Staff ensured that volatility within the month did not bias the forecast, as might have happened if the forecasted rate as observed on a single day was used.

The second step of this process involved calculating the spread between A-Rated Utility bonds and US Treasurys. The "spread" is the difference in borrowing costs for A-Rated utilities compared with less risky US Treasurys.

Finally, the spread was applied to the forecasted US Treasury interest rate for like maturity, resulting in the forecasted interest rate for Avista's debt issuances in 2019 and 2020.

Staff favors the approach described above because liquidity in the US Treasurys market is high. The large number of buyers and sellers of these securities increases the accuracy of the forecast. The addition of the spread

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63 As calculated by Staff from the values in columns (e) and (f) of Avista's Exhibit/201, Thies/3.

64 Forward US Treasury rates reflect the market's best estimate borrowing costs on a date in the future. As Avista expects to issue debt on October 1, 2019 and October 1, 2020, Staff focused its analysis on forecasted forward interest rates for these dates.

adjusts the forecast to reflect borrowing costs typical of other utilities issuing first mortgage bonds with comparable credit ratings to Avista.

Q. Have costs associated with Pollution Control Revenue Bonds (PCRB) been excluded from Staff's calculation of LT Debt carrying costs?

A. Yes, all costs related to PCRBs have been excluded from Staff's table of LT Debt. Avista's PCRBs[65] relate to its thermal electric generation in Montana. However, as Avista's General Rate Case relates to its Natural Gas business in Oregon, it is not appropriate for these costs to be included in Avista's cost of LT Debt. This approach is consistent with the treatment of PCRBs in Avista's previous General Rate Cases.[66]

Q. Did you prepare a debt maturity profile for Avista?

A. Yes. In Exhibit Staff/1111, I have provided a debt maturity profile for the test year, reflecting Staff's proposed Cost of LT Debt table. This profile shows that the Company's forecasted issuances of 30 year debt on 2019 and 2020 avoid maturity concentrations.

Q. What is Staff's summary recommendation for Avista's Cost of LT Debt?

A. Staff recommends a Cost of LT Debt of 5.07 percent. This recommendation is supported by comprehensive analysis by Staff and is therefore a value in which the Commission can place high confidence.

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[65] PCRBs are debt instruments issued by municipalities to finance investment by private entities in pollution control. These instruments allow companies such as Avista to take advantage of the lower interest rates enjoyed by municipalities when raising debt for specific uses.

[66] See recent Avista general rate cases, including: OPUC Order No. 14-015 in Docket UG 246, Order No. 15-109 in Docket UG 284, and Order Nos.16-076 and 16-109 in Docket UG 288.

ISSUE 4 – INDEPENDENT THIRD PARTY REVIEW OF FINANCIAL HEDGING

Q. Why does Staff recommend the Commission authorize an intensive independent third-party review of Avista's financial hedging program?

A. Staff has three primary reasons for recommending this course of action:

First, Staff's position is that review of results, and reassessment based on results, matters, especially when ratepayer dollars are involved. If an investor with finite resources incurs setbacks, it is reasonable to reassess what parts of a financial strategy are working as intended and which are not. For example, if an investor expects to win half of the time and lose half of the time but in practice gets different results, it is reasonable to identify why the results differed from projected results–in this instance, results from a financial hedging program.

Second, when consensus changes about market direction so that market and analyst sentiment diverge sharply from prior expectations, practical and prudent financial managers will reassess the durability of early assumptions, correlations, and general market trajectories that were relied on to control risks or to deliver targeted results.

And finally, if an investor does not have natural constraints on the amount of money to put at risk – think a gambler at a casino with a line of credit, or in our case, a utility with the backstop of ratepayers – then independent unbiased third party review by an expert with no financial ties or affiliation to prior advisors or counterparties can refresh confidence in an ongoing program, i.e. Avista's financial hedging practices. As a result, the current program informed by expert findings may be able to be adjusted to incorporate new insights that serve to benefit ratepayers. Alternatively, such a financial plan may be found to no longer be the best use of resources for ratepayers considering alternative uses of capital and market changes.

Q. Can you describe a situation in which brilliant people relied on sophisticated acclaimed financial modeling but lost all of their money effectively terminating their financial plan?

A. Yes. The points is that even models built by brilliant persons can require reassessment.

Long-Term Capital Management L.P. (LTCM) was a hedge fund that used complex trading strategies. The theories and models on which LTCM placed its trades were intellectually impressive. LTCM was founded by Wall Street giants like John W. Meriwether, the former vice-chairman and head of bond trading at Salomon Brothers, and the brilliant Myron S. Scholes and Robert C. Merton, who shared the 1997 Nobel Prize in Economics for a "New Method to Determine the Value of Derivatives".

In the first three years, LTCM returns were 21 percent after fees; 43 percent and 41 percent respectively. Then in just four months in the fourth year, LTCM lost $4.6 billion following the 1997 Asian financial crisis and 1998 Russian financial crisis. The hedge fund collapsed. In the 1990's, the U.S. Federal Reserve in the 1990's bailed out 14 banks who had lost $3.6 billion in

LTCM including: Bankers Trust, Barclays, Chase Manhattan Bank, Crédit Agricole, Credit Suisse First Boston, Deutsche Bank, Goldman Sachs, JP Morgan, Merrill Lynch, Morgan Stanley, Paribas, Salomon Smith Barney, Société Générale, and UBS.

LTCM was run by very smart people with awe inspiring quantitative models. Yet they vaporized a large amount of money. This highlights Staff's point that results and outcomes matter – and demand careful review, reassessment, and sometimes revision by the prudent investor or financial manager. However brilliant the people and models, when there are substantial losses, one must assess whether the complex thinking and modeling are still well correlated to the prevailing financial conditions, purposes, and target results for which they were deployed.

Q. Why does Staff take a forward looking perspective?

A. Staff's analysis lends to the conclusion that Avista's hedging practices are no longer operating in the best interests of customers. However, because these are complex issues, pitting different market theories and complex models against each other, Staff does not propose forensic financial analysis nor retroactive adjustments regarding hedging losses. Rather, correlations which once were strong may have weakened. And referent entities such as the U.S. Federal Reserve (Fed) and European Central Bank may have entirely reversed their forward looking guidance. As a result, Staff, CUB, AWEC and the Company (All Parties) recommend the Commission seek an unbiased third party report that is provided to All Parties and to the Commission on an informational basis. Avista agrees that it will take into consideration the report findings to modify or terminate its financial hedging program.

Q. Is Avista's Interest rate hedging program voluntary or is the Company required to have this program by a regulatory or other authority?

A. Avista's program is voluntary based on its own internal guidance.[67]

Q. Why do people and companies hedge in general?

A. Commodity hedging is often undertaken by persons and companies who need a certain commodity at time certain to create their products and to deliver contracted services. Similarly, farmers and other producers of a commodity may hedge to obtain certainty that the price they receive for their product will meet their obligations.

In contrast, financial interest rate hedging may be entered into voluntarily rather than of necessity. Often swaps of fixed vs. floating debt are made to better match the nature of incoming cash flows with that of outgoing cash flows or obligations. For example, a company with variable incoming cash flows may prefer fixed income to better match payments on a 30-year mortgage and swap its incoming cash flows with a firm who has income from bonds its holds with interest coming in paid semi-annually but with a variable cash outflow that varies with market conditions. Each firm in this example can be made better off by the swap, but the benefit may not be equally shared.

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67 See Exhibit AVA … for a confidential discussion of Avista's interest rate hedging program.

Over the very long-run, exposure to variable rates may outperform strictly fixed income, but any such determination depends on the time periods studied. An indicative rates report from an investment bank sales team selling the arrangement of fixed vs. floating interest rate transactions will tend to show a perspective customer created data for a representative timeline that generates attractive outcomes for the prospective client – with footnotes that caution both that the data is illustrative and not actual validated market information, and that the investment bank has no fiduciary duty to the prospective client. The investment bank can earn an arrangement fee and then decide whether to take the counterparty position opposite the utility, essentially betting against the utility's position. Staff's point is that investment banks are regularly are on the opposite sides of transactions.

Q. In interest rate hedging, do investment banks generally have a fiduciary duty to utilities?

A. No. Because investment banks have no fiduciary duty to utilities in such arrangements, Staff has recommended that the Commission insist that jurisdictional utilities perform their own quantitative analysis or retain directly-paid third-party experts with the ability to perform said analytics. However, over time, correlations and expectations based on initial modeling may not hold true or may be less predictive of outcomes. Rather than some wins and some losses that more or less balance out, there can be a preponderance of losses. Staff again notes that in such situations, investment banks have no obligations to look out for the interests of utilities or their ratepayers. So one cannot rely on investment banks to warn when a financial hedging program is not working well from a ratepayer perspective.

Whereas the investment bank may have a large portfolio of debt securities and derivative positions, a utility infrequently issues debt, perhaps just several tranches of different maturities and only several times a year. Thus, the investment bank may take a counterparty position for which risk is offset by another held position(s). To overcome having very few issuances, a utility may divide annual issuance amounts into more notional monthly fixed vs. floating financial hedges. But that may leave the utility with a rather rigid program against which investment banks and other counterparties can win two of three times or win big when interest rates fall such as they have this year.

Q. In the U.S., are we in a historical rising interest rate environment?

A. Investment banks and market analysts have said we are in a rising interest rate environment for the last decade. But rates have been falling for the last three quarters, and central banks are talking about rate cuts rather than rate increases. This is a fundamental material change in direction that by itself merits review of Avista's financial hedging program.

A person who was an adult prior to 1980 might look at the graphs in this section of testimony and at a glance conclude we are NOT in a rising interest rate environment by historical standards. After all, interest rates have been falling since 1980. A plot of rates flat lines for a good part of the recent decade and then climbs only minimally compared to plots from prior recoveries. Looking at the short term, interest rates (though already low) fell back substantially such that a 52 week plot has a downward slope. This dramatic change in forward market expectations differs materially from when Avista's interest rate hedging program was created.

Q. Are rising interest rates the top threat Avista faces?

A. Possibly not. Interest rate rise may not be a major threat for Avista looking forward. Independent third party review may help frame the forward looking utility of Avista's financial hedging program.

Q. Please provide a simple overview of the mechanics of Avista's hedging policy.

A. Avista's Interest Rate Risk Management Plan is summarized in Exhibit Avista/202 Thies/1-10.

Q. Has Staff reviewed Avista's procedures to ensure that the hedging policy has been followed correctly?

A. Yes. Staff read Avista's hedging policy in detail, identified the steps involved in hedging decisions, and the oversight procedures in place. Staff issued ten data requests relating to the Company's hedging policy, and found no evidence of deviations from the hedging policy. It is important to be clear that Staff in no way suggests that Avista failed to follow its internal financial hedging guidelines.

[BEGIN CONFIDENTIAL]

[redacted]

[redacted]

68 [redacted]

[redacted]

Q. [redacted]

A. [redacted]

[redacted]

[redacted]

[END CONFIDENTIAL]

Q. Please summarize your recommendation.

A. Staff recommends that the Commission adopt the All Parties Partial Stipulation, which would allow for an independent third-party review of Avista's financial hedging program.

CONCLUSION

Q. What is Staff's recommendation regarding Capital Structure?

A. Staff recommends a 50.0 percent Equity and 50.0 percent LT Debt Capital Structure, reflecting best available information at this time.[71]

Q. What is Staff's recommendation regarding ROE?

A. Staff recommend that the Commission adopt a point ROE of 9.40 percent consistent with the findings herein, with national trends and with the recommendation of All Parties.

Q. What is Staff's recommendation regarding LT Debt?

[71] This capital structure is consistent with Figure 16-1 of Chapter 16, Relationship between Capital Structure and the Cost of Capital, in the earlier mentioned text, "New Regulatory Finance" by Dr. Roger A Morin, Ph.D., when a finance practitioner seeks to balance minimization of the Cost of Capital against credit and liquidity cost and risk.

A. Staff recommends a Cost of LT Debt of 5.07 percent, which is beneficial to customers and a reasonable compromise between perspectives on forward markets. Again, All Parties support Staff's work in this regard.

Q. What Rate of Return (ROR) is generated by the above recommendations?

A. Staff's calculations generate a 7.235 percent Overall Rate of Return, which in settlement between All Parties is rounded as 7.24 percent. This minor rounding adjustment is still reflective of Staff's analysis and findings.

Q. Has enough material change occurred in financial markets that an independent third party review of Avista's financial Hedging Program would be appropriate and timely?

A. Yes. Enough data is now available on Avista's financial hedging program and enough significant changes have occurred in financial markets for an independent third party report to be informative and of good value to ratepayers. This report may offer insights that allow Avista to better tailor program guidelines and internal analytics to bolster Commission confidence going forward. Alternatively, the report might find that the program served its purpose based on former market expectations, but that Avista's financial hedging program is no longer needed in the near term based on changed market conditions.

Q. Does that conclude your testimony?

A. Yes.

CASE: UG 366
WITNESS: MATT MULDOON

PUBLIC UTILITY COMMISSION
OF
OREGON

STAFF EXHIBIT 1101

Witness Qualifications Statement

July 11, 2019

WITNESS QUALIFICATION STATEMENT

NAME:	Matthew (Matt) J. Muldoon
EMPLOYER:	PUBLIC UTIILTY COMMISSION OF OREGON
TITLE:	Senior Economist Energy – Rates Finance and Audit Division
ADDRESS:	201 High Street SE, Suite 100 Salem, OR 97301
EDUCATION:	In 1981, I received a Bachelor of Arts Degree in Political Science from the University of Chicago. In 2007, I received a Masters of Business Administration from Portland State University with a certificate in Finance.
EXPERIENCE:	From April of 2008 to the present, I have been employed by the OPUC. My current responsibilities include financial and rate analysis with an emphasis on Cost of Capital. I have worked on Cost of Capital in the following general rate case dockets: AVA UG 186; UG 201, UG 246, UG 284, UG 288, UG 325, and UG 366 current; NWN UG 221, and UG 344; PAC UE 246, and UE 263; PGE UE 262, UE 283, UE 294, UE 319, and UE 335; and CNG UG 287, UG 305, and UG 347 From 2002 to 2008 I was Executive Director of the Acceleration Transportation Rate Bureau, Inc. where I developed new rate structures for surface transportation and created metrics to insure program success within regulated processes. I was the Vice President of Operations for Willamette Traffic Bureau, Inc. from 1993 to 2002. There I managed tariff rate compilation and analysis. I also developed new information systems and did sensitivity analysis for rate modeling.
OTHER:	I have prepared, and defended formal testimony in contested hearings before the OPUC, ICC, STB, WUTC and ODOT. I have also prepared OPUC Staff testimony in BPA rate cases.

Abbreviations: AVA – Avista Corp., CNG – Cascade Natural Gas Company, IPC – Idaho Power Company, NWN – Northwest Natural Gas Company, PAC – PacifiCorp, PGE – Portland General Electric Company

CASE: UG 366
WITNESS: MOYA ENRIGHT

PUBLIC UTILITY COMMISSION OF OREGON

STAFF EXHIBIT 1102

Witness Qualifications Statement

July 11, 2019

WITNESS QUALIFICATIONS STATEMENT

NAME:	Moya Enright
EMPLOYER:	Public Utility Commission of Oregon
TITLE:	Senior Utility and Energy Analyst Energy Rates, Finance and Planning Division
ADDRESS:	201 High Street SE. Suite 100 Salem, OR. 97301
EDUCATION:	Energy Risk Professional Certification (part-qualified). Global Association of Risk Professionals. M.Sc. Political Science, 2015. University of Amsterdam. M.Sc. Investment, Treasury and Banking, 2011. Dublin City University. B.A. International Business and Languages, 2008. Dublin City University through a joint curriculum with École Supérieure de Commerce de Montpellier.
EXPERIENCE:	Senior Utility and Energy Analyst at OPUC since January 2019. Energy Trader for Meridian Energy from 2015 to 2019. Meridian Energy is a power generator and retailer operating both in New Zealand and Australia. Trading and Operations Analyst at Tynagh Energy from 2011 to 2013. Tynagh Energy is an independent power producer operating in the Republic of Ireland. Senior Electricity Market Controller at EirGrid from 2008 to 2011. EirGrid is the Irish electricity Transmission System Operator. It operates the Single Electricity Market for the Republic of Ireland and Northern Ireland. Accounts Assistant roles from 2004 to 2008, including Audit Intern at KPMG in Northern Ireland.

CASE: UG 366
WITNESSES: MATT MULDOON &
MOYA ENRIGHT

PUBLIC UTILITY COMMISSION
OF
OREGON

STAFF EXHIBIT 1103

Exhibits in Furtherance
of Testimony in Support of Partial Stipulation

July 11, 2019

STAFF EXHIBIT 1103

IS CONFIDENTIAL AND SUBJECT TO

PROTECTIVE ORDER NO. 19-091

CASE: UG 366
WITNESSES: MATT MULDOON &
MOYA ENRIGHT

PUBLIC UTILITY COMMISSION
OF
OREGON

STAFF EXHIBIT 1104

Three Stage Discounted Cash Flow
ROE Peer Screening

Exhibits in Furtherance
of Testimony in Support of Partial Stipulation

July 11, 2019

STAFF EXHIBIT 1104

PROVIDED IN ELECTRONIC FORMAT ONLY

CASE: UG 366
WITNESSES: MATT MULDOON &
MOYA ENRIGHT

PUBLIC UTILITY COMMISSION
OF
OREGON

STAFF EXHIBIT 1105

Three Stage Discounted Cash Flow
ROE Models

Exhibits in Furtherance
of Testimony in Support of Partial Stipulation

July 11, 2019

STAFF EXHIBIT 1105

PROVIDED IN ELECTRONIC FORMAT ONLY

CASE: UG 366
WITNESSES: MATT MULDOON &
MOYA ENRIGHT

PUBLIC UTILITY COMMISSION
OF
OREGON

STAFF EXHIBIT 1106

Long Run
GDP Growth Rates

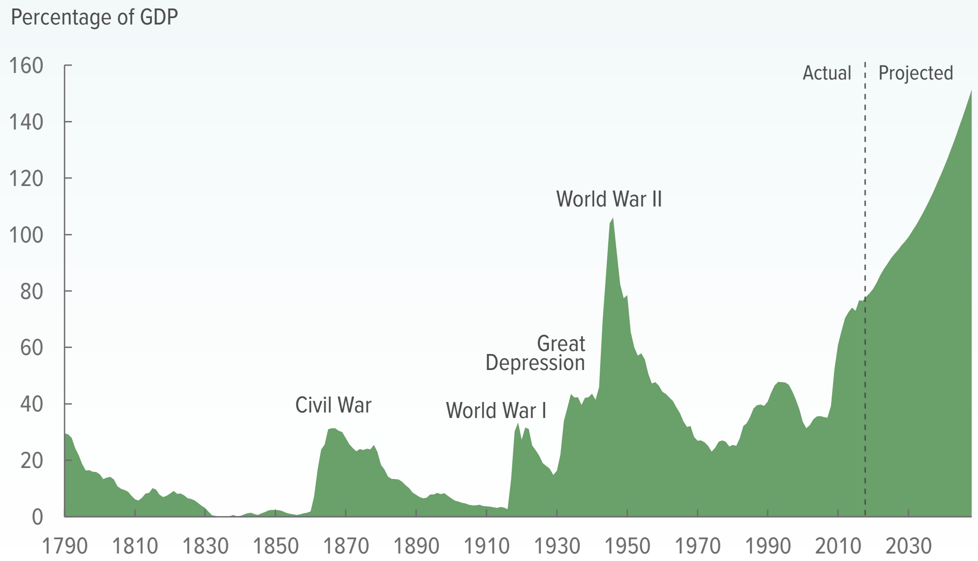
Exhibits in Furtherance
of Testimony in Support of Partial Stipulation

July 11, 2019

CONGRESS OF THE UNITED STATES
CONGRESSIONAL BUDGET OFFICE

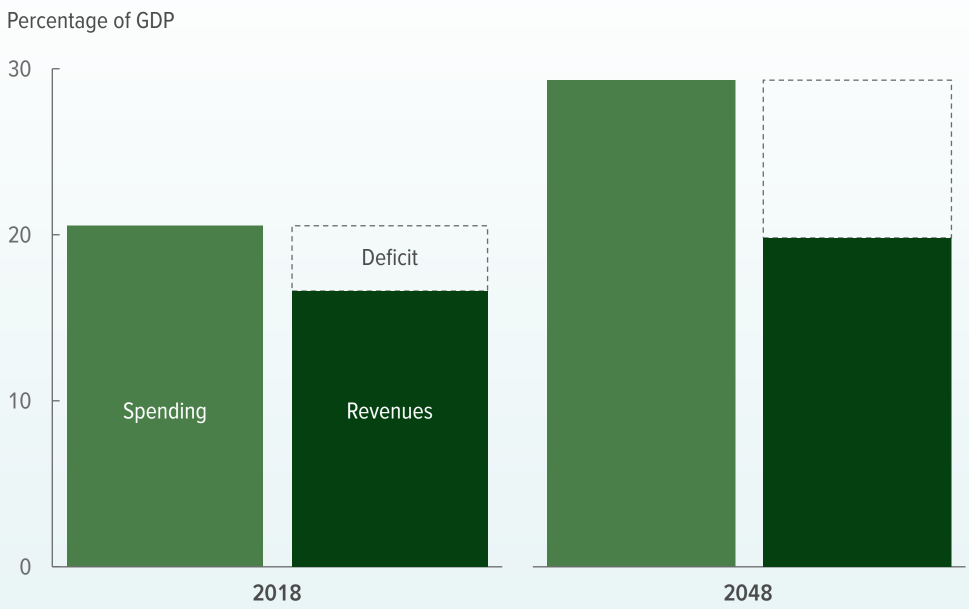
CBO

The 2018 Long-Term Budget Outlook



Under current law, federal debt held by the public is projected to increase sharply over the next 30 years…

…as spending grows more quickly than revenues do. Driving that spending growth are interest payments on the debt, major health care programs, and Social Security.



JUNE 2018

At a Glance

Each year, the Congressional Budget Office issues a set of long-term budget projections—that is, projections of what federal spending, revenues, deficits, and debt would be for the next 30 years if current laws generally did not change. This report is the latest in the series.

- In CBO's projections, the federal budget **deficit**, relative to the size of the economy, grows substantially over the next several years, stabilizes for a few years, and then grows again over the rest of the 30-year period, leading to federal **debt** held by the public that would approach 100 percent of gross domestic product (GDP) by the end of the next decade and 152 percent by 2048. Moreover, if lawmakers changed current laws to maintain certain policies now in place—preventing a significant increase in individual income taxes in 2026, for example—the result would be even larger increases in debt.

- The federal government's **net interest costs** are projected to climb sharply as interest rates rise from their currently low levels and as debt accumulates. Such spending would about equal spending for Social Security, currently the largest federal program, by the end of the projection period.

- **Noninterest spending** is projected to rise from 19 percent of GDP in 2018 to 23 percent in 2048, mainly because of increases in spending for Social Security and the major health care programs (primarily Medicare). Much of the spending growth for Social Security and Medicare results from the aging of the population. Growth in spending for Medicare and the other major health care programs is also driven by rising health care costs per person.

- **Revenues,** in contrast, are projected to be roughly flat over the next few years relative to GDP, rise slowly, and then jump in 2026. Thereafter, revenues would continue to rise relative to the size of the economy—although they would not keep pace with growth in spending. The projected growth in revenues is largely attributable to increases in individual income tax receipts.

- **Compared with last year's projections,** debt as a percentage of GDP is larger, but only modestly so, through 2041 and then lower thereafter. Deficits are higher as a percentage of GDP through 2025 and lower thereafter. That change is largely driven by changes in revenues and net interest costs. Revenues are initially lower as a share of GDP, but ultimately are higher because individual income taxes are now projected to grow more quickly as a result of provisions of Public Law 115-97 (originally called the Tax Cuts and Jobs Act and called the 2017 tax act in this report).

Contents

Notes

The Congressional Budget Office's extended baseline shows the budget's long-term path under most of the same assumptions that the agency uses, in accordance with statutory requirements, in constructing its 10-year baseline. Both baselines incorporate the assumptions that current law generally remains unchanged but that some mandatory programs are extended after their authorizations lapse and that spending for Medicare and Social Security continues as scheduled even if their trust funds are exhausted.

Unless this report indicates otherwise, the years that it refers to are federal fiscal years, which run from October 1 to September 30 and are designated by the calendar year in which they end. Budgetary values, such as the ratio of debt or deficits to gross domestic product, are calculated on a fiscal year basis; economic variables, such as gross national product or interest rates, are calculated on a calendar year basis.

Numbers in the text, tables, and figures may not sum to totals because of rounding.

Unless the report specifies otherwise, Medicare outlays are presented net of offsetting receipts, which reduce outlays for the program.

As referred to in this report, the Affordable Care Act comprises the Patient Protection and Affordable Care Act; the health care provisions of the Health Care and Education Reconciliation Act of 2010; and the effects of subsequent judicial decisions, statutory changes, and administrative actions.

Data and supplemental information files—the data underlying the figures in this report, supplemental budget projections, and the demographic and economic variables underlying those projections—are posted along with the report on CBO's website.

The 2018 Long-Term Budget Outlook

Summary

At 78 percent of gross domestic product (GDP), federal debt held by the public is now at its highest level since shortly after World War II. If current laws generally remained unchanged, the Congressional Budget Office projects, growing budget deficits would boost that debt sharply over the next 30 years; it would approach 100 percent of GDP by the end of the next decade and 152 percent by 2048 (see Table 1). That amount would be the highest in the nation's history by far. Moreover, if lawmakers changed current law to maintain certain policies now in place—preventing a significant increase in individual income taxes in 2026, for example—the result would be even larger increases in debt.[1] The prospect of large and growing debt poses substantial risks for the nation and presents policymakers with significant challenges.

In this report, CBO presents its projections of federal spending, revenues, deficits, and debt for the next three decades and describes some possible consequences of those budgetary outcomes. This report's projections are consistent with the 10-year baseline budget and economic projections that CBO published in the spring of 2018.[2] They extend most of the concepts underlying those projections for an additional 20 years, and they reflect the macroeconomic effects of projected fiscal policy over that 30-year period. All together, they constitute the agency's *extended baseline* projections.

CBO's 10-year and extended baseline projections are not predictions of budgetary outcomes. Rather, they represent the agency's best assessment of future spending, revenues, deficits, and debt under the assumption that current laws generally remain unchanged. They also give lawmakers a point of comparison from which to measure the effects of proposed legislation.

Why Are Projected Deficits Rising?

In CBO's projections, the federal budget deficit, relative to the size of the economy, would grow substantially over the next several years, stabilize for a few years, and then grow again over the rest of the 30-year period. In total, deficits would rise from 3.9 percent of GDP in 2018 to 9.5 percent in 2048. (Adjusted to exclude the effects of timing shifts that occur because fiscal year 2018 began on a weekend, the budget deficit in 2018 would be higher, at 4.2 percent of GDP).[3] Those large budget deficits would arise because spending would grow steadily under current law, and revenues would not keep pace with that spending growth (see Figure 1).

In particular, over the next 30 years, spending as a share of GDP would increase for Social Security, the major health care programs (primarily Medicare), and interest on the government's debt. In CBO's projections, most of the spending growth for Social Security and Medicare results from the aging of the population: As members of

1. CBO will analyze the effects of alternative fiscal scenarios in a forthcoming report.

2. CBO bases its long-term projections on its most recent 10-year budget projections. Typically, those projections are from the *Budget and Economic Outlook*; however, CBO made a number of relatively small changes to its baseline projections since the publication of that report in April. As a result, the long-term budget projections in this report are based on CBO's adjusted April 2018 baseline. For information on those underlying budget projections, see Congressional Budget Office, *An Analysis of the President's 2019 Budget* (May 2018), www.cbo.gov/publication/53884. For information on CBO's most recent economic projections, see Congressional Budget Office, *The Budget and Economic Outlook: 2018 to 2028* (April 2018), www.cbo.gov/publication/53651.

3. When the first day of the fiscal year (October 1) falls on a weekend, certain monthly payments (mostly for mandatory benefit programs such as Medicare, Supplemental Security Income, and certain programs for veterans) normally made on that day are shifted to the preceding fiscal year. Accordingly, for those benefit programs, only 11 months of payments will be made in that fiscal year rather than the usual 12, and the previous year will have one more payment. October 1 fell on a weekend in 2017, and that will happen again in 2022, 2023, and 2028. The resulting shifts in payments noticeably boost projected spending and deficits in 2022 and 2028; they reduce spending and the deficit in 2018 and 2024.

Table 1.

Key Projections in CBO's Extended Baseline

Percentage of Gross Domestic Product

		Projected Annual Average		
	2018	2019–2028	2029–2038	2039–2048
Revenues				
Individual income taxes	8.2	8.9	10.1	10.7
Payroll taxes	5.9	5.9	6.0	6.0
Corporate income taxes	1.2	1.5	1.4	1.4
Other[a]	1.4	1.2	1.3	1.5
Total Revenues	**16.6**	**17.5**	**18.8**	**19.5**
Outlays				
Mandatory				
Social Security	4.9	5.5	6.2	6.3
Major health care programs[b]	5.2	6.0	7.4	8.7
Other	2.6	2.5	2.3	2.1
Subtotal	12.6	13.9	15.9	17.2
Discretionary	6.3	5.7	5.4	5.5
Net interest	1.6	2.7	3.6	5.3
Total Outlays	**20.6**	**22.4**	**24.9**	**27.9**
Deficit	**-3.9**	**-4.9**	**-6.1**	**-8.4**
Debt Held by the Public at the End of the Period	**78**	**96**	**118**	**152**
Memorandum:				
Social Security				
Revenues[c]	4.4	4.5	4.6	4.5
Outlays[d]	4.9	5.5	6.2	6.3
Contribution to the Federal Deficit[e]	-0.4	-1.0	-1.6	-1.9
Medicare				
Revenues[c]	1.4	1.5	1.6	1.6
Outlays[d]	3.5	4.3	5.7	6.8
Offsetting Receipts	-0.6	-0.8	-1.0	-1.3
Contribution to the Federal Deficit[e]	-1.5	-2.1	-3.0	-3.9
Gross Domestic Product at the End of the Period (Trillions of dollars)	20.1	29.8	44.1	65.0

Source: Congressional Budget Office.

This table satisfies a requirement specified in section 3111 of S. Con. Res. 11, the Concurrent Resolution on the Budget for Fiscal Year 2016.

The extended baseline generally reflects current law, following CBO's 10-year baseline budget projections through 2028 and then extending most of the concepts underlying those baseline projections for the rest of the long-term projection period.

a. Consists of excise taxes, remittances to the Treasury from the Federal Reserve System, customs duties, estate and gift taxes, and miscellaneous fees and fines.

b. Consists of spending for Medicare (net of premiums and other offsetting receipts), Medicaid, and the Children's Health Insurance Program, as well as outlays to subsidize health insurance purchased through the marketplaces established under the Affordable Care Act and related spending.

c. Includes all payroll taxes for the program other than those paid by the federal government on behalf of its employees (which are intragovernmental transactions). Also includes income taxes paid on Social Security benefits, which are credited to the trust funds. Excludes interest credited to the trust funds.

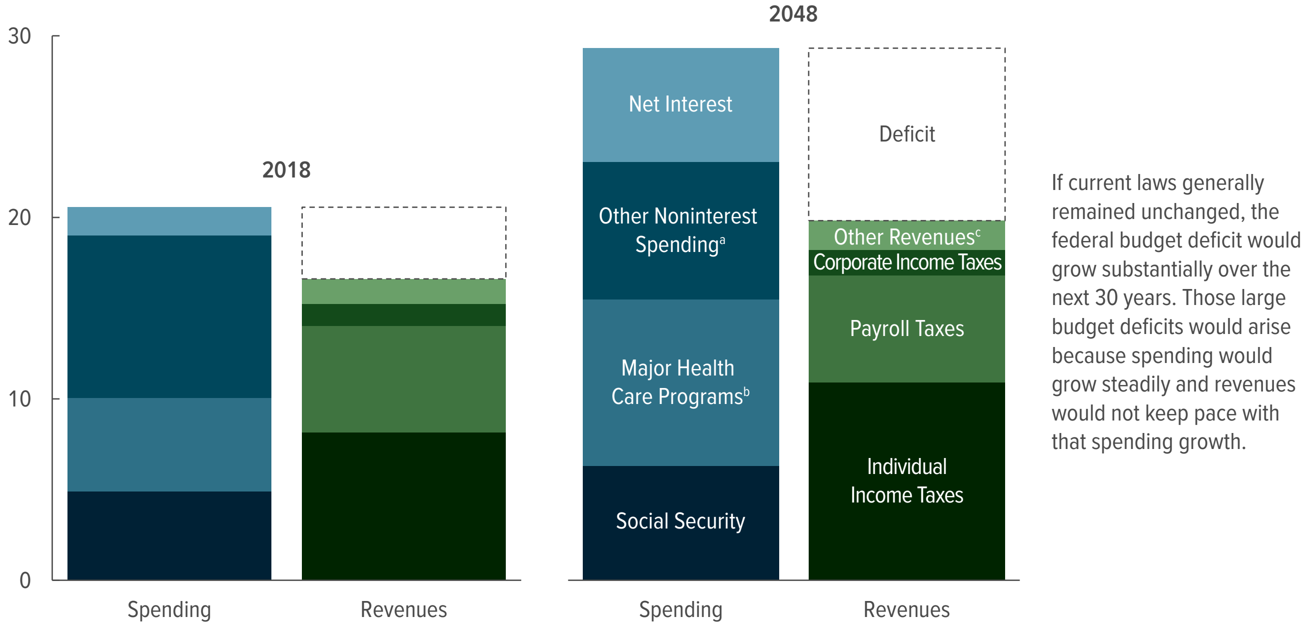
d. Excludes discretionary outlays related to administration of the program.

e. The contribution to the deficit shown here differs from the change in the trust fund balance for the program because it excludes intragovernmental transactions, interest earned on balances, and outlays related to administration of the program.

Figure 1.

The Federal Budget in CBO's Extended Baseline

Percentage of Gross Domestic Product



Source: Congressional Budget Office.

The extended baseline generally reflects current law, following CBO's 10-year baseline budget projections through 2028 and then extending most of the concepts underlying those baseline projections for the rest of the long-term projection period.

a. Consists of all federal spending other than that for Social Security, the major health care programs, and net interest.

b. Consists of spending for Medicare (net of premiums and other offsetting receipts), Medicaid, and the Children's Health Insurance Program, as well as outlays to subsidize health insurance purchased through the marketplaces established under the Affordable Care Act and related spending.

c. Consists of excise taxes, remittances to the Treasury from the Federal Reserve System, customs duties, estate and gift taxes, and miscellaneous fees and fines.

the baby-boom generation (people born between 1946 and 1964) age and as life expectancy continues to rise, the percentage of the population age 65 or older will grow sharply, boosting the number of beneficiaries of those programs. Growth in spending on Medicare and the other major health care programs is also driven by rising health care costs per person. In addition, the federal government's net interest costs are projected to climb sharply as a percentage of GDP as interest rates rise from their currently low levels and as debt accumulates.

That spending growth would be only partially offset by declining spending for other programs. Mandatory spending other than that for Social Security and the major health care programs—such as spending for federal employees' pensions and for various income security programs—is projected to decrease as a percentage of GDP. Discretionary spending is projected to decline in most years over the next decade and then roughly stabilize as a percentage of GDP. (Mandatory spending is generally governed by provisions of permanent law, whereas discretionary spending is controlled by annual appropriation acts.)

Revenues, in contrast, would take a different path. They are projected to be roughly flat over the next few years relative to GDP, rise slowly, and then jump in 2026. Revenues would sharply increase that year because most of the provisions of Public Law 115-97 (originally called the Tax Cuts and Jobs Act and called the 2017 tax act in this report) that directly affect the individual income tax rate are set to expire at the end of calendar year 2025. (The 2017 tax act lowered individual income taxes beginning in 2018.) Thereafter, revenues would continue to rise relative to the size of the economy—although they would not keep pace with spending growth.

The projected growth in revenues beyond 2028 is largely attributable to increases in individual income tax receipts. Those receipts are projected to grow mainly because income would rise more quickly than the price index that is used to adjust tax brackets and other parameters of the tax system. As a result, more income would be pushed into higher tax brackets over time. (Because of provisions of the 2017 tax act, the effect of real bracket creep in this year's projections is slightly greater than the effect that CBO projected in prior years.) Combined receipts from all other sources are projected to increase slightly as a percentage of GDP.

What Might Happen If Current Laws Remained Unchanged?

Large and growing federal debt over the coming decades would hurt the economy and constrain future budget policy. The amount of debt that is projected under the extended baseline would reduce national saving and income in the long term; increase the government's interest costs, putting more pressure on the rest of the budget; limit lawmakers' ability to respond to unforeseen events; and increase the likelihood of a fiscal crisis. (In that event, investors would become unwilling to finance the government's borrowing unless they were compensated with very high interest rates.)

How Does CBO Make Its Long-Term Budget Projections?

CBO's extended baseline, produced once a year, shows the budget's long-term path under most of the same assumptions that the agency uses in constructing its 10-year baseline. Both baselines incorporate these assumptions: current laws will generally remain unchanged, mandatory programs will be extended after their authorizations lapse, and spending for Medicare and Social Security will continue as scheduled even if their trust funds are exhausted. CBO makes those assumptions to conform to statutory requirements.

Some projections, such as those for Social Security spending and collections of individual income taxes, incorporate detailed estimates of how people would be affected by particular elements of programs or by the tax code. Other projections reflect past trends and CBO's assessments of how those trends would evolve if current laws generally remained unchanged.[4]

CBO's budget projections are built on its demographic and economic projections. CBO estimates that the population will grow more slowly than it has in the past and will be older, on average. CBO also anticipates that if current laws generally did not change, real GDP—that is, GDP with the effects of inflation removed—would increase by 1.9 percent per year, on average, over the next 30 years. That rate is nearly 1 percentage point lower than the annual average growth rate of real GDP over the past 50 years. That expectation of slower economic growth in the future is attributable to several factors—most notably, slower growth of the labor force. Projected growth in output is also held down by the effects of changes in fiscal policy under current law—above all, by the reduction in private investment that is projected to result from rising federal deficits.

How Uncertain Are Those Projections?

If current laws governing taxes and spending remained generally the same, debt would rise as a percentage of GDP over the next 30 years, according to CBO's central estimate (the middle of the distribution of potential outcomes). That projection is very uncertain, however, so the agency examined in detail how debt would change if four key factors were higher or lower than their levels in the extended baseline. Those four factors are labor force participation, productivity in the economy, interest rates on federal debt, and health care costs per person. Other factors—such as an economic depression, a major war, or unexpected changes in rates of fertility, immigration, or mortality—also could affect the trajectory of debt. Taking into account a range of uncertainty around CBO's central projections of those four key inputs, CBO concludes that despite the considerable uncertainty of long-term projections, debt as a percentage of GDP would probably be greater—in all likelihood, much greater—than it is today if current laws remained generally unchanged.

How Large Would Changes in Spending or Revenues Need to Be to Reach Certain Goals for Federal Debt?

CBO estimated the size of changes that would be needed to achieve a chosen goal for federal debt. For example, if lawmakers wanted to reduce the amount of debt in 2048 to 41 percent of GDP (its average over the past 50 years), they might cut noninterest spending, increase revenues, or take a combination of both approaches to make changes

4. For more information about how CBO makes long-term projections about the economy and federal budget, see Congressional Budget Office, *An Overview of CBOLT: The Congressional Budget Office Long-Term Model* (April 2018), www.cbo.gov/publication/53667.

that equaled 3.0 percent of GDP each year starting in 2019. (In dollar terms, that amount would total about $630 billion in 2019.) If, instead, policymakers wanted debt in 2048 to equal its current share of GDP (78 percent), the necessary changes would be smaller (although still substantial), totaling 1.9 percent of GDP per year (or about $400 billion in 2019). The longer lawmakers waited to act, the larger the policy changes would need to be to reach any particular goal for federal debt.

How Have CBO's Projections Changed Over the Past Year?

Compared with last year's projections, CBO's current projections of debt as a share of GDP are higher through 2041 and lower thereafter. CBO now projects that debt measured as a share of GDP would be 3 percentage points lower in 2047 than it projected last year. (The previous edition of this volume showed projections through 2047.)[5] The increase in debt through 2041 stems primarily from tax and spending legislation enacted since then that boosted projected deficits through 2025—especially the 2017 tax act, the Bipartisan Budget Act of 2018 (P.L. 115-123), and the Consolidated Appropriations Act, 2018 (P.L. 115-141). In particular, the budgetary effects of the tax act are expected to peak during the middle of the next decade. In later years, the effects are expected to be modest, although their precise magnitudes are uncertain.

Deficits are smaller after 2025 than CBO projected last year because of lower projections as a share of GDP of noninterest spending and because of projections of revenues that are the same or higher than CBO estimated last year. The smaller deficits result in lower debt as a share of GDP after 2041 than CBO projected last year.

The Budget Outlook for the Next 30 Years

CBO's extended baseline shows a substantial imbalance in the federal budget over the next three decades. Growing budget deficits would lead to rising amounts of federal debt, which in turn would increase pressures on the federal budget and dampen economic growth.

Rising Budget Deficits

If current laws generally remained unchanged, the federal budget deficit would grow substantially over the next few years. It would rise to 4.2 percent of GDP this year (up from 3.5 percent last year) and then climb to 5.1 percent by 2022 (adjusted to exclude shifts in timing). The deficit would then continue to rise in dollar terms but stabilize as a percentage of GDP for the rest of the 10-year baseline period—although it would remain much higher than its 50-year average of 2.9 percent. In the following two decades, deficits would become notably larger again relative to the size of the economy as the gap between spending and revenues grew (see Figure 2). As a result, the deficit would rise from 4.8 percent of GDP in 2028 (adjusted to exclude shifts in timing) to 9.5 percent in 2048.

CBO projects that mandatory spending would rise significantly as a percentage of GDP under current law, driving up spending relative to revenues. The aging of the population will lead to increased outlays for Social Security and Medicare, mandatory programs that primarily benefit people 65 or older. Medicare outlays would also climb as a result of rising health care costs per person, in CBO's estimation. By 2048, under current law, federal spending through those two programs as well as Medicaid—the federal health care program for people with limited income and resources—for people age 65 or older would account for about half of all federal noninterest spending, compared with about two-fifths today. Moreover, because federal debt is projected to grow and interest rates are expected to rise from their currently low levels, interest payments on the government's debt would rise sharply.

All told, under CBO's extended baseline, federal spending would increase from today's 21 percent of GDP to 23 percent in 2028 (adjusted to exclude shifts in timing; that spending would be 24 percent if timing shifts were included) and to 29 percent by 2048. (Federal spending has averaged 20 percent of GDP over the past 50 years.)

Meanwhile, if current laws generally remained unchanged, revenues would remain near 16.6 percent of GDP for a few years (their current level), rise steadily to 17.5 percent by 2025, and then increase sharply in 2026 following the scheduled expiration of many provisions of the 2017 tax act.[6] Revenues are projected to increase to 18.1 percent of GDP in that year and then rise to 18.5 percent by 2028. Beyond 2028, revenues would grow faster than the economy but more slowly

5. See Congressional Budget Office, *The 2017 Long-Term Budget Outlook* (March 2017), www.cbo.gov/publication/52480.

6. That law made many significant changes to the individual and corporate income tax systems. Those changes, on net, lowered taxes owed by most individuals and businesses beginning in calendar year 2018. Nearly all of the changes to individual income taxes are set to expire at the end of calendar year 2025.

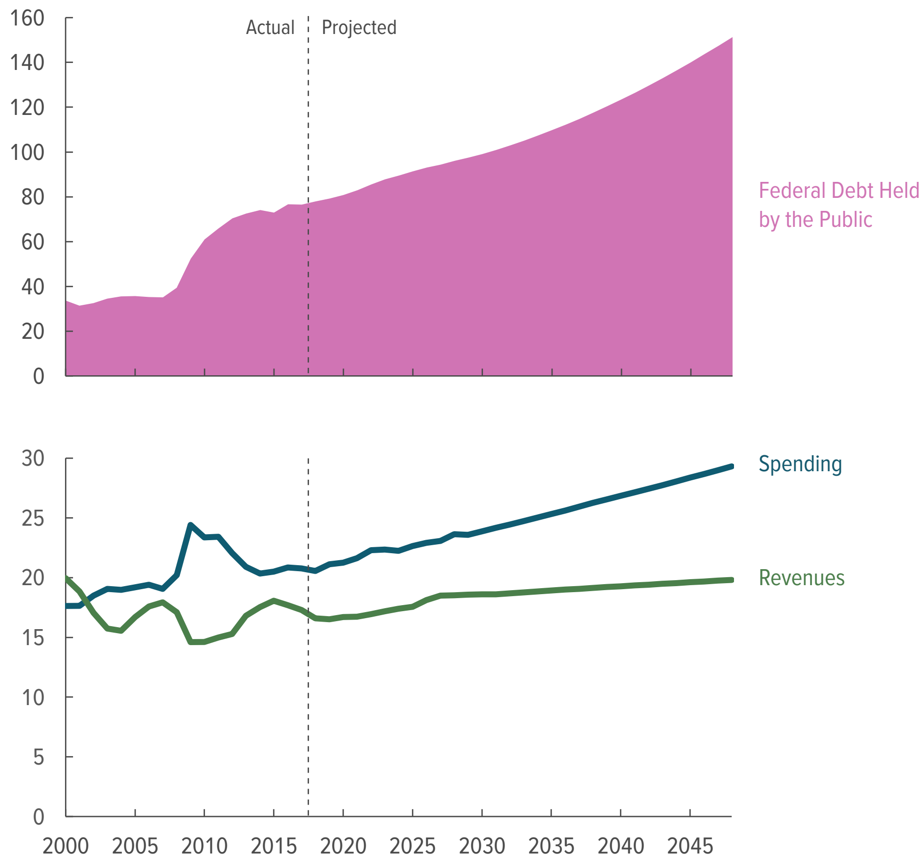
Figure 2.

Federal Debt, Spending, and Revenues

Percentage of Gross Domestic Product

In CBO's extended baseline, **federal debt held by the public** rises...

...because growth in **total spending** outpaces growth in **total revenues**, resulting in larger budget deficits.



Source: Congressional Budget Office.

The extended baseline generally reflects current law, following CBO's 10-year baseline budget projections through 2028 and then extending most of the concepts underlying those baseline projections for the rest of the long-term projection period.

GDP = gross domestic product.

Continued

than spending. In part, revenues would rise because of real bracket creep, which pushes more income into higher tax brackets as people's income rises faster than inflation. In addition, revenues would grow rapidly from a new excise tax on certain employment-based health insurance plans if that law took effect, as scheduled, in 2022. All told, CBO projects, revenues would reach 19.8 percent of GDP in 2048. Although that share would exceed the 50-year average of about 17 percent, it would still fall short of projected spending.

Greater Accumulation of Federal Debt

Debt held by the public represents the amount that the federal government has borrowed in financial markets by issuing Treasury securities to pay for its operations and activities.[7] Measuring debt as a percentage of GDP is useful for comparing amounts of debt in different

7. When the federal government borrows in financial markets, it competes with other participants for financial resources and, in the long term, crowds out private investment, thus reducing economic output and income. By contrast, federal debt held by trust funds and other government accounts represents internal transactions of the government and does not directly affect financial markets. (Together, that debt and debt held by the public make up gross federal debt.) For more discussion, see Congressional Budget Office, *Federal Debt and Interest Costs* (December 2010), www.cbo.gov/publication/21960. Several factors not directly included in the budget totals also affect the government's need to borrow from the public. They include fluctuations in the government's cash balance, as well as the cash flows of the financing accounts used for federal credit programs.

Figure 2.

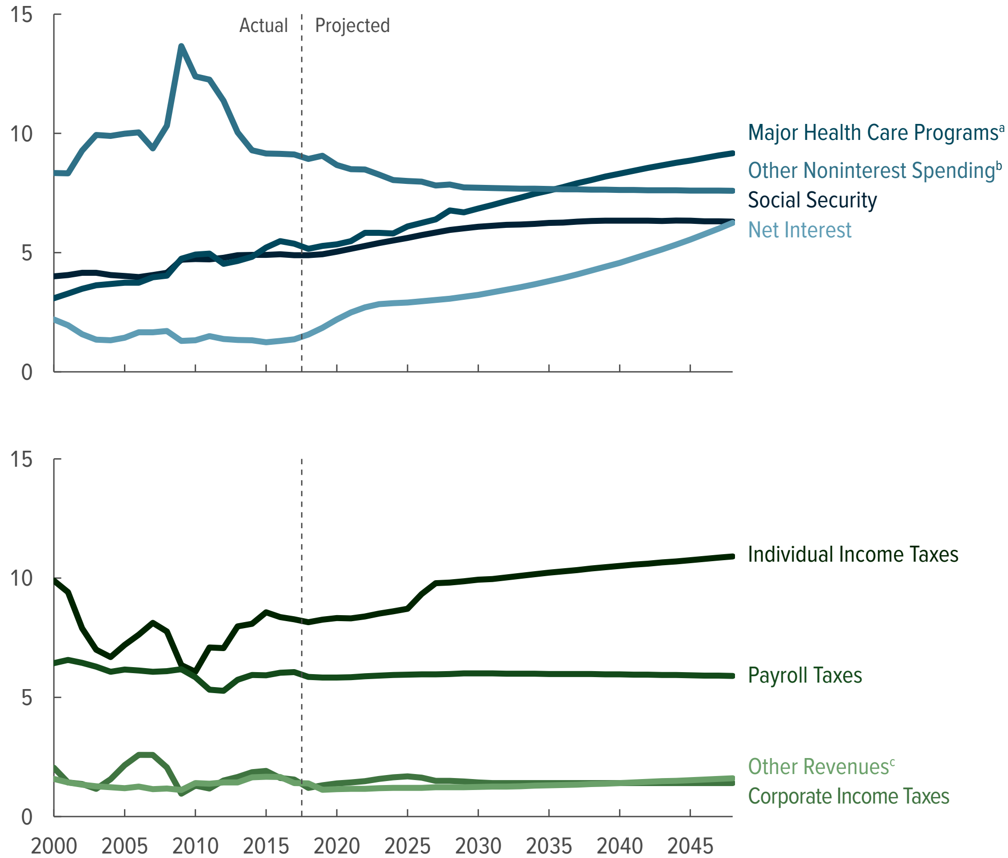
Continued

Federal Debt, Spending, and Revenues

Percentage of Gross Domestic Product

Spending on certain components of the budget—Social Security, the major health care programs, and net interest—is projected to rise relative to GDP; other spending, in total, is projected to decline.

Increases in individual income taxes account for most of the rise in total **revenues** relative to GDP. Receipts from all other sources, taken together, are projected to be slightly higher in 2048 than they are today.



a. Consists of spending for Medicare (net of premiums and other offsetting receipts), Medicaid, and the Children's Health Insurance Program, as well as outlays to subsidize health insurance purchased through the marketplaces established under the Affordable Care Act and related spending.

b. Consists of all federal spending other than that for Social Security, the major health care programs, and net interest.

c. Consists of excise taxes, remittances to the Treasury from the Federal Reserve System, customs duties, estate and gift taxes, and miscellaneous fees and fines.

years because it accounts for changes in price levels, population, output, and income—all of which affect the nation's ability to finance the debt. The ratio of debt to GDP places the effects of potential adjustments to the budget within the context of the nation's resources. Examining whether debt as a percentage of GDP is increasing is therefore a simple and meaningful way to assess the budget's sustainability.

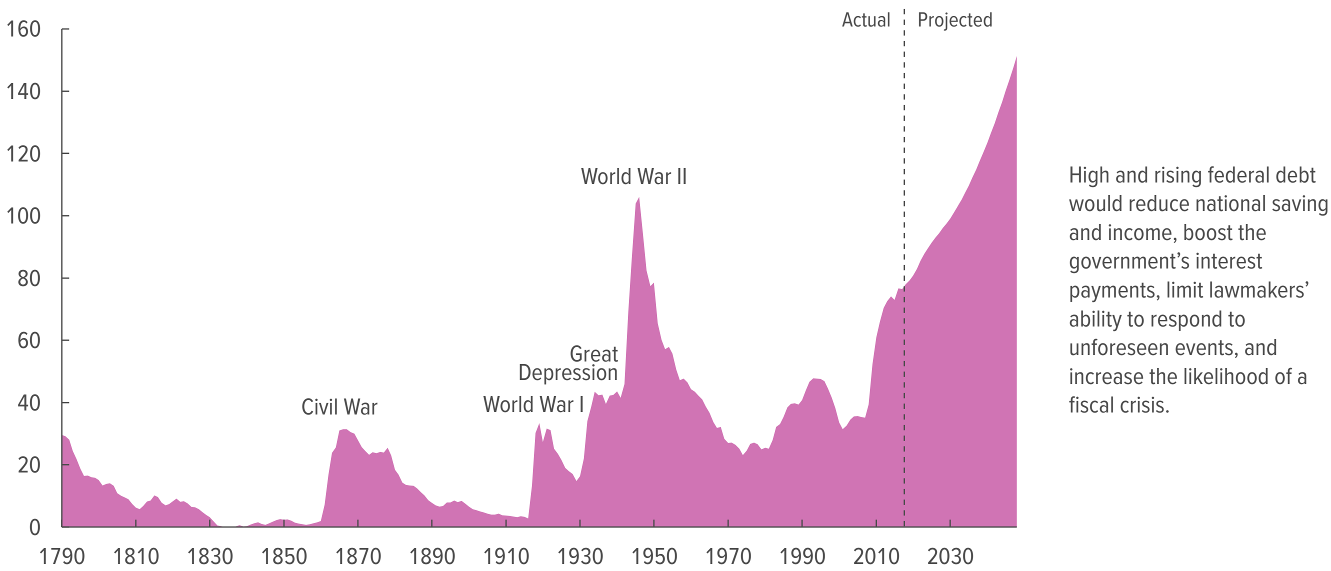
Federal debt held by the public has ballooned over the past decade. At the end of 2007, that debt stood at 35 percent of GDP, but deficits arising from the 2007–2009 recession and the resulting policy responses caused it to grow sharply over the next five years. By the end of 2012, debt as a share of GDP had doubled to 70 percent. Since then, the upward trajectory has generally continued, and debt is projected to reach 78 percent of GDP by the end of this year—a very high amount by historical standards. (For comparison, such debt has averaged 41 percent of GDP over the past 50 years.) During only one other period in U.S. history—from 1944 through 1950, because of the surge in federal spending during World War II—has that debt exceeded 70 percent of GDP (see Figure 3).

If current laws generally remained unchanged, the gap between spending and revenues would grow substantially through 2022, stabilize for a few years, and then continue to widen. As a result, federal debt as a percentage of GDP would reach unprecedented levels. CBO projects that debt

Figure 3.

Federal Debt Held by the Public

Percentage of Gross Domestic Product



Source: Congressional Budget Office.

would rise to 96 percent of GDP by 2028, and six years later, in 2034, it would surpass the peak of 106 percent recorded in 1946. By 2048, federal debt would reach 152 percent of GDP—significantly larger than the average of the past five decades—and would be on track to grow even larger. Moreover, if lawmakers changed current laws to maintain certain policies now in place—preventing a significant increase in individual income taxes in 2026, for example—the result would be even larger increases in debt.

Consequences of a Large and Growing Federal Debt

The burgeoning federal debt over the coming decades would have these effects:

- Reduce national saving and income in the long term;
- Increase the government's interest costs, putting more pressure on the rest of the budget;
- Limit lawmakers' ability to respond to unforeseen events; and
- Increase the likelihood of a fiscal crisis, a situation in which the interest rate on federal debt rises abruptly, dramatically increasing the cost of government borrowing.

Less National Saving and Lower Income

Large federal budget deficits over the long term would reduce investment, resulting in lower national income and higher interest rates than would otherwise be the case. If the government borrowed more money, a greater amount of household and business saving would be used to buy Treasury securities, thus crowding out private investment. Both the government and private borrowers would face higher interest rates to compete for savings. Although those higher rates would strengthen the incentive to save, the increased government borrowing would exceed the rise in saving by households and businesses. As a result, total saving by all sectors of the economy (national saving) would be lower, as would private investment and economic output. (Private investment would be affected less than national saving because higher interest rates tend to attract more foreign capital to the United States and induce U.S. savers to keep more of their money at home.) With less investment in capital goods—such as factories and computers—workers would be less productive. Because productivity growth is the main driver of growth in people's real compensation, decreased investment also would reduce average compensation per hour, making people less inclined to work. CBO's extended baseline incorporates those economic effects as well as the feedback to the budget from negative effects on the economy.

Greater Pressure on the Budget From Higher Interest Costs

Current net interest costs are relatively small because interest rates have been so low. Under CBO's extended baseline, however, rising interest rates and increased federal borrowing boost net interest costs substantially. By 2045, those costs would surpass discretionary spending for the first time since 1962 (the earliest year for which relevant data are available).

Over the next few years, the unemployment rate is expected to decline and inflation is projected to rise. CBO expects the Federal Reserve to respond to those developments by continuing to raise the federal funds rate to keep inflation close to the central bank's long-term goal.[8] In addition, long-term interest rates are projected to rise gradually relative to short-term rates as the term premium (the premium paid to bondholders for the extra risk associated with holding longer-term bonds) moves up from its recent low levels. The term premium is projected to rise as investors gain more confidence in global economic growth, the demand for long-term Treasury securities as a hedge against unexpected declines in inflation dissipates, and the Federal Reserve reduces its holdings of long-term assets. CBO projects that interest rates would eventually settle at levels consistent with factors such as productivity growth, the demand for investment, and federal deficits. Under the extended baseline, interest costs are much higher than they would be if deficits were smaller and interest rates were lower.

The higher the government's interest costs, the more difficult it would be to achieve any particular target for deficit reduction. That is because, in order to reduce the deficit, tax increases, spending reductions, or both would have to be greater. Such policy changes could affect the economy and people's well-being. If, for example, policy changes included an increase in marginal tax rates (the rates that apply to an additional dollar of income), people's incentives to work and save would diminish as tax rates rose.[9] Alternatively, if policy changes included a reduction in federal spending for investment, both output and income would be lower than they would have been if that spending had not been reduced.[10] In contrast, if reductions in, say, Social Security benefits were made to lessen spending, people might feel compelled to work more to replace that lost income, thus increasing output.

Reduced Ability to Respond to Unforeseen Events

When outstanding debt is relatively small, the federal government is able to borrow money at lower rates to cover unexpected costs, such as those that arise from recessions, financial crises, natural disasters, or wars. By contrast, when outstanding debt is large, the government has less flexibility to address financial and economic crises. A large debt also can compromise a country's national security by constraining military spending in times of international crisis or by limiting the government's ability to prepare for (or respond to) such a crisis.

At the outset of the 2007–2009 recession, when federal debt held by the public was below 40 percent of GDP, lawmakers had the flexibility necessary to respond to the financial crisis. The recession resulted in lower output and income, which caused sharp declines in tax revenues and increases in mandatory spending. The policy responses included increases in federal spending to stabilize the financial sector, boost investment in infrastructure, and add to income security programs, along with temporary decreases in business and payroll taxes. As a result, by 2012, federal debt as a percentage of GDP had doubled from its 2007 level.

If another recession or fiscal crisis occurred and if federal debt was at its current level or higher, the government might have a more difficult time implementing similar costly actions in response. As a result, such events could have larger negative effects on the economy and on people's well-being. Moreover, the reduced financial flexibility and increased dependence on foreign investors that would accompany high and rising debt could weaken U.S. international leadership.

Greater Chance of a Fiscal Crisis

A large and growing federal debt would increase the chance of a fiscal crisis in the United States—a situation in which it would become increasingly difficult to finance federal borrowing and investors would have to be compensated with continuously increasing interest

8. The federal funds rate is the interest rate financial institutions charge each other for overnight loans of their monetary reserves.

9. See Congressional Budget Office, *How the Supply of Labor Responds to Changes in Fiscal Policy* (October 2012), www.cbo.gov/publication/43674.

10. For more information, see Congressional Budget Office, *The Macroeconomic and Budgetary Effects of Federal Investment* (June 2016), www.cbo.gov/publication/51628.

rates.[11] Those concerns could perpetuate a cycle: Higher interest rates would increase concerns over repayment, which would continue to raise interest rates even further. Even in the absence of a full-blown crisis, such risks would lead to higher rates and borrowing costs for the U.S. government and the private sector.

In a fiscal crisis, dramatic increases in Treasury rates would reduce the market value of outstanding government securities, and the resulting losses—for mutual funds, pension funds, insurance companies, banks, and other holders of government debt—could be large enough to cause some financial institutions to fail. Because the United States currently benefits from the U.S. dollar being the world's reserve currency and because the federal government borrows in dollars, it is less likely that a sudden fiscal crisis would lead to a catastrophic financial crisis similar to those that befell Argentina, Greece, or Ireland. As one example, in the event of a dramatic increase in interest rates, the Federal Reserve could buy Treasury securities and thereby limit losses to bondholders. However, such moves, if extensive, would ultimately lead to high inflation, a sharp depreciation in the value of the dollar, or both.[12] Those developments would reduce the value of U.S. assets.

No one can accurately predict whether or when a fiscal crisis might occur in the United States or how it would unfold. In particular, the debt-to-GDP ratio has no identifiable tipping point to indicate that a crisis is likely or imminent. Nonetheless, a large and rising federal debt would almost certainly increase the risk of a fiscal crisis.

The likelihood of a fiscal crisis also depends on economic conditions. If investors anticipate continued economic growth and low interest rates, they are generally less concerned about the government's debt burden. Conversely, substantial debt can reinforce a more generalized concern about the economy. Thus, fiscal crises around the world often have begun during recessions and, in turn, have exacerbated them.

If a fiscal crisis occurred in the United States, policymakers would have limited—and unappealing—options for responding. The government would need to undertake some combination of three approaches: restructure the debt (that is, seek to modify the contractual terms of existing obligations), use monetary policy to raise inflation above expectations, or implement large and abrupt spending cuts or tax increases.

Demographic and Economic Trends That Underlie CBO's Long-Term Projections

Demographic and economic projections are key determinants of the long-term budget outlook. Through 2028, the projections in this report are the same as those that underlie CBO's 10-year baseline; for later years, the agency projects conditions according to its assessment of long-term trends. (Appendix A describes CBO's demographic and economic projections.) In addition, the economic projections take into account the effects that projected fiscal policies—in particular, increased federal borrowing and rising effective marginal tax rates—would have on the economy. Such effects would result in a smaller labor supply, a smaller stock of capital, and lower output than would otherwise be the case.

Demographic Projections

The size and age profile of the U.S. population affect the federal budget and the nation's economy. For example, the composition of the population influences the size of the labor force and the number of beneficiaries of Social Security and other federal programs. In CBO's projections, the U.S. population increases from 332 million at the beginning of this year to 392 million in 2048, expanding by 0.6 percent per year, on average. That annual rate of growth is slower than the rate of the past 50 years (0.9 percent). The share of the population age 65 or older also rises over the coming decades, maintaining a long-standing historical trend. By 2048, 22 percent of the population would be age 65 or older, compared with 16 percent today (see Figure 4).

To estimate growth in the U.S. population, CBO projects rates of fertility, immigration, and mortality. The total fertility rate is calculated as the sum of fertility rates for women between 15 and 49 in a given year and represents the average number of children that a woman would have in her lifetime.[13] In general, that rate tends to decline during recessions and rebound during recoveries. Instead of rebounding after the

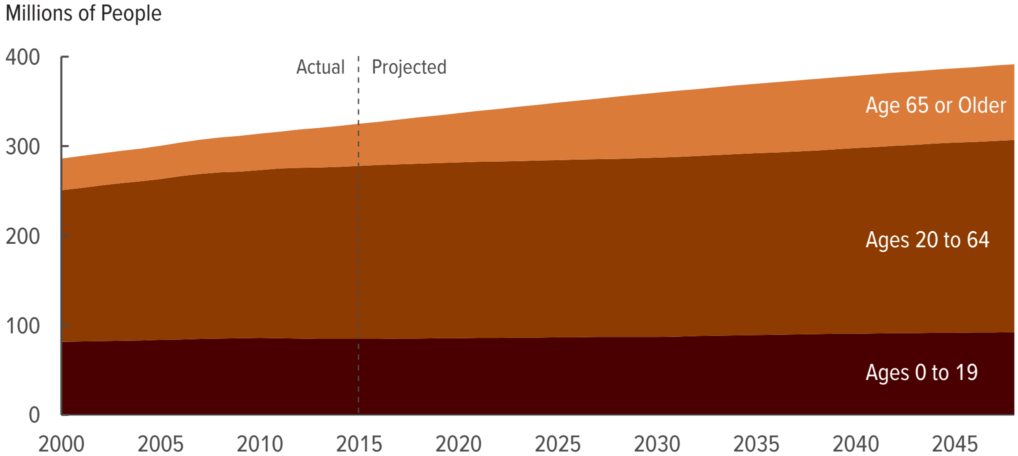
11. For more information, see Congressional Budget Office, *Federal Debt and the Risk of a Fiscal Crisis* (July 2010), www.cbo.gov/publication/21625. That report points out, for example, that during past fiscal crises, Argentina, Greece, and Ireland were forced to make difficult choices in the face of sharp increases in interest rates on government debt.

12. Over time, such currency debasement would erode the status of the U.S. dollar as the world's reserve currency.

13. The total fertility rate can also be defined as the average number of children that a woman would have if, in each year of her life, she experienced the birth rates observed or assumed for that year and if she survived her entire childbearing period.

Figure 4.

Population, by Age Group



The share of the population age 65 or older is projected to rise over the coming decades, maintaining a long-standing historical trend.

Source: Congressional Budget Office.

This figure shows actual data through calendar year 2015, the most recent year for which such data are available.

2007–2009 recession, however, the fertility rate fell. In 2007, the rate was 2.1 births per woman, but it declined to 1.9 by 2010 and has remained below that point since then. CBO expects the total fertility rate to be 1.9 for the next 30 years.[14]

Under current law, the rate of net annual immigration to the United States is expected to rise slightly over the next three decades. CBO projects that rate would inch up from an average of 3.1 per thousand people in the U.S. population over the next decade to 3.2 in 2048. That rate, which accounts for anyone who either enters or leaves the United States in any year, is slightly higher than the average net annual immigration rates since the end of the 2007–2009 recession. On balance, CBO projects that the increase in net annual immigration over the next decade would be mostly driven by higher numbers of legal permanent residents. The annual increase in the number of legal temporary and unauthorized immigrants is projected to be relatively steady over the next 10 years. Beyond 2028, the annual average rate of growth is the same for different categories of immigrants in CBO's projections. Using that simplified approach, CBO projects that net annual immigration would grow at an average rate of 0.6 percent annually through 2048, slightly faster than the average rate of growth in the U.S. population overall.[15]

Mortality rates are projected to improve over the next 30 years, on average. Those rates, which measure the number of deaths per thousand people in the population, are projected to decline at the same rates that were recorded for each age and sex group from 1950 to 2014. Improved, or lower, mortality rates mean higher life expectancy. CBO projects an average life expectancy at birth of 82.8 years in 2048, compared with 79.2 years in 2018.[16] Similarly, CBO projects life expectancy at age 65 in 2048 to be 21.7 years, or 2.2 years longer than life expectancy at age 65 in 2018.

Economic Projections

The performance of the U.S. economy in coming decades will affect the federal government's spending, revenues, and debt accumulation. CBO makes its economic projections by projecting trends in key economic

14. Recent data show that low total fertility rates have persisted since the recession, remaining below 1.9. See Brady E. Hamilton and others, *Births: Provisional Data for 2017*, Vital Statistics Rapid Release Report 4 (National Center for Health Statistics, May 2018), www.cdc.gov/nchs/nvss/vsrr/reports.htm.

15. That rate is based on the Census Bureau's projections for late in the coming decade. See Census Bureau, "2014 National Population Projections: Summary Tables," Table 1, https://go.usa.gov/xQAbu. The Census Bureau has recently released a new set of projections, but information from those projections has not been incorporated in this analysis. In those projections, the population is slightly smaller than the Census Bureau projected in 2014.

16. Life expectancy as used here is period life expectancy, which is the amount of time that a person in a given year would expect to survive beyond his or her current age on the basis of that year's mortality rates for various ages.

Figure 5.

Average Annual Growth of Real Potential GDP in CBO's Extended Baseline

Percent

Source: Congressional Budget Office.

Real potential GDP is the maximum sustainable output of the economy adjusted to remove the effects of inflation. The two contributing factors are potential labor force productivity (the ratio of potential GDP to the potential labor force) and the potential labor force (the labor force adjusted for ups and downs in the business cycle).

GDP = gross domestic product.

variables, such as the size and composition of the labor force, capital accumulation, productivity, inflation, and interest rates. The agency also considers ways in which fiscal policy influences economic activity.

In CBO's projections, growth in potential (maximum sustainable) GDP in the future is slower than it has been over the past 50 years. Under its extended baseline, CBO projects an increase in real potential GDP of 1.9 percent per year, on average, over the next 30 years, compared with its historical growth rate of 2.8 percent. That slower economic growth is attributable to several factors—most notably, slower growth of the potential labor force (the labor force adjusted for ups and downs in the business cycle). In CBO's projections, the potential labor force grows by 0.4 percent per year, on average, through 2048 (see Figure 5); the average annual growth rate over the 1968–2017 period was 1.5 percent. That slower projected growth of the potential labor force mainly results from the aging of the population and the relative stability (after rising for decades) in the share of women participating in the labor force.[17]

In CBO's projections, total factor productivity grows more slowly than its historical average, increasing by 1.2 percent per year, on average, from 2018 to 2048. That rate, which measures the average real output per unit of combined labor and capital services, is slower than the annual average of 1.5 percent since 1950. Factors influencing that projection include slower productivity growth over the past several decades (except during a period of rapid growth in the late 1990s and early 2000s), modest growth in labor quality (a measure of workers' skills), and a projected reduction in federal investment as a share of GDP. Potential labor productivity—defined as real potential output per potential hour of labor—is likewise projected to grow more slowly than it has in the past, reflecting less

17. For more details about how CBO projects labor force participation rates, see Joshua Montes, *CBO's Projection of Labor Force Participation Rates,* Working Paper 2018-04 (Congressional Budget Office, March 2018), www.cbo.gov/publication/53616.

private investment in capital goods. Since 1950, labor productivity has expanded by 1.7 percent per year, on average; through 2048, that growth rate is projected to average 1.5 percent per year (see Figure 5).

Interest rates, in CBO's projections, rise as the economy continues to expand but remain lower than they have been historically. Slower growth of the labor force and lower inflation push interest rates down from their historical levels, and those factors are projected to outweigh the effects of rising federal debt and other factors that tend to push interest rates up. In CBO's latest economic projections, the interest rate on 10-year Treasury notes rises from 2.4 percent at the end of 2017 to 3.7 percent in 2028. That rate is projected to rise to 4.8 percent in 2048—1 percentage point below the 5.8 percent average recorded over the 1990–2007 period. (That period is used for comparison because it was characterized by fairly stable expectations for inflation and by a lack of significant financial crises or severe economic downturns.)

The average interest rate on all federal debt held by the public tends to be lower than the rate on 10-year Treasury notes. (Interest rates generally are lower on shorter-term debt than on longer-term debt, and the average term to maturity of federal debt has been less than 10 years since the 1950s.) Based on projections of interest rate spreads and the term structure of rates on federal debt, the average interest rate on federal debt is projected to be about 0.4 percentage points lower than the interest rate on 10-year Treasury notes after 2028.[18] As a result, in CBO's projections, the average interest rate on federal debt rises to 4.4 percent by 2048.

CBO's economic projections incorporate the macroeconomic effects of federal tax and spending policies. In particular, the agency projects that increased borrowing by the federal government under current law generally would crowd out some private investment in productive capital in the long term. Less private investment in capital goods would make workers less productive, leading to lower wages and a smaller supply of labor. Furthermore, the extended baseline incorporates the economic effects of higher marginal tax rates. As more income is pushed into higher tax brackets over time, labor and capital income face higher tax rates. Higher marginal tax rates on labor income would lessen people's incentive to work, and the increase in the marginal tax rate on capital income would reduce their incentive to save. All told, less private domestic investment and a smaller labor supply would result in lower economic output and income than would otherwise be the case.

Projected Spending Through 2048

Spending for all of the government's programs and activities, combined with net interest costs, is projected to account for a larger percentage of GDP in coming years than it has, on average, over the past 50 years. From 1968 to 2017, federal outlays other than those for the government's net interest costs averaged 18 percent of GDP. The percentage was higher over the past decade, when noninterest spending averaged 20 percent of GDP, because of underlying demographic trends and because of temporary conditions in the economy (namely, the financial crisis, the weak recovery, and the federal policies that were created to address those circumstances). Under current law, noninterest outlays are projected to rise from 19 percent in 2018 to 20 percent in 2028 (adjusted to exclude shifts in timing; the share would be 21 percent if timing shifts were included). Over the next decade, mandatory spending (which includes spending on Social Security and the major health care programs, along with many smaller programs) is generally projected to increase as a share of the economy, and discretionary spending is generally projected to decrease.

After 2028, under the assumptions that govern the extended baseline, noninterest spending would continue to rise relative to the size of the economy, reaching 23 percent of GDP by 2048. (For a summary of CBO's assumptions about spending and revenues, see Table 2.) That increase would mostly result from larger outlays for the two biggest mandatory programs: Social Security and Medicare (see Figure 6).

Under current law, net interest costs would rise from 1.6 percent of GDP in 2018 to 3.1 percent in 2028, CBO projects, as debt accumulates and as interest rates increase from their currently low levels. By 2048, net interest costs would equal 6.3 percent of GDP, boosting total federal spending to 29 percent of GDP. Spending has exceeded that amount only once, for a three-year period during World War II. For those years, when

18. Term structure is the relationship between interest rates or bond yields and different terms or maturities.

Table 2.

Assumptions About Spending and Revenues Underlying CBO's Extended Baseline

	Assumptions About Spending
Social Security	As scheduled under current law[a]
Medicare	As scheduled under current law through 2028; thereafter, projected spending depends on the estimated number of beneficiaries and health care costs per beneficiary (for which excess cost growth is projected to move smoothly to a rate of 1.0 between 2029 and 2048)[a]
Medicaid	As scheduled under current law through 2028; thereafter, projected spending depends on the estimated number of beneficiaries and health care costs per beneficiary (for which excess cost growth is projected to move smoothly to a rate of 1.0 between 2029 and 2048)
Children's Health Insurance Program	As projected in CBO's baseline through 2028; constant as a percentage of GDP thereafter
Subsidies for Health Insurance Purchased Through the Marketplaces Established Under the Affordable Care Act	As scheduled under current law through 2028; thereafter, projected spending depends on the estimated number of beneficiaries, an additional indexing factor for subsidies, and excess cost growth for private health insurance premiums (which is projected to move smoothly to an annual rate of 1.0 between 2029 and 2048)
Other Mandatory Spending	As scheduled under current law through 2028; thereafter, refundable tax credits are estimated as part of revenue projections, and the rest of other mandatory spending is assumed to decline as a percentage of GDP at roughly the same annual rate at which it is projected to decline between 2023 and 2028[b]
Discretionary Spending	As projected in CBO's baseline through 2028; roughly constant as a percentage of GDP thereafter[c]
	Assumptions About Revenues
Individual Income Taxes	As scheduled under current law
Payroll Taxes	As scheduled under current law
Corporate Income Taxes	As scheduled under current law
Excise Taxes	As scheduled under current law[d]
Estate and Gift Taxes	As scheduled under current law
Other Sources of Revenues	As scheduled under current law through 2028; constant as a percentage of GDP thereafter

Source: Congressional Budget Office.

The extended baseline generally reflects current law, following CBO's 10-year baseline budget projections through 2028 and then extending most of the concepts underlying those baseline projections for the rest of the long-term projection period.

For CBO's most recent 10-year baseline projections, see Congressional Budget Office, *An Analysis of the President's 2019 Budget* (May 2018), www.cbo.gov/publication/53884.

Excess cost growth refers to the extent to which the growth rate of nominal health care spending per person—adjusted for demographic characteristics of the relevant populations—exceeds the growth rate of potential GDP per person. (Potential GDP is the maximum sustainable output of the economy.)

GDP = gross domestic product.

a. Assumes the payment of full benefits as calculated under current law, regardless of the amounts available in the program's trust funds.

b. In that projection, GDP includes the macroeconomic effects of the policies underlying the extended baseline. If it did not, the rest of other mandatory spending after 2028 would decline at the same rate at which it is projected to decline between 2023 and 2028 (excluding the decline in spending for the Supplemental Nutrition Assistance Program).

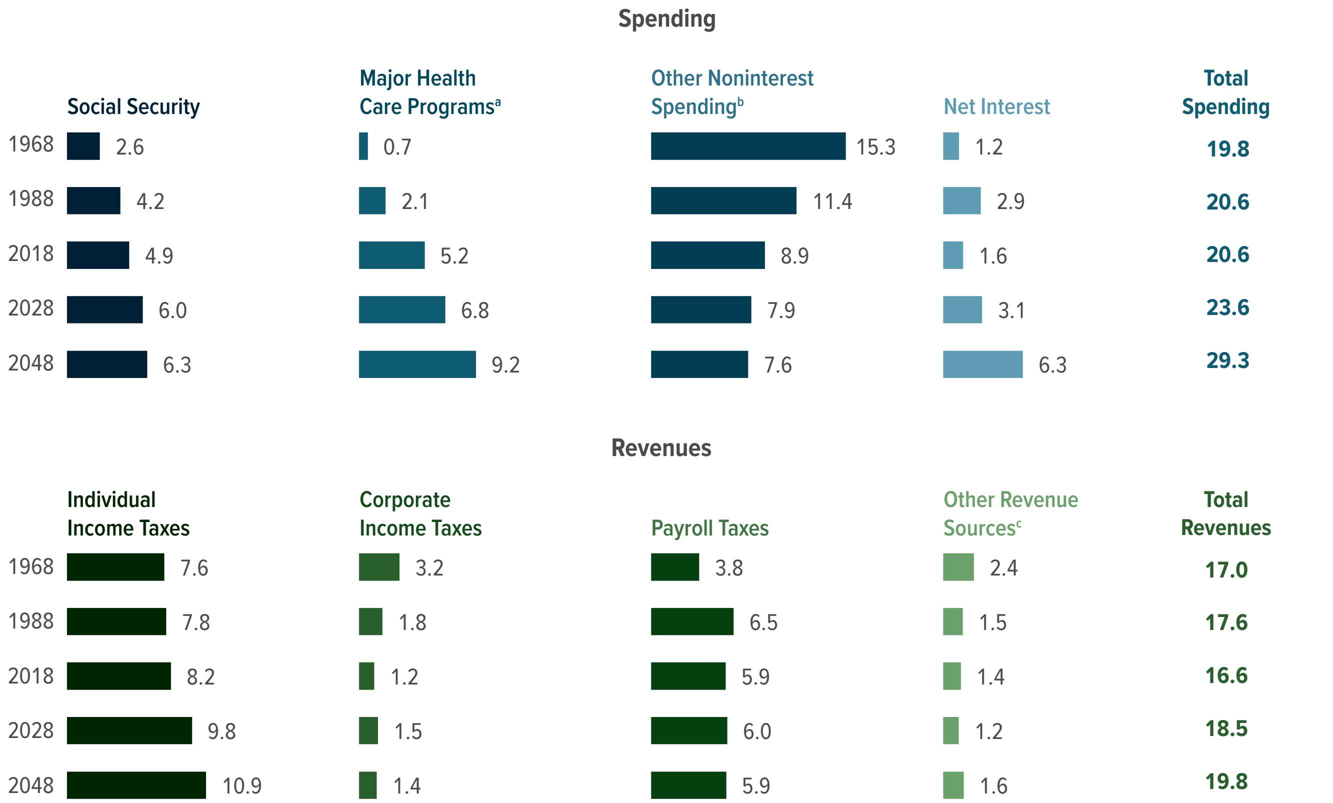
c. In that projection, GDP includes the macroeconomic effects of the policies underlying the extended baseline. If it did not, discretionary spending after 2028 would remain the same (measured as a percentage of GDP) as the amount projected for 2028.

d. The exception to the current-law assumption applies to expiring excise taxes dedicated to trust funds. The Balanced Budget and Emergency Deficit Control Act of 1985 requires CBO's baseline to reflect the assumption that those taxes would be extended at their current rates. That law does not stipulate that the baseline include the extension of other expiring tax provisions, even if they have been routinely extended in the past.

Figure 6.

Spending and Revenues in the Past and in CBO's Extended Baseline

Percentage of Gross Domestic Product



Source: Congressional Budget Office.

The extended baseline generally reflects current law, following CBO's 10-year baseline budget projections through 2028 and then extending most of the concepts underlying those baseline projections for the rest of the long-term projection period.

a. Consists of spending for Medicare (net of premiums and other offsetting receipts), Medicaid, and the Children's Health Insurance Program, as well as outlays to subsidize health insurance purchased through the marketplaces established under the Affordable Care Act and related spending.

b. Consists of all federal spending other than that for Social Security, the major health care programs, and net interest.

c. Consists of excise taxes, remittances to the Treasury from the Federal Reserve System, customs duties, estate and gift taxes, and miscellaneous fees and fines.

defense spending increased sharply, total federal spending topped 40 percent.

CBO projects that the growth in spending for Social Security, the major health care programs, and net interest would continue to reshape the spending patterns of the U.S. government (see Figure 7). Spending for net interest would account for a much greater portion of total federal spending by 2048 than it does today, and spending on Social Security and the major health care programs would account for a much larger share of all federal noninterest spending.

Spending for Social Security and the Major Health Care Programs

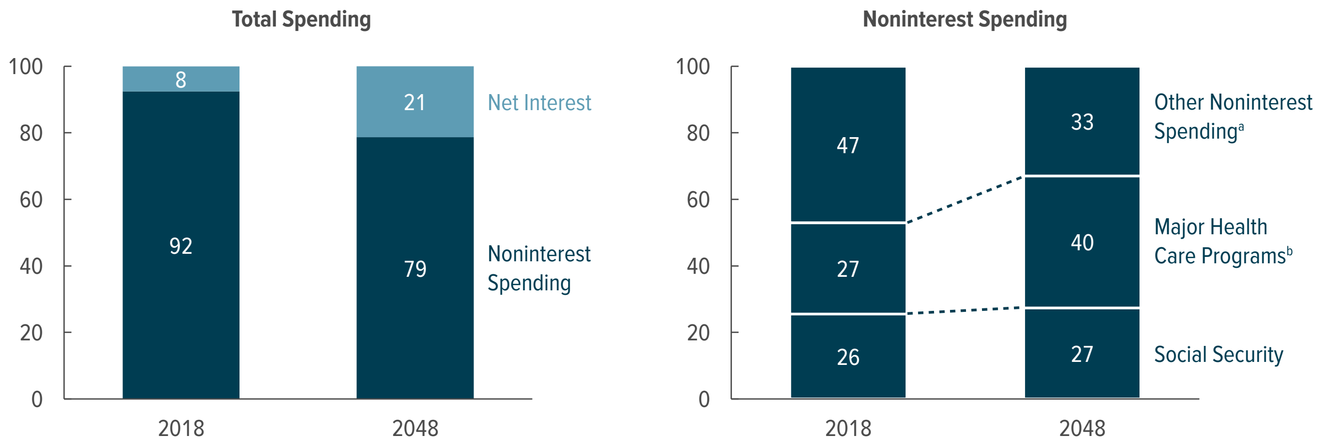
Mandatory programs have accounted for a rising share of the federal government's noninterest spending over the past few decades. Most of the growth has occurred because Social Security and Medicare provide benefits mainly to people age 65 or older, a group that has been growing significantly.

Social Security. Created in 1935, Social Security is the largest single program in the federal budget. Its two components pay benefits to 62 million people in all.

Figure 7.

Composition of Federal Spending in CBO's Extended Baseline

Percent



Source: Congressional Budget Office.

The extended baseline generally reflects current law, following CBO's 10-year baseline budget projections through 2028 and then extending most of the concepts underlying those baseline projections for the rest of the long-term projection period.

a. Consists of all federal spending other than that for Social Security, the major health care programs, and net interest.

b. Consists of spending for Medicare (net of premiums and other offsetting receipts), Medicaid, and the Children's Health Insurance Program, as well as outlays to subsidize health insurance purchased through the marketplaces established under the Affordable Care Act and related spending.

The larger of the two, Old-Age and Survivors Insurance (OASI), pays benefits to retired workers, to their eligible dependents, and to some survivors of deceased workers. The smaller program, Disability Insurance (DI), makes payments to disabled workers and to their dependents until those workers are old enough to claim full retirement benefits under OASI.

Under current law, CBO projects, spending for Social Security would increase noticeably as a share of the economy, continuing the trend of the past five decades. That spending would increase from 4.9 percent of GDP in 2018 to 6.3 percent in 2048 (see Figure 6 on page 15), and the number of beneficiaries would rise from 62 million to nearly 99 million. In CBO's extended baseline projections, Social Security is assumed to pay benefits as scheduled under current law, regardless of the status of the program's trust funds.[19] That approach is consistent with a statutory requirement that CBO's 10-year baseline projections incorporate the assumption that funding for such programs is adequate to make all payments required by law.[20]

The Social Security program is funded by dedicated tax revenues from two sources. Currently, 96 percent comes from a payroll tax; the rest is collected from income taxes on Social Security benefits. Revenues from the payroll tax and the tax on benefits are credited to the Old-Age and Survivors Insurance Trust Fund and the Disability Insurance Trust Fund, which finance the program's benefits.

A common measure of the sustainability of a program that has a trust fund and a dedicated revenue source is its estimated actuarial balance over a given period—that

19. The balances of the trust funds represent the total amount that the government is legally authorized to spend for those purposes. For more details about the legal issues related to exhaustion of a trust fund, see Noah P. Meyerson, *Social Security: What Would Happen If the Trust Funds Ran Out?* Report for Congress RL33514 (Congressional Research Service, August 28, 2014), available from U.S. House of Representatives, Committee on Ways and Means, *2014 Green Book*, Chapter 1: Social Security, "Social Security Congressional Research Service Reports" (accessed April 19, 2018), http://go.usa.gov/cCXcG.

20. Sec. 257(b)(1) of the Balanced Budget and Emergency Deficit Control Act of 1985 (Deficit Control Act), Public Law 99-177 (codified at 2 U.S.C. §907(b)(1) (2016)).

is, the sum of the present value of projected tax revenues and the current trust fund balance minus the sum of the present value of projected outlays and a year's worth of benefits at the end of the period.[21] For Social Security, that difference is traditionally presented as a percentage of the present value of taxable payroll over 75 years.[22]

Over the next 75 years, if current laws remained in place, the program's actuarial shortfall would be 1.5 percent of GDP, or 4.4 percent of taxable payroll, CBO projects (see Table 3).[23] According to CBO's projections, therefore, it would be possible to pay the benefits prescribed by current law and maintain the necessary trust fund balances through 2092 if payroll taxes were raised immediately and permanently by about 4.4 percent of taxable payroll, if scheduled benefits were reduced by an equivalent amount, or if some combination of tax increases and spending reductions of equal present value was adopted.[24]

21. A present value expresses a flow of past and future income or payments as a single amount received or paid at a specific time. The value depends on the rate of interest, known as the discount rate, used to translate past and future cash flows into current dollars at that time. To account for the difference between a trust fund's current balance and the balance desired for the end of the period, the balance at the beginning is added to the projected tax revenues, and an additional year of costs at the end of the period is added to projected outlays.

22. Taxable payroll is the total amount of earnings (wages and self-employment income) for employment covered by Social Security that is below the applicable annual taxable maximum ($128,400 in 2018).

23. The 75-year projection period used here begins in calendar year 2018 and ends in calendar year 2092. The Social Security trustees have estimated that the program's 75-year actuarial shortfall would be 2.8 percent of taxable payroll, which is about 1.6 percentage points less than CBO's projection. For details on the trustees' projections, see Social Security Administration, *The 2018 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds* (June 2018), www.ssa.gov/oact/tr/2018.

24. A policy that either increased revenues or reduced outlays by the same percentage of taxable payroll each year that would be required to eliminate the 75-year shortfall would not necessarily place Social Security on a permanently stable financial path. Estimates of the actuarial shortfall do not account for revenues or outlays after the 75-year projection period. Because shortfalls are smaller earlier in the 75-year projection period than they are later, such a policy would create surpluses in the next several decades but result in deficits later and leave the system financially unbalanced after calendar year 2092. Additionally, the calculation of the actuarial balance excludes the effects of any macroeconomic feedback that would result from an increase in taxes or a reduction in benefits.

Table 3.

Financial Measures for Social Security

Projection Period (Calendar years)	Income Rate	Cost Rate	Actuarial Balance (Difference)
	As a Percentage of Gross Domestic Product		
25 Years (2018 to 2042)	5.1	6.2	-1.0
50 Years (2018 to 2067)	4.8	6.2	-1.4
75 Years (2018 to 2092)	4.7	6.2	-1.5
	As a Percentage of Taxable Payroll		
25 Years (2018 to 2042)	14.6	17.5	-2.9
50 Years (2018 to 2067)	14.0	18.0	-4.0
75 Years (2018 to 2092)	13.9	18.3	-4.4

Source: Congressional Budget Office.

These projections incorporate the assumption that spending for Social Security continues as scheduled even if its trust funds are exhausted. Through 2048, the projections incorporate macroeconomic feedback caused by rising federal debt and marginal tax rates. After 2048, they do not account for such feedback.

Over each projection period, the income rate is the present value of annual tax revenues plus the initial trust fund balance, and the cost rate is the present value of annual outlays plus the present value of a year's worth of benefits as a reserve at the end of the period, each divided by the present value of gross domestic product or taxable payroll. (The present value of a flow of revenues or outlays over time expresses that flow as a single amount received or paid at a specific time. The present value depends on a rate of interest, known as the discount rate, that is used to translate past and future cash flows into current dollars.) The actuarial balance is the difference between the income and cost rates.

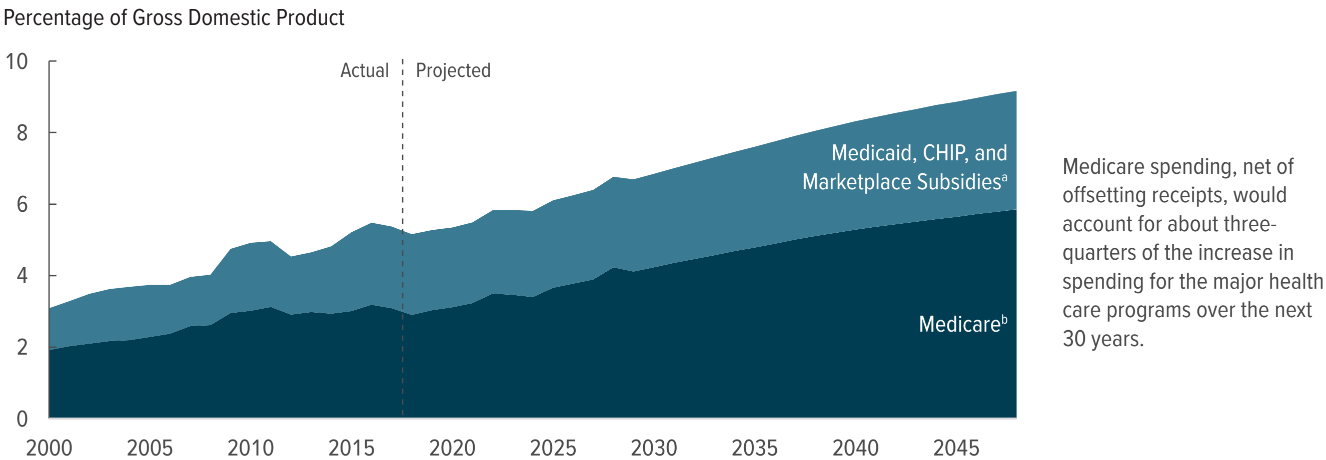
Another commonly used measure of Social Security's sustainability is a trust fund's date of exhaustion. CBO projects that, under current law, the DI trust fund would be exhausted in fiscal year 2025 and the OASI trust fund would be exhausted in calendar year 2032. If their balances were combined, the OASDI trust funds would be exhausted in calendar year 2031, according to CBO's estimate.

The Major Health Care Programs. Outlays for the major health care programs consist of spending for Medicare, Medicaid, and the Children's Health Insurance Program (CHIP), as well as outlays to subsidize health insurance purchased through the marketplaces established under the Affordable Care Act (ACA) and related spending.[25] Medicare, which provides health insurance to about

25. Spending related to subsidies for insurance purchased through the marketplaces includes spending for subsidies for insurance provided through the Basic Health Program and spending for the risk-adjustment and reinsurance programs that were established by the ACA to stabilize premiums for health insurance purchased by individuals and small employers.

Figure 8.

Federal Spending on the Major Health Care Programs, by Category



Source: Congressional Budget Office.

The extended baseline generally reflects current law, following CBO's 10-year baseline budget projections through 2028 and then extending most of the concepts underlying those baseline projections for the rest of the long-term projection period.

CHIP = Children's Health Insurance Program; GDP = gross domestic product.

a. "Marketplace Subsidies" refers to spending to subsidize health insurance purchased through the marketplaces established under the Affordable Care Act and insurance provided through the Basic Health Program, as well as spending to stabilize premiums for health insurance purchased by individuals and small employers.

b. Refers to net spending for Medicare, which accounts for offsetting receipts that are credited to the program. Those offsetting receipts are mostly premiums paid by beneficiaries to the government.

59 million people (most of whom are at least 65 years old), accounts for more than half of that spending.

CBO projects federal spending for the government's major health care programs for 2018 through 2028 under the assumption that the laws governing those programs will, in general, remain unchanged. As with Social Security, CBO assumes that Medicare will pay benefits as scheduled under current law, regardless of the amounts in the program's trust funds. For longer-term projections, considerable uncertainty surrounds the evolution of health care delivery and financing systems. That uncertainty leads CBO to employ a formulaic approach for its projections beyond 2028: It combines estimates of the number of expected beneficiaries of the government's health care programs with mechanical estimates of the growth in spending per beneficiary.

Over the past five decades, spending for the major health care programs has steadily grown faster than the economy, and that trend continues in CBO's extended baseline. In 2018, net federal spending for the major health care programs is estimated to equal 5.2 percent of GDP, CBO projects. If current laws generally remained in place, net outlays for those programs would increase to 9.2 percent in 2048, with Medicare spending, net of offsetting receipts (mostly premiums paid by enrollees), growing by about 3 percent of GDP, and spending on Medicaid and CHIP, combined with outlays for marketplace subsidies and related spending, growing by about 1 percent of GDP (see Figure 8).[26]

Causes of Growth in Spending for Social Security and the Major Health Care Programs

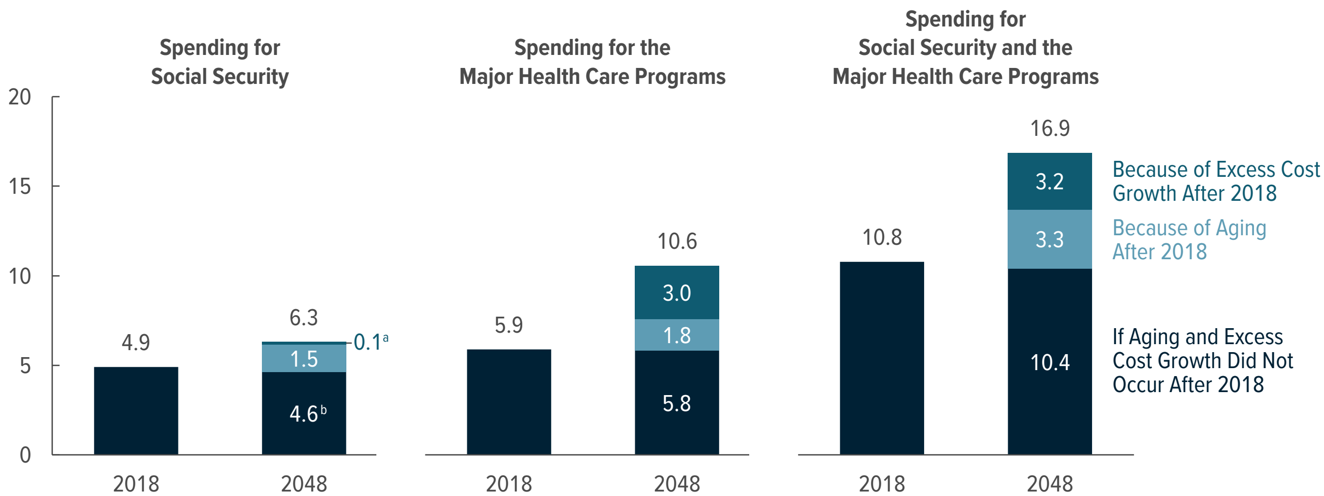
The aging of the population and rising health care costs per person are reasons for the sharp rise in projected spending for Social Security and the major federal health care programs over the next 30 years. The extent to which health care costs per person, adjusted for demographic changes, grow faster than potential GDP per person is known as excess cost growth.

26. In CBO's projections, the outlays for subsidies for insurance purchased through the marketplaces and related spending are presented in combination with outlays for Medicaid and CHIP. Most of those outlays constitute federal subsidies for health insurance for low- and moderate-income households.

Figure 9.

Spending Growth in Social Security and the Major Health Care Programs in CBO's Extended Baseline

Percentage of Gross Domestic Product



Source: Congressional Budget Office.

The extended baseline generally reflects current law, following CBO's 10-year baseline budget projections through 2028 and then extending most of the concepts underlying those baseline projections for the rest of the long-term projection period.

Outlays for the major health care programs consist of gross spending for Medicare (which does not account for offsetting receipts that are credited to the program), Medicaid, and the Children's Health Insurance Program, as well as outlays to subsidize health insurance purchased through the marketplaces established under the Affordable Care Act and related spending. Those outlays have been adjusted to exclude the effects of shifting payments from one fiscal year into another so that those payments are not made on a weekend.

Excess cost growth refers to the extent to which the growth rate of nominal health care spending per person—adjusted for demographic characteristics of the relevant populations—exceeds the growth rate of potential gross domestic product per person. (Potential gross domestic product is the maximum sustainable output of the economy.)

This figure highlights the most important effects of aging and excess cost growth.

a. Excess cost growth accounts for a small portion of the increase in spending for Social Security as a share of GDP in 2048 because greater spending on federal health care programs leads to larger deficits, which in turn slow the growth of GDP.

b. If aging and excess cost growth did not occur after 2018, spending on Social Security as a share of GDP would be lower in 30 years, mainly because of the scheduled increase in the full retirement age for Social Security.

In developing its projections, if CBO had set the shares of the population by age at today's proportions and had set excess cost growth at zero, spending on those programs as a share of GDP in 2048 would be 0.4 percentage points below the 10.8 percent estimated for 2018 (adjusted to exclude shifts in timing).[27] In the extended baseline, however, that spending reaches 16.9 percent of GDP by 2048 (see Figure 9).[28] Aging accounts for an increase of 3.3 percentage points, or roughly half of the difference. Excess cost growth, at an increase of 3.2 percentage points, accounts for the other half.

The Aging Population. In CBO's projections, the aging of the baby-boom generation and continued gains in life expectancy increase the share of the population that is age 65 or older from 16 percent to 22 percent between 2018 and 2048.

Aging accounts for nearly all of the projected long-term increase in Social Security spending as a percentage of

27. Excluding aging and excess cost growth, spending on those programs as a percentage of GDP would be lower in 30 years, mainly because of the scheduled increase in the full retirement age for Social Security.

28. This analysis of causes of spending growth includes gross spending on Medicare.

GDP.[29] Because of growth in the share of the population that is 65 or older, a larger segment of the population will consist of Social Security beneficiaries, and their benefits will require greater federal spending.

Aging also contributes to the projected increase in the share of GDP taken up by spending for the major health care programs, particularly Medicare, which is the largest such program. Most beneficiaries qualify for Medicare at age 65. As that group becomes larger and older, on average, Medicare spending will increase because the number of beneficiaries will rise and because people tend to require more health care as they age. In CBO's projections for the 2018–2048 period, aging explains about one-third of the increase in spending for the major health care programs as a share of GDP.

Rising Health Care Costs per Person. Even though growth in health care costs per person has slowed recently, over the next 30 years it is projected to still be faster than growth in potential GDP per person. In CBO's extended baseline, excess cost growth accounts for about two-thirds of the increase in spending for the major health care programs as a share of GDP between 2018 and 2048. Such cost growth also leads to greater federal debt, which slows the growth of GDP and slightly raises projected spending as a share of GDP.

Other Noninterest Spending

In the extended baseline, total federal spending for everything other than Social Security, the major health care programs, and net interest declines to a smaller percentage of GDP than has been the case for more than 70 years. During the past 50 years, such spending has averaged 11 percent of GDP, but it has been as high as 15 percent (in 1968) and as low as 8 percent (in the late 1990s and early 2000s). Other noninterest spending in 2018 is estimated to equal 8.9 percent of GDP. Under the assumptions used for this analysis, that spending is projected to fall to 7.9 percent of GDP in 2028 and to 7.6 percent of GDP in 2048.

Discretionary Spending. About half of all discretionary spending is dedicated to national defense, and the rest is for an array of federally funded investments and activities, including education, transportation, housing assistance, veterans' health care, health-related research and public programs, administration of justice, and international affairs.

Over the past half-century, discretionary spending has diminished markedly as a percentage of GDP: Between 1968 and 2017, it declined from 13.1 percent to 6.3 percent. In CBO's baseline, discretionary outlays remain at about that level through next year before decreasing again, to 5.4 percent of GDP by 2028.

Through 2021, most discretionary funding is limited by caps on annual discretionary appropriations that were originally specified in the Budget Control Act of 2011 (P.L. 112-25, as amended). The Bipartisan Budget Act of 2018 increased limits on discretionary funding that otherwise would have been in place for 2018 and 2019. The subsequent decline in discretionary outlays relative to GDP reflects lower statutory limits on discretionary funding in 2020 and 2021 and the assumption (required by law) that discretionary funding will grow at the rate of inflation—which is slower than projected growth in GDP—beginning in 2022. After 2028, in CBO's extended baseline projections, discretionary spending is assumed to remain roughly constant as a percentage of GDP (see Figure 10).[30]

Other Mandatory Spending. Since the mid-1960s, mandatory spending other than that for Social Security and the major health care programs has generally remained between 2 percent and 4 percent of GDP. (An exception was the spike to 5.1 percent in 2009 because of higher spending in response to the severe recession.) That category of mandatory spending includes retirement programs for federal civilian and military employees, certain veterans' programs, the Supplemental Nutrition Assistance Program (SNAP), Supplemental Security

29. Excess cost growth accounts for a small portion of the increase in spending for Social Security as a share of GDP in 2048, amounting to about 0.1 percent of GDP, because greater spending on federal health care programs leads to larger deficits, which in turn slow the growth of GDP.

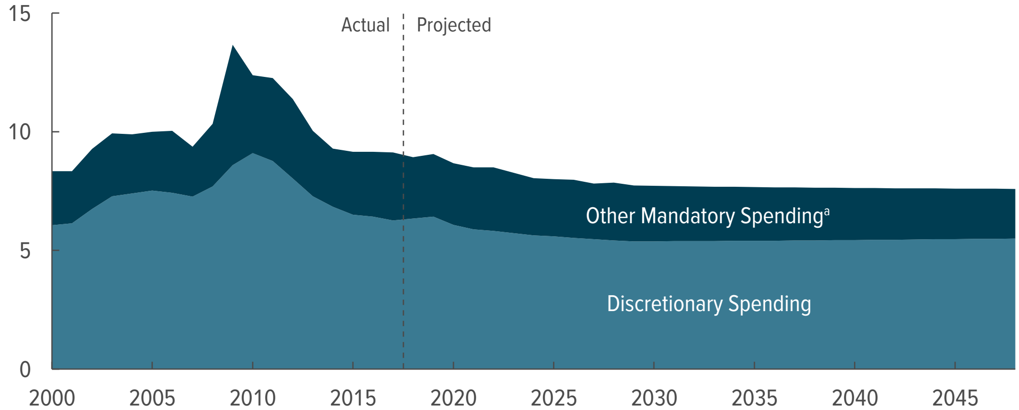
30. CBO assumed that discretionary spending after 2028 would remain constant as a percentage of GDP before the agency accounted for the effect on the economy of the fiscal policies projected under the extended baseline. Because CBO estimates that fiscal policy under the extended baseline would dampen economic growth, its projection of discretionary spending would not grow at precisely the same rate as GDP.

Although discretionary spending would decline relative to GDP from 2018 to 2028 in CBO's projections, historical evidence suggests that such a decline is unlikely to persist: Discretionary spending has historically been a larger share of economic output than it is projected to be in 2028. For that reason, CBO did not assume that the share would decline further.

Figure 10.

Other Federal Noninterest Spending in CBO's Extended Baseline

Percentage of Gross Domestic Product



Measured as a percentage of economic output, other federal noninterest spending in CBO's extended baseline declines between 2018 and 2048, mainly because of a projected decrease in discretionary spending over the next decade.

Source: Congressional Budget Office.

The extended baseline generally reflects current law, following CBO's 10-year baseline budget projections through 2028 and then extending most of the concepts underlying those baseline projections for the rest of the long-term projection period.

a. "Other Mandatory Spending" is all mandatory spending other than that for Social Security and the major health care programs. It includes the refundable portions of the earned income and child tax credits and of the American Opportunity Tax Credit.

Income, unemployment compensation, and refundable tax credits.[31]

Other mandatory spending is projected to decline slightly as a share of the economy over the next 10 years. That category accounts for 2.6 percent of GDP today and, if current laws generally remained unchanged, it would decline to 2.4 percent of GDP in 2028, CBO projects.[32] That small decrease primarily reflects the effects of growth in average income on eligibility for some programs and refundable tax credits as well as reductions in the average payment per beneficiary (when measured relative to average income) for certain large programs.

In CBO's extended baseline, other mandatory spending is projected to fall to 2.1 percent of GDP by 2048. In part, that reduction reflects the effects of further growth in income on eligibility for refundable tax credits. It also reflects the assumption that other mandatory spending, excluding outlays for such tax credits, would decline roughly in line with projections for such spending between 2023 and 2028.[33]

Net Interest Costs

Over the past 50 years, the government's net interest costs have averaged 2.0 percent of GDP, although they have been as high as 3.2 percent and as low as 1.2 percent. In CBO's extended baseline, net interest costs are projected to roughly double as a share of the economy over the next decade—from 1.6 percent of GDP in 2018 to 3.1 percent by 2028—as greater federal borrowing boosts debt-service costs and as currently low interest

31. Refundable tax credits reduce a filer's overall income tax liability; if the credit exceeds the rest of the filer's income tax liability, the government pays all or some portion of that excess to the taxpayer (and the payment is treated as an outlay in the budget). See Congressional Budget Office, *Refundable Tax Credits* (January 2013), www.cbo.gov/publication/43767.

32. Sec. 257(b)(2) of the Deficit Control Act, which governs CBO's baseline projections, makes exceptions regarding current law for some programs, such as SNAP, that have expiring authorizations but that are assumed to continue as currently authorized.

33. For the years after 2028, mandatory spending excluding that for Social Security, the major health care programs, and refundable tax credits was not projected in detail because of the number of programs involved and the variety of factors that influence spending on them. Instead, CBO used an approximate method to project spending for those programs as a group. Except for the outlays for refundable tax credits, such spending is assumed to decline relative to GDP (excluding any effects that fiscal policy may have on the economy) after 2028 at the same rate at which it is projected to fall between 2023 and 2028 (excluding the decrease in spending for SNAP).

rates rise. In the extended baseline, those costs reach 6.3 percent of GDP by 2048, a higher amount than has ever been experienced (see Figure 6 on page 15). Those costs would exceed mandatory spending other than that for Social Security and the major health care programs in the next few years, exceed all discretionary spending by 2045, and be about equal to spending for Social Security by 2048.

In CBO's projections, deficits and debt rise because of the growing gap between spending and revenues, and higher interest costs are a major contributor to that growing gap. Between 2018 and 2048, more than half of the increase in spending as a percentage of GDP results from higher net interest costs. In large part, those rising interest costs stem from increases in interest rates that reflect long-term economic trends, which CBO projects would occur even if debt did not rise beyond its current level. But greater federal borrowing places additional upward pressure on interest rates and thus on interest costs. Moreover, growth in net interest costs and growth in debt reinforce one another: Rising interest costs would boost deficits and debt, and rising debt would push up interest costs.

Projected Revenues Through 2048

In CBO's extended baseline, revenues are generally projected to constitute a larger share of GDP than they have, on average, in recent decades. Over the past 50 years, revenues as a share of GDP have averaged about 17 percent, but the number has fluctuated between 15 percent and 20 percent of GDP because of changes in tax laws and interactions between those laws and economic conditions.

If current laws generally remained unchanged, revenues would increase as a share of GDP over the coming decade, CBO projects. Revenues would remain near 16.6 percent of GDP through 2021, rise steadily to 17.5 percent by 2025, and then increase sharply in 2026—to 18.1 percent of GDP—following the scheduled expiration of many temporary provisions of the 2017 tax act. By 2028, revenues are projected to total 18.5 percent of GDP.

For years beyond 2028, revenues are projected following the assumption that the rules for all tax sources will evolve as scheduled under current law.[34] Thus, under CBO's extended baseline, revenues would continue to grow faster than GDP beyond 2028 and, two decades later, would total 19.8 percent of GDP. Increases in receipts from individual income taxes account for most of the projected rise of 3.2 percentage points in total revenues as a share of GDP over the next three decades. All told, receipts from all other sources combined are projected to increase slightly as a share of GDP (see Figure 6 on page 15).

The projected increase in total revenues through 2048 reflects structural features of the income tax system, new and expiring tax provisions, demographic trends, changes in the distribution of income, and other factors.

Structural features of the income tax system are the largest contributor to the increase in total revenues (see Table 4). If current laws remained generally unchanged, real bracket creep would continue to gradually push up taxes relative to income over the next three decades, CBO projects. That occurs because most income tax brackets, exemptions, and other tax thresholds are indexed only to inflation. When income grows faster than inflation, as generally happens during economic expansions, tax receipts grow faster than income.[35]

Under current law, some provisions of tax law will expire and others will take effect during the next decade. In total, those changes lead to higher tax revenues in the extended baseline. The most significant change is the expiration, after calendar year 2025, of nearly all provisions in the 2017 tax act that affect individual income taxes. The expiration of those provisions boosts individual income tax receipts relative to GDP by 0.7 percentage points, CBO projects. In addition, a new tax on certain employment-based health insurance plans with high premiums is scheduled to take effect in 2022. Although the revenues raised by that tax would be small initially, rapid growth in health care costs would cause revenues from that tax to rise rapidly over subsequent decades. Also, some rules that allow businesses to accelerate

34. The sole exception to the current-law assumption during the baseline period applies to expiring excise taxes dedicated to trust funds. The Deficit Control Act requires CBO's baseline to reflect the assumption that those taxes would be extended at their current rates. That law does not stipulate that the baseline include the extension of other expiring tax provisions, even if lawmakers have routinely extended them before.

35. The 2017 tax act changed the measure of inflation used to index many parameters of the tax system to an alternative measure that grows more slowly. Consequently, the effect of real bracket creep is slightly greater than CBO projected in prior years.

Table 4.

Reasons for Growth in Total Revenues in CBO's Extended Baseline, 2018 to 2048

Percentage of Gross Domestic Product

Reason for Growth	2018–2028	2029–2048	Total, 2018–2048
Structural Features of the Individual Income Tax[a]	0.5	0.9	1.4
New and Expiring Tax Provisions	0.8	0.4	1.2
Aging and the Taxation of Retirement Income	0.2	0.1	0.3
Changes in the Distribution of Income (Effect on individual income taxes)	0.1	0.1	0.2
Changes in the Distribution of Income (Effect on payroll taxes)	-0.1	-0.1	-0.2
Other Factors	0.4	-0.1	0.3
Total Growth in Revenues Between 2018 and 2048	**1.9**	**1.3**	**3.2**

Source: Congressional Budget Office.

The extended baseline generally reflects current law, following CBO's 10-year baseline budget projections through 2028 and then extending most of the concepts underlying those baseline projections for the rest of the long-term projection period.

a. Includes real bracket creep, which occurs as more income is pushed into higher tax brackets because people's income rises faster than inflation.

deductions for investment expenses are scheduled to be phased out by the end of December 2027, increasing revenues as a result.

As the population ages, distributions from tax-deferred retirement accounts (including individual retirement accounts, 401(k) plans, and traditional defined benefit pension plans) will tend to grow more rapidly than GDP. Those rising taxable distributions would also boost revenues relative to GDP, mainly between 2018 and 2028, CBO projects.

Earnings are projected to grow faster for higher-income people than for other people over the next 30 years. That trend would cause a larger share of income to be taxed at higher rates under the individual income tax, pushing up revenues relative to GDP by nearly 0.2 percentage points. That increase would be largely offset by a projected decrease of nearly the same amount in payroll tax receipts, as a greater share of earnings would be above the maximum amount subject to Social Security payroll taxes.

As a result of those factors, the effects of the tax system in 2048 would differ substantially from the effects today, both because of the changes in tax rules scheduled under current law and because of structural features in the tax code that gradually push up taxes relative to income. Average taxpayers at every income level would pay more of their income in taxes in 2048 than similar taxpayers do now, primarily because of real bracket creep. Effective marginal federal tax rates also would rise if current laws generally stayed in place, so a larger share of each additional dollar of income that households earned would go to pay taxes (see Table 5). The increase in the marginal tax rate on labor income would reduce people's incentive to work, and the increase in the marginal tax rate on capital income would reduce their incentive to save, thus dampening economic activity, in CBO's estimation.[36] (For a discussion of the long-term economic effects of the 2017 tax act, see Box 1 on page 26.)

Uncertainty of CBO's Long-Term Projections

Even if future tax and spending policies did not vary from those specified in current law, budgetary outcomes would undoubtedly differ from those in CBO's baseline projections because of unexpected changes in the economy, demographics, and other factors. To illustrate the uncertainty of its projections, CBO examined the extent to which federal debt as a percentage of GDP would differ from the amounts in its extended baseline if the agency varied four key factors in its analysis:[37]

- The labor force participation rate,[38]

36. Even though the marginal tax rate on capital income is projected to rise under current law, it would still be lower than in recent years.

37. For additional details about this analytical approach, see Congressional Budget Office, *The 2016 Long-Term Budget Outlook* (July 2016), Chapter 7, www.cbo.gov/publication/51580.

38. The labor force participation rate is the percentage of people in the civilian noninstitutionalized population who are age 16 or older and either working or actively seeking work.

Table 5.

Effective Marginal Federal Tax Rates in CBO's Extended Baseline

Percent

	2018	2028	2048
Marginal Tax Rate on Labor Income	27.2	30.8	32.4
Marginal Tax Rate on Capital Income	14.7	16.5	17.0

Source: Congressional Budget Office.

The extended baseline generally reflects current law, following CBO's 10-year baseline budget projections through 2028 and then extending most of the concepts underlying those baseline projections for the rest of the long-term projection period.

The effective marginal tax rate on labor income is the share of an additional dollar of such income that is paid in federal individual income taxes and payroll taxes, averaged among taxpayers, with weights proportional to their labor income. The effective marginal tax rate on capital income is the share of the return on an additional dollar of investment made in a particular year that will be paid in taxes over the life of that investment. The before- and after-tax rates of return used to calculate that effective tax rate are weighted averages of the rates for every combination of asset type, industry, form of organization, and source of financing; the weights used are the asset values of each combination.

- The growth rate of total factor productivity,
- Interest rates on federal debt held by the public, and
- Excess cost growth for Medicare and Medicaid spending.

The degree of variation was based on historical movements and on possible future developments. The resulting estimates show that if CBO varied one factor at a time, federal debt held by the public after 30 years would range from 42 percentage points of GDP below the agency's central estimate—152 percent of GDP—to 60 percentage points above it.[39]

If all four factors were varied simultaneously such that projected deficits increased, federal debt held by the public in 2048 would be about 96 percent of GDP above CBO's central estimate.[40] Conversely, if all four factors were varied such that projected deficits decreased, debt after 30 years would be 67 percentage points below the central estimate (see Figure 11).

Those calculations do not cover the full range of possible outcomes, and they do not address other sources of uncertainty in the budget projections, such as the risk of an economic depression or a major war or catastrophe, or the possibility of unexpected changes in rates of birth, immigration, or mortality. Nonetheless, they show that the main implications of this report apply under a wide range of possible values for some key factors that influence federal spending and revenues. In 30 years, if current laws remained generally unchanged, federal debt—which is already high by historical standards—would probably be at least as high as it is today and would most likely be much higher.

Policymakers could take that uncertainty into account in various ways as they make choices for fiscal policy.[41] For example, they might design policies that reduced the budgetary implications of certain unexpected events. Or they might decide to provide a buffer against events with negative budgetary implications by aiming for lower debt than they would in the absence of such uncertainty.

The Size and Timing of Policy Changes Needed to Meet Various Goals for Deficit Reduction

CBO estimated the size of changes in spending or revenues that would be needed if lawmakers wanted to achieve some specific targets for federal debt held by the public. CBO also assessed the extent to which the size of policy adjustments would change if such deficit reduction was delayed, and it examined the effects of waiting to resolve the long-term fiscal imbalance on different generations of the U.S. population.

The Size of Policy Changes Needed to Meet Various Goals for Deficit Reduction

If lawmakers set out to ensure that debt in 2048 matched its current level of 78 percent of GDP, they could achieve

39. CBO's estimates of federal debt with each factor varied individually are presented in the supplemental data accompanying this report at www.cbo.gov/publication/53919.

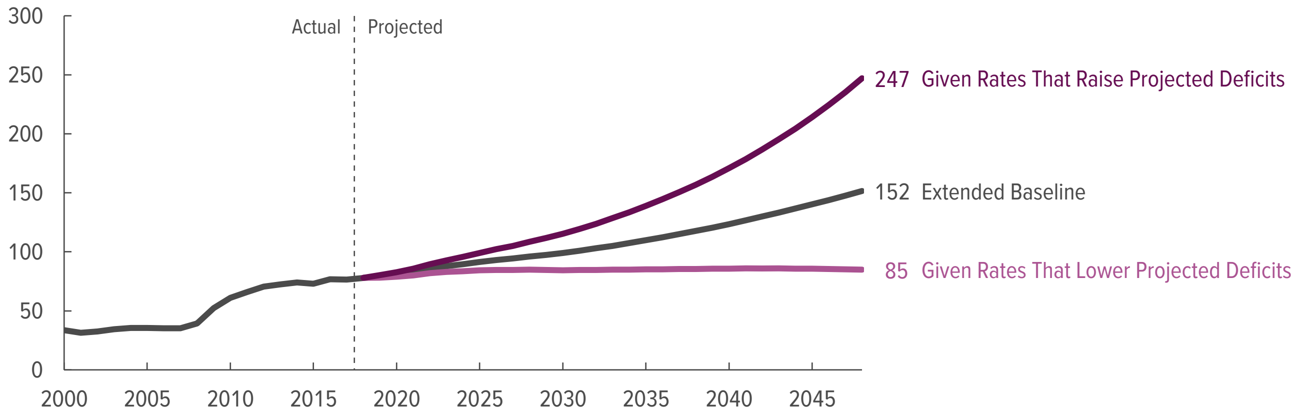
40. When CBO varied all factors simultaneously, it varied each factor by only 60 percent of the amount of variation in each factor individually. The agency used only part of the full range for each of the four factors because the chances of federal debt being above or below the estimates when all four factors are at the high or low ends of their ranges are much smaller than when each individual factor is at the high or low end of its range.

41. See Alan J. Auerbach and Kevin Hassett, "Uncertainty and the Design of Long-Run Fiscal Policy," in Auerbach and Ronald D. Lee, eds., *Demographic Change and Fiscal Policy* (Cambridge University Press, 2001), pp. 73–92, http://tinyurl.com/p93enfp.

Figure 11.

Federal Debt Given Different Rates of Labor Force Participation, Productivity Growth, Federal Borrowing, and Excess Cost Growth for Federal Spending on Medicare and Medicaid

Percentage of Gross Domestic Product



Source: Congressional Budget Office.

The extended baseline generally reflects current law, following CBO's 10-year baseline budget projections through 2028 and then extending most of the concepts underlying those baseline projections for the rest of the long-term projection period.

Federal debt refers to debt held by the public. Values are CBO's central estimates from ranges determined by alternative assessments of two factors: how much deficits crowd out investment in capital goods, such as factories and computers (because a larger portion of private saving is being used to purchase government securities), and how much people respond to changes in after-tax wages by adjusting the number of hours they work.

The labor force participation rate is the percentage of people in the civilian noninstitutionalized population who are age 16 or older and either working or actively seeking work.

Productivity growth is the growth of total factor productivity—that is, the growth of real (inflation-adjusted) output that is not explained by the growth of labor and capital.

The federal borrowing rate is the interest rate on the federal debt.

Excess cost growth refers to the extent to which the growth rate of nominal health care spending per person—adjusted for demographic characteristics of the relevant populations—exceeds the growth rate of potential gross domestic product per person. (Potential gross domestic product is the maximum sustainable output of the economy.)

For this figure, CBO used values for four factors with a deviation from the extended baseline that was about 60 percent as large as the deviation the agency used when it varied each factor separately. The alternative projections for the four factors begin in 2019.

that result by cutting noninterest spending or raising revenues (or both) in each year beginning in 2019 by amounts totaling 1.9 percent of GDP (see Figure 12 on page 28). (In 2019, 1.9 percent of GDP would be about $400 billion, or $1,200 per person.) If the changes came entirely from revenues or entirely from spending, they would amount, roughly, to an 11 percent increase in revenues or a 10 percent cut in noninterest spending (in comparison with amounts in the extended baseline).

Increases in revenues or cuts in noninterest spending would need to be larger than 1.9 percent of GDP to reduce debt to the percentages of GDP that are more typical of those in recent decades. If lawmakers wanted to lower the debt to 41 percent of GDP (its average over the past 50 years) by 2048, they could achieve that outcome by increasing revenues or cutting noninterest spending (relative to amounts under current law) or by adopting some combination of those two actions beginning in 2019 by amounts totaling 3.0 percent of GDP each year. (In 2019, 3.0 percent of GDP would be about $630 billion, or $1,900 per person.)

If lawmakers wanted to lower debt to its average over the past 50 years by increasing all revenues or by cutting all noninterest spending, the following changes would be necessary:

Box 1.

Effects of the 2017 Tax Act on the Long-Term Budget Outlook

The Congressional Budget Office's extended baseline generally reflects current law, including the economic and budgetary effects of changes to legislation enacted over the past year—notably, the 2017 tax act (Public Law 115-97, originally called the Tax Cuts and Jobs Act). Those long-term projections are consistent with CBO's prior estimates of the 2017 tax act's effects on the U.S. economy—including higher investment, employment, and output—over the 2018–2028 period.[1]

Because various provisions of the 2017 tax act expire by the end of 2026, the economic and budgetary effects of the act as a whole are expected to peak during the early to middle part of the next decade. Beyond 2028, the effects of the major permanent provisions are expected to be modest, although their precise magnitudes are highly uncertain. CBO has not performed a detailed, quantitative analysis of the long-run effects of the 2017 tax act but is able to describe the qualitative effects of its most significant provisions.

Major Provisions of the 2017 Tax Act

The 2017 tax act has temporary and permanent provisions. For the next eight years, the major individual income tax changes are lower rates, a larger standard deduction, limits on the deductibility of mortgage interest and state and local taxes, elimination of personal exemptions, expansion of the child tax credit, changes to the treatment of "pass-through" business income, changes to the individual alternative minimum tax, and increases in the tax exemptions for property transferred at death and for certain gifts. For the next five years, the act allows businesses to immediately deduct the full cost of their investments for eligible equipment and software; that bonus-depreciation provision then phases out over the subsequent five years.

Following the expiration of most of the individual provisions at the end of 2025 and the phaseout of bonus depreciation by the end of 2026, the major permanent provisions of the act that continue are these:

- Lower corporate income taxes (a single rate of 21 percent);
- Higher thresholds for deducting the cost of a tangible asset in the year it is placed in service under section 179 of the tax code;
- Amortization of spending for research and experimentation;
- Limitations on net interest deductions and the use of net operating losses;
- Changes in the inflation adjustments for most tax parameters, including for income tax brackets;
- Elimination of the penalty for not having health insurance; and
- Changes in the taxation of foreign income and measures to reduce profit shifting.

Budgetary Effects Without Macroeconomic Feedback

The 2017 tax act has significant direct effects on CBO's budget projections. Those direct effects do not take into account any changes to the aggregate economy.

Budgetary Effects for 2018 to 2028. Before incorporating macroeconomic feedback, CBO estimated that the tax act would increase the primary deficit (that is, the deficit excluding the costs of servicing the debt) by a cumulative $1.843 trillion from 2018 to 2028 as a result of higher deficits through 2026. Once the temporary provisions have expired and scheduled changes to certain business provisions have taken effect, the permanent provisions are projected to reduce, on net, the primary deficit in 2027 and 2028. Because of the increased deficits, debt-service costs are higher in every year by growing amounts, totaling $471 billion over the period. The total direct effect on the deficit through 2028 would be $2.314 trillion.

Budgetary Effects for 2029 to 2048. After 2028, CBO estimates, the permanent provisions of the act would continue to reduce the primary deficit, on net, over the next 20 years. In particular, the change in the inflation indexing of tax parameters and elimination of the penalty for not having health insurance (which causes fewer people to enroll in health insurance programs subsidized by the federal government) would reduce the deficit by more than the revenues lost through lower corporate taxes.

Economic Effects of the 2017 Tax Act

The largest effects on investment, employment, and output are estimated to occur in the early to middle part of the 2018–2028 period, when both individual and corporate income tax rates are lower and when other temporary provisions and investment incentives (notably, full bonus depreciation) are in place. Most of the tax act's positive effects on the growth of real (inflation-adjusted) gross domestic product (GDP) would occur in the first few years of CBO's projection period. The positive effects on the economy would diminish over the following several years and are expected to be modest after 2028.

Economic Effects for 2018 to 2028. The 2017 tax act would boost the level of real GDP by 0.7 percent, on average, through 2028, with a peak effect of 1.0 percent in 2022. By lowering the corporate income tax rate, the act would give businesses

1. See Congressional Budget Office, *The Budget and Economic Outlook: 2018 to 2028* (April 2018), Appendix B, www.cbo.gov/publication/53651.

Continued

Box 1. Continued

Effects of the 2017 Tax Act on the Long-Term Budget Outlook

incentives to boost investment, and by decreasing individual income tax rates through 2025, it would give people incentives to increase their participation in the labor force and work more hours, expanding the labor supply and employment. Although some provisions of the tax act would deter residential investment, the overall effect on investment is estimated to be positive. However, private investment gains would be partially crowded out by higher federal deficits. Altogether, the largest positive effects on the economy would occur from 2022 to 2024 (before the individual income tax provisions expire at the close of 2025).

The effect of the tax act on real GDP is more modest over the following few years, and by 2028, real GDP would be 0.5 percent higher than it would have been otherwise. Between 2026 and 2028, investment would be boosted by the permanent reduction in the corporate income tax rate. However, the permanent change to amortization of research and experimentation expenses (instead of immediate expensing) would reduce the incentive for that type of investment.

The effects on the supply of labor are projected to be mixed. Marginal personal income tax rates would be higher after 2025 than under prior law because of the change in how various parameters of the tax system, including income tax brackets, are adjusted for inflation. That change would tend to reduce the supply of labor, as more income is pushed into higher tax brackets for a given amount of income growth because the new measure of inflation is expected to rise more slowly than the measure it replaced. In contrast, the permanent elimination of the penalty for not having health insurance would tend to increase the supply of labor, in part because under prior law the penalty rose as household income grew, causing it to act as a tax on income.

From 2026 to 2028, the pattern of the economic effects of the act reflects the transition from all the major provisions of the tax act being in place to only the permanent provisions remaining in effect. As a result, the positive effects on labor, investment, and real GDP would diminish. Nonetheless, those positive effects would be boosted by the reduction in the budget deficit by 2027 that results from the tax act, which makes additional resources available for private investment.

Furthermore, the tax act's international provisions are expected to change the reported location of profits in a way that boosts GDP through 2028, without changing the location of labor or capital. As a result, the provisions are expected to raise total factor productivity slightly over time.

Economic Effects for 2029 to 2048. In CBO's assessment, the various permanent provisions of the act would continue to boost the level of real GDP, on net, for a few years after 2028; over the longer term, the economic effects of the different provisions are expected to be modest, but the net effect is uncertain. The accelerated bracket creep resulting from the change in the indexing of tax parameters for inflation and the permanent change to amortization of research and experimentation expenses would tend to lower output by modestly reducing the supply of labor and capital, respectively. Elimination of the penalty for not having health insurance is expected to partially offset the negative effect on labor, and the permanent reduction in the corporate income tax rate and lower federal deficits would tend to increase output modestly by boosting investment.

The tax act's international provisions are expected to increase GDP slightly over the long term, although their overall economic effects are uncertain. Those effects would depend on how companies adjusted their international business structures and transactions and how foreign governments changed their tax rules in response.

Overall, the net impact on output would depend on the balance of all those effects. Individually and collectively, the effects become increasingly uncertain over the last 20 years of the projection period.

Budgetary Effects With Macroeconomic Feedback

CBO estimates that macroeconomic feedback from the tax act—that is, the ways in which the act would affect the budget by changing the overall economy—would subtract a total of $571 billion from primary deficits over the 2018–2028 period. That reduction would mainly result from the act's boost to taxable income, which would increase revenues. With that macroeconomic feedback incorporated, CBO projects that the act would increase primary deficits by $1.272 trillion through 2028. Incorporating the act's effects on debt-service costs from changes in federal borrowing and changes in interest rates would push the deficit to an estimated $1.854 trillion over the 2018–2028 period.

The net effects of the tax act on real GDP and other economic variables are expected to be modest after 2028 but the magnitudes are uncertain (in part because a number of factors tend to offset each other). As a result, the macroeconomic feedback to federal spending and revenues is also expected to be small but uncertain in those years. Despite that uncertainty, the overall effects of the permanent provisions of the act, including their macroeconomic feedback, are projected to reduce the primary deficit somewhat from 2029 to 2048.

Figure 12.

The Size of Policy Changes Needed to Make Federal Debt Meet Two Possible Goals in 2048

If lawmakers aimed for debt in 2048 to equal...

41% of GDP (Its 50-year average)	**78% of GDP** (Its Current Level)

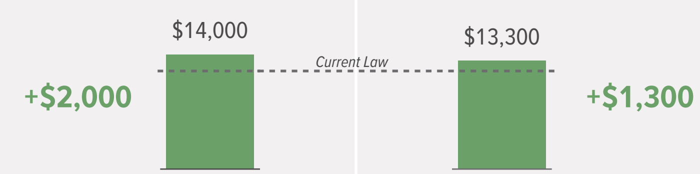
Each year, they would need to reduce deficits as a share of GDP by...

3.0% of GDP, which is equal to a	17% ▲ increase in revenues or a 15% ▼ cut in spending	**1.9% of GDP,** which is equal to a	11% ▲ increase in revenues or a 10% ▼ cut in spending

In 2019, that would amount to...

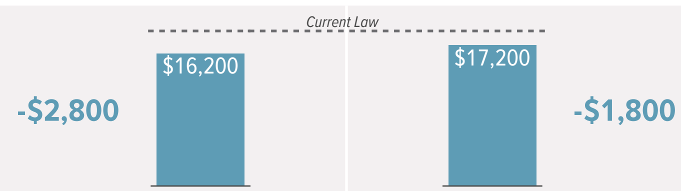
$630 billion	**$400 billion**

If the changes were increases (of equal percentage) in all types of revenues, one effect in 2019 is that taxes per household would be higher than they would be under current law by...



Values are for households in the middle fifth of the income distribution.
Under current law, their taxes are projected to average $12,000.

If the changes were cuts (of equal percentage) in all types of noninterest spending, one effect in 2019 is that initial Social Security benefits would be lower than they would be under current law by...



Values are averages for people in the middle fifth of the lifetime earnings distribution who were born in the 1950s and who would claim benefits at age 65.
Under current law, their benefits are projected to be $19,000.

Source: Congressional Budget Office.

In this figure, the indicated sizes of the policy changes are relative to CBO's extended baseline, which generally reflects current law, following CBO's 10-year baseline budget projections through 2028 and then extending most of the concepts underlying those baseline projections for the rest of the long-term projection period. The projected effects of the policy changes on debt include the direct effects of the policy changes and the feedback to the federal budget that would be attributable to faster economic growth. The effects on growth and the feedback to the federal budget reflect the positive economic effects of lowering the debt but do not reflect any assumptions about the specific details of the policy changes.

GDP = gross domestic product; n.a. = not applicable.

- If collections of the various types of revenues were increased proportionally, total revenues would need to rise by about 17 percent each year over the 2019–2048 period. On average, that adjustment would result in federal taxes that were about $2,000 higher than they are under current law for households in the middle fifth of the income distribution in 2019.

- If all types of noninterest spending were cut by an equal percentage, spending overall would need to decrease by about 15 percent in each of the next 30 years. For example, such cuts would lower initial annual Social Security benefits by about $2,800, on average, for people in the middle fifth of the lifetime earnings distribution who were born in the 1950s and who first claimed benefits at age 65.

In all of those examples, the projected effects on debt include both the direct effects of the policy changes and the feedback to the federal budget that would result from faster economic growth. Those economic effects reflect the reduction in debt but do not reflect any assumptions about the specific details of the policy changes. For example, such changes could alter productivity growth and people's incentives to work and save, which would then affect overall economic output and have macroeconomic feedback effects on the federal budget.

The Timing of Policy Changes Needed to Meet Various Goals for Deficit Reduction

The size of the policy changes that would be needed to achieve a particular goal for federal debt would depend, in part, on how quickly that goal was expected to be reached. Regardless of the chosen goal for federal debt, lawmakers would face trade-offs in deciding how quickly to implement policies designed to put federal debt on a sustainable path. The benefits of reducing the deficit sooner would include a smaller accumulated debt, smaller policy changes required to achieve long-term outcomes, and less uncertainty about the policies lawmakers would adopt. However, if lawmakers implemented spending cuts or tax increases too quickly, people might have insufficient time to plan for or adjust to the new system.

Over the next few years, such policy changes would dampen overall demand for goods and services, thus decreasing output and employment relative to CBO's projections under current law. However, that dampening effect would be temporary, CBO expects, because of the response of prices and interest rates to the reductions in demand and to the resulting actions by the Federal Reserve. Those responses to changing demand would be stronger over the next few years than they would be if the economy was weaker.

By contrast, if policymakers waited several years to reduce federal spending or increase taxes, more debt would accumulate over the long term, which would slow long-term growth in output and income. Thus, reaching any chosen target for debt would require larger changes. Nonetheless, if policymakers waited several years to enact deficit-reduction policies, the economy probably would be affected less over the short term than would be the case if immediate changes were made.

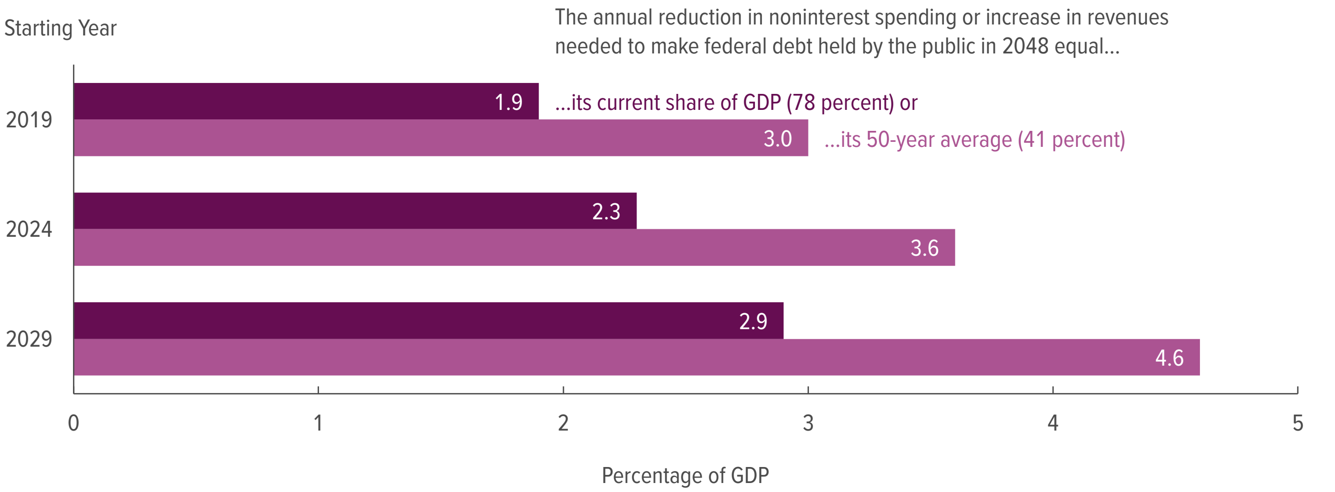
Faster or slower implementation of policies to reduce budget deficits would tend to impose different burdens on different generations. Reducing deficits sooner would probably require older workers and retirees to sacrifice more but would benefit younger workers and future generations. Reducing deficits later would require smaller sacrifices from older people but greater ones from younger workers and future generations.

CBO has analyzed those trade-offs in two ways. First, it estimated the extent to which the size of policy adjustments would change if deficit reduction was delayed. For example, if lawmakers sought to reduce debt as a share of GDP to its historical 50-year average of 41 percent in 2048 and if the necessary policy changes did not take effect until 2024, the annual deficit reduction would need to amount to 3.6 percent of GDP rather than the 3.0 percent that would accomplish the same goal if the changes were made in 2019 (see Figure 13). If lawmakers chose to wait another five years to implement the policies (having them take effect in 2029 instead), even larger changes would be necessary; the required annual deficit reduction in that case would amount to 4.6 percent of GDP.

Second, CBO studied the effects on various generations from waiting to resolve the long-term fiscal imbalance. In 2010, CBO compared economic outcomes under two policies. One would stabilize the debt-to-GDP ratio starting in a particular year; the other would wait

Figure 13.

How Timing Affects the Size of Policy Changes Needed to Make Federal Debt Meet Two Possible Goals in 2048



Source: Congressional Budget Office.

GDP = gross domestic product.

10 years to do so.[42] That analysis suggested that people in generations born after the earlier implementation date would be worse off under the second option. However, people born more than 25 years before the earlier implementation date would be better off if action was delayed—largely because they would partly or entirely avoid the policy changes needed to stabilize the debt. Generations born between those two groups could either gain or lose from delayed action, depending on the details of the policy changes.[43]

Even if lawmakers waited several years to implement policy changes to reduce deficits in the long term, making decisions about them sooner would offer two main advantages. First, people would have more time to prepare. Second, policy changes that reduced the debt would hold down longer-term interest rates and could lessen uncertainty—thus enhancing businesses' and consumers' confidence. Those factors would boost output and employment in the near term.

Changes From Last Year's Long-Term Budget Outlook

Compared with last year's projections of federal debt, those presented in this report are higher through 2041 and slightly lower thereafter. Most of the increases in debt through 2041 stem from larger projected deficits through 2025 that arise from tax and spending legislation enacted since last March: the 2017 tax act, the Bipartisan Budget Act of 2018, and the Consolidated Appropriations Act, 2018. After 2025, deficits are smaller as a share of GDP than CBO projected last year because of lower projected noninterest spending and similar or higher projected revenues. Those lower deficits ultimately result in lower projected debt as a share of GDP. (Appendix A describes the differences in demographic and economic projections between last year's report and this year's, and Appendix B describes key revisions to the budgetary projections since last year that are summarized in this section.)

42. See Congressional Budget Office, *Economic Impacts of Waiting to Resolve the Long-Term Budget Imbalance* (December 2010), www.cbo.gov/publication/21959. That analysis was based on a projection of slower growth in debt than CBO now projects, so the estimated effects of a similar policy today would be close, but not identical, to the effects estimated in that analysis. For a different approach to analyzing the costs of debt reduction for different generations, see Felix Reichling and Shinichi Nishiyama, *The Costs to Different Generations of Policies That Close the Fiscal Gap*, Working Paper 2015-10 (Congressional Budget Office, December 2015), www.cbo.gov/publication/51097.

43. Those conclusions do not incorporate the possible negative effects of a fiscal crisis or effects that might arise from the government's reduced flexibility to respond to unexpected challenges.

As a percentage of GDP, noninterest spending is generally lower than the amount projected last year. That slowdown is driven by lower projected spending as a share of GDP for Social Security, the major health care programs, and other mandatory spending. Those declines are partially offset by increases in discretionary spending. Revenues are lower as a share of GDP through 2026, largely unchanged for most of the next two decades, and slightly higher by 2048. Those changes reflect provisions of the 2017 tax act.

Under the extended baseline, CBO projects that debt would reach 148 percent of GDP in 2047, which is lower than the amount the agency projected last year. Projected deficits as a share of GDP in this year's report are larger from 2018 through 2025 and smaller thereafter than those in last year's report. The budgetary changes needed to make federal debt 30 years from now equal either today's level or the 50-year historical average (as a share of GDP) are similar to the changes CBO projected would be required in last year's report.

The 75-year actuarial deficit currently projected for Social Security is 1.5 percent of GDP (the same amount that CBO estimated last year) or 4.4 percent of taxable payroll (slightly smaller than last year's estimate of 4.5 percent). The projected actuarial deficit declined since last year because CBO boosted its projection of the share of earnings that are subject to Social Security payroll taxes over the next 30 years and because CBO projects slightly smaller benefits relative to GDP and taxable payroll and, over the next two decades, higher interest rates. Offsetting those changes is an adjustment to the 75-year period of analysis, which ends in 2092 in this report and thus includes an additional year of deficits.

APPENDIX

A

CBO's Projections of Demographic and Economic Trends

The Congressional Budget Office's assessment of the long-term outlook for the federal budget is based on projections over the next three decades of trends in a host of demographic and economic variables. Through 2028, the economic and demographic projections presented in this report are the same as those that CBO published in April.[1] For the years beyond 2028, CBO's projections generally reflect historical trends and anticipated demographic changes. (Average values for 2018 to 2048, the period encompassed by CBO's extended baseline, as well as for shorter periods, are shown in Table A-1.[2] The table also provides historical data for comparison. A set of annual projections is included in this report's supplemental data, available online at www.cbo.gov/publication/53919.)

Demographic Variables

Both the size and composition of the U.S. population influence the overall growth of the economy and affect federal tax revenues and spending. Rates of fertility, immigration, and mortality determine the population and thus the size of the labor force and the number of people receiving benefits from federal programs such as Social Security and Medicare. CBO projects the population to be about the same in the future as it projected last year.

Population

In CBO's projections, the total population increases from 332 million at the beginning of 2018 to 392 million in 2048, and its annual growth rate gradually declines from 0.7 percent in 2018 to 0.4 percent in 2048. The population is projected not only to grow more slowly but also to become older, on average, than in the past. In the agency's projections, over the 30-year period, the share of the population that is 65 or older grows, whereas the share that is of working age (defined as those between ages 20 and 64) shrinks. As a result, CBO projects, a growing portion of the population will receive benefits from the Social Security and Medicare programs while a shrinking portion will pay into the trust funds that support them.

Fertility

CBO projects a total fertility rate of 1.9 children per woman for the 2018–2048 period.[3] (That rate, which represents the average number of children that a woman would have in her lifetime, is calculated as the sum of fertility rates for all ages between 15 and 49 in a given year.)[4] The total fertility rate for the 1988–2007 period averaged 2.0 children per woman. Fertility rates often decline during recessions and rebound during recoveries. However, the U.S. fertility rate did not recover after the 2007–2009 recession; the rate (which was 2.1 in 2007) dropped and has remained below 1.9.[5] CBO's projected rate is consistent with the rate recommended to the Social Security Advisory Board by its 2015 Technical Panel on Assumptions and Methods, the board's most recent panel.[6]

1. See Congressional Budget Office, *The Budget and Economic Outlook: 2018 to 2028* (April 2018), www.cbo.gov/publication/53651.

2. The extended baseline generally reflects current law, following CBO's 10-year baseline projections through 2028 and then extending most of the concepts underlying those baseline projections for the rest of the long-term projection period.

3. In CBO's long-term model, the likelihood that a particular woman will have a child depends on such factors as that woman's education, marital status, immigration status, and childbearing history.

4. The total fertility rate can also be defined as the average number of children that a woman would have in her lifetime if, in each year of her life, she experienced the birth rates observed or assumed for that year and if she survived her entire childbearing period.

5. Recent data show that total fertility rates have remained below 1.9. See Brady E. Hamilton and others, *Births: Provisional Data for 2017*, Vital Statistics Rapid Release Report 4 (National Center for Health Statistics, May 2018), www.cdc.gov/nchs/nvss/vsrr/reports.htm.

6. See 2015 Technical Panel on Assumptions and Methods, *Report to the Social Security Advisory Board* (September 2015), p. 9, https://go.usa.gov/cJYR5 (PDF, 3.4 MB).

Table A-1.

Average Annual Values for Demographic and Economic Variables That Underlie CBO's Extended Baseline

	1988–2017	2018–2028	2029–2038	2039–2048	Overall, 2018–2048
			Demographic Variables		
Growth of the Population (Percent)	0.9	0.7	0.5	0.4	0.6
Fertility Rate (Children per woman)	2.0	1.9	1.9	1.9	1.9
Immigration Rate (Per 1,000 people in the U.S. population)	3.7	3.1	3.2	3.2	3.2
Life Expectancy at Birth, End of Period (Years)[a]	79.1	80.5	81.7	82.8	82.8
Life Expectancy at Age 65, End of Period (Years)[a]	19.4	20.2	20.9	21.7	21.7
			Economic Variables (Percent)		
Growth of GDP					
Real GDP	2.5	1.9	1.9	1.9	1.9
Nominal GDP (Fiscal Year)	4.7	4.1	4.0	4.0	4.0
Growth of the Labor Force	1.0	0.5	0.4	0.4	0.4
Labor Force Participation Rate	65.6	62.1	60.3	59.6	60.7
Unemployment					
Unemployment rate	5.9	4.4	4.8	4.7	4.6
Natural rate of unemployment	5.1	4.6	4.5	4.5	4.5
Growth of Average Hours Worked	-0.1	*	-0.1	-0.1	*
Growth of Total Hours Worked	1.0	0.5	0.3	0.4	0.4
Earnings as a Share of Compensation	81	81	81	81	81
Growth of Real Earnings per Worker	0.9	1.5	1.2	1.1	1.2
Share of Earnings Below the Taxable Maximum	85	81	81	80	81
Growth of Productivity					
Total factor productivity	1.2	1.1	1.2	1.2	1.2
Labor productivity[b]	1.5	1.4	1.6	1.6	1.5
Inflation					
Growth of the CPI-U	2.6	2.4	2.4	2.4	2.4
Growth of the GDP price index	2.1	2.1	2.0	2.0	2.0
Interest Rates					
Real rates					
On 10-year Treasury notes and Social Security bonds	2.3	1.4	1.6	2.1	1.7
Nominal rates					
On 10-year Treasury notes and Social Security bonds	4.9	3.8	4.0	4.5	4.1
On all federal debt held by the public[c]	5.0	3.1	3.6	4.1	3.6

Source: Congressional Budget Office.

The extended baseline generally reflects current law, following CBO's 10-year baseline budget projections through 2028 and then extending most of the concepts underlying those baseline projections for the rest of the long-term projection period.

CPI-U = consumer price index for all urban consumers; GDP = gross domestic product; * = between -0.05 percent and 0.05 percent.

a. Life expectancy as used here is period life expectancy, which is the amount of time that a person in a given year would expect to survive beyond his or her current age on the basis of that year's mortality rates for various ages.

b. The measure of labor productivity reported here is the ratio of real output to hours worked in the economy. Note that elsewhere CBO reports different measures of labor productivity, such as the ratio of potential real output to the potential labor force.

c. The interest rate on all federal debt held by the public equals net interest payments in the current fiscal year divided by debt held by the public at the end of the previous fiscal year.

Immigration

Under current law, CBO projects, net immigration to the United States (a measure that accounts for all people who either enter or leave the United States in any year) would grow by an average of 0.7 percent per year over the next decade. Thereafter, net immigration is projected to grow more slowly, at a rate of 0.6 percent per year. On the basis of those projections, CBO expects net annual immigration to rise from 1.1 million people in 2018 to 1.3 million people in 2048. Expressed another way, the rate of net annual immigration per thousand people in the U.S. population would rise from an average of 3.1 over the next decade to 3.2 in 2048.

CBO's projection of net immigration over the next decade is informed by the agency's economic projections and by recent demographic trends, both of which have particularly important implications for projections of net unauthorized immigration. CBO's projections of unauthorized immigration are the result of two offsetting effects, to which the agency gave equal weight in its analysis. On the one hand, in CBO's estimation, periods of moderate growth in the U.S. economy over the past two decades have been associated with increases in unauthorized immigration; consequently, CBO's projections of economic growth suggest growth in such immigration over the coming decade. On the other hand, although unauthorized immigration is very difficult to measure, historical estimates indicate that the number of unauthorized immigrants in the United States in 2015 was about the same as in 2005. The implication is that factors other than the strength of the economy have been more important recently and may continue to be in the future.[7]

CBO projects that the increase in net immigration over the next decade would be mostly driven by increases in the number of legal permanent residents. The annual increase in the number of legal temporary and unauthorized immigrants is projected to be relatively steady over the next 10 years.

For projections beyond the next decade, CBO employed a simplified approach: After 2028, under current law, the agency projects that net immigration would grow at an average rate of 0.6 percent annually, slightly faster than the overall average rate of population growth.[8]

Mortality

The mortality rate, which is the number of deaths per thousand people, has generally declined in the United States for at least the past half century. For the most part, the mortality rate has dropped more quickly for younger people than for older people during that period. Mortality rates for each five-year age group are projected to decline at the same average pace each group experienced from 1950 through 2014. After projecting average mortality rates for men and women in each age group, CBO incorporates differences in those rates on the basis of marital status, education, disability insurance status, and lifetime household earnings. CBO projects lower mortality rates and thus longer life expectancies for people who are married, have more education, do not receive benefits through the Social Security Disability Insurance (DI) program, or are in higher-income groups.[9] (For people under 30, the mortality projections account for age and sex only.)

CBO's projections result in an average life expectancy at birth of 82.8 years in 2048, compared with 79.2 years in 2018.[10] Similarly, CBO projects life expectancy at age

7. For the most recent estimates, see Jens Manuel Krogstad, Jeffrey S. Passel, and D'Vera Cohn, *As Mexican Share Declined, U.S. Unauthorized Immigrant Population Fell in 2015 Below Recession Level* (Pew Research Center, April 2017), https://tinyurl.com/mn5zbb5. For more details, see Jeffrey S. Passel and D'Vera Cohn, *Overall Number of U.S. Unauthorized Immigrants Holds Steady Since 2009* (Pew Research Center, September 2016), https://tinyurl.com/j45zw05. Official data on unauthorized immigrants do not exist, so historical estimates are very uncertain.

8. That rate is based on the Census Bureau's projections for late in the coming decade. See Census Bureau, "2014 National Population Projections: Summary Tables," Table 1, https://go.usa.gov/xQGwc. The Census Bureau has recently released a new set of projections, but information from those projections has not been incorporated in this analysis. In those projections, the population is slightly smaller than the Census Bureau projected in 2014.

9. For more information about mortality differences among groups with different earnings, see Tiffany Bosley, Michael Morris, and Karen Glenn, *Mortality by Career-Average Earnings Level*, Actuarial Study 124 (Social Security Administration, April 2018), https://tinyurl.com/yct5qdew (PDF, 301KB); Congressional Budget Office, *Growing Disparities in Life Expectancy* (April 2008), www.cbo.gov/publication/41681; and Julian P. Cristia, *The Empirical Relationship Between Lifetime Earnings and Mortality*, Working Paper 2007–11 (Congressional Budget Office, August 2007), www.cbo.gov/publication/19096.

10. Life expectancy as used here is period life expectancy, which is the amount of time that a person in a given year would expect to survive beyond his or her current age on the basis of that year's mortality rates for various ages.

65 to be 21.7 years in 2048, or 2.2 years longer than life expectancy at age 65 in 2018.[11]

Changes in Demographic Projections Since Last Year

CBO's projections of population growth in most years are very similar to those published in last year's report, except for small changes to CBO's projections of net immigration and mortality rates. Net immigration was projected to grow, on average, more quickly in the decade following 2017 in last year's report than it is projected to grow in the decade following 2018 in this year's report. That is because last year's projections included growth in 2017 that was higher than in the rest of the 10-year period. The average growth in net immigration over the decade following 2018 in this year's report does not include that year of higher growth.

The life expectancies CBO now projects are only slightly different from those reported last year. Life expectancy at birth is projected to be 82.7 years in 2047, 0.1 year shorter than CBO projected last year, and life expectancy at age 65 is projected to be 21.6 years, 0.1 year longer than in last year's projection. Those changes reflect recent data that show higher mortality rates than CBO expected last year for people ages 15 to 74 and lower mortality rates than expected last year for people 75 or older. Those data led CBO to increase its projection of mortality rates for people ages 15 to 74 in the near term and to reduce their rates of mortality improvement over the next three decades, which reduced CBO's projection of life expectancy at birth. In contrast, for people 75 or older, CBO decreased its projection of mortality rates and increased the rate of mortality improvement, which increased CBO's projection of life expectancy at age 65 throughout the 30-year period.

Economic Variables

The performance of the U.S. economy in coming decades will affect the federal government's tax revenues, spending, and debt accumulation. In CBO's analysis, the long-term effects depend on key economic variables such as the growth of gross domestic product (GDP), the size and composition of the labor force, the number of hours worked, earnings per worker, capital accumulation, and productivity. Over the short term, the effects also depend on variables that fluctuate over the business cycle, such as inflation and interest rates. The agency also considers ways in which fiscal policy influences economic activity.

Gross Domestic Product

CBO expects total output in the economy to grow moderately over the 2018–2048 period. In the agency's projections, real GDP growth over that period averages 1.9 percent per year, about what was projected last year for the 2017–2047 period. However, the pattern of that growth is different in this year's projections; CBO now projects that real GDP grows faster over the next few years. As a result, the level of real GDP remains higher over the projection period.

Projections of GDP. CBO anticipates that recent changes to the tax code, changes in discretionary spending, and continuing increases in aggregate demand will spur a pickup in the growth of real GDP over the next few years (see Box 1 on page 26 for details on the effects of the recent changes to the tax code).[12] Thereafter, growth in real GDP is projected to make a transition to a pace that reflects the increases in the supply of labor, capital services, and productivity described below. That projected pace also takes into consideration the influences of the marginal tax rates and increases in federal debt that CBO projects in its extended baseline.[13]

Over the long term, total GDP is projected to be one-half of one percent below its potential (maximum sustainable) amount, as it has roughly been, on average, over past decades. Those projected outcomes reflect CBO's assessment that, during and after economic downturns, actual output has fallen short of potential output to a greater extent and for longer periods than actual output has exceeded potential output during economic booms.[14]

11. CBO projects life expectancy in 2090 to be 86.9 years at birth and 24.4 years at age 65. CBO's projections of life expectancies are longer than those of the Social Security trustees (85.8 and 23.5 years, respectively) but shorter than the projections (88.3 and 25.3 years, respectively) recommended by the 2015 Technical Panel on Assumptions and Methods in *Report to the Social Security Advisory Board* (September 2015), pp. 13–20, https://go.usa.gov/cJYR5 (PDF, 3.4 MB).

12. Aggregate demand is total purchases by consumers, businesses, government, and foreigners of a country's output of final goods and services during a given period.

13. The marginal tax rate is the percentage of an additional dollar of income from labor or capital that is paid in taxes.

14. See Congressional Budget Office, *Why CBO Projects That Actual Output Will Be Below Potential Output on Average* (February 2015), www.cbo.gov/publication/49890.

Projected real GDP growth over the next three decades is slower than the average annual rate of 2.5 percent recorded over the past three decades, primarily because the labor force is anticipated to grow more slowly in the coming years. Moreover, with the labor force growing more slowly than the overall population, per capita real GDP is expected to increase at a slower pace than it has in the past—at an average annual rate of 1.4 percent over the 2018–2048 period, compared with 1.6 percent for the past 30 years.

Changes in Projections of GDP Since Last Year. In CBO's current projections, the level of real GDP is about 1.4 percent higher in 2027 than the agency projected last year. That gap shrinks over the next two decades; by 2047 real GDP is 0.7 percent higher than it was last year. The higher level of real GDP in this year's projections stems primarily from three factors: revisions to historical data, changes in federal fiscal policy, and improvements in analytical methods.

The Rate of Labor Force Participation

The size of the labor force is determined by the size of the population and the rate at which people participate in the labor market. CBO has slightly raised its projection of the labor force participation rate since last year.

Projections of the Labor Force Participation Rate. In CBO's projections, the rate of labor force participation—that is, the share of the civilian noninstitutionalized population age 16 or older that is either working or seeking work—declines from 62.8 percent in 2018 to 61.0 percent in 2028 and to 59.5 percent in 2048. The aging of the population is the most important factor driving down the overall participation rate over the next 30 years; the effects of other factors roughly offset one another.

Because older people tend to participate in the labor force at lower rates than younger people, the aging of the population is expected to significantly dampen the rate of participation over the next 30 years. The share of people over the age of 65 is projected to increase from 16 percent in 2018 to 22 percent in 2048, and the share of the population ages 20 to 64 is expected to decline from 59 percent to 55 percent during that 30-year period. Without the effects of an aging population—that is, if the age-and-sex composition of the population remained the same as it is expected to be in 2018—the labor force participation rate would stay roughly constant over the next 30 years, in CBO's judgment.[15]

The effects of several other trends and fiscal policies roughly offset one another. Three trends put downward pressure on the participation rate:

- Men of the generations that followed the baby boomers tend to participate in the labor force at lower rates than male baby boomers did at the same age. (The participation of women from generations following the baby boomers has remained relatively constant.)
- The share of people receiving DI benefits is generally projected to continue to rise, and people who receive such benefits are less likely to work.
- The marriage rate is projected to continue to fall, especially among men, and unmarried men tend to participate in the labor force at lower rates than married men.

CBO expects those forces to be mostly offset by two trends. As the population becomes more educated, labor participation rates are expected to increase because workers with more education tend to participate in the labor force at higher rates than do people with less education. Second, increasing longevity is expected to lead people to continue working to increasingly older ages.[16]

In addition to the effects of those demographic trends, recent changes in tax law, combined with economic and budgetary trends, would also affect the labor force:

- CBO estimates that, under current law, lower tax rates on labor would increase participation in the labor force over most of the next decade because individuals would see a greater return on their labor. However, the lower tax rates are scheduled to expire

15. That calculation includes an adjustment for age and sex, but the sex composition of the population is projected to change only slightly. Therefore, the decline in the labor force participation rate is attributable almost entirely to aging.

16. The agency recently updated its methods for projecting labor force participation to more adequately account for recent trends in educational attainment and aging. See Josh Montes, *CBO's Projection of Labor Force Participation Rates*, Working Paper 2018-04 (Congressional Budget Office, March 2018), www.cbo.gov/publication/53616.

at the end of 2025, reducing the incentive to work, which would in turn reduce participation in the labor force toward the end of the decade.

- In addition, major tax legislation enacted in 2017 adopted an alternative measure of inflation for the tax code that grows slightly more slowly than the inflation measure used previously. Tax brackets, which are set to increase with inflation, will increase more slowly because of this new measure. Consequently, real income growth in the future will cause an increased share of labor income to be pushed into higher tax brackets. Over time, under an assumption that current laws remain unchanged, that bracket creep would reduce incentives to work.

- Rising federal deficits are projected to slow growth in the stock of private capital and limit the growth of after-tax wages, also reducing the supply of labor. However, recent changes to the tax code provide greater incentives to invest, mitigating some of the effects of higher deficits on the stock of private capital.

Changes in Projections of the Labor Force Participation Rate Since Last Year. CBO's current projections of the labor force participation rate through 2025 are higher than its projections last year because of the enactment of individual tax provisions that raise after-tax wages during the next several years. Last year, CBO projected the participation rate would be 61.3 percent by 2025. This year, CBO projects the participation rate to be 61.7 percent in 2025.

Beyond 2025, participation rates over the next three decades are slightly higher than the rates published last year. Last year, the participation rates were projected to be 61.0 percent in 2027 and 59.3 percent in 2047. In the current projections, those rates are 61.2 percent and 59.5 percent, respectively.

When combined with CBO's projections of the population, the projected rates of labor force participation imply that the labor force grows by 0.4 percent per year, on average, over the 2018–2048 period. That rate is slightly less than the 0.5 percent per year projected a year ago.

Other Labor Market Outcomes

Among the factors accounted for in CBO's labor market projections—in addition to the size of the population and the rate of labor force participation—are the unemployment rate, the average and total number of hours that people work, and various measures of workers' earnings. The agency has changed its projections of those variables over the past year because of updates to historical data and reexamination of recent trends.

Unemployment. In CBO's projections, the unemployment rate, which was 4.1 percent at the end of 2017, declines to 3.3 percent in 2019, gradually rises to 4.8 percent by 2024, and then remains at that level, on average, through 2028. In the meantime, the natural rate of unemployment (the rate that results from all sources other than fluctuations in overall demand related to the business cycle) is projected to remain at 4.6 percent from 2018 to 2028. From 2024 onward, the unemployment rate is expected to remain about one-quarter of one percentage point above the natural rate, a difference that is consistent both with the historical average relationship between the two measures and with the projected gap of one-half of one percent between actual and potential GDP.

After 2028, both the actual and the natural rates of unemployment are projected to decline gradually as the labor force ages and becomes increasingly more educated. (Older and more educated workers tend to have lower actual and natural rates of unemployment.) By 2048, the natural rate of unemployment is projected to be slightly less than 4.4 percent, and the actual rate is projected to be about 4.7 percent.

Average Hours Worked. Different subgroups of the labor force work different numbers of hours, on average. Men tend to work more hours than women do, for example, and people between the ages of 30 and 40 tend to work more hours than people between the ages of 50 and 60. In CBO's estimation, those differences among groups will remain stable. However, over the long term, the composition of the labor force is projected to shift toward groups that tend to work less (such as older workers). As a result, the average number of hours worked by the labor force as a whole is expected to decline slightly. By 2048, the average number of hours that people work is expected to be about 1 percent less than it is today.

Total Hours Worked. On the basis of projections of the size of the labor force, average hours worked, and unemployment, total hours worked are estimated to increase at an average annual rate of 0.4 percent between 2018 and 2048.

Earnings as a Share of Compensation. Workers' total compensation consists of taxable earnings and nontaxable benefits such as employers' contributions to health insurance and pensions. Over the years, the share of total compensation paid in the form of earnings has declined—from about 90 percent in 1960 to about 81 percent in 2017—mainly because the cost of health insurance has risen more quickly than total compensation.[17]

CBO expects that trend in health care costs to continue, which would further decrease the proportion of compensation that workers receive as earnings. However, under current law, a new excise tax on certain employment-based health insurance plans that have premiums above specified amounts is scheduled to take effect in 2022. Some employers and workers are expected to respond by shifting to less expensive plans, thereby reducing the share of compensation consisting of health insurance premiums and increasing the share that consists of earnings. In CBO's projections, the effects of the tax on the mix of compensation roughly offset the effects of rising costs for health care until the effects of rising costs outweigh those of the excise tax late in the projection period. As a result, the share of compensation that workers receive as earnings is projected to remain close to 81 percent through most of the 2018–2048 period.

Growth of Real Earnings per Worker. Projections of prices, nonwage compensation (such as employment-based health insurance), average hours worked, and labor productivity (discussed below) imply that real earnings per worker grow by an average of 1.2 percent annually over the 2018–2048 period. That rate is higher than the average annual growth—0.9 percent—of real earnings per worker over the last 30 years.

Distribution of Earnings. Over the past several decades, earnings have grown faster for higher earners than for lower earners. In CBO's projections, the unequal growth in earnings continues for the next three decades. The distribution of earnings affects revenues from income taxes and payroll taxes, among other things. Income taxes are affected by the earnings distribution because of the progressive rate structure of the income tax; people with lower earnings pay a smaller share of their earnings than people with higher earnings.

Social Security payroll taxes are also affected by the earnings distribution. Those taxes are levied only on earnings up to a certain annual amount ($128,400 in 2018). Below that amount, earnings are taxed at a combined rate of 12.4 percent, split between the employer and employee (self-employed workers pay the full amount); no tax is paid on earnings above the cap. The taxable maximum has remained a nearly constant proportion of the average wage since the mid-1980s, but because earnings have grown more for higher earners than for others, the portion of covered earnings on which Social Security payroll taxes are paid has fallen from 90 percent in 1983 to 83 percent in 2016.[18] The portion of earnings subject to Social Security taxes is projected to fall to about 81 percent by 2028 and to fall below 80 percent by 2048.

Changes in Projections of Other Labor Market Outcomes Since Last Year. Projections of most other labor market outcomes are similar to what CBO projected last year. For example, CBO's long-term projection of the natural rate of unemployment is only slightly lower than its projection a year ago because of updates to historical data and trends.

An important change since last year in the labor market outcomes discussed in this section is to the projected distribution of earnings. Data for the past few years show smaller-than-expected increases in the share of wages and salaries received by higher earners. In response, the agency made a downward revision to projected increases in that share over the next decade. As a result, in this year's projections, households with lower individual income tax rates earn a larger share of total income than CBO projected last year, and total income tax revenues are lower than would otherwise be the case.

Additionally, with a smaller share of wages and salaries received by higher earners, a larger share is received by

17. For more details, see Congressional Budget Office, *How CBO Projects Income* (July 2013), www.cbo.gov/publication/44433.

18. Covered earnings are those received by workers in jobs subject to Social Security payroll taxes. Most workers pay payroll taxes on their earnings, although a small number—mostly in state and local government jobs or in the clergy—are exempt.

people whose annual earnings are below the maximum amount subject to Social Security payroll taxes. Thus, the share of earnings below the taxable maximum is expected to decline more slowly than CBO projected last year. In last year's projections, the share of earnings below the taxable maximum declined until 2027 and then remained at roughly that level through the end of the projection period. In this year's projections, the share of earnings below the taxable maximum declines gradually through 2048. By 2027 that share is 1.4 percentage points higher than in last year's projections, and declines to roughly the same level in 2047 as CBO projected last year. Over the 30-year period, that share is about half of a percentage point higher, on average, than CBO estimated last year.

Capital Accumulation and Productivity

In addition to growth in the labor force and the number of hours worked, two other important factors affect the growth in output. One is the accumulation of capital, including physical structures, equipment, land, and inventories used in production, along with intangible capital such as computer software. The accumulated stock contributes a stream of services to production. The second is the growth of total factor productivity (TFP), which is the growth of real output per unit of combined labor and capital services—that is, the growth of output that is not explained by the growth of labor and capital. Combined, the growth rates projected for the labor supply, the capital stock, and TFP result in a projection of the average growth of labor productivity (output per worker).

Capital Services. Over the longer term, in CBO's view, growth in the nation's stock of capital will be driven by private saving, federal borrowing, and international flows of financial capital. Private saving and international capital flows tend to move with the after-tax rate of return on investment, which measures the extent to which investment in the stock of capital results in a flow of income. That rate is affected both by tax rates and by the growth of TFP. Recent reductions in statutory tax rates on corporations permanently increase incentives to invest in capital and consequently raise the level of capital services.

Total Factor Productivity. The annual growth of TFP is projected to increase from about 0.9 percent in 2018 to about 1.2 percent in 2022 and then to remain at that rate through 2048, yielding an average annual growth rate of roughly 1.2 percent from 2018 to 2048. That projected growth rate is about 0.3 percentage points slower than the average annual rate of 1.5 percent observed since 1950 and slightly slower than the average rate recorded since 1990.

The projected path for TFP reflects several considerations that, in CBO's judgment, suggest slower growth in coming decades than the long-term historical average. For example, with the exception of a period of rapid growth in the late 1990s and early 2000s, productivity has tended to grow more slowly in recent decades than it did during the 1950s and 1960s. The long-term trend suggests that projections for the next few decades should place greater weight on more recent, slower growth than on the relatively rapid growth of the more distant past. Thus, although CBO projects an acceleration of TFP growth from its unusually slow recent rate, the agency anticipates it to return to a rate that is slower than its long-term historical average.

A number of developments support slow-growth projections for TFP. One is the anticipated slowing of growth in labor quality, a measure of workers' skills that accounts for educational attainment and work experience that, in CBO's analysis, is implicitly a part of TFP. Following a relatively rapid rise during the 1980s and 1990s, growth in labor quality slowed after 2000. In CBO's judgment, that change results both from a gradual slowdown in the increase in average educational attainment and from the burgeoning retirement of a relatively large and skilled portion of the workforce—the baby-boom generation. In coming decades, however, the slowdown in the growth of labor quality is expected to be partly offset by the aging of those remaining in the labor force, especially as better health and longer life expectancy lead people to stay in the workforce longer than did members of previous generations. (An older workforce generally has a larger proportion of more highly educated workers because they tend to remain in the labor force longer than do workers with less education.) Nevertheless, CBO anticipates slower growth in labor quality than in the past.

Another factor that is projected to slow the growth of TFP relative to its long-term average is the projected reduction in spending for federal investment. Under the assumptions used for CBO's baseline, the government's nondefense discretionary spending is projected to decline over the next decade to a much smaller percentage of GDP than it has averaged in the past. About half of nondefense discretionary spending from the 1980s onward has consisted of federal investment in physical capital (such as roads and other infrastructure), education and training, and research and development—all of which, in CBO's judgment, contributed to TFP growth. Consequently, lower nondefense discretionary spending as a percentage of GDP would mean less federal investment, causing TFP to grow more slowly.

In contrast, changes to the tax code are projected to raise productivity by discouraging multinational corporations' profit-shifting strategies that historically have reduced official estimates of TFP. Because TFP is a component of GDP, CBO projects an increase in GDP as tax incentives encourage firms to claim as domestic production the services of intellectual property that were previously claimed as production abroad. CBO has slightly increased its projections of TFP to account for this anticipated increase in output, which is not matched by an increase in production inputs.

Labor Productivity. Taken together, the projections of labor supply, capital services, and TFP result in labor productivity that is expected to grow by 1.5 percent annually over the 2018–2048 period.[19]

Changes in Projections of Capital Accumulation and Productivity Since Last Year. CBO projects roughly the same average TFP growth that it projected last year. However, CBO's projection of capital services is above the level it projected last year, largely because of stronger investment incentives in the tax code that cause businesses to raise investment.

Inflation

CBO projects rates of inflation for two categories: prices of consumer goods and services and prices of final goods and services in the economy.[20] Those rates influence nominal (current year) levels of income and interest rates and thereby influence tax revenues, various types of federal expenditures that are indexed for inflation, and interest payments on federal debt.

Prices of Consumer Goods and Services. One measure of consumer price inflation is the annual rate of change in the consumer price index for all urban consumers (CPI-U). Over the 2018–2048 period, inflation in that measure averages 2.4 percent in CBO's projections. That long-term rate is slightly less than the average rate of inflation since 1990 of 2.5 percent per year. CBO projects that, under a chained measure of inflation, prices grow at a rate 0.25 percent less than the annual increase in the consumer price index.[21]

Prices of Final Goods and Services. After 2018, the annual inflation rate for all final goods and services produced in the economy, as measured by the rate of increase in the GDP price index, is projected to average 0.4 percentage points less than the annual increase in the consumer price indexes. The GDP price index grows more slowly than the consumer price indexes because it is based on the prices of a different set of goods and services and a different method of calculation.

Changes in Projections of Inflation Since Last Year. Inflation in both measures of consumer prices is projected to be roughly the same as the rates CBO projected last year for the 2017–2047 period.

Interest Rates

CBO projects the interest rates, both real and nominal, that apply to federal borrowing, including the rate on 10-year Treasury notes and special-issue Social Security bonds. It also projects the average nominal interest rates on federal debt held by the public and on the bonds held in the Social Security trust funds. Those rates influence the cost of the government's debt burden and the evolution of the trust funds.

After considering a number of factors, including slower growth of the labor force, CBO expects real interest rates on federal borrowing to be lower in the future than they have been, on average, over the past few decades. The

19. The measure of labor productivity reported here is the ratio of real output to hours worked in the economy. Note that elsewhere CBO reports different measures of labor productivity, such as the ratio of potential real output to the potential labor force.

20. Final goods and services are those purchased directly by consumers, businesses (for investment), and governments, as well as net exports.

21. The chained CPI-U tends to grow more slowly than the standard CPI-U because it uses a formula that better accounts for households' tendency to substitute similar goods and services for each other when relative prices change and because, unlike the CPI-U, it is little affected by statistical bias related to the sample sizes that the Bureau of Labor Statistics uses in computing each index. Historically, inflation as measured by the chained CPI-U has been 0.25 percentage points lower, on average, than inflation as measured by the CPI-U. CBO's projections reflect that average difference between the two measures.

real interest rate on 10-year Treasury notes (calculated by subtracting the rate of increase in the consumer price index from the nominal yield on those notes) averaged roughly 2.9 percent between 1990 and 2007.[22] That rate has averaged 1.0 percent since 2009 and is projected to be 1.4 percent in 2028. In CBO's projections, the rate continues to rise thereafter, reaching 2.4 percent in 2048, 0.5 percentage points below its average over the 1990–2007 period. CBO's projections of interest rates this year are higher than last year's.

Factors Affecting Interest Rates. Interest rates are determined by a number of factors. CBO projects the rates by comparing how the values of those factors are expected to differ in the long term relative to their average values in the past. However, conclusions from such analyses depend greatly on the period being considered, as some recent decades show: Real interest rates were low in the 1970s because of an unexpected surge in inflation. In the 1980s, when inflation declined at an unexpectedly rapid pace, real rates were high.[23] Interest rates fell sharply during the financial crisis and recession that began in 2007.

To avoid using any of those possibly less representative periods, CBO considered average interest rates and their determinants over the 1990–2007 period and then judged how different those determinants might be over the long term.[24] That period was chosen for comparison because it featured fairly stable expectations of inflation and no severe economic downturns or significant financial crises.

Some factors reduce interest rates; others increase them. In CBO's estimates for the 2018–2048 period, several factors tend to reduce interest rates on government securities relative to their 1990–2007 average:

- The labor force is projected to grow much more slowly than it did from 1990 to 2007. That slower growth in the number of workers would tend to increase the amount of capital per worker in the long term, reducing the return on capital and, therefore, also reducing the return on government bonds and other investments.[25]

- The share of total income received by higher-income households is expected to be larger in the future than during the 1990–2007 period. Higher-income households tend to save a greater proportion of their income, so the difference in the distribution of income is projected to increase the total amount of saving available for investment, other things being equal. As a consequence, the amount of capital per worker is projected to rise and interest rates are expected to be lower.

- TFP is projected to grow more slowly in the future than it did from 1990 to 2007. For a given rate of investment, lower productivity growth reduces the return on capital and results in lower interest rates, all else being equal.

- CBO expects investors' preferences for Treasury securities relative to riskier assets to remain elevated compared with inclinations over the 1990–2007 period. Investors began to have less appetite for risk

22. Between 1970 and 2007, the real interest rate on 10-year Treasury notes averaged 2.8 percent; the average from 1954 to 2007 was 2.6 percent. Historical inflation rates are taken from the consumer price index, adjusted to account for changes over time in the way that the index measures inflation. See Bureau of Labor Statistics, "CPI Research Series Using Current Methods (CPI-U-RS)" (March 28, 2018), www.bls.gov/cpi/cpiurs.htm.

23. CBO calculates real interest rates by subtracting expected rates of inflation from nominal interest rates. In general, borrowers and lenders agree to nominal interest rates after accounting for their expectations of what inflation will be. However, if inflation ends up being higher than was expected when the rates were agreed to, real interest rates will turn out to be lower than anticipated. If inflation ends up lower than expected, the opposite will occur. CBO uses the actual consumer price index, adjusted to account for changes over time in the way that the index measures inflation, as a proxy for both what expectations of inflation have been in the past and what they will be in the future. One drawback is that if inflation fluctuates rapidly over time, changes in expectations may lag behind changes in actual inflation. Although CBO's approach could mismeasure expectations of inflation and real interest rates in some years, the way inflation has varied over time suggests that CBO's approach is a useful proxy over long periods, on average.

24. A Bank of England study identified a similar set of determinants that account for the decline in real interest rates over the past 30 years. See Rachel Lukasz and Thomas D. Smith, *Secular Drivers of the Global Real Interest Rate*, Staff Working Paper 571 (Bank of England, December 2015), https://tinyurl.com/z6zqnb7 (PDF, 1.8 MB).

25. For more information about the relationship between the growth of the labor force and interest rates, see Congressional Budget Office, *How Slower Growth in the Labor Force Could Affect the Return on Capital* (October 2009), www.cbo.gov/publication/41325.

in the early 2000s, and the demand for low-risk assets was strengthened by the economic fallout from the financial crisis, the slow subsequent recovery, and financial institutions' response to increased regulatory oversight. Moreover, in the past several years, the perception that investments in emerging market economies were riskier than investments in the United States probably contributed to the increased demand for U.S. assets (particularly federal debt) that are considered to be relatively risk-free. The rise in demand for Treasury securities from those sources contributed to lower returns (that is, to lower interest rates). CBO expects preferences for Treasury securities relative to riskier assets to gradually decline over the next three decades but to remain above their average levels from 1990 to 2007.

At the same time, in CBO's estimates, several factors tend to boost interest rates on government securities relative to their average over the 1990–2007 period:

- Under CBO's extended baseline, federal debt is projected to be much larger as a percentage of GDP than it was before 2007—reaching 96 percent by 2028 and 152 percent by 2048. The latter figure is more than three and a half times the average over the 1990–2007 period. Greater federal borrowing tends to crowd out private investment in the long term, reducing the amount of capital per worker and increasing both interest rates and the return on capital over time.

- CBO anticipates that emerging market economies will attract a greater share of foreign investment in coming decades than they did in the 1990–2007 period. As economic and financial conditions in those economies continue to improve, they will become increasingly attractive destinations for foreign investment. CBO projects that development to put upward pressure on interest rates in the United States.

- The capital share of income—the percentage of total income that is paid to owners of capital—has been on an upward trend for the past few decades. The share is projected to decline over the next decade from its current, elevated level but remain higher than its average over recent decades. The factors that appear to have contributed to the rise in income for owners of capital (such as technological change and globalization) are likely to persist, keeping it above the historical average. In CBO's estimation, a larger share of income accruing to owners of capital would directly boost the return on capital and, thus, interest rates.

- The retirement of members of the baby-boom generation and slower growth of the labor force will reduce the number of workers in their prime saving years relative to the number of older people who are drawing down their savings, CBO projects. As a result, in CBO's estimates, the total amount of saving available for investment decreases (all else being equal), which tends to reduce the amount of capital per worker and thereby push up interest rates. (CBO estimates that this effect only partially offsets the positive effect of increased income inequality on saving, leaving a net increase in savings available for investment.)

Some factors mentioned above are easier than others to quantify. For instance, the effect of labor force growth and rising federal debt can be estimated from available data, theoretical models, and estimates in the literature. The extent to which other factors will affect interest rates is more difficult to estimate. A shift in preferences for low- rather than high-risk assets is not directly observable, for example. And although the distribution of income is observable, neither models nor empirical estimates offer much guidance for quantifying its effect on interest rates.

In light of those sources of uncertainty, CBO relies not only on economic models and findings from the research literature but also on information from financial markets to guide its assessments of the effects of various factors on interest rates over the long term. The current rate on 30-year Treasury bonds, for example, reflects market participants' judgments about the path that interest rates on short-term securities will take 30 years into the future. That market forecast informs CBO's assessment of market expectations for the risk premium—the premium paid to investors for the extra risk associated with holding longer-term bonds—and for investment opportunities in the United States and abroad, and it points to considerably lower interest rates well into the future than those of recent decades.

Projections of Interest Rates. CBO anticipates considerable movement in long-term interest rates over the first 11 years of the projection. For the next few years, CBO projects interest rates to rise as GDP expands beyond its potential and the Federal Reserve tightens monetary policy. Beginning in late 2021, CBO expects long-term interest rates to decline as GDP growth slows and the economy moves back towards its historical relationship with potential output. Beginning in 2024, long-term interest rates in CBO's projections gradually rise in response to increases in the ratio of debt to GDP.

The nominal interest rate on 10-year Treasury notes is projected to average 4.1 percent over the 2018–2048 period and to reach 4.8 percent in 2048. The real interest rate on 10-year Treasury notes is projected to average about 1.7 percent and, at the end of the period, to be 2.4 percent.

The average interest rate on all federal debt held by the public tends to be lower than the rates on 10-year Treasury notes because interest rates are generally lower on shorter-term debt than on longer-term debt and because Treasury securities are expected to mature, on average, over periods of less than 10 years.[26] CBO projects a 0.4 percentage-point difference between the rate on 10-year Treasury notes and the effective rate on federal debt over the 2029–2048 period. That difference is projected to average 0.6 percentage points over the next decade. The difference is larger over the coming decade than for later years because a significant portion of federal debt that will be outstanding during the next 10 years was issued at the very low interest rates prevailing in the aftermath of the 2007–2009 recession. (The average interest rate on all federal debt changes more slowly than the 10-year rate because only a portion of federal debt matures each year.) Thus, in CBO's projections, the average nominal interest rate on all federal debt held by the public is about 3.6 percent for the 2018–2048 period and reaches 4.4 percent in 2048.

The Social Security trust funds hold special-issue bonds that generally earn interest at rates that are higher than the average rate on federal debt. In CBO's projections, the nominal interest rate on bonds newly issued to the trust funds averages 4.1 percent over the 2018–2048 period and reaches 4.8 percent in 2048. The corresponding real rates are 1.7 percent, on average, over the full period and 2.4 percent in 2048.

Because interest rates have been low for much of the past decade, CBO projects the average interest rate earned by all bonds held (both new and previously issued) by the Social Security trust funds to be slightly lower than the interest rate on newly issued bonds over the next decade. The average interest rate on all bonds, which CBO uses to calculate the present value of future streams of revenues and outlays for those funds, is projected to average 3.8 percent for the 2018–2048 period.[27]

Changes in Projections of Interest Rates Since Last Year. CBO's projections of interest rates this year are higher than last year's. The real rates on 10-year Treasury notes and the Social Security bonds are projected to average 1.7 percent over the 2018–2048 period and to be 2.3 percent in 2047. Last year, CBO projected both rates would average 1.5 percent over the 2017–2047 period and would be 2.3 percent in 2047.

The path of interest rates is higher in this year's projections than in last year's. Long-term interest rates are poised to end the first half of 2018 roughly half a percentage point higher than CBO projected last year. The higher rate probably reflects the expectation of tighter monetary policy (in response to a stronger labor market and greater inflationary pressure) as well as reduced demand for long-term Treasury bonds. Both trends are expected to continue over the next several years. In addition, CBO projects greater federal borrowing to push up interest rates. The upward revision to 10-year Treasury rates is anticipated to peak at 1 percentage point in 2020. The upward revision is predicted to be smaller in later years, as economic growth returns to its historical relationship with potential output growth and downward revisions to projected deficits gradually reduce the upward revision to the stock of debt. From 2023 to 2047, the 10-year Treasury rate is roughly unchanged in this year's report compared to last year's projection.

26. In particular, from 2018 to 2028, the difference between the rate on 3-month Treasury bills and the rate on 10-year Treasury notes shrinks from 1.2 percentage points to its longer-run level of 1 percentage point.

27. A present value is a single number that expresses a flow of past and future income or payments in terms of an equivalent lump sum received or paid at a specific time. The value depends on the rate of interest, known as the discount rate, that is used to translate past and future cash flows into current dollars at that time.

APPENDIX

B

Changes in Long-Term Budget Projections Since March 2017

The 30-year projections of federal spending and revenues presented in this report differ from the projections that the Congressional Budget Office published in 2017 because of certain changes in law, revisions to some of the agency's assumptions and methods, the availability of more recent data, and changes to the agency's projections of demographic and economic variables.[1] For the same reasons, CBO's 10-year projections have also changed since 2017, and they serve as the foundation for the 30-year projections. The 10-year projections are typically published in *The Budget and Economic Outlook*; however, since the publication of that report in April, the agency has adjusted them.[2] As a result, the long-term projections in this report are based on those adjusted projections (see Table B-1).

This appendix compares CBO's current long-term budget projections with those published last year. Because most of the projections in the 2017 report ended in 2047, the appendix compares projections only through that year.

Measured as a percentage of gross domestic product (GDP), federal debt held by the public is now projected to be higher through 2041, and lower thereafter, than CBO projected last year. Under the extended baseline, debt is projected to grow from about 78 percent of GDP this year to 148 percent in 2047; last year, CBO projected that it would rise from 77 percent of GDP in 2018 to 150 percent in 2047 (see Figure B-1).[3] The revised projections of debt resulted from changes in both spending and revenue projections, all of them presented here as a percentage of GDP:

- Projected noninterest spending is lower than CBO anticipated last year, though the difference shrinks toward the end of the 30-year projection period. The main cause is downward revisions to outlays for Social Security and the major health care programs in CBO's projections, though those reductions in mandatory spending are partially offset by increases in discretionary spending.[4]

- Net spending for interest is projected to be higher through the late 2030s than it was in last year's projections and lower thereafter. The initial difference results from higher projected interest rates and greater projected levels of debt held by the public than CBO projected last year. That relationship reverses later in the projection period as deficits become smaller than projected a year ago, a change that leads to lower interest costs and slower accumulation of debt.

- Projected revenues are lower through 2026 than they were in last year's projections, similar for most of the following two decades, and then slightly higher by the end of the 30-year projection period. Those changes reflect provisions of Public Law 115-97, which is referred to here as the 2017 tax act.

1. See Congressional Budget Office, *The 2017 Long-Term Budget Outlook* (March 2017), www.cbo.gov/publication/52480. The changes in demographic and economic projections are described in Appendix A of this report.

2. In total, the adjustments reduced the projected deficit for 2018 by $12 billion and reduced projected deficits over the 2019–2028 period by a cumulative $17 billion. For the April report, see Congressional Budget Office, *The Budget and Economic Outlook: 2018 to 2028* (April 2018), www.cbo.gov/publication/53651. For the adjusted projections, see Congressional Budget Office, *An Analysis of the President's 2019 Budget* (May 2018), www.cbo.gov/publication/53884.

3. The extended baseline generally reflects current law, following CBO's 10-year baseline budget projections and then extending most of the concepts underlying those baseline projections for the rest of the long-term projection period.

4. Mandatory spending is generally governed by provisions of permanent law, whereas discretionary spending is controlled by annual appropriation acts.

Table B-1.

Comparison of CBO's Adjusted April 2018 Baseline and January 2017 Baseline

Billions of Dollars

	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
					Adjusted April 2018 Baseline						
Revenues	3,339	3,490	3,680	3,829	4,016	4,232	4,448	4,667	5,003	5,301	5,520
Outlays	4,131	4,463	4,683	4,947	5,290	5,505	5,693	6,020	6,324	6,616	7,047
Deficit	-793	-973	-1,003	-1,118	-1,275	-1,273	-1,245	-1,352	-1,321	-1,314	-1,527
Debt Held by the Public at the End of the Year[a]	15,676	16,743	17,804	18,970	20,290	21,609	22,904	24,310	25,687	27,058	28,642
					January 2017 Baseline						
Revenues	3,604	3,733	3,878	4,019	4,176	4,346	4,527	4,724	4,931	5,140	n.a.
Outlays	4,091	4,334	4,562	4,816	5,135	5,346	5,554	5,890	6,228	6,548	n.a.
Deficit	-487	-601	-684	-797	-959	-1,000	-1,027	-1,165	-1,297	-1,408	n.a.
Debt Held by the Public at the End of the Year[a]	15,416	16,092	16,845	17,704	18,721	19,776	20,858	22,078	23,430	24,893	n.a.
					Difference Between Adjusted April 2018 Baseline and January 2017 Baseline						
Revenues	-265	-243	-199	-190	-160	-114	-79	-57	72	161	n.a.
Outlays	40	129	121	132	155	158	139	130	96	68	n.a.
Deficit[b]	-305	-372	-320	-322	-315	-272	-217	-187	-24	93	n.a.
Debt Held by the Public at the End of the Year[a]	260	650	959	1,266	1,569	1,832	2,046	2,232	2,257	2,165	n.a.

Sources: Congressional Budget Office; staff of the Joint Committee on Taxation.

n.a. = not applicable.

a. The net amount that the Treasury borrows is determined primarily by the annual budget deficit. In addition, several factors—collectively labeled "other means of financing" and not directly included in budget totals—also affect the government's need to borrow from the public.

b. Negative numbers indicate that CBO's projection of the deficit has grown.

Over most of the coming decade, the decrease relative to last year's projections, measured as a share of GDP, is larger for revenues than for noninterest spending (see Figure B-2). The result is that projected deficits through 2025 are now markedly larger than previously projected. Beginning in 2026, however, they are smaller than previously projected.

Changes in Projected Spending

In CBO's extended baseline, noninterest spending as a percentage of GDP is slightly lower than anticipated last year, mainly because the agency's projections of outlays for Social Security and the major health care programs have fallen. CBO's projections of discretionary spending, by contrast, are higher than they were a year ago. Projections of net interest costs are higher than previously projected through the late 2030s and then lower.

Noninterest Spending

As a share of GDP, noninterest spending—that is, spending for Social Security, spending for the major federal health care programs, and other noninterest spending—is projected to be about the same in 2018 as projected last year and lower thereafter. Specifically, it is projected to equal 19.0 percent of GDP in 2018 and to reach 23.0 percent of GDP by 2047 (0.2 percentage points lower than in last year's projection).

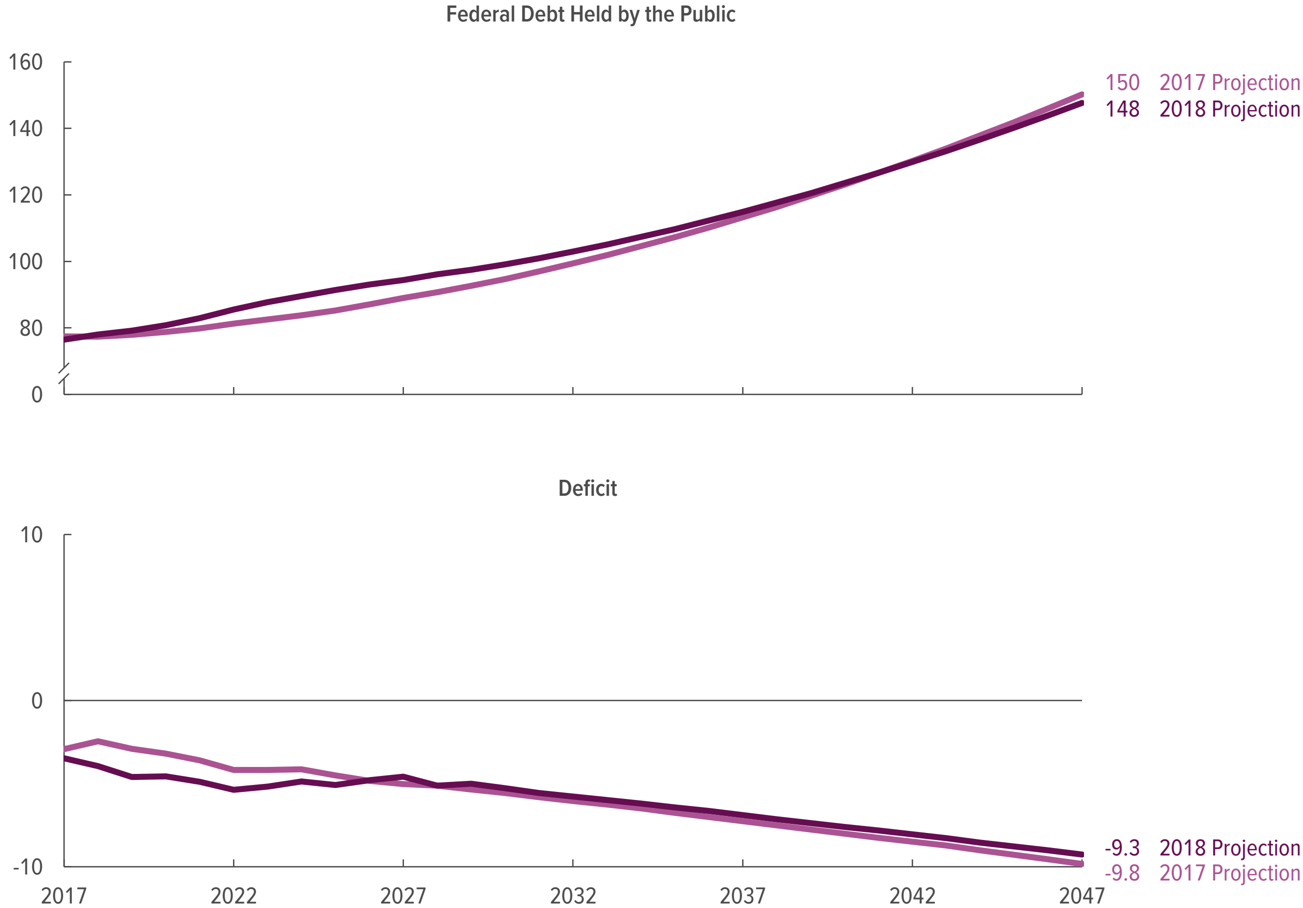
Social Security Spending. CBO projects that outlays for Social Security as a percentage of GDP will be slightly lower than the agency anticipated last year. That change reflects slightly lower projections of nominal outlays over the next 10 years and higher projections of GDP.

The revisions to nominal outlays over the next 10 years include a downward adjustment of projected spending

Figure B-1.

Comparison of CBO's 2017 and 2018 Projections of Federal Debt Held by the Public and the Deficit in the Extended Baseline

Percentage of Gross Domestic Product



Source: Congressional Budget Office.

The extended baseline generally reflects current law, following CBO's 10-year baseline budget projections and then extending most of the concepts underlying those baseline projections for the rest of the long-term projection period.

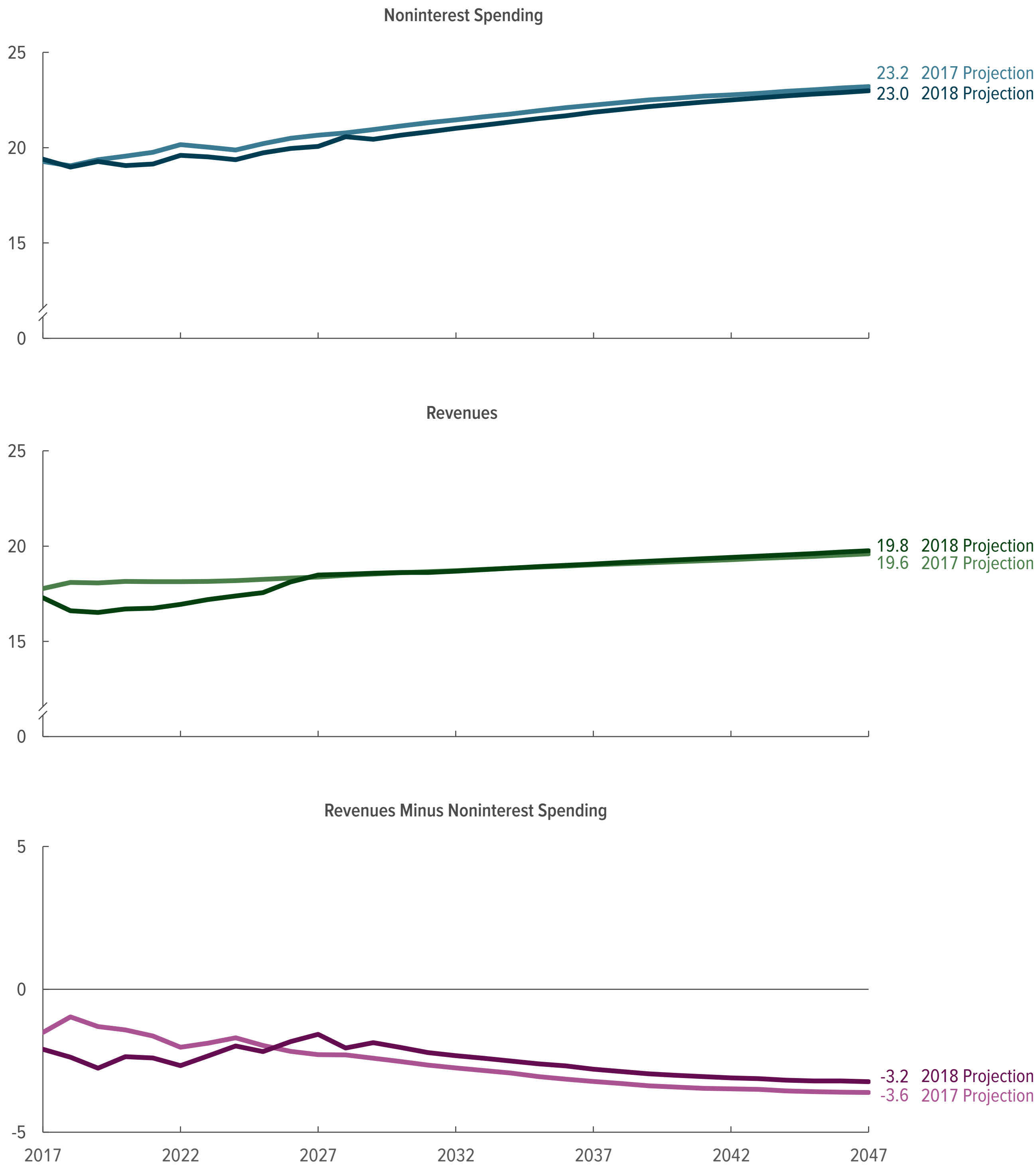
on Disability Insurance (DI), which is a component of the Social Security program, and lower projections of average wage rates through 2020. The DI projections are lower mainly because caseloads have been lower than anticipated over the past year, which led CBO to reduce its projection of the number of DI beneficiaries initially as well as projections of growth in the number of beneficiaries over the next several years. The projections of average wage rates are lower because of downward revisions to historical data. (Lower projections of average wage rates reduce projected spending on Social Security benefits because the earnings on which initial benefits are based are indexed to growth in average wages. When that growth is lower, the resulting benefits are also lower.)

Major Federal Health Care Spending. CBO's current long-term projection of federal spending for the major health care programs, measured as a percentage of GDP, is lower than last year's projection. Spending for Medicare net of offsetting receipts (that is, premiums paid by beneficiaries) is now projected to equal 2.9 percent of GDP in 2018 (0.1 percent of GDP lower than projected last year) and then to rise steadily to 5.8 percent of GDP in 2047 (0.3 percent of GDP

Figure B-2.

Comparison of CBO's 2017 and 2018 Projections of Spending and Revenues in the Extended Baseline

Percentage of Gross Domestic Product



Source: Congressional Budget Office.

The extended baseline generally reflects current law, following CBO's 10-year baseline budget projections and then extending most of the concepts underlying those baseline projections for the rest of the long-term projection period.

lower than projected last year). That reduction occurred mostly because CBO has increased its projections of GDP. Outlays for Medicaid and the Children's Health Insurance Program (CHIP), combined with spending to subsidize health insurance purchased through the marketplaces established under the Affordable Care Act and related spending, are projected to be lower than previously anticipated through the late 2030s and higher thereafter, totaling 3.3 percent of GDP in 2047, slightly larger than the sum projected last year. That larger ultimate amount results from faster growth of Medicaid spending in the second and third decades than projected a year ago.

To project long-term spending for the major health care programs, CBO used the same method that it used last year. Namely, it combined estimates of the number of people who are projected to receive benefits from those programs with fairly mechanical estimates of the growth of spending per beneficiary (adjusted to account for demographic changes to the beneficiaries in each program). CBO has estimated such growth by combining projected growth in potential GDP per person with projected excess cost growth for each program.[5] (From 2018 to 2027, potential GDP per person is projected to grow at an average rate of about 3.4 percent per year, up from the 3.1 percent estimated last year; from 2018 to 2047, the average growth rate is projected to be about 3.4 percent per year, roughly the same as last year's estimate.)

For each category of spending except CHIP, through 2028, CBO used the rate of excess cost growth implicit in the agency's 10-year baseline projections.[6] For 2029, the rate equals the average rate from 2024 to 2028 (the last 5 years of the 10-year baseline projections). The rates of excess cost growth for Medicare, Medicaid, and private health insurance therefore all differ in 2029. After 2029, the rate for each category moves linearly, by the same fraction of a percentage point each year, from that category-specific rate to a rate of 1.0 percent in 2048.[7]

5. Potential GDP is the maximum sustainable output of the economy. Excess cost growth is the extent to which health care costs per person, after being adjusted for demographic changes, grow faster than potential GDP per person.

6. Spending for CHIP is projected differently. Outlays for CHIP are projected to be a constant percentage of GDP after 2028.

7. For more information, see Congressional Budget Office, *The 2016 Long-Term Budget Outlook* (July 2016), Chapter 3, www.cbo.gov/publication/51580.

For Medicare, the average annual rate of excess cost growth implicit in CBO's baseline projections is about 1.0 percent from 2019 through 2028, slightly lower than last year's average of 1.1 percent from 2018 through 2027. The rate of excess cost growth for 2029 is 1.2 percent, the same as last year's estimate. Excess cost growth is projected to average 1.1 percent over the full projection period, the same as last year's estimate but lower than the historical average of 1.3 percent from 1985 to 2016.

For Medicaid, the average annual rate of excess cost growth implicit in CBO's baseline projections for the federal share of such spending is 1.5 percent from 2019 through 2028, up by 0.3 percentage points from last year's estimate for 2018 through 2027. The rate for 2029 is 1.6 percent, up by 0.9 percentage points from last year's estimate. That change was the cumulative result of many updates that CBO made to its baseline projections for legislative, economic, and technical reasons—with the largest contribution resulting from an update to CBO's methods that made the agency's estimates of growth in costs per beneficiary more consistent throughout the 10-year projection period. The rate of excess cost growth is projected to average 1.4 percent over the full projection period, which is 0.4 percentage points higher than last year's estimate and 0.4 percentage points higher than the 1985–2016 average.

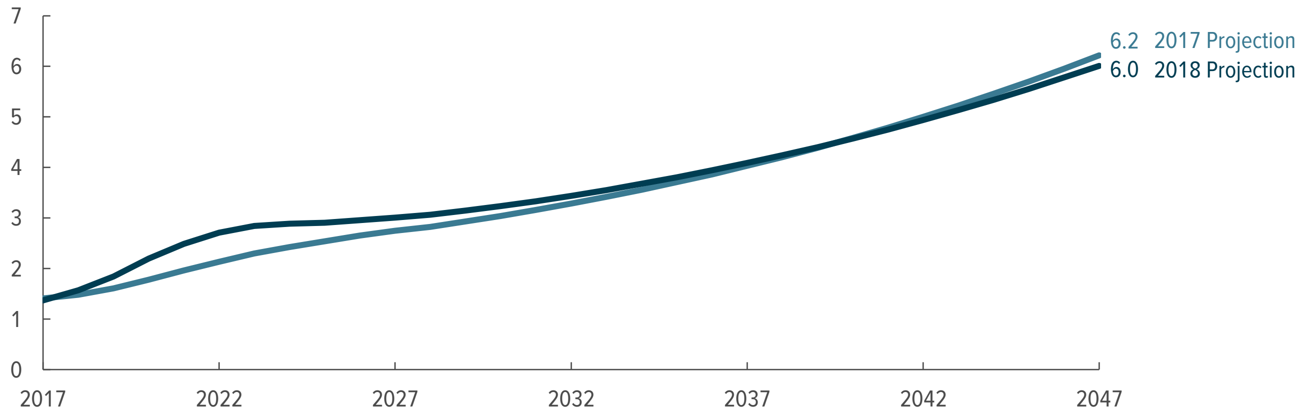
For private health insurance premiums, which CBO uses as an input to its calculation of marketplace subsidies, the average annual rate of excess cost growth implicit in CBO's baseline projections is about 2 percent from 2019 through 2028 (the same as last year's estimate). The rate for 2029 is also about 2 percent, which again is similar to last year's estimate. The rate is projected to decline from 2029 to 2048 and to be lower in 2048 than its historical average.

Other Noninterest Spending. Over the next 10 years, other noninterest spending—total federal spending on everything other than Social Security, the major federal health care programs, and net interest—is projected to be slightly higher as a percentage of GDP than projected last year and roughly the same thereafter. For most of the next 10 years, the part of that spending that is mandatory is slightly lower than previously projected as a share of GDP because CBO has revised its projections of GDP upward. But that decline is more than offset

Figure B-3.

Comparison of CBO's 2017 and 2018 Projections of Net Spending for Interest in the Extended Baseline

Percentage of Gross Domestic Product



Source: Congressional Budget Office.

The extended baseline generally reflects current law, following CBO's 10-year baseline budget projections and then extending most of the concepts underlying those baseline projections for the rest of the long-term projection period.

by an increase in projected discretionary spending. That increase stems primarily from legislative changes that increased funding for defense and nondefense spending limited by caps on annual appropriations and that increased funding for emergency requirements.

Beyond 2028, other noninterest spending as a share of GDP is projected to be about the same as projected last year, reflecting lower projections of other mandatory spending offset by higher projections of discretionary spending. The projections of other mandatory spending as a percentage of GDP are lower because such spending is projected to be slightly smaller after 10 years, and CBO projects that it will decline in relation to GDP at the same rate by which it is projected to fall between 2023 and 2028, although at a slightly slower rate than last year. The projections of discretionary spending are higher than they were last year because such spending, at the end of the 10-year period, is now higher than it was in last year's projections. (CBO assumes that discretionary spending will remain roughly constant as a share of GDP after 2028.)

Interest Costs

In CBO's projections, net interest costs are higher through the late 2030s and lower thereafter than they were a year ago (see Figure B-3). Those costs are higher initially because the agency's projections of interest rates and federal debt held by the public are likewise higher. After the late 2030s, smaller deficits and eventually smaller debt result in lower net interest costs. For the coming decade, net interest costs are projected to average 2.5 percent of GDP; last year, the projected average was 2.2 percent. They are projected to equal 3.1 percent of GDP by 2028 (up 0.2 percentage points from last year's projections) and 6.0 percent of GDP by 2047 (down 0.2 percentage points from last year's projections).

Changes in Projected Revenues

In CBO's current projections, revenues measured as a percentage of GDP are lower through 2026 than they were in last year's projections, similar for most of the following two decades, and then slightly higher by the end of the 30-year projection period. They equal 16.6 percent of GDP this year (which is 1.5 percentage points lower than last year's estimate) and then rise to 18.1 percent of GDP in 2026 (which is 0.2 percentage points lower than last year's estimate). Those downward revisions are the result of recently enacted legislative changes and increased projections of GDP. In particular, provisions of the 2017 tax act temporarily reduced individual income tax rates, nearly doubled the standard deduction, modified or eliminated certain deductions or exemptions, and temporarily allowed firms to deduct the cost of capital investments immediately.

Measured as a share of GDP, revenues in 2027 are projected to be largely the same as in last year's projections, following the scheduled expiration of most of the individual income tax provisions of the 2017 tax act.[8] From 2027 to 2038, projected revenues average 18.8 percent of GDP (which is equal to last year's estimate). But by 2047, revenues are projected to be 0.2 percentage points higher than projected a year ago. That is because individual income taxes are now projected to grow more quickly through most of the projection period as a result of a change in the price index that is used to adjust tax brackets.[9] As a consequence, income will be pushed into higher tax brackets more quickly than projected a year ago.

Those effects are partially offset by a change in CBO's projection of the distribution of earnings. Specifically, the agency has lowered its projection of the share of earnings that will accrue to the highest earners over the next 30 years (though it still projects that earnings will grow more quickly for higher-income people than for others). The change causes a smaller share of income to be taxed at higher rates under the individual income tax, reducing receipts from that tax source. That decrease is largely offset by an increase in projected payroll taxes, as a smaller increase in the share of income accruing to the highest earners results in more earnings falling below the maximum amount subject to Social Security payroll taxes.

Changes in Social Security's Projected Finances

A common measure of the sustainability of a program that has a trust fund and a dedicated revenue source is its estimated actuarial balance over a given period—that is, the sum of the present value of projected tax revenues and the current trust fund balance minus the sum of the present value of projected outlays and a year's worth of benefits at the end of the period.[10] When that balance is negative, it is a deficit.

The 75-year actuarial deficit currently projected for Social Security is 1.5 percent of GDP (which is the same as estimated last year) or 4.4 percent of taxable payroll (which is smaller than last year's estimate of 4.5 percent). That reduction resulted from a number of factors. CBO has lowered its projection of nominal outlays for Social Security over the next 10 years and increased its projection of the share of earnings that are subject to Social Security payroll taxes over the next 30 years.[11] In addition, the agency projects slightly higher interest rates over the 75-year period. Partially offsetting those effects is an increase in the actuarial deficit that results each year from incorporating another year of relatively large deficits into the analysis.[12]

Another commonly used measure of Social Security's sustainability is its trust funds' date of exhaustion. CBO projects that if current law did not change, the Disability Insurance Trust Fund would be exhausted in fiscal year 2025, the Old-Age and Survivors Insurance (OASI) Trust Fund would be exhausted in calendar year 2032, and the combined trust funds would be exhausted in calendar year 2031. Last year, those exhaustion dates were two years earlier for the DI trust fund, one year earlier for the OASI trust fund, and one year earlier for the combined funds. The changes in those dates are the result of the lower projections of nominal outlays from the trust funds, the higher projections of interest rates on balances in the trust funds, and higher projections of revenues into the trust funds. The revenues are projected to be higher because of increased projections of earnings relative to last year and because the projected share of earnings that is subject to Social Security payroll taxes has grown.

8. For more information about the effects of the 2017 tax act, see *The Budget and Economic Outlook: 2018 to 2028* (April 2018), Appendix B, www.cbo.gov/publication/53651, and Box 1 on page 26 of this report.

9. Beginning in 2018, the measure used for adjusting most parameters of the tax system will be changed from the standard consumer price index for urban consumers (CPI-U) to the chained CPI-U. The chained CPI-U tends to grow more slowly than the standard CPI-U because it uses a formula that better accounts for households' tendency to substitute similar goods and services for each other when relative prices change and because, unlike the CPI-U, it is little affected by statistical bias related to the sample sizes that the Bureau of Labor Statistics uses in computing each index. Historically, inflation as measured by the chained CPI-U has been 0.25 percentage points lower, on average, than inflation as measured by the standard CPI-U. CBO's projections reflect that average difference between the two measures.

10. A present value is a single number that expresses a flow of past and future income or payments in terms of an equivalent lump sum received or paid at a specific time. The value depends on the rate of interest, known as the discount rate, used to translate past and future cash flows into current dollars at that time. To account for the difference between the trust fund's current balance and the balance desired for the end of the period, the balance at the beginning is added to projected tax revenues, and an additional year of costs at the end of the period is added to projected outlays.

11. Beyond the 30-year projection period, the share of earnings subject to Social Security payroll taxes is held constant in CBO's projections.

12. The actuarial deficit includes the trust fund balance at the beginning of the projection period, and that balance represents the present value of all income and costs to the trust funds since their beginning.

List of Tables and Figures

Tables

Figures

About This Document

This volume is one of a series of reports on the state of the budget and the economy that the Congressional Budget Office issues each year. In keeping with CBO's mandate to provide objective, impartial analysis, the report makes no recommendations.

Overseen by Julie Topoleski and prepared with guidance from Devrim Demirel, Ed Harris, John Kitchen, John McClelland, David Weaver, and Jeff Werling, the report represents the work of many analysts at CBO. Stephanie Hugie Barello wrote the main text of the report. Aaron Betz, Edward Gamber, and Charles Pineles-Mark wrote Appendix A. Ricci Reber wrote Appendix B. Susan Beyer, Barry Blom, Tom Bradley, Sebastien Gay, Lori Housman, Jamease Kowalczyk, Sarah Masi, Eamon Molloy, Sam Papenfuss, Lisa Ramirez-Branum, Dan Ready, Robert Stewart, and Rebecca Yip contributed to the analysis.

Michael Simpson developed the long-term budget simulations with assistance from Stephanie Hugie Barello, Marina Miller, Xiaotong Niu, and Charles Pineles-Mark. Aaron Betz and Robert Shackleton prepared the macroeconomic simulations. Ed Harris coordinated the revenue simulations, which were prepared by Paul Burnham, Shannon Mok, Cecilia Pastrone, Kurt Seibert, and Joshua Shakin. Justin Lee, Claire Sleigh, and Adam Staveski fact-checked the report. The report builds on the 10-year projections of the economy and budget that CBO released earlier this year, which reflected the contributions of more than 100 people at the agency.

Wendy Edelberg, Mark Hadley, Jeffrey Kling, and Robert Sunshine reviewed the report. Christine Bogusz, Benjamin Plotinsky, and Elizabeth Schwinn edited it, and Casey Labrack prepared it for publication. Charles Pineles-Mark and Ricci Reber prepared the supplemental data.

The report is available on CBO's website (www.cbo.gov/publication/53919).

Keith Hall
Director
June 2018

Annual Energy Outlook 2019

with projections to 2050

U.S. Energy Information Administration

#AEO2019

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The Annual Energy Outlook provides long-term energy projections for the United States

- Projections in the *Annual Energy Outlook 2019* (AEO2019) are not predictions of what will happen, but rather modeled projections of what may happen given certain assumptions and methodologies.
- The AEO is developed using the National Energy Modeling System (NEMS), an integrated model that captures interactions of economic changes and energy supply, demand, and prices.
- Energy market projections are subject to much uncertainty because many of the events that shape energy markets as well as future developments in technologies, demographics, and resources cannot be foreseen with certainty. To illustrate the importance of key assumptions, AEO2019 includes a Reference case and six side cases that systematically vary important underlying assumptions.
- More information about the assumptions used in developing these projections will be available shortly after the release of the AEO2019.
- The AEO is published to satisfy the Department of Energy Organization Act of 1977, which requires the Administrator of the U.S. Energy Information Administration to prepare annual reports on trends and projections for energy use and supply.

What is the Reference case?

- The AEO2019 Reference case represents EIA's best assessment of how U.S. and world energy markets will operate through 2050, based on many key assumptions. For instance, the Reference case projection assumes improvement in known energy production, delivery, and consumption technology trends.

- The economic and demographic trends reflected in the Reference case reflect current views of leading economic forecasters and demographers.

- The Reference case generally assumes that current laws and regulations that affect the energy sector, including laws that have end dates, are unchanged throughout the projection period. This assumption is important because it permits EIA to use the Reference case as a benchmark to compare policy-based modeling.

- The potential impacts of proposed legislation, regulations, or standards are not included in the AEO2019 cases.

- The Reference case should be interpreted as a reasonable baseline case that can be compared with the cases that include alternative assumptions.

What are the side cases?

- The side cases in AEO2019 show the effect that changing important model assumptions have on the projections when compared with the Reference case.

- Two AEO2019 side cases are the High and Low Oil Price cases, which represent international conditions outside the United States that could collectively drive prices to extreme, sustained deviations from the Reference case price path.

- Additional AEO2019 side cases are the High and Low Oil and Gas Resource and Technology cases, where production costs and resource availability within the United States are varied, allowing for more or less production at given world oil and natural gas prices.

- The two AEO2019 side cases that vary the effects of economic assumptions on energy consumption are the High and Low Economic Growth cases, which modify population growth and productivity assumptions throughout the projection period to yield higher or lower compound annual growth rates for U.S. gross domestic product than in the Reference case.

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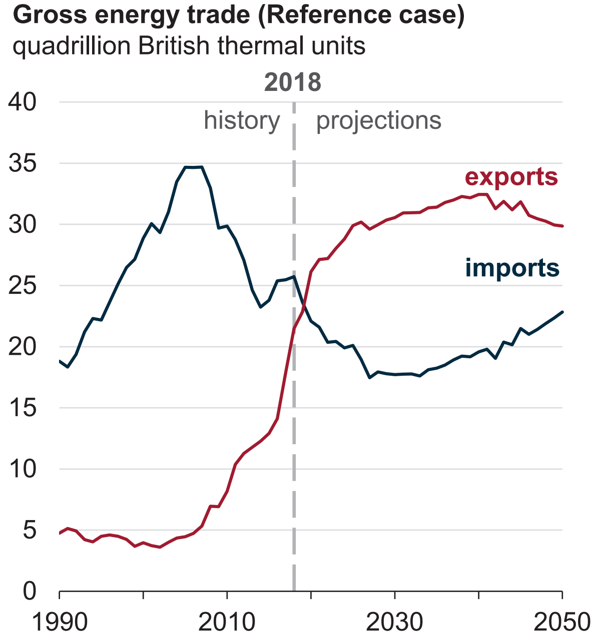
Key takeaways

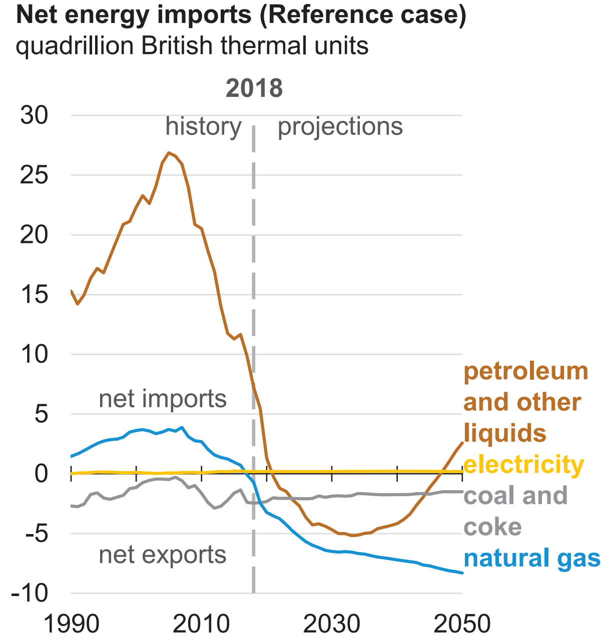
EIA's *Annual Energy Outlook* provides modeled projections of domestic energy markets through 2050, and it includes cases with different assumptions regarding macroeconomic growth, world oil prices, and technological progress.

Key takeaways from the Reference case

- The United States becomes a net energy exporter in 2020 and remains so throughout the projection period as a result of large increases in crude oil, natural gas, and natural gas plant liquids (NGPL) production coupled with slow growth in U.S. energy consumption.
- Of the fossil fuels, natural gas and NGPLs have the highest production growth, and NGPLs account for almost one-third of cumulative U.S. liquids production during the projection period.
- Natural gas prices remain comparatively low during the projection period compared with historical prices, leading to increased use of this fuel across end-use sectors and increased liquefied natural gas exports.
- The power sector experiences a notable shift in fuels used to generate electricity, driven in part by historically low natural gas prices. Increased natural gas-fired electricity generation; larger shares of intermittent renewables; and additional retirements of less economic existing coal and nuclear plants occur during the projection period.
- Increasing energy efficiency across end-use sectors keeps U.S. energy consumption relatively flat, even as the U.S. economy continues to expand.

The United States becomes a net energy exporter after 2020 in the Reference case—





—but the United States continues to import and export throughout the projection period

- The United States has been a net energy importer since 1953, but continued growth in petroleum and natural gas exports results in the United States becoming a net energy exporter by 2020 in all cases.

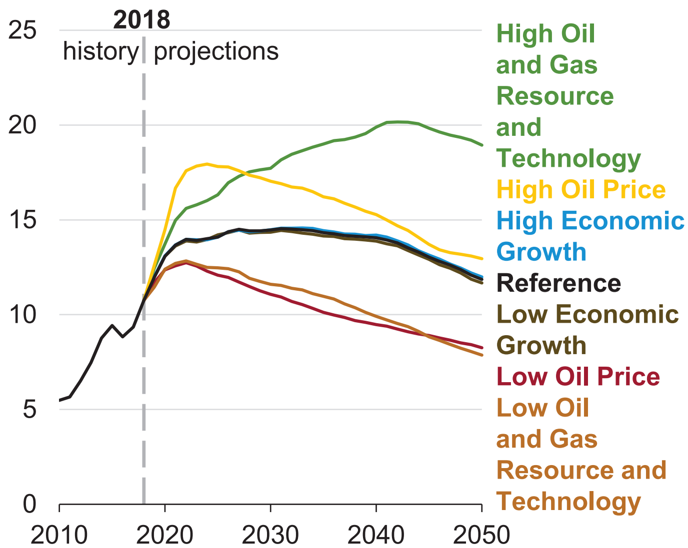
- In the Reference case, the United States becomes a net exporter of petroleum liquids after 2020 as U.S. crude oil production increases and domestic consumption of petroleum products decreases. Near the end of the projection period, the United States returns to being a net importer of petroleum and other liquids on an energy basis as a result of increasing domestic gasoline consumption and falling domestic crude oil production in those years.

- The United States became a net natural gas exporter on an annual basis in 2017 and continued to export more natural gas than it imported in 2018. In the Reference case, U.S. natural gas trade, which includes shipments by pipeline from and to Canada and to Mexico as well as exports of liquefied natural gas (LNG), will be increasingly dominated by LNG exports to more distant destinations.

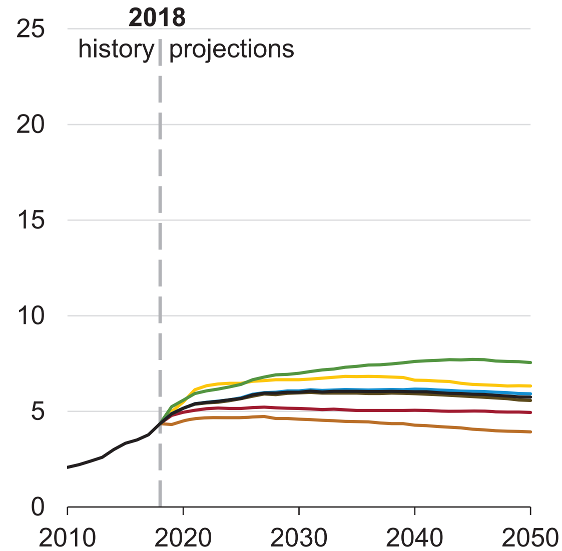
- The United States continues to be a net exporter of coal (including coal coke) through 2050 in the Reference case, but coal exports are not expected to increase because of competition from other global suppliers closer to major world markets.

Production of U.S. crude oil and natural gas plant liquids continues to grow through 2025 in the Reference case—

U.S. crude oil production
million barrels per day



U.S. natural gas plant liquids production
million barrels per day



—and natural gas plant liquids comprise nearly one-third of cumulative 2019–2050 U.S. liquids production

- In the Reference case, U.S. crude oil production continues to set annual records through 2027 and remains greater than 14.0 million barrels per day (b/d) through 2040. Lower 48 onshore tight oil development continues to be the main source of growth in total U.S. crude oil production.

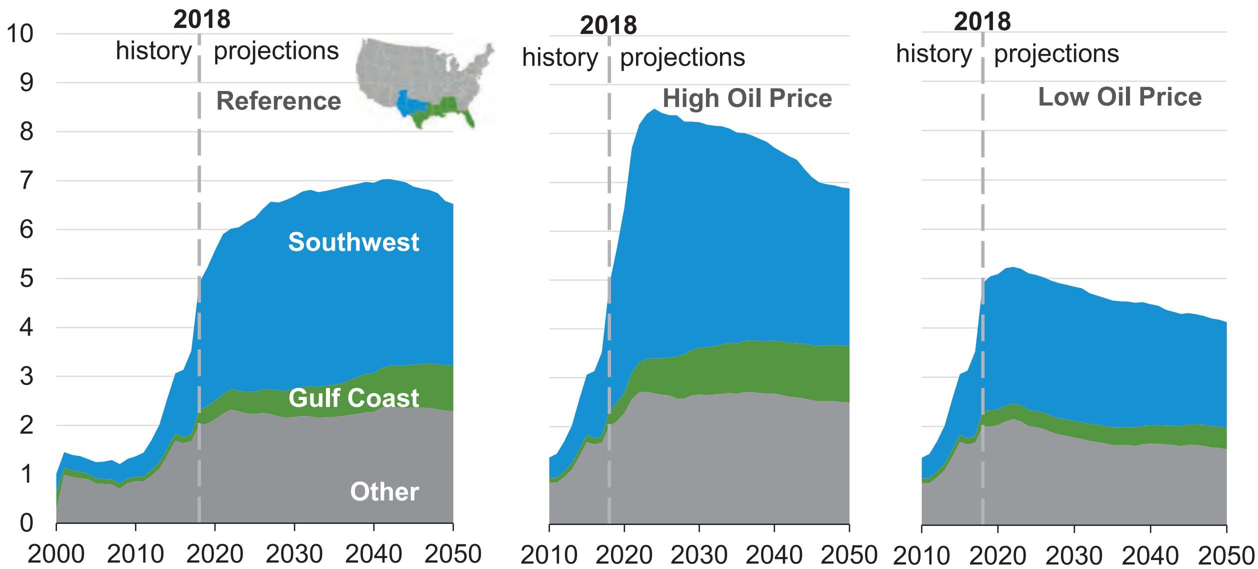
- The continued development of tight oil and shale gas resources supports growth in natural gas plant liquids (NGPL) production, which reaches 6.0 million b/d by 2029 in the Reference case.

- The High Oil and Gas Resource and Technology case represents a potential upper bound for crude oil and NGPL production, as additional resources and higher levels of technological advancement result in continued growth in crude oil and NGPL production. In the High Oil Price case, high crude oil prices lead to more drilling in the near term, but cost increases and fewer easily accessible resources decrease production of crude oil and NGPL.

- Conversely, under conditions with fewer resources, lower levels of technological advancement, and lower crude oil prices, the Low Oil and Gas Resource and Technology case and the Low Oil Price case represent potential lower bounds for domestic crude oil and NGPL production. Changes in economic growth have little impact on domestic crude oil and NGPL production.

The United States continues to produce large volumes of natural gas from oil formations, even with relatively low oil prices—

Dry natural gas production from oil formations
trillion cubic feet

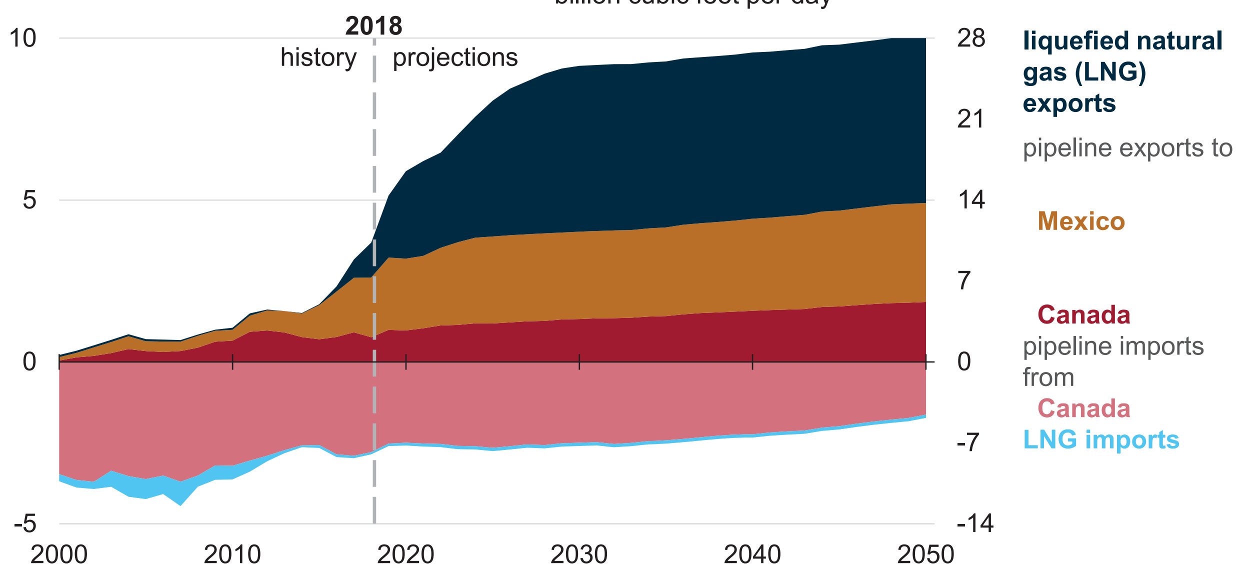


—putting downward pressure on natural gas prices

- The percentage of dry natural gas production from oil formations increased from 8% in 2013 to 17% in 2018 and remains near this percentage through 2050 in the Reference case.
- Growth in drilling in the Southwest region, particularly in the Wolfcamp formation in the Permian basin, is the main driver for natural gas production growth from tight oil formations.
- The Low Oil Price case, with the U.S. crude oil benchmark West Texas Intermediate (WTI, Cushing, Oklahoma) price at $58 per barrel or lower, is the only case in which natural gas production from oil formations is lower in 2050 than at current levels.
- The level of drilling in oil formations primarily depends on crude oil prices rather than natural gas prices. Increased natural gas production from oil-directed drilling puts downward pressure on natural gas prices throughout the projection period.

U.S. net exports of natural gas continue to grow in the Reference case—

Natural gas trade (Reference case)
trillion cubic feet



—as liquefied natural gas becomes an increasingly significant export

- In the Reference case, U.S. liquefied natural gas (LNG) exports and pipeline exports to Canada and to Mexico increase until 2030 and then flatten through 2050 as relatively low, stable natural gas prices make U.S. natural gas competitive in North American and global markets.

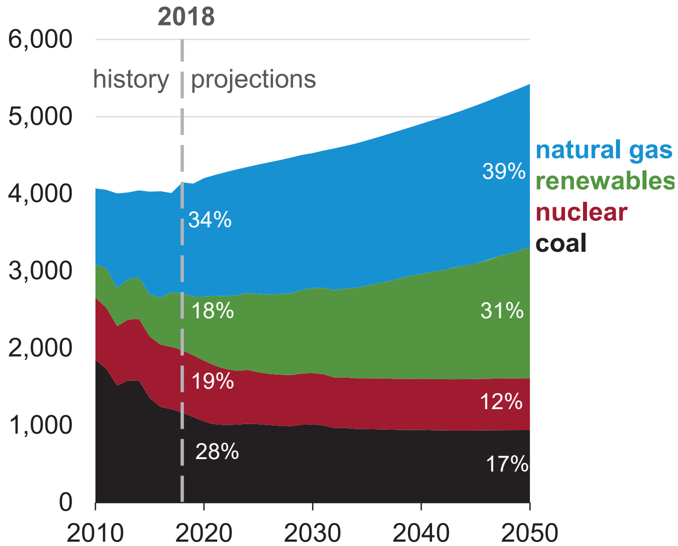
- After LNG export facilities currently under construction are completed by 2022, U.S. LNG export capacity increases further. Asian demand growth allows U.S. natural gas to remain competitive there. After 2030, U.S. LNG is no longer as competitive because additional suppliers enter the global LNG market, reducing LNG prices and making additional U.S. LNG export capacity uneconomic.

- Increasing natural gas exports to Mexico are a result of more pipeline infrastructure to and within Mexico, resulting in increased natural gas-fired power generation. By 2030, Mexican domestic natural gas production begins to displace U.S. exports.

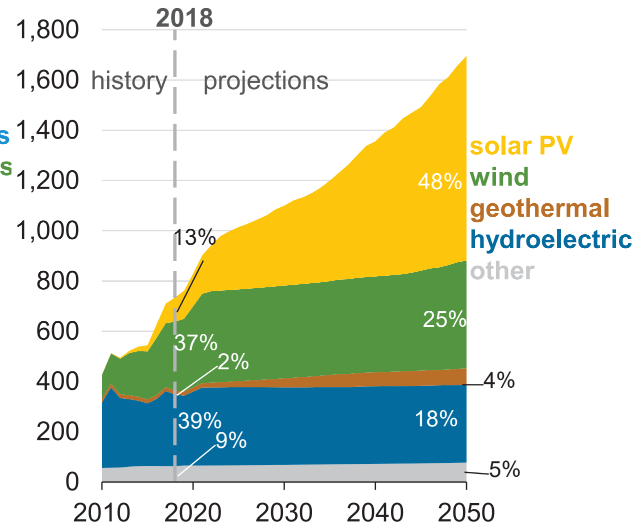
- As Canadian natural gas faces competition from relatively low-cost U.S. natural gas, U.S. imports of natural gas from Western Canada continue to decline from historical levels. U.S. exports of natural gas to Eastern Canada continue to increase because of its proximity to U.S. natural gas resources in the Marcellus and Utica plays and because of recent additions to pipeline infrastructure.

Electricity generation from natural gas and renewables increases, and the shares of nuclear and coal generation decrease—

Electricity generation from selected fuels (Reference case)
billion kilowatthours



Renewable electricity generation, including end-use (Reference case)
billion kilowatthours



—as lower natural gas prices and declining costs of renewable capacity make these fuels increasingly competitive

- The continuing decline in natural gas prices and increasing penetration of renewable electricity generation have resulted in lower wholesale electricity prices, changes in utilization rates, and operating losses for a large number of baseload coal and nuclear generators.

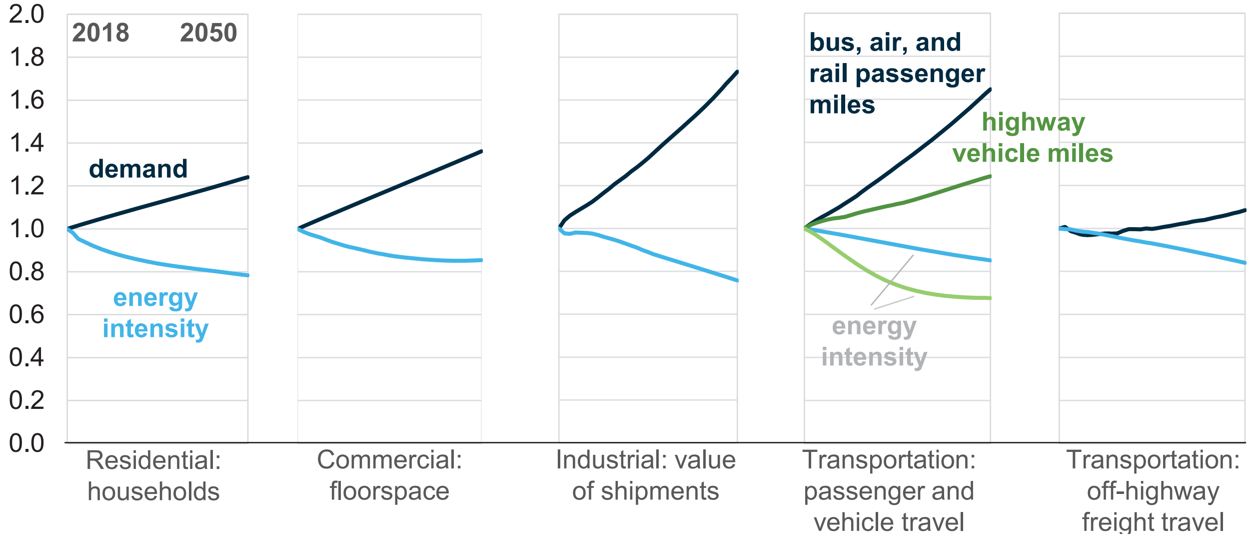
- Generation from both coal and nuclear is expected to decline in all cases. In the Reference case, from a 28% share in 2018, coal generation drops to 17% of total generation by 2050. Nuclear generation declines from a 19% share of total generation in 2018 to 12% by 2050. The share of natural gas generation rises from 34% in 2018 to 39% in 2050, and the share of renewable generation increases from 18% to 31%.

- Assumptions of declining costs and improving performance make wind and solar increasingly competitive compared with other renewable resources in the Reference case. Most of the wind generation increase occurs in the near term, when new projects enter service ahead of the expiration of key federal production tax credits.

- Solar Investment Tax Credits (ITC) phase down after 2024, but solar generation growth continues because the costs for solar continue to fall faster than for other sources.

End-use activities grow, and energy intensities decrease in all sectors in the Reference case—

Indexed end-use demand drivers and energy intensities by sector (2018–50) (Reference case)
index (2018=1.0)



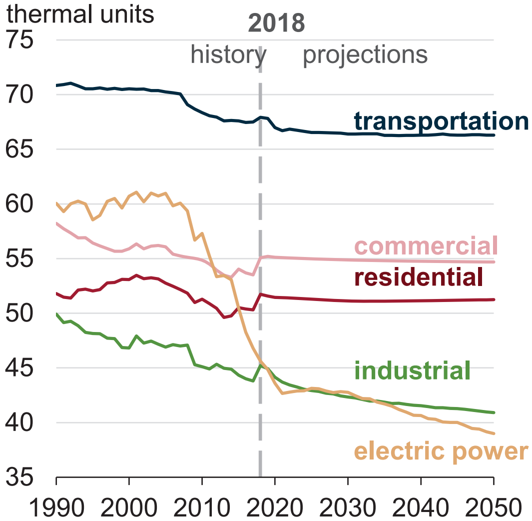
Note: Energy intensities are a lighter shade of the same color as the respective demand, and they are calculated as energy used per unit of respective demand.

—offsetting each other to limit energy consumption growth

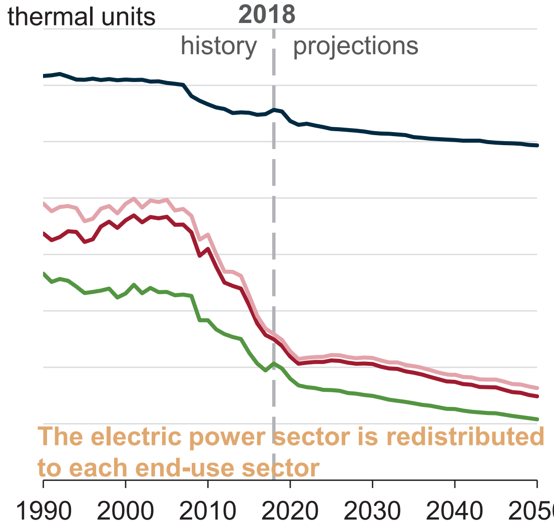
- Delivered U.S. energy consumption grows across all major end-use sectors, with electricity and natural gas growing fastest. However, increases in efficiency, represented by declines in energy intensity (the amount of energy consumed per unit of potential demand), partially offset growth in total U.S. energy consumption across all end-use sectors.
- The end-use sectors have different representative metrics for demand used to estimate energy intensity—number of households for the residential sector, floorspace for the commercial sector, industrial value of shipments for the industrial sector, and travel metrics for the transportation sector.
- Transportation travel is measured in three ways, depending on the mode: highway vehicle miles (light- and heavy-duty vehicles), passenger miles (bus, passenger rail, and air), and off-highway freight ton-miles (freight rail, air, and domestic shipping).
- The steepest decline in energy intensity is in the transportation sector, with the level of energy used per highway vehicle-mile traveled declining by 32% from 2018 to 2050 as a result of increasingly stringent fuel economy and energy efficiency standards for light- and heavy-duty vehicles.

Across end-use sectors, carbon dioxide intensity declines with changes in the fuel mix—

Carbon dioxide intensity by end-use sector (Reference case)
metric tons of carbon dioxide per billion British thermal units



Carbon dioxide intensity by end-use sector (Reference case)
metric tons of carbon dioxide per billion British thermal units



Note: Carbon dioxide intensities are calculated as carbon dioxide emissions per unit energy output (in British thermal units).

—despite overall increases in energy consumption

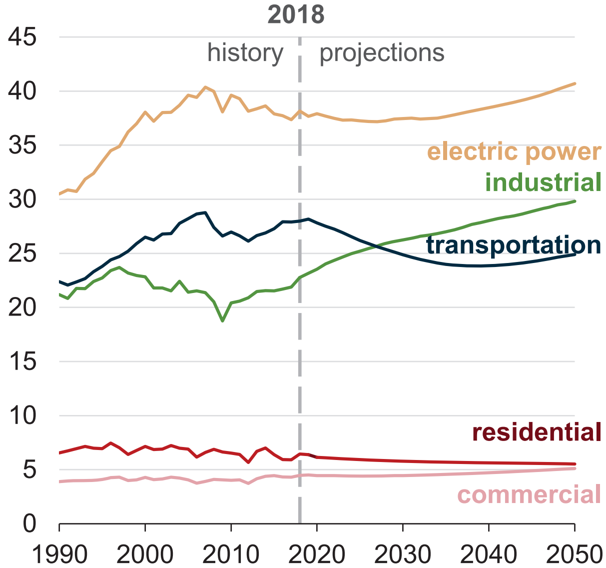
- Carbon dioxide (CO2) intensity can vary greatly depending on the mix of fuels the end-use sectors consume. Historically, the industrial sector has had the lowest CO2 intensity, as measured by CO2 emissions per British thermal unit (Btu). The transportation sector historically has had the highest CO2 intensity, which continues in the projection because carbon-intensive petroleum remains the dominant fuel used in vehicles throughout the projection period.

- The generation fuel mix in the electric power sector has changed since the mid-2000s, with lower generation from high-carbon intensive coal and higher generation from natural gas and carbon-free renewables, such as wind and solar. This change resulted in the overall CO2 intensity of the electric power sector declining by 25% from the mid-2000s to 2018 and continuing to decline through 2050.

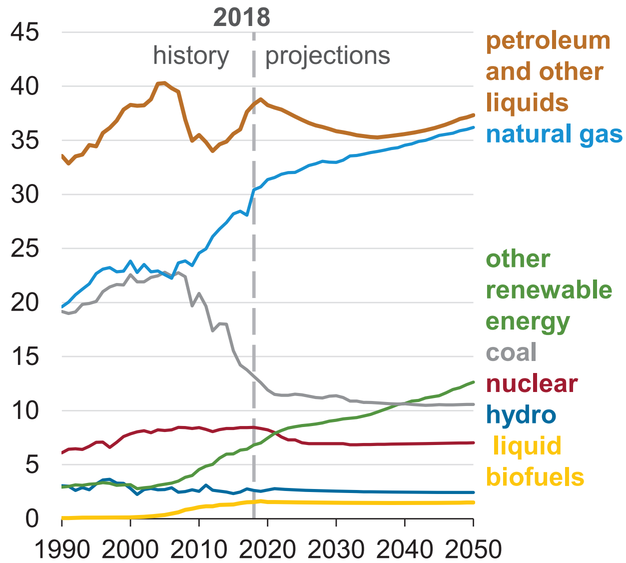
- Accounting for the CO2 emissions from the electricity sector in the end-use sectors that consume the electricity results in larger declines in CO2 intensity across those sectors for all AEO2019 cases. In the Reference case, the CO2 intensities of the residential and commercial sectors decline less than 1% when only their direct CO2 intensities are counted. When the electric power sector energy is distributed to the end-use sectors, the residential and commercial sectors decline by 11% and 10%, respectively, while the industrial sector declines by 11%. Transportation carbon intensity declines by 5%.

Policy, technology, and economics affect the mix of U.S. fuel consumption—

Energy consumption by sector (Reference case)
quadrillion British thermal units



Energy consumption by fuel (Reference case)
quadrillion British thermal units



—which affects energy consumption patterns throughout the projection period

- In all cases, non-hydroelectric renewables consumption grows the most (on a percentage basis). Implementing policies at the state level (renewable portfolio standards) and at the federal level (production and investment tax credits) has encouraged the use of renewables. Growing renewable use has driven down the costs of renewables technologies (wind and solar photovoltaic), further supporting their expanding adoption by the electric power and buildings sectors.

- Natural gas consumption rises as well, driven by projected low natural gas prices. In the Reference case, the industrial sector becomes the largest consumer of natural gas starting in the early 2020s. This sector will expand the use of natural gas as feedstock in the chemical industries and as lease and plant fuel, for industrial heat and power, and for liquefied natural gas production. Natural gas consumption for electric power also increases significantly in the power sector in response to low natural gas prices and to installing lower cost natural gas-fired combined-cycle generating units.

- The transportation sector is the largest consumer of petroleum and other liquids, particularly motor gasoline and distillate fuel oil. Current fuel economy standards stop requiring additional efficiency increases in 2025 for light-duty vehicles and in 2027 for heavy-duty vehicles, but travel continues to rise, and as a result, consumption of petroleum and other liquids increases later in the projection period.

Critical drivers and model updates

Many factors influence the model results in AEO2019, including varying assumptions about domestic energy resources and production technology; global oil prices; macroeconomic growth; model improvements; and new and existing laws and regulations since AEO2018.

Critical drivers and uncertainty

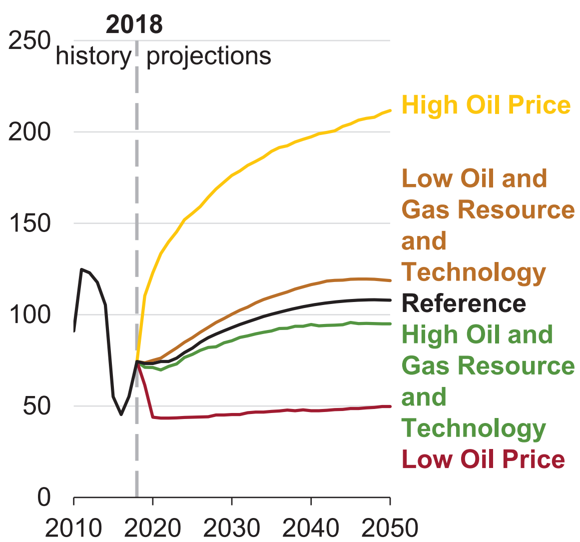
- Future oil prices are highly uncertain and are subject to international market conditions influenced by factors outside of the National Energy Modeling System. The High and Low Oil Price cases represent international conditions that could collectively drive prices to extreme, sustained deviations from the Reference case price path. Compared with the Reference case, in the High Oil Price case, non-U.S. demand is higher and non-U.S. supply is lower; in the Low Oil Price case, the opposite is true.

- Projections of tight oil and shale gas production are uncertain because large portions of the known formations have relatively little or no production history, and extraction technologies and practices continue to evolve rapidly. In the High Oil and Gas Resource and Technology case, lower production costs and higher resource availability than in the Reference case allow for higher production at lower prices. In the Low Oil and Gas Resource and Technology case, assumptions of lower resources and higher production costs are applied. These assumptions are not extended outside the United States.

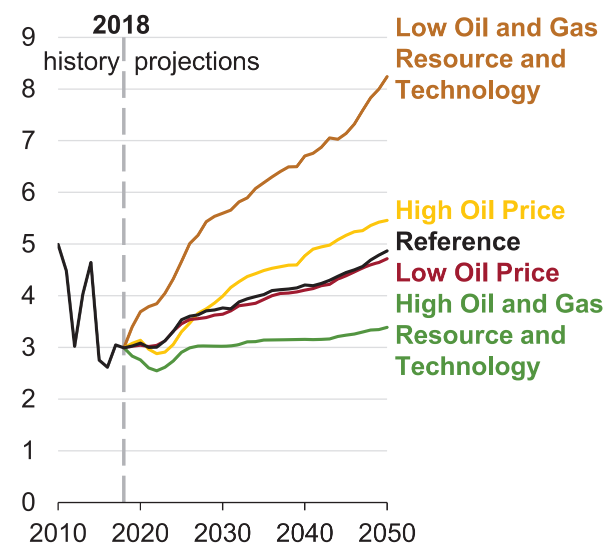
- Economic growth particularly affects energy consumption, and those effects are addressed in the High and Low Economic Growth cases, which modify population growth and productivity assumptions throughout the projection period to yield higher or lower compound annual growth rates for U.S. gross domestic product than in the Reference case.

Oil and natural gas prices are affected by assumptions about international supply and demand and the development of U.S. shale resources—

North Sea Brent oil price
2018 dollars per barrel



Natural gas price at Henry Hub
2018 dollars per million British thermal unit



—with global conditions more important for oil prices and assumptions about resource and technology more important for natural gas

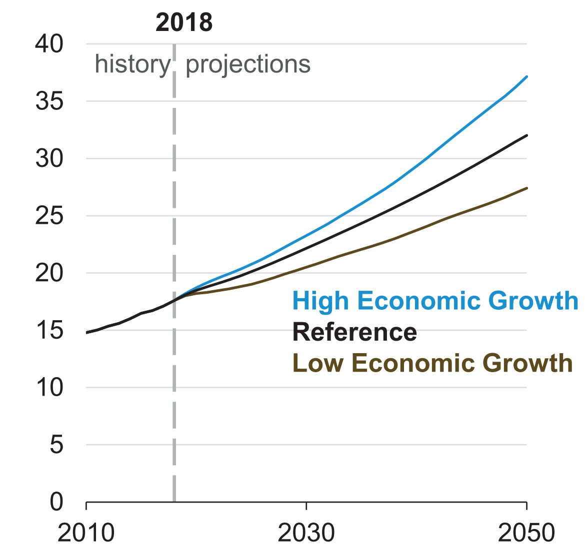
- Crude oil prices are influenced more by international markets than by assumptions about domestic resources and technological advances. In the High Oil Price case, the price of Brent crude oil, in 2018 dollars, is projected to reach $212 per barrel (b) by 2050 compared with $108/b in the Reference case and $50/b in the Low Oil Price case.

- Natural gas prices are highly sensitive to factors that drive supply, such as domestic resource and technology assumptions, and less dependent on the international conditions that drive oil prices. In the High Oil and Gas Resource and Technology case, Henry Hub natural gas prices remain near $3 per million British thermal units ($/MMBtu) throughout the projection period, while in the Low Oil and Gas Resource and Technology case they rise to more than $8/MMBtu.

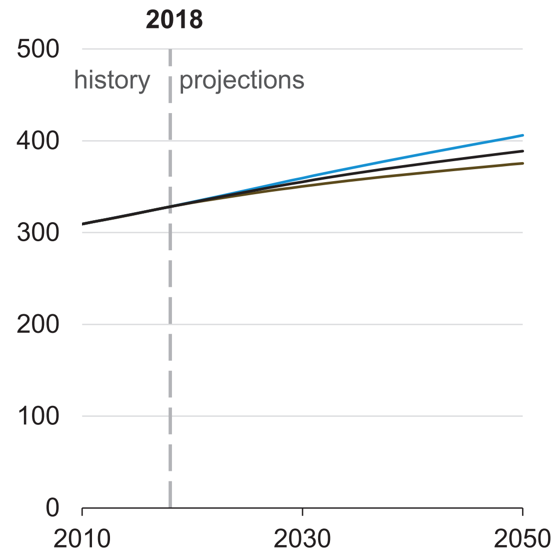
- Across most cases, by 2050, consumption of natural gas increases even as production expands into more expensive-to-produce areas, putting upward pressure on production costs.

Economic growth side cases explore the uncertainty in macroeconomic assumptions inherent in future economic growth trends—

Gross domestic product
trillion 2009 dollars



Population
millions



—which also affect important drivers of energy demand growth

- The Reference, High Economic Growth, and Low Economic Growth cases illustrate three possible paths for U.S. economic growth. In the High Economic Growth case, average annual growth in real gross domestic product (GDP) is 2.4% from 2018 to 2050, compared with 1.9% in the Reference case. The Low Economic Growth case assumes a lower rate of annual growth in real GDP of 1.4%.

- Differences among the cases reflect different assumptions for growth in the labor force, capital stock, and productivity. These changes affect capital investment decisions, household formation, industrial activity, and amounts of travel.

- All three economic growth cases assume expectations of smooth economic growth and do not anticipate business cycles or large economic shocks.

Significant data and model updates

- EIA released data from its 2015 *Residential Energy Consumption Survey* (RECS) in May 2018, and introduced estimates of energy consumption for an expanded list of energy end uses. Incorporating these updated estimates resulted in revised total housing units and end-use energy consumption shares.

- EIA updated residential and commercial technology efficiency and cost characteristics for space heating, space cooling, water heating, cooking equipment, and appliances based on reports Navigant Consulting, Inc. prepared for EIA.

- EIA updated vehicle stock data and related inputs such as vehicle scrappage and annual travel by vintage, which affected stock fuel economy and vehicle-miles traveled. Along with improved modeling of fleet-operated automated vehicles, these changes resulted in higher estimates of the number of light-duty vehicles on the road and higher vehicle-miles traveled.

New laws and regulations reflected in the Reference case as of October 2018

- EIA updated its modeling of the Annex VI of the International Convention for the Prevention of Pollution from Ships (MARPOL Convention), which limits sulfur emissions to 0.5% by weight, compared with the current 3.5% by weight, for ocean-going ships by 2020. The new modeling reflects expectations that U.S. refiners will supply a larger share of the low-sulfur fuel market. EIA also lowered the initial penetration of marine scrubbers and added a 60/40 blend of high sulfur fuel oil and distillate as a 2020 global sulfur-compliant fuel.

- In December 2017, Congress enacted the Tax Cuts and Jobs Act of 2017 (P.L. 115-97). Although this act is mainly associated with reducing the maximum marginal tax rate for corporations from 38% to 21% and temporarily allowing immediate expensing of major capital expenditures, it also established an oil and natural gas program for the leasing, development, production, and transportation of oil and natural gas in and from the coastal plain (1002 Area) of the Arctic National Wildlife Refuge (ANWR). Modeling the opening of ANWR to drilling increases Alaskan crude oil production after 2030.

New laws and regulations reflected in the Reference case as of October 2018 (continued)

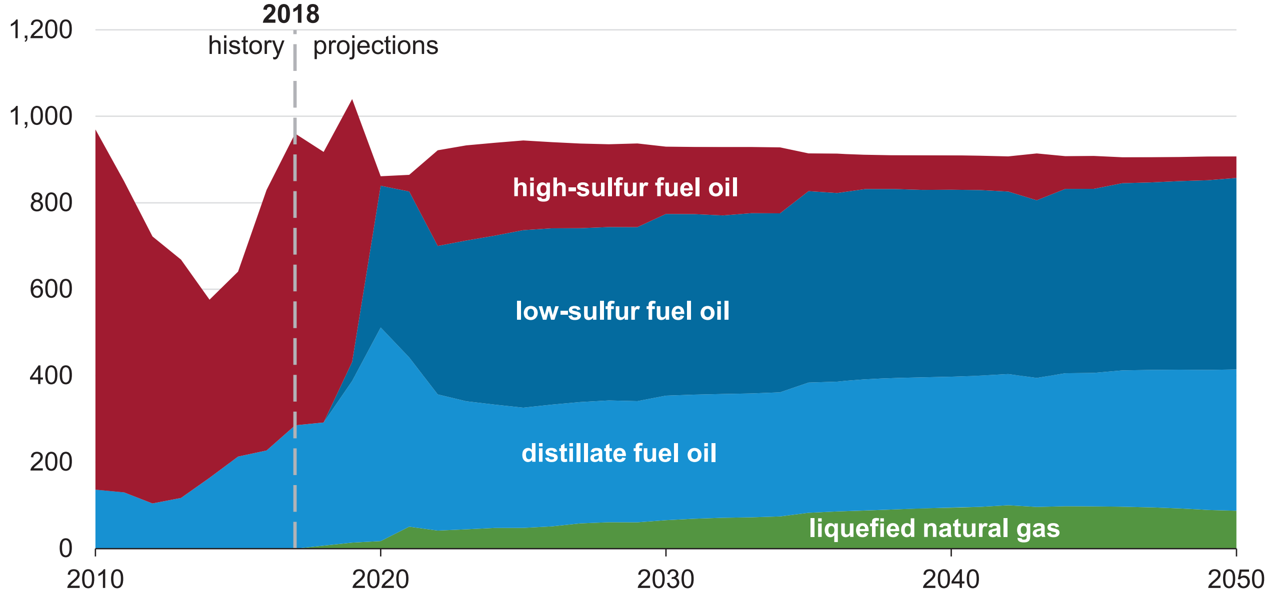
- The Internal Revenue Service issued safe harbor guidance for solar facilities to qualify for the Investment Tax Credit (ITC) as it phases down from 30% to 10% after 2020. Under the new guidance, utility-scale solar photovoltaic (PV) projects starting construction before January 1, 2020, have up to four years to bring the plant online, while still qualifying for the full 30% ITC. Projects entering service after January 1, 2024, receive a 10% ITC, including those starting construction after 2020. Modeling the safe harbor guidance results in later additions of solar PV systems as developers postpone in-service dates and in higher total solar PV builds.

- A number of new state and regional policies were enacted in the past year. These policies included California's requirement for 100% clean energy generation by 2045 and New Jersey's and Massachusetts's increased renewable portfolio standard (RPS) requirements that renewables contribute 50% and 35% of generation, respectively, by 2030. Even with the stricter requirements, EIA projects compliance to be easily met.

- EIA did not include the effects of the existing 45Q federal tax credits for carbon capture and sequestration in AEO2019 because the credits, although recently doubled, still do not appear large enough to encourage substantial market penetration of carbon capture in the scenarios modeled.

New limit on global sulfur emissions affects refinery operations and maritime transport—

International marine shipping fuel consumption (Reference case)
trillion British thermal units



—as refiners and marine transporters adapt to meet the new requirements

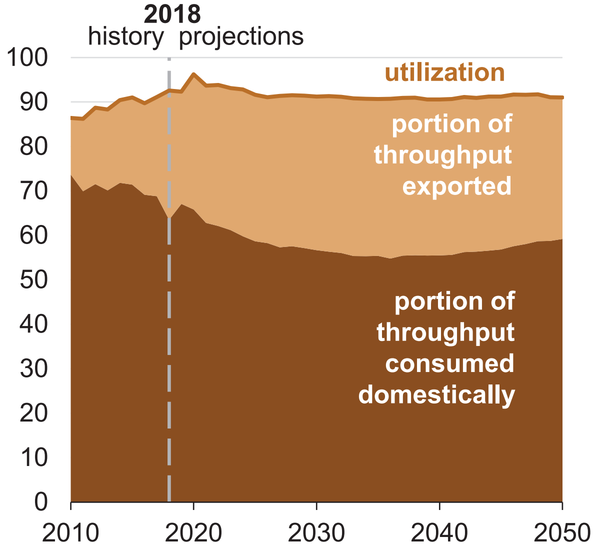
- Annex VI of the International Convention for the Prevention of Pollution from Ships (MARPOL Convention) limits emissions for ocean-going ships by 2020 (IMO 2020). From January 1, 2020, the limit for sulfur in fuel used on board ships operating outside designated emission control areas will be reduced to 0.5% m/m (mass by mass), a reduction of more than 85% from its present level of 3.5% m/m. Ships can meet the new global sulfur limit by installing pollutant-control equipment (scrubbers); by using a low-sulfur, petroleum-based marine fuel; or by switching to an alternative non-petroleum fuel such as liquefied natural gas (LNG).

- Shippers that install scrubbers have remained limited, and refineries continue to announce plans to upgrade high-sulfur fuel oils into higher quality products and increase availability of low-sulfur compliant fuel oils. Some shippers have also announced plans to address the costs associated with higher quality fuels by shifting those costs to their customers.

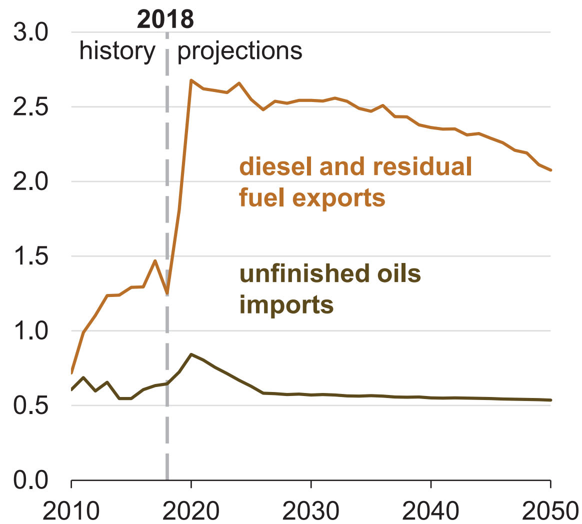
- Although some price swings and fuel availability issues are expected when the regulations take effect in 2020, by 2030 more than 83% of international marine fuel purchases in U.S. ports are for low-sulfur compliant fuel in the Reference case, and the share of LNG increases from negligible levels in 2018 to 7% in 2030.

Refinery utilization in the Reference case peaks in 2020—

U.S. refinery utilization (Reference case)
percent



U.S. diesel and residual fuel exports and unfinished oils imports (Reference case)
million barrels per day



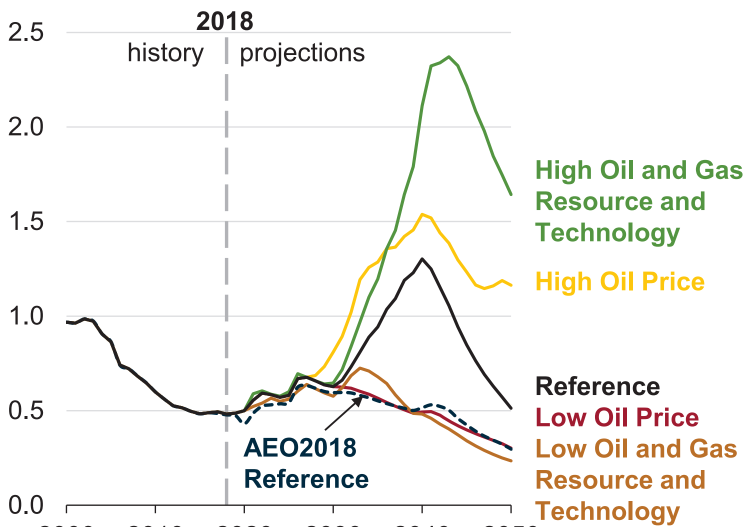
—as a result of sulfur emissions regulations that take effect in 2020

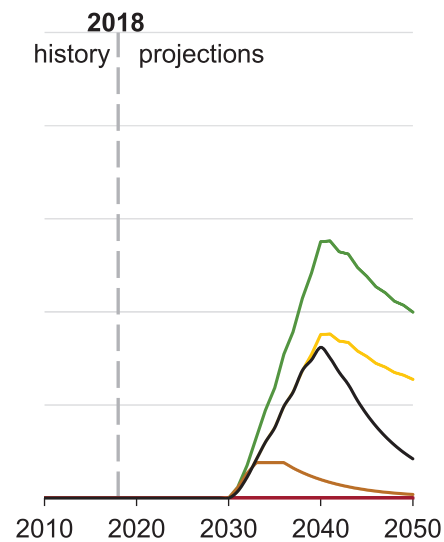
- U.S. refinery utilization peaks in most cases in 2020 as complex refineries in the United States that can process high-sulfur fuel oil in downstream units take advantage of the increased price spread between light and heavy crude oil. In the Reference case, refinery utilization peaks at 96% in 2020, gradually decreases between 2020 and 2026, and remains between 90% and 92% for the rest of the projection.

- The share of U.S. refinery throughput that is exported increases as more petroleum products are exported from 2020 to 2036 and as domestic consumption of refined products decreases. The trend reverses after 2036 when domestic consumption (especially of gasoline) increases.

- Imports of unfinished oils peak in 2020 as U.S. refineries take advantage of the increased discount of the heavy, high-sulfur residual fuel oil available on the global market.

Development of the Arctic National Wildlife Refuge increases Alaskan crude oil production in AEO2019—





—but only after 2030 because of the time needed to acquire leases and develop infrastructure

- The passage of Public Law 115-97 required the Secretary of the Interior to establish a program to lease and develop oil and natural gas from the coastal plain (1002 Area) of the Arctic National Wildlife Refuge (ANWR). Previously, ANWR was effectively under a drilling moratorium.

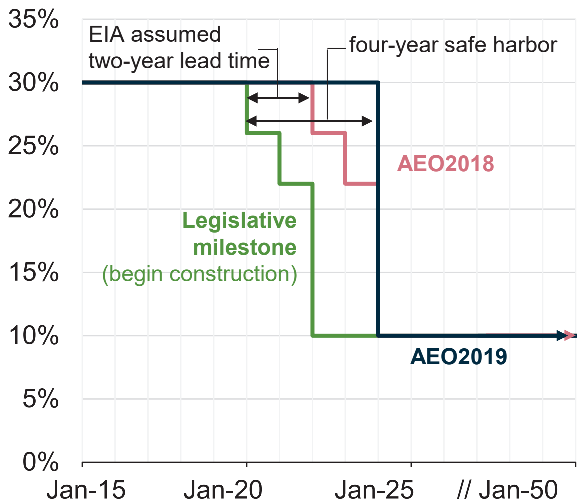
- Opening ANWR is not expected to have a significant impact on crude oil production before the 2030s because of the time needed to acquire leases, explore, and develop the required production infrastructure. Alaskan crude oil production in AEO2019 is 90% higher (3.2 billion barrels) from 2031 to 2050 than previously forecasted for that period in last year's AEO Reference case.

- The ANWR projections are highly uncertain because of several factors that affect the timing and cost of development, little direct knowledge of the resource size and quality that exists in ANWR, and inherent uncertainty about market dynamics. Cumulative ANWR crude oil production from 2031 to 2050 is 6.8 billion barrels, 0.7 billion barrels, and zero in the High Oil and Gas Resource and Technology, Low Oil and Gas Resource and Technology, and Low Oil Price cases, respectively.

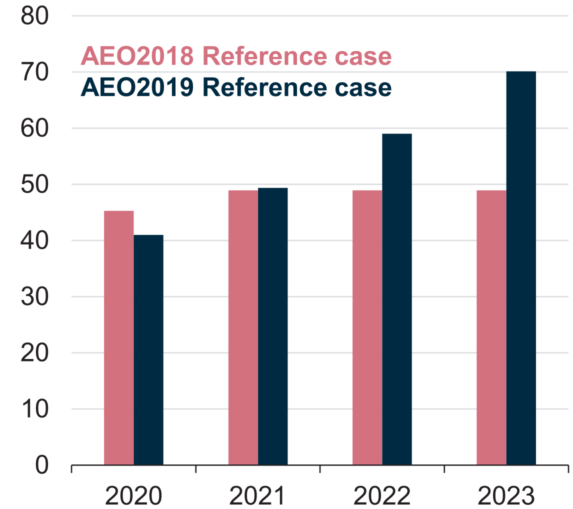
- A more in-depth analysis exploring the effect of this law on U.S. crude oil production projections was published in May 2018 as part of the AEO2018 *Issues in Focus* series.

Recently issued IRS guidance effectively eliminates the Investment Tax Credit phasedown in AEO2019—

Tax credit assumptions for utility-scale solar
percentage of installed cost



Power sector solar photovoltaic installed capacity
gigawatts



—increasing projected photovoltaic capacity in the near term

- In June 2018, the Internal Revenue Service (IRS) issued safe harbor guidance for solar facilities to qualify for the Investment Tax Credit (ITC).

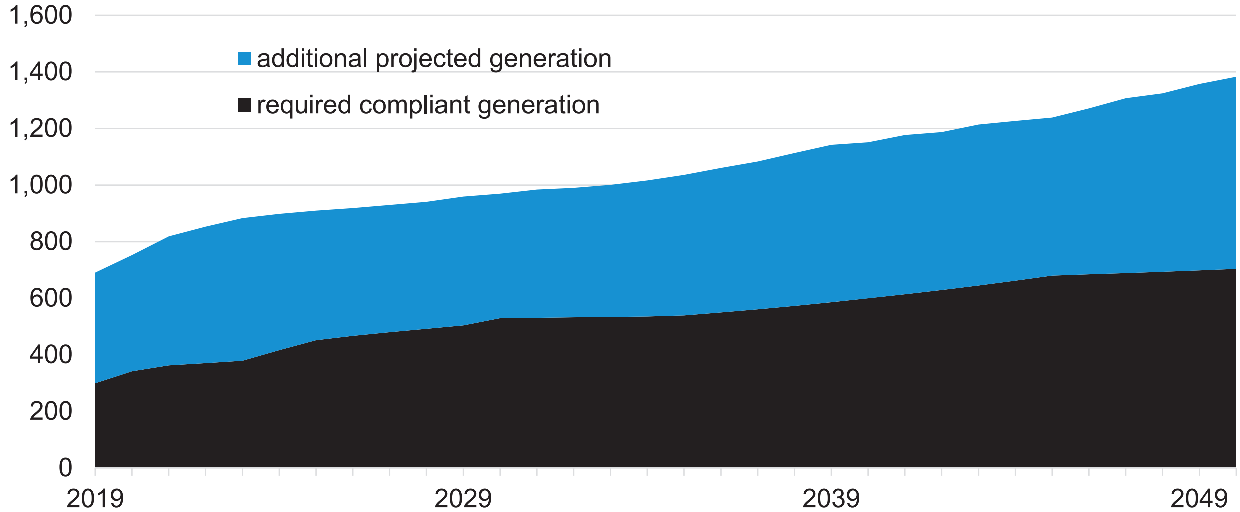
- Under current law, utility-scale solar plants that are under construction before January 1, 2020, receive the full 30% ITC, while those under construction before January 1, 2021, receive a 26% ITC and those under construction before January 1, 2022, receive a 22% ITC. For AEO2018, before the IRS issued its guidance, EIA assumed a two-year construction lead time for new solar photovoltaic (PV) plants, so that PV plants entering service in 2023 received a 22% ITC.

- With the new IRS guidance, EIA assumes that utility-scale solar plants starting construction before January 1, 2020, and entering service before January 1, 2024, receive the full 30% ITC. This assumption results in 21 gigawatts of additional solar PV capacity coming online before January 1, 2024, in AEO2019 as compared with AEO2018.

- The figure shown above applies to utility-owned solar PV installations. Residential systems individuals own have a different treatment under the ITC, and systems that commercial or other non-utility entities own have different financial considerations, and so are not shown above.

Renewable generation exceeds requirements for state renewable portfolio standards—

Total qualifying renewable generation required for combined state renewable portfolio standards and projected total achieved 2019-2050
billion kilowatthours



—even with recent increases in several states' standards

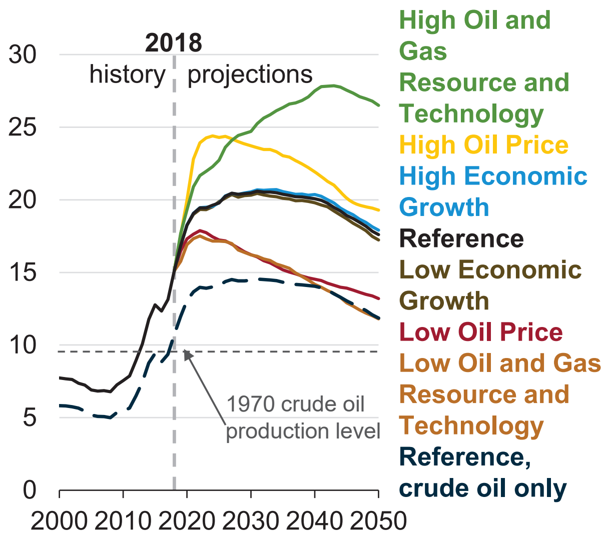
- California, New Jersey, and Massachusetts enacted new policies since AEO2018 to increase renewable and/or non-emitting electric generation and, in New Jersey, to support operation of existing nuclear generators.
- The combined generation required to comply with all U.S. state-level renewable portfolio standards (RPS) is 704 billion kilowatthours by 2050, but compliant renewable generation collectively exceeds these requirements in all AEO2019 cases in 2050, nearly double the requirement for 2050 in the Reference case.
- Near-term expiration of tax credits for wind and solar photovoltaics (PV) spurs installation of these generating technologies through 2024. The continued decline in solar PV costs throughout the projection period encourages new additions beyond the existing RPS requirements.
- For AEO2019, pending formal rulemaking, EIA assumed that the 100% clean energy standard recently adopted in California also includes nuclear, large-scale hydroelectric, and fossil-fired plants with carbon sequestration as qualifying generation.

Petroleum and other liquids

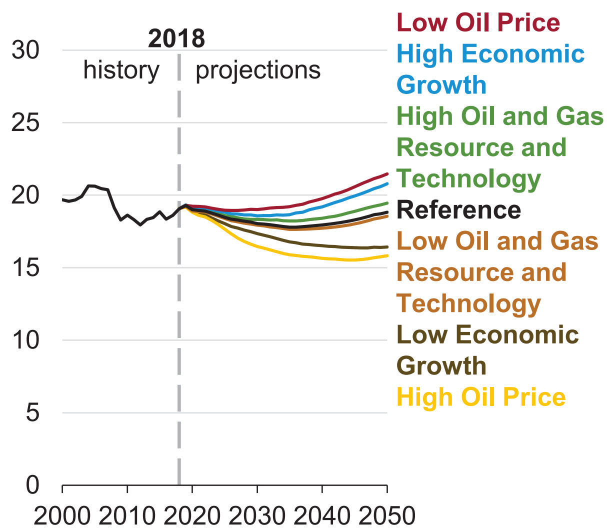
U.S. crude oil and natural gas plant liquids production continues to grow as a result of the further development of tight oil resources during the projection period. During the same period, domestic consumption falls, making the United States a net exporter of liquid fuels in the Reference case.

U.S. crude oil and natural gas plant liquids production continues to increase through 2022 in all cases with crude oil exceeding its previous peak 1970 level in 2018—

U.S. crude oil and natural gas plant liquids production
million barrels per day



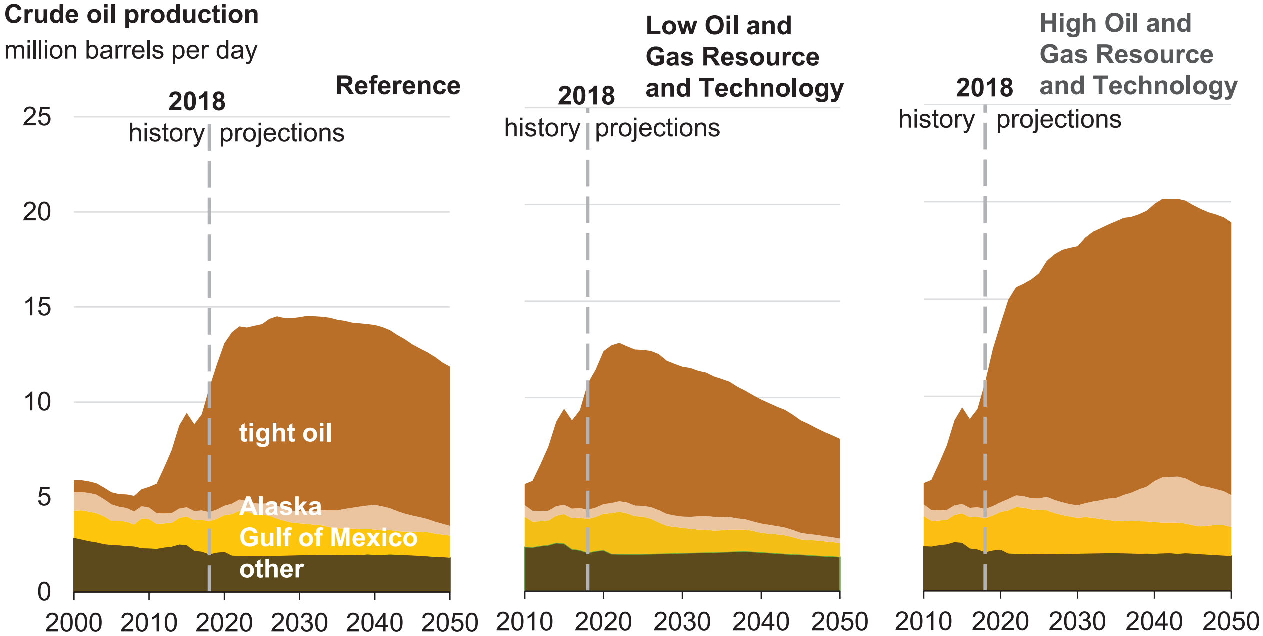
Petroleum and other liquids consumption
million barrels per day



—while consumption declines to lower than its 2004 peak level through 2050 in most cases

- In the Reference case, U.S. crude oil production continues to grow through 2030 and then plateaus at more than 14.0 million barrels per day (b/d) until 2040.
- With continuing development of tight oil and shale gas resources, natural gas plant liquids (NGPL) production reaches the 6.0 million b/d mark by 2030, a 38% increase from the 2018 level.
- Total liquids production varies widely under different assumptions about resources, technology, and oil prices. The size of resources and the pace of technology improvements to lower production costs translate directly to long-term total production. Much higher oil prices can boost near-term production but cannot sustain the higher production pace. Production is less variable in the economic growth cases because domestic wellhead prices are less sensitive to macroeconomic growth assumptions.
- Consumption of petroleum and other liquids is less sensitive to varying assumptions about resources, technology, and oil prices. With higher levels of economic activity and relatively low oil prices, consumption of petroleum and other liquids increases in the High Economic Growth and Low Oil Price cases, while consumption remains comparatively flat or decreases in the other cases.

Tight oil development drives U.S. crude oil production from 2018 to 2050—

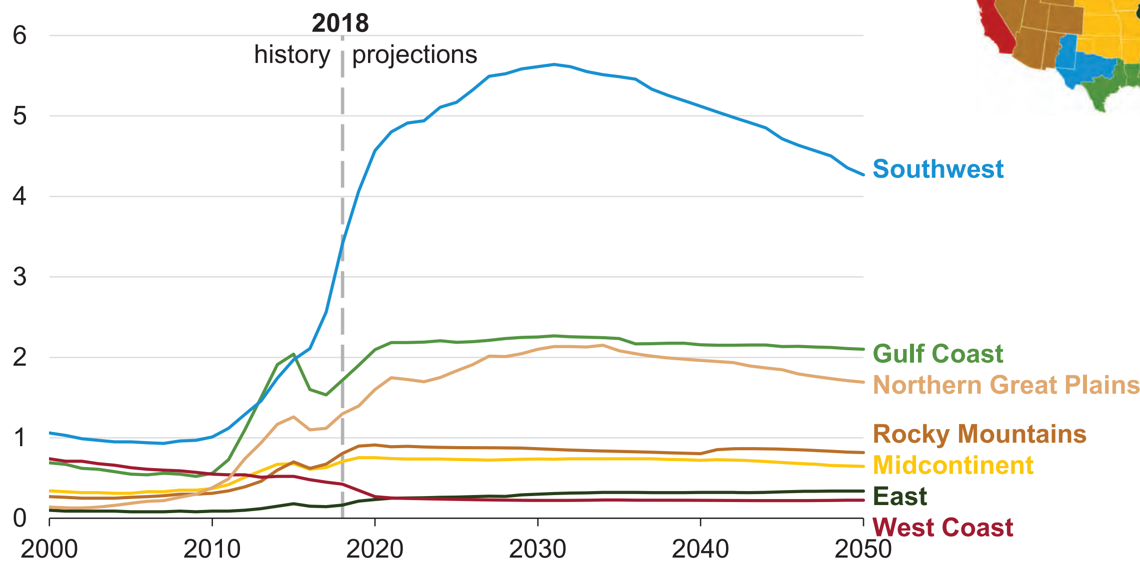


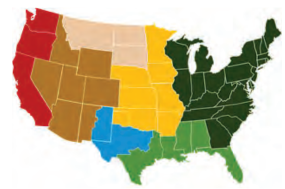
—a result consistent across all side cases

- Lower 48 onshore tight oil development continues to be the main driver of total U.S. crude oil production, accounting for about 68% of cumulative domestic production in the Reference case during the projection period.
- U.S. crude oil production levels off at about 14 million barrels per day (b/d) through 2040 in the Reference case as tight oil development moves into less productive areas and well productivity declines.
- In the Reference case, oil and natural gas resource discoveries in deepwater in the Gulf of Mexico lead Lower 48 states offshore production to reach a record 2.4 million b/d in 2022. Many of these discoveries resulted from exploration when oil prices were higher than $100 per barrel before the oil price collapse in 2015 and are being developed as oil prices rise. Offshore production then declines through 2035 before flattening through 2050 as a result of new discoveries offsetting declines in legacy fields.
- Alaska crude oil production increases through 2030, driven primarily by the development of fields in the National Petroleum Reserve–Alaska (NPR-A), and after 2030, the development of fields in the 1002 Section of the Arctic National Wildlife Refuge (ANWR). Exploration and development of fields in ANWR is not economical in the Low Oil Price case.

The Southwest region leads tight oil production growth in the United States in the Reference case—

Lower 48 onshore crude oil production by region (Reference case)
million barrels per day





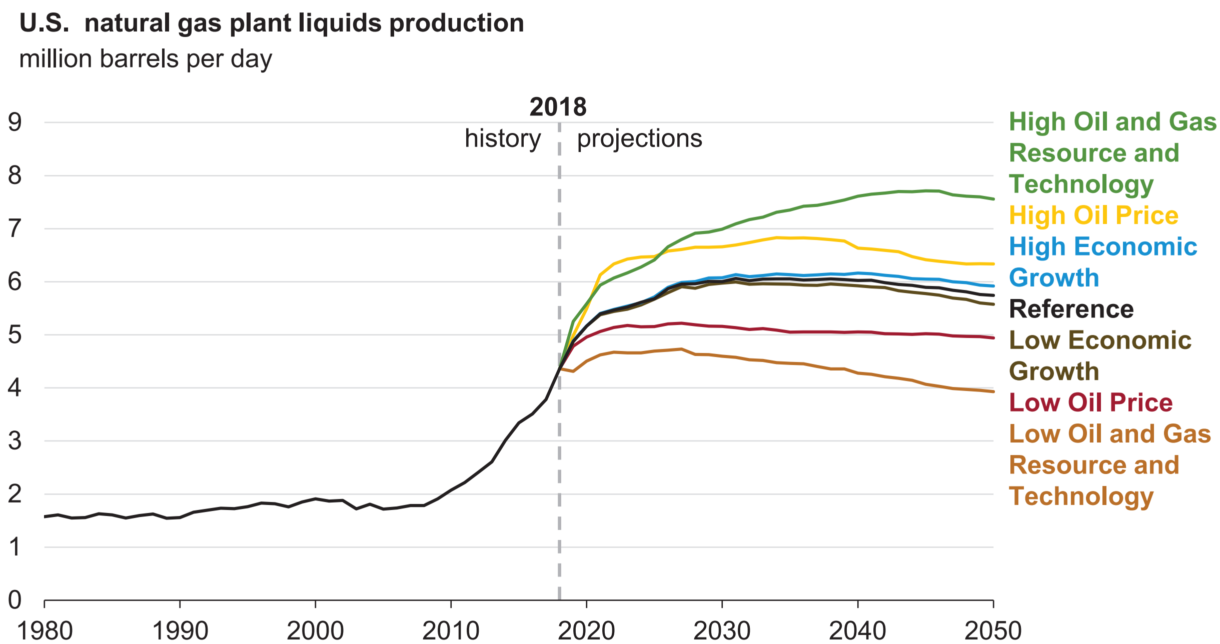
—but the Gulf Coast and Northern Great Plains regions also contribute

- Growth in Lower 48 onshore crude oil production occurs mainly in the Permian Basin in the Southwest region. This basin includes many prolific tight oil plays with multiple layers, including the Bone Spring, Spraberry, and Wolfcamp, making it one of the lower-cost areas to develop.

- Northern Great Plains production grows into the 2030s, driven by increases in production from the Bakken and Three Forks tight oil plays.

- Production in the Gulf Coast region increases through 2021 before flattening out as the decline in production from the Eagle Ford is offset by increasing production from other tight/shale plays such as the Austin Chalk.

Natural gas plant liquids production increases in most AEO cases—



—because of higher levels of drilling in liquid-rich natural gas formations and increased demand

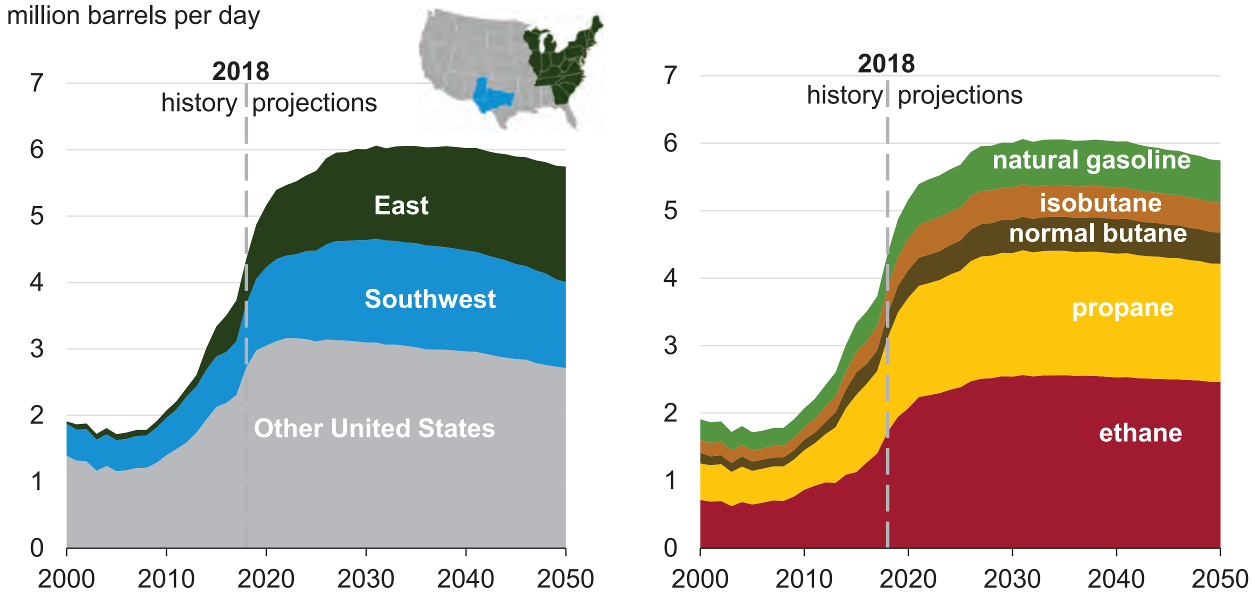
- In the Reference case, natural gas plant liquids (NGPL) production grows by 32% between 2018 and 2050 as a result of demand increases in the global petrochemical industry.

- Most NGPL production growth in the Reference case occurs before 2025 as producers focus on natural gas liquids-rich plays, where NGPL-to-gas ratios are highest and increased demand spurs higher ethane recovery.

- NGPL production is sensitive to changes in resource and technology assumptions. In the High Oil and Gas Resource and Technology case, which has higher rates of technological improvement, higher recovery estimates, and additional tight oil and shale gas resources, NGPL production grows by 73% between 2018 and 2050. In contrast, in the Low Oil and Gas Resource and Technology, which has lower rates of technological improvement and lower recovery estimates, NGPL production declines by 10% between 2018 and 2050.

The East and Southwest regions lead production of natural gas plant liquids in the Reference case—

U.S. natural gas plant liquids production (Reference case)
million barrels per day



—as development focuses on tight plays with low production costs and easy access to markets

- Natural gas plant liquids (NGPL) are light hydrocarbons predominantly found in natural gas wells and diverted from the natural gas stream by natural gas processing plants. These hydrocarbons include ethane, propane, normal butane, isobutane, and natural gasoline.

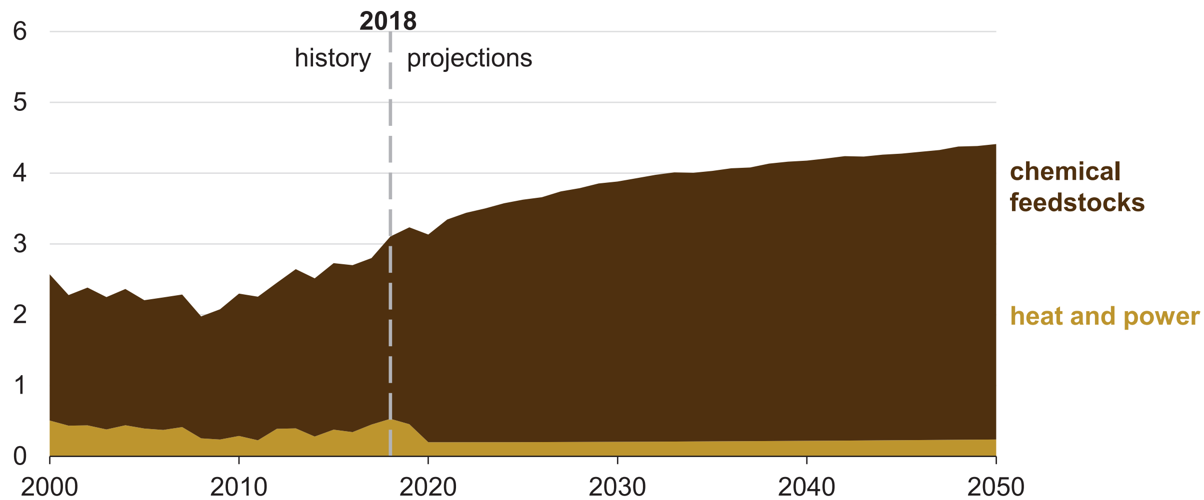
- The large increase in NGPL production in the Reference case in the East (Marcellus and Utica plays) and Southwest (Permian plays) during the next 10 years is mainly caused by the close association NGPLs have with the development of crude oil and natural gas resources. By 2050, the Southwest and East regions account for more than 50% of total U.S. NGPL production.

- NGPLs are used in many different ways. Ethane is used almost exclusively for petrochemicals. Approximately 40% of propane is used for petrochemicals, and the remainder is used for heating, grain drying, and transportation. Approximately 60% of butanes and natural gasoline are used for blending with motor gasoline and fuel ethanol, and the remainder is used for petrochemicals and solvents.

- The shares of NGPL components in the Reference case are relatively stable during the entire projection period (2018 to 2050), with ethane and propane contributing about 42% and 30%, respectively, to the total volume.

Most natural gas liquids in the Reference case serve as feedstocks to the bulk chemical industry—

U.S. industrial NGL consumption (Reference case)
quadrillion British thermal units



—although a small proportion is also used as fuel

- Consumption of ethane, propane, and butane used as bulk chemical feedstock grows an average of 1.5% per year between 2018 and 2050 in the Reference case, compared with 3.1% per year from 2010 to 2018.

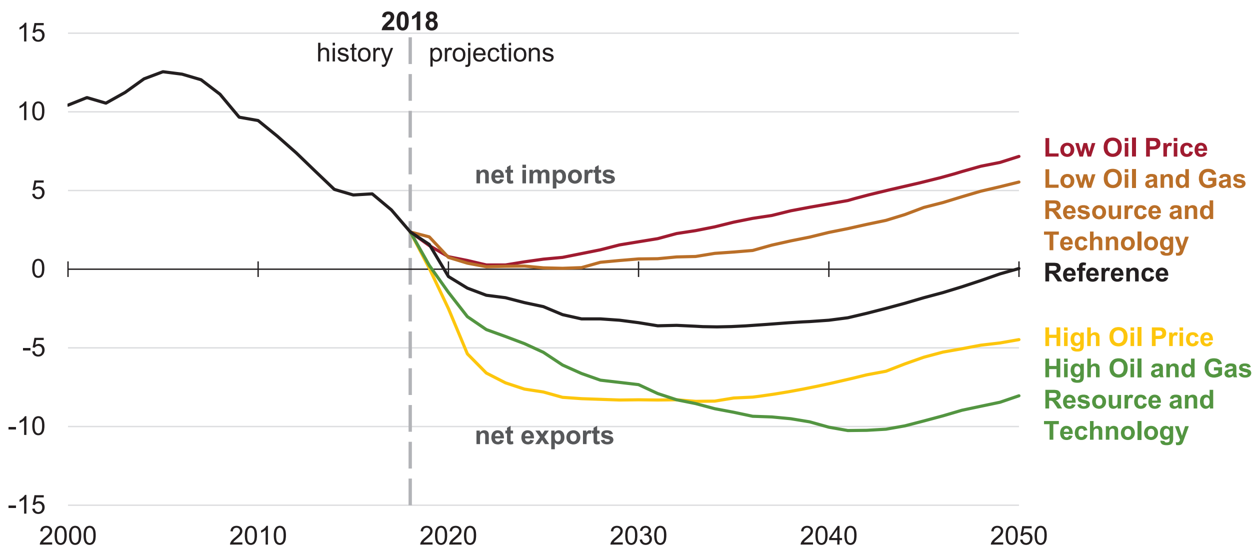
- The consumption of natural gas liquids (NGL) as feedstock grows faster in the High Economic Growth case (1.9% per year) and the High Resource and Technology case (1.8% per year). In the High Economic Growth case, demand for all goods is higher than in the Reference case, including bulk chemicals for domestic use and export. In the High Resource and Technology case, NGL are more abundant and less expensive. As a result, shipments of bulk chemicals are greater.

- Most NGL feedstock is ethane, which is processed almost exclusively into ethylene, a building block for plastics, resins, and other industrial products. Propane, normal butane, and isobutane are also used to produce propylene and butadiene, respectively, but in much smaller quantities compared with ethane.

- Propane is used in the agriculture sector for grain drying and heating and in the construction industry for heating and for powering vehicles and equipment.

In the Reference case, the United States becomes a net exporter of petroleum on a volume basis from 2020 to 2049—

U.S. petroleum and other liquids net imports/exports
million barrels per day



—but side case results vary significantly using different assumptions

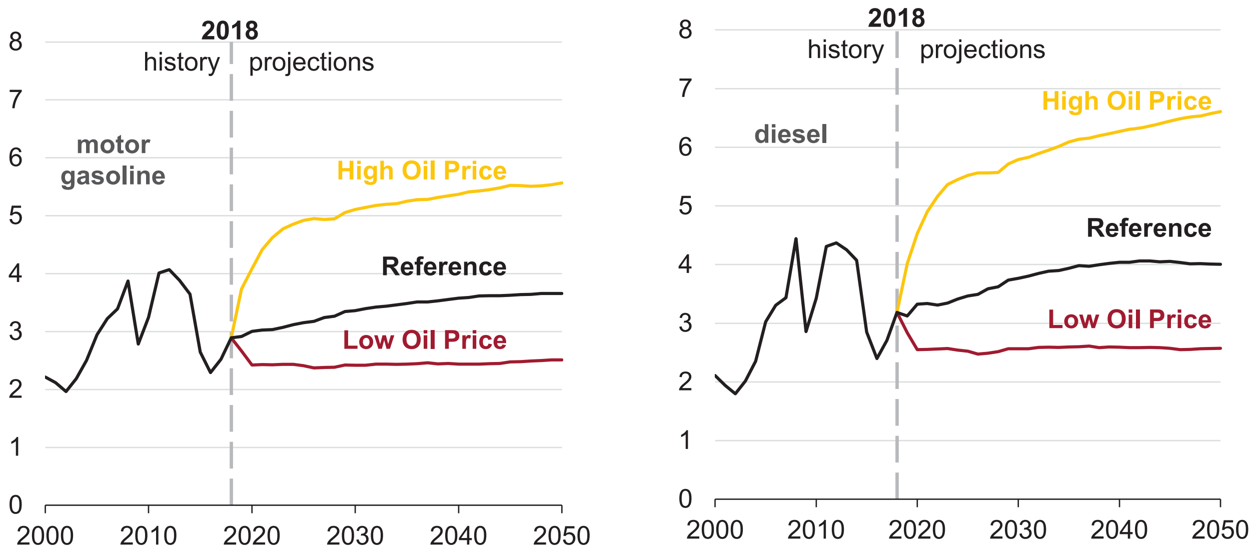
- Net U.S. imports of crude oil and liquid fuels will fall between 2018 and 2034 in the Reference case as strong production growth and decreasing domestic demand result in the United States becoming a net exporter.

- In the Reference case, net exports from the United States peak at more than 3.68 million barrels per day (b/d) in 2034 before gradually reversing as domestic consumption rises. The United States returns to being a net importer in 2050 on a volume basis.

- Additional resources and higher levels of technological improvement in the High Oil and Gas Resource and Technology case results in higher crude oil production and higher exports, with exports reaching a high of 10.26 million b/d in 2041. Projected net exports reach a high of 8.39 million b/d in 2033 in the High Oil Price case as a result of higher prices that support higher domestic production. Conversely, low oil prices in the Low Oil Price case drive projected net imports up from 2.37 million b/d in 2018 to 7.17 million b/d in 2050.

In the Reference case, motor gasoline and diesel fuel prices rise after 2018 throughout the projections—

Retail prices of selected petroleum products
2018 dollars per gallon



—but neither price returns to previous peaks

- In the Reference case, motor gasoline and diesel fuel retail prices increase by 76 cents per gallon and 82 cents per gallon, respectively, from 2018 to 2050, largely because of increasing crude oil prices.

- Implementing the International Maritime Organization sulfur regulations in 2020 triggers short-term price increases because the refinery and maritime shipping industries must adjust fuel specifications and consumption. These effects peak in 2020 and gradually fade out of the market by 2026.

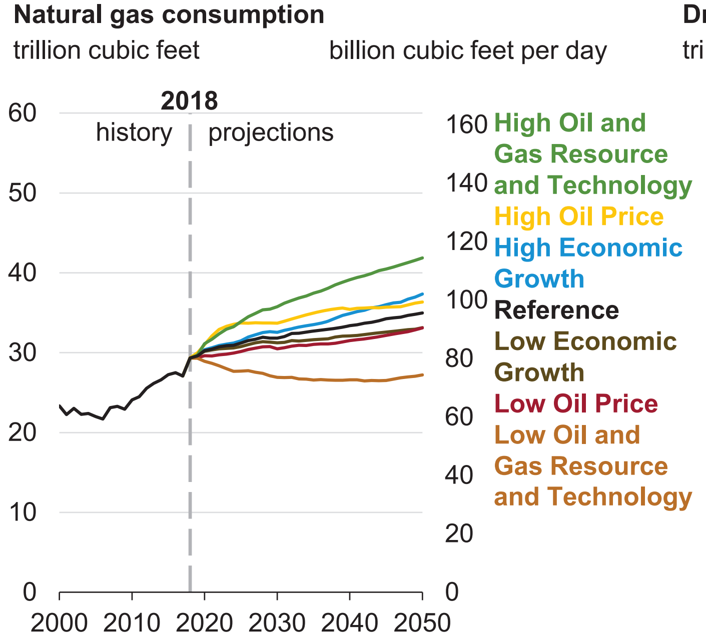
- The recent trend of an increasing price spread between diesel fuel and motor gasoline retail prices continues in the Reference case through 2038, in part, because of strong growth in domestic diesel fuel demand and declining demand for gasoline.

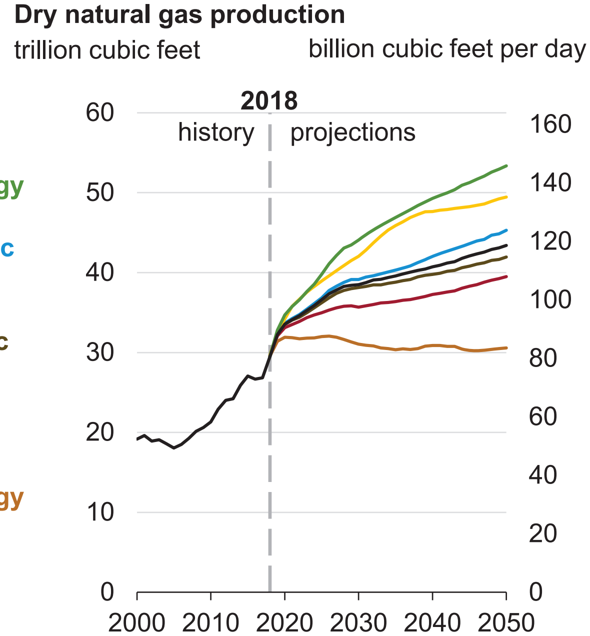
- Motor gasoline and diesel fuel retail prices move in the same direction as crude oil prices in the High and Low Oil Price cases. Motor gasoline retail prices in 2050 range from $5.57 per gallon in the High Oil Price case to $2.51 per gallon in the Low Oil Price case. Diesel fuel retail prices range from $6.61 per gallon in the High Oil Price case to $2.57 per gallon in the Low Oil Price case in 2050.

Natural gas

Natural gas experiences the largest production increase of all fossil fuels during the projection period across all cases, driven by continued development of lower-cost shale gas and tight oil resources. The growth in natural gas production supports increasing domestic consumption, particularly in the industrial and electric power sectors, and higher levels of natural gas exports.

U.S. dry natural gas consumption and production increase in most cases—





—with production growth outpacing natural gas consumption in all cases

- Natural gas production in the Reference case grows 7% per year from 2018 to 2020, which is more than the 4% per year average growth rate from 2005 to 2015. However, after 2020, growth slows to less than 1% per year as growth in both domestic consumption and demand for U.S. natural gas exports slows.

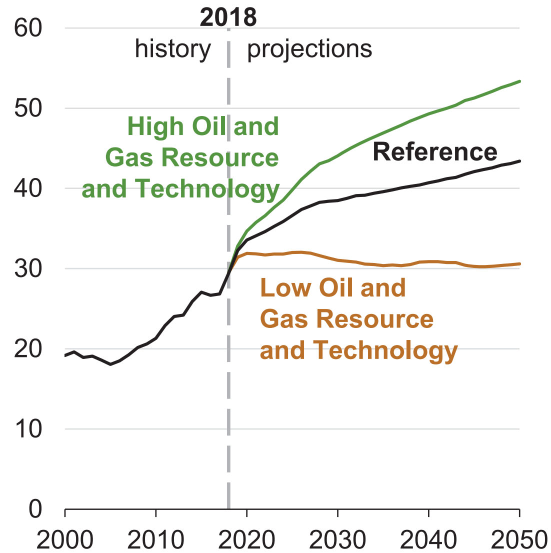
- Across the Reference and all sensitivity cases, recent historical and near-term natural gas production growth in an environment of relatively low and stable prices supports growing demand from large natural gas- and capital-intensive projects currently under construction, including chemical projects and liquefaction export terminals.

- After 2020, production grows at a higher rate than consumption in most cases, leading to a corresponding growth in U.S. exports of natural gas to global markets. The exception is in the Low Oil and Gas Resource and Technology case, where production, consumption, and net exports all remain relatively flat as a result of higher production costs.

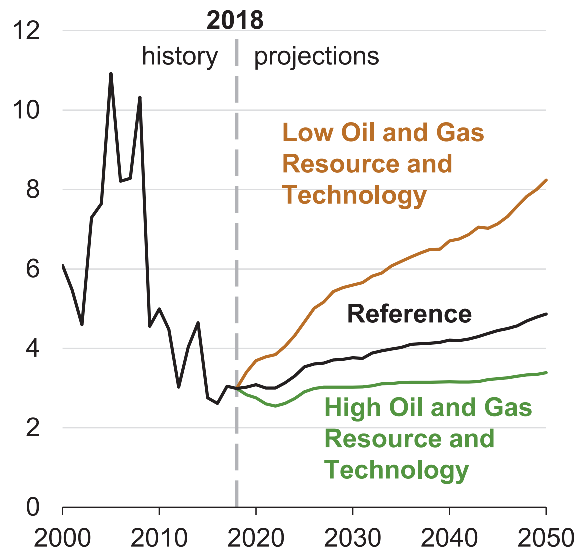
- The Low Oil and Gas Resource and Technology case, which has the highest natural gas prices relative to the other cases, is the only case where U.S. natural gas consumption does not increase during the projection period.

Natural gas prices depend on resource and technology assumptions—

Dry natural gas production
trillion cubic feet



Natural gas spot price at Henry Hub
2018 dollars per million British thermal unit



—and Henry Hub prices in the AEO2019 Reference case remain lower than $5 per million Btu throughout the projection period

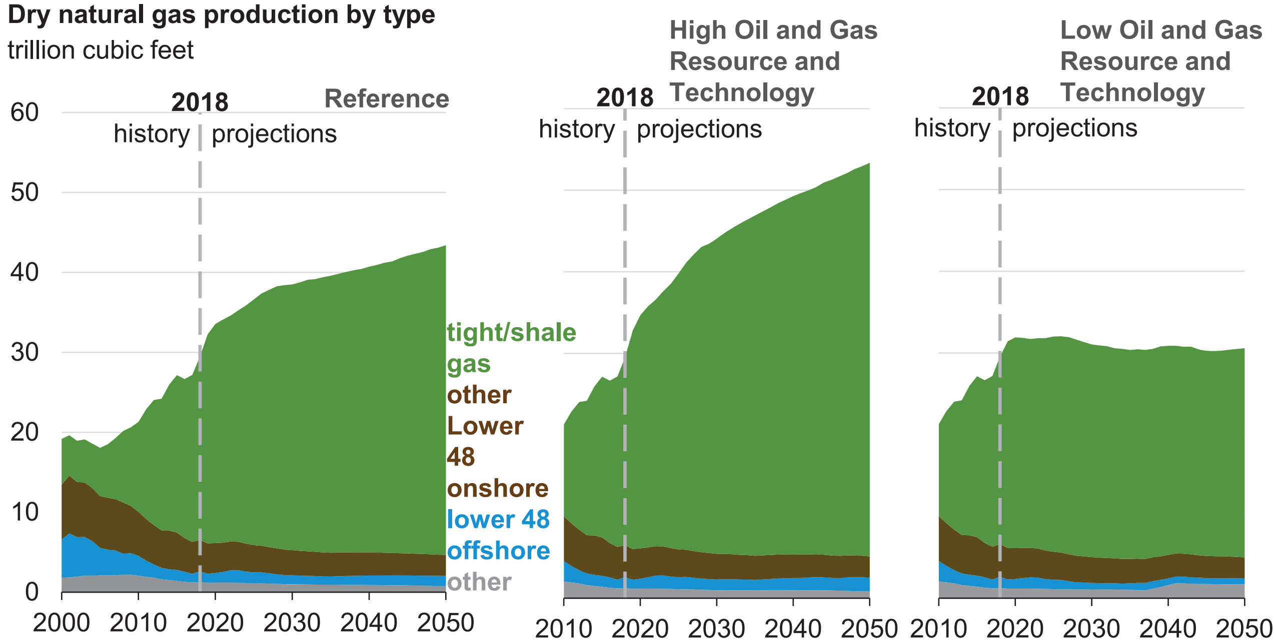
- In the Reference case, growing demand in domestic and export markets leads to increasing natural gas spot prices at the U.S. benchmark Henry Hub during the projection period in the Reference case despite continued technological advances that support increased production.

- To satisfy the growing demand for natural gas, production must expand into less prolific and more expensive-to-produce areas, putting upward pressure on production costs.

- Natural gas prices in the AEO2019 Reference case remain lower than $4 per million British thermal units (Btu) through 2035 and lower than $5 per million Btu through 2050 because of an increase in lower-cost resources, primarily in tight oil plays in the Permian Basin, which allows higher production levels at lower prices during the projection period.

- The High Oil and Gas Resource and Technology case, which reflects lower costs and higher resource availability, shows an increase in production and lower prices relative to the Reference case. In the Low Oil and Gas Resource and Technology case, high prices, which result from higher costs and fewer available resources, result in lower domestic consumption and exports during the projection period.

U.S. dry natural gas production increases as a result of continued development of tight and shale resources—



—which account for nearly 90% of dry natural gas production in 2050

- Natural gas production from shale gas and tight oil plays as a share of total U.S. natural gas production continues to grow in both share and absolute volume because of the sheer size of the associated resources, which extend over nearly 500,000 square miles, and because of improvements in technology that allow for the development of these resources at lower costs.

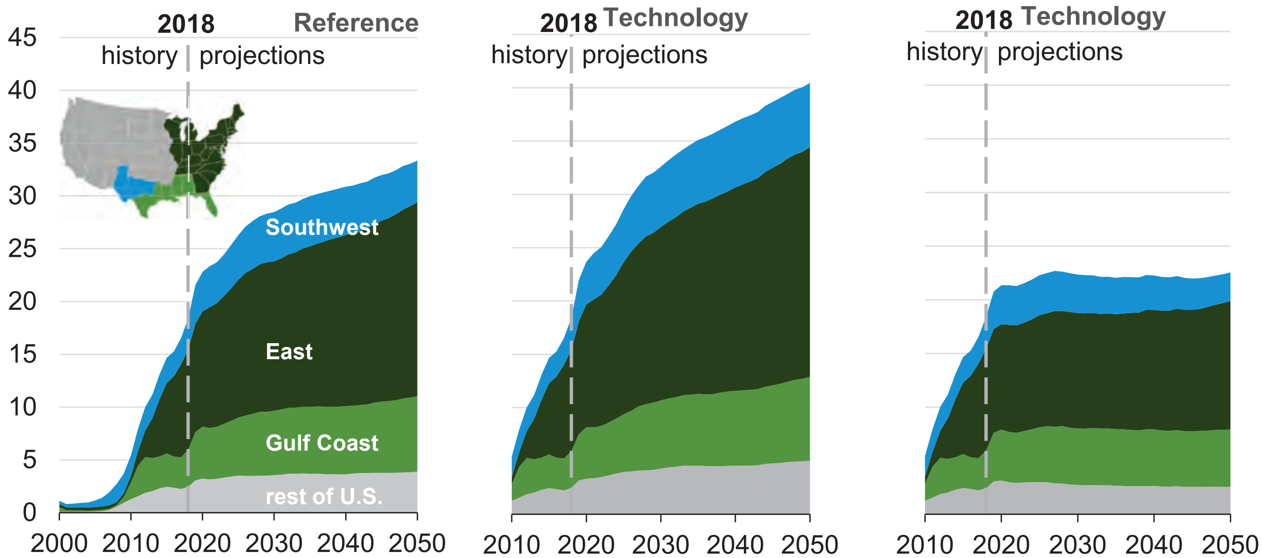
- In the High Oil and Gas Resource and Technology case, which has more optimistic assumptions regarding resource size and recovery rates, cumulative production from shale gas and tight oil is 18% higher than in the Reference case. Conversely, in the Low Oil and Gas Resource and Technology case, cumulative production from those resources is 24% lower.

- Across all cases, onshore production of natural gas from sources other than tight oil and shale gas, such as coalbed methane, generally continues to decline through 2050 because of unfavorable economic conditions for producing that resource.

- Offshore natural gas production in the United States remains nearly flat during the projection period in all cases as a result of production from new discoveries that generally offsets declines in legacy fields.

Eastern U.S. production of natural gas from shale resources leads growth in the Reference case—

Dry shale gas production by region
trillion cubic feet

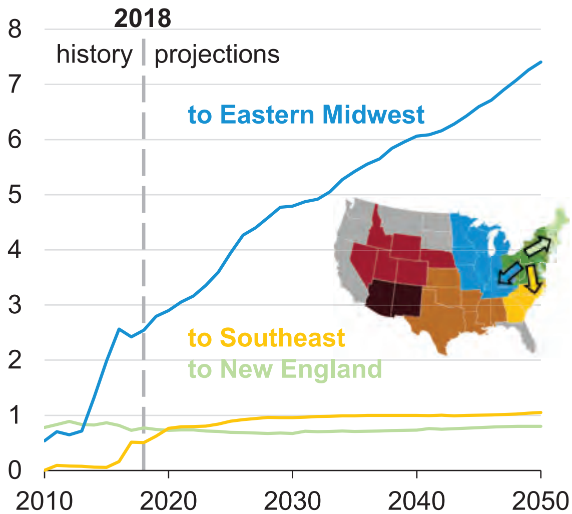


—followed by growth in Gulf Coast onshore production

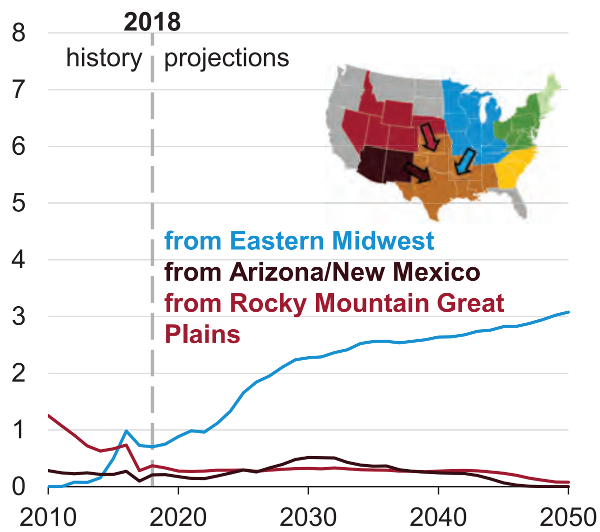
- Total U.S. natural gas production across most cases is driven by continued development of the Marcellus and Utica shale plays in the East.
- Natural gas from the Eagle Ford (co-produced with oil) and the Haynesville plays in the Gulf Coast region also contributes to domestic dry natural gas production.
- Associated natural gas production from tight oil production in the Permian Basin in the Southwest region grows strongly in the early part of the projection period but remains relatively flat after 2030.
- Technological advancements and improvements in industry practices lower production costs in the Reference case and increase the volume of oil and natural gas recovery per well. These advancements have a significant cumulative effect in plays that extend over wide areas and that have large undeveloped resources (Marcellus, Utica, and Haynesville).
- Natural gas production from regions with shale and tight resources show higher levels of variability across the resource and technology cases, compared with the Reference case because assumptions in those cases target those specific resources.

Natural gas production flows increase from the Mid-Atlantic and Ohio to the South Central through the Eastern Midwest—

Flows of natural gas from the Mid-Atlantic and Ohio (Reference case)
trillion cubic feet



Flows of natural gas to the South Central (Reference case)
trillion cubic feet



—as growth in domestic consumption and exports is concentrated in the Gulf Coast

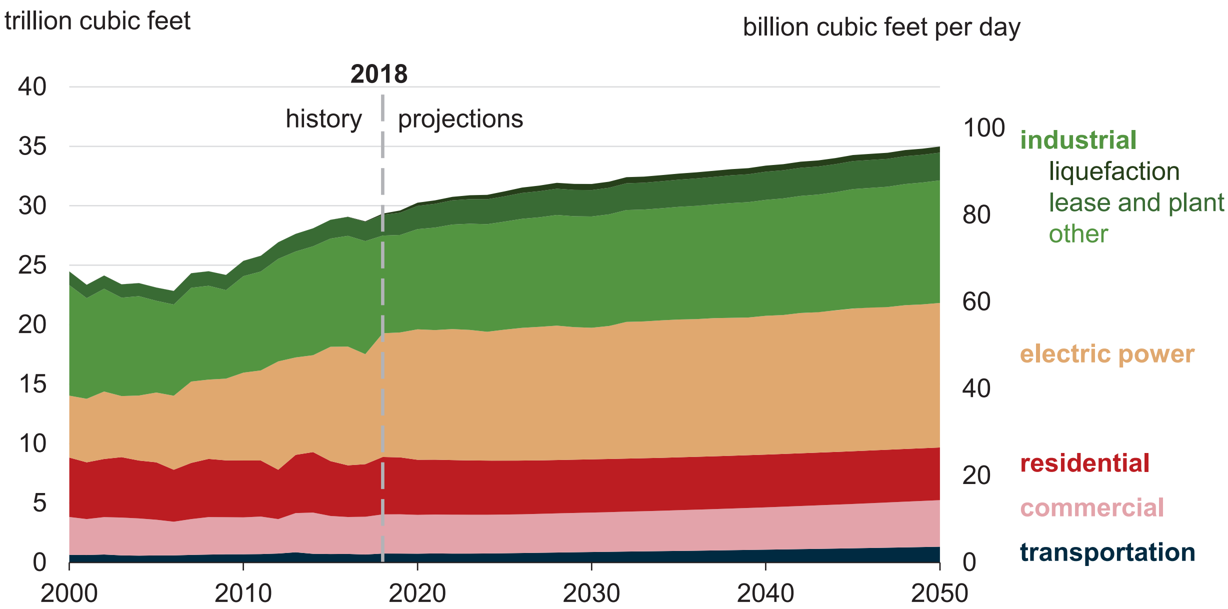
- Reference case growth of natural gas production in the Mid-Atlantic and Ohio region, from the Marcellus and Utica formations, continues the trend of more natural gas flowing out of the region. This trend continues the recent reversal of past flows, where natural gas from the South Central region—which includes Texas and the Gulf Coast—traditionally moved into the Northeast.

- Although historically a net supplier of natural gas to U.S. markets, the South Central region's demand growth outpaces production growth throughout the projection period. In addition to increased natural gas consumption in both the industrial and electric power sectors during the projection period in this region, U.S. natural gas exports to Mexico and U.S. liquefied natural gas exports from Gulf Coast facilities also rise. As a result, the Gulf Coast will become the fastest-growing demand market in the United States.

- To transport increased volumes of natural gas from the Mid-Atlantic and Ohio region to demand in the South Central region, additional natural gas pipeline capacity will be built from the Mid-Atlantic through the Eastern Midwest region.

Industrial and electric power demand drives natural gas consumption growth—

Natural gas consumption by sector (Reference case)



—while consumption in the residential and commercial sectors remains relatively flat across the projection period in the Reference case

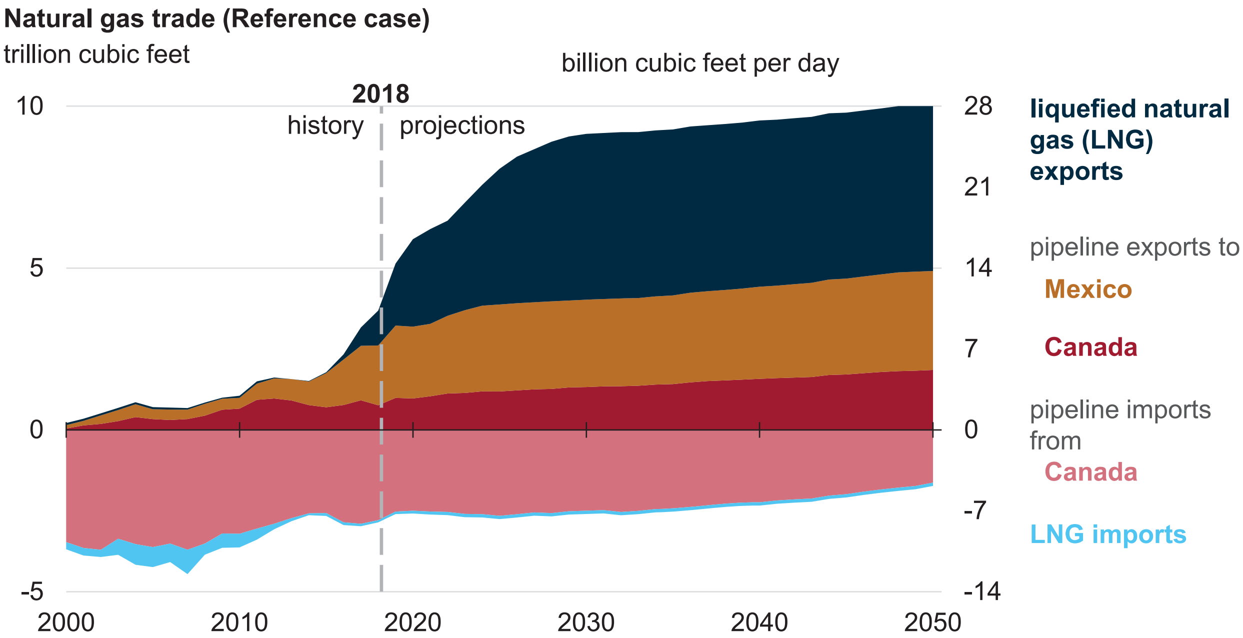
- Natural gas prices that are relatively low compared with historical prices lead to growing use of natural gas across most end-use sectors.

- The industrial sector, which includes fuel used for liquefaction at export facilities and in lease and plant operations, is the largest consumer of natural gas in the Reference case. Major natural gas consumers in this sector include the chemical industry (where natural gas is used as a feedstock to produce methanol and ammonia), industrial heat and power, and lease and plant fuel.

- Natural gas used for electric power generation generally increases during the projection period but at a slower rate than in the industrial sector. This growth is supported by the scheduled expiration of renewable tax credits in the mid-2020s, as well as the retirement of coal-fired and nuclear generation capacity during the projection period.

- Natural gas consumption in the residential and commercial sectors remains largely flat because of efficiency gains and population shifts that counterbalance demand growth. Although natural gas use rises in the transportation sector, particularly for freight trucks and rail and marine shipping, it remains a small share of both transportation fuel demand and total natural gas consumption.

Net exports of natural gas from the United States continue to grow in the Reference case—

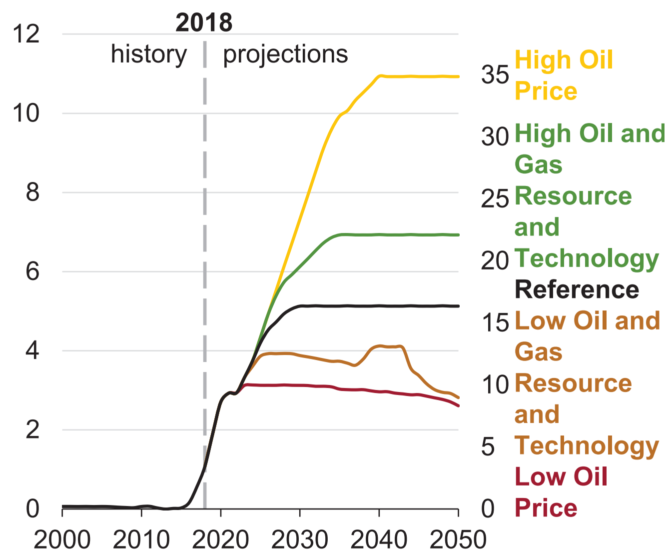


—because of near-term export growth and LNG export facilities delivering domestic production to global markets

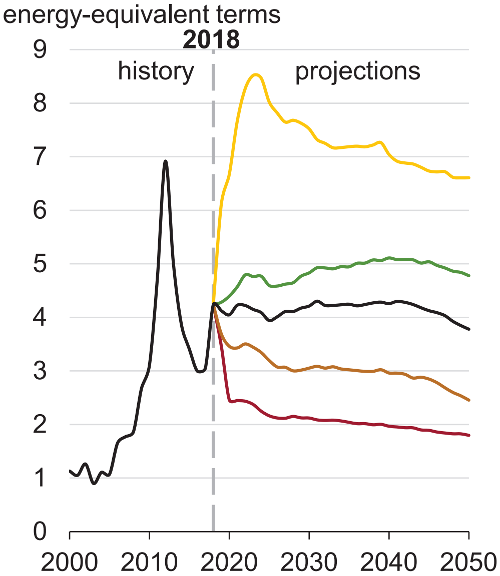
- In the Reference case, pipeline exports to Mexico and liquefied natural gas (LNG) exports increase until 2025, after which pipeline export growth to Mexico slows and LNG exports continue rising through 2030.
- Increasing natural gas exports to Mexico are a result of more pipeline infrastructure to and within Mexico, allowing for increased natural gas-fired power generation. By 2030, Mexican domestic natural gas production begins to displace U.S. exports.
- Three LNG export facilities were operational in the Lower 48 states by the end of 2018. After all LNG export facilities and expansions currently under construction are completed by 2022, LNG export capacity increases further as a result of growing Asian demand and U.S. natural gas prices remaining competitive. As U.S.-sourced LNG becomes less competitive, export volumes stop growing, remaining steady during the later years of the projection period.
- U.S. imports of natural gas from Canada, primarily from its prolific western region, continue their decline from historical levels. U.S. exports of natural gas to Eastern Canada continue to increase because of Eastern Canada's proximity to U.S. natural gas resources in the Marcellus and Utica plays and additional, recently built pipeline infrastructure.

U.S. LNG exports are sensitive to both oil and natural gas prices—

Liquefied natural gas exports
trillion cubic feet   billion cubic feet per day



Brent crude oil price to Henry Hub natural gas price ratio
energy-equivalent terms



—resulting in a wide range of U.S. LNG export levels across cases

- Historically, most liquefied natural gas (LNG) was traded under long-term contracts linked to crude oil prices because the regional nature of natural gas markets prevented the development of a natural gas price index that could be used globally. In addition to providing a liquid pricing benchmark, crude oil to some degree can substitute for natural gas in industry and for power generation.

- When the crude oil-to-natural gas price ratio is highest, such as in the High Oil Price case, U.S. LNG exports are at their highest levels. U.S. LNG supplies have the advantage of being priced based on relatively low domestic spot prices instead of oil-linked contracts. Also, demand for LNG increases, in part, as a result of consumers moving away from petroleum products.

- In the High Oil and Gas Resource and Technology case, low U.S. natural gas prices make U.S. LNG exports competitive relative to other suppliers. Conversely, higher U.S. natural gas prices in the Low Oil and Gas Resource and Technology case result in lower U.S. LNG exports.

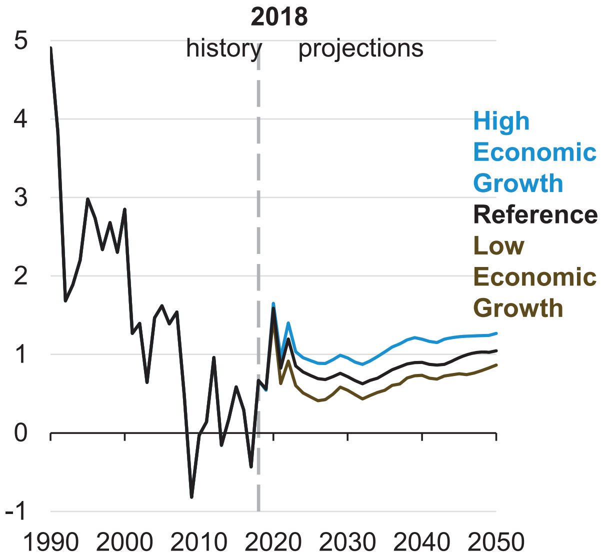
- As more natural gas is traded via short-term contracts or traded on the spot market, the link between LNG and oil prices weakens over time, making U.S. LNG exports less sensitive to the crude oil-to-natural gas price ratio and causing growth in U.S. LNG exports to slow in all cases.

Electricity

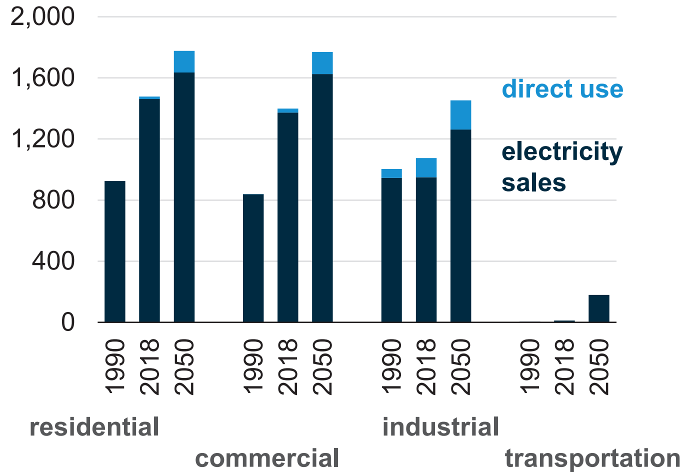
As electricity demand grows modestly, the primary drivers for new capacity in the Reference case are the retirements of older, less-efficient fossil fuel units, the near-term availability of renewable energy tax credits, and the continued decline in the capital cost of renewables, especially solar photovoltaic. Low natural gas prices and favorable costs for renewables result in natural gas and renewables as the primary sources of new generation capacity. The future generation mix is sensitive to the price of natural gas and the growth in electricity demand.

Electricity demand grows slowly through 2050 in the Reference case—

Electricity use growth rate
percent growth (three-year rolling average)



Electricity use by end-use demand sector (Reference case)
billion kilowatthours



—with increases occurring across all demand sectors

- Although near-term electricity demand increases or decreases as a result of year-to-year weather fluctuations, long-term projections typically assume long-term average weather patterns. As a result, economic growth tends to drive long-term demand trends offset by increases in energy efficiency. The annual growth in electricity demand averages about 1% throughout the projection period in the Reference case.

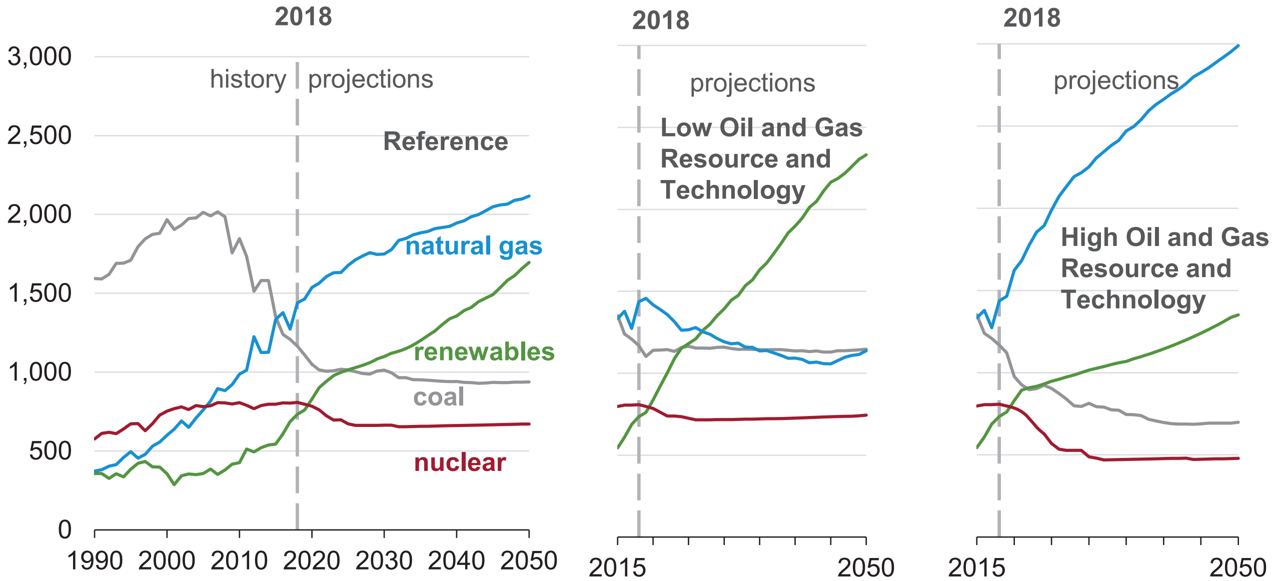
- Historically, electricity demand growth rates have slowed as new efficient devices and production processes replaced older, less-efficient appliances, heating, ventilation, cooling units, and capital equipment, even as the economy continued to grow.

- Average electricity growth rates in the High and Low Economic Growth cases vary the most from the Reference case. Electricity use in the High Economic Growth case grows about 0.2 percentage points faster on average as opposed to 0.2 percentage points slower in the Low Economic Growth case.

- The modest growth in projected electricity sales from 2018 to 2050 would be higher but for significant direct-use generation from rooftop photovoltaic (PV) systems primarily on residential and commercial buildings and combined heat and power systems in industrial and some commercial applications.

The abundance of natural gas supports its growth in the electric generation fuel mix—

Electricity generation from selected fuels
billion kilowatthours



—but the results are sensitive to resource and price assumptions

- Persistent low natural gas prices have decreased the competitiveness of coal-fired power generation. The 2017 coal-fired generation level was only about three-fifths of its peak in 2005. With relatively low natural gas prices throughout the projection period in the Reference case, natural gas-fired generation grows steadily and remains the dominant fuel in the electric power sector through 2050.

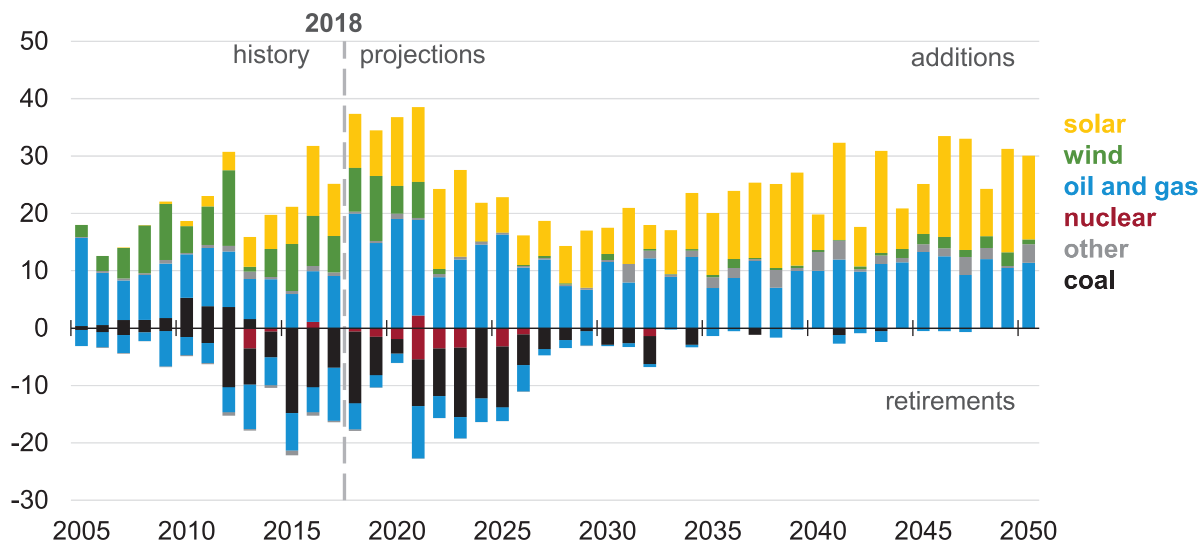
- Continued availability of renewable tax credits and declining capital costs for solar photovoltaic result in strong growth in non-hydro renewables generation. Increased natural gas-fired generation and renewables additions result in coal-fired generation slightly decreasing in the Reference case.

- In the Low Oil and Gas Resource and Technology case, renewables emerge as the primary source of electricity generation. Although higher natural gas prices increase utilization of the existing coal-fired generation fleet and prevent some coal-fired unit retirements, growth in coal-fired generation is muted by the lack of new capacity additions because of the relatively-high capital costs compared with other fuels.

- Lower projected natural gas prices in the High Oil and Gas Resource and Technology case support substantially higher natural gas-fired generation at the expense of renewables growth. In addition, coal-fired generation by 2050 is 26% lower than projected in the Reference case.

Expected requirements for new generating capacity will be met by renewables and natural gas—

Annual electricity generating capacity additions and retirements (Reference case)
gigawatts



—as a result of declining costs and competiveness of natural gas

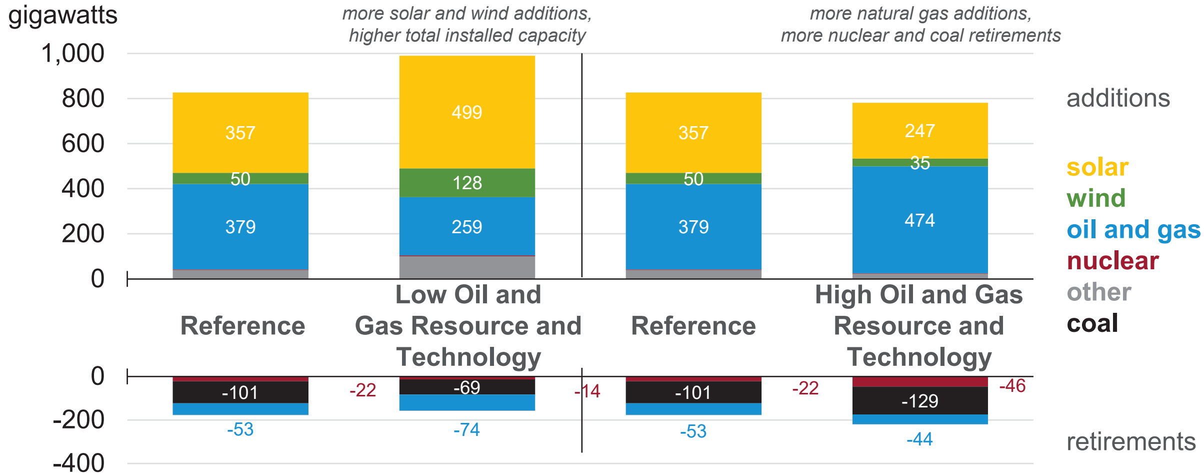
- In the Reference case, the United States adds 72 gigawatts (GW) of new wind and solar photovoltaic (PV) capacity between 2018 and 2021, motivated by declining capital costs and the availability of tax credits.

- New wind capacity additions continue at much lower levels after production tax credits expire in the early 2020s. Although the commercial solar Investment Tax Credits (ITC) decreases and the ITC for residential-owned systems expires, the growth in solar PV capacity continues through 2050 for both the utility-scale and small-scale applications because the cost of PV declines throughout the projection.

- Most electric generation capacity retirements occur by 2025 as a result of many regions that have surplus capacity and lower natural gas prices. The retirements reflect both planned and additional projected retirements of coal-fired capacity. On the other hand, new high-efficiency natural gas-fired combined-cycle and renewables generating capacity is added steadily through 2050 to meet growing electricity demand.

Long-term trends in electricity generation are dominated by solar and natural gas-fired capacity additions—

Cumulative electricity generating capacity additions and retirements (2050)



—with coal, nuclear, and less efficient natural gas generators contributing to capacity retirements

- In the Reference case, coal-fired generating capacity declines faster than coal-fired generation through 2050, with 101 gigawatts (GW) (or 42% of existing coal-fired capacity) projected to retire by 2050. For nuclear generators, 22 GW (22% of current nuclear capacity) retires by 2050 in the Reference case.

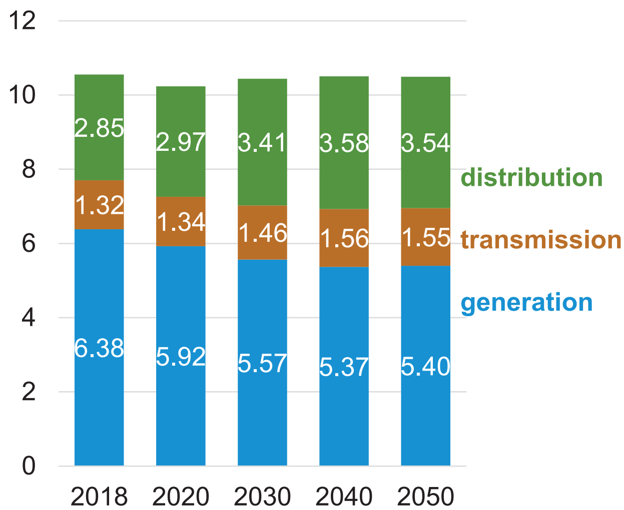
- From 2018 to 2021, wind builds play a more significant role in total capacity additions, accounting for 20% of the additions. Over time, solar generation grows for both the utility- and small-scale sectors. In the Reference case, 43% of total capacity additions through 2050 are solar photovoltaic capacity.

- In the Low Oil and Gas Resource and Technology case, the relatively higher natural gas prices support the build-out of wind and solar generating technologies instead of natural gas-fired additions. More total installed capacity is required because the wind and solar generator capacity factors are lower than for natural gas-fired combined-cycle units.

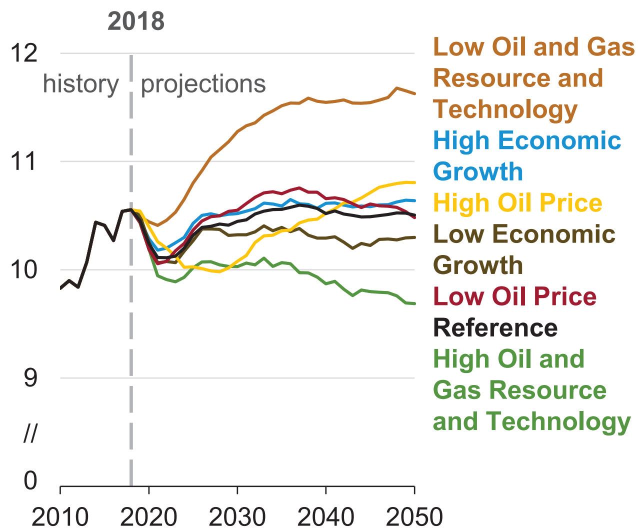
- Low natural gas prices resulting from higher-than-expected natural gas resources in the High Oil and Gas Resource and Technology case favor the installation of natural gas capacity (61% of the capacity added through 2050) instead of renewables (36% of capacity additions through 2050) and result in higher levels of coal and nuclear retirements compared with the Reference case.

Reference case electricity prices fall slightly, with dropping generation costs offset by rising transmission and distribution costs—

Electricity prices by service category (Reference case)
2018 cents per kilowatthours



Average electricity price
2018 cents per kilowatthour

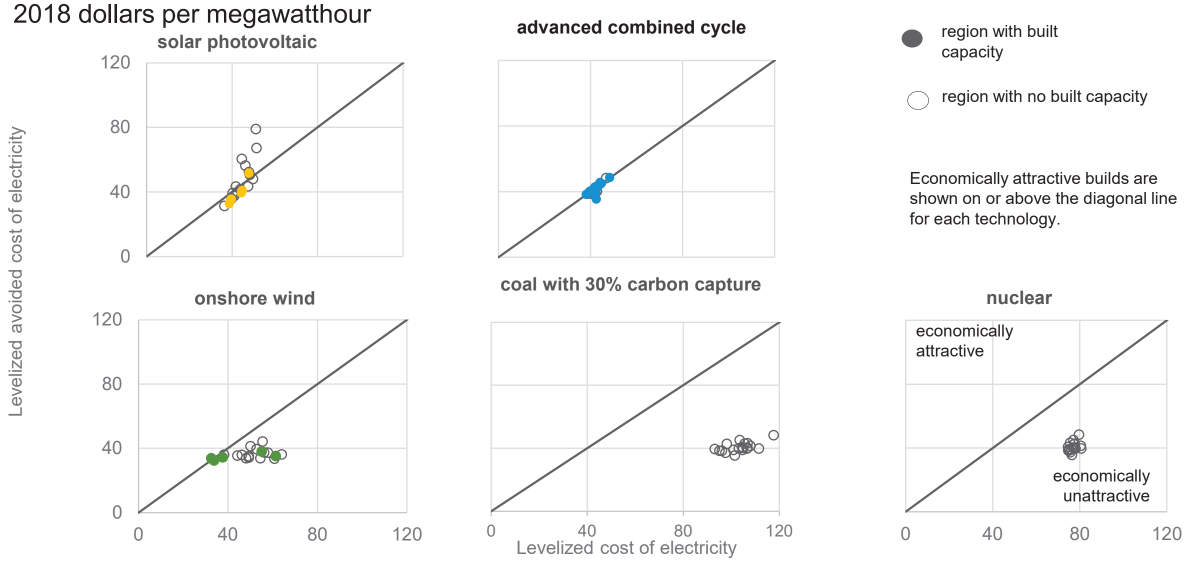


—while generation costs vary across the resource cases that influence the generation mix

- Average electricity prices vary considerably across scenarios mainly because of the effect natural gas prices have on the projections. By 2050, prices range from 9.7 cents/kilowatthours (kWh) to 11.6 cents/kWh across the High and Low Oil and Gas Resource and Technology cases.
- Generation costs, which account for the largest share of the price of electricity, decrease 15% from 2018 to 2050 in the Reference case. Generation costs in regulated markets (70% of the United States) reflect recovery of investment costs and fuel and operating costs. Investment costs decline over time as older capacity is retired and new, lower cost capacity is added. Fuel and operating costs are projected to remain flat as more efficient generators and renewables offsets long-term increases in fuel prices.
- Average electricity prices fall 4.2% from 2018 to 2022. This decline is driven by customer rebates from lower utility taxes associated with the Tax Cuts and Jobs Act of 2017, lower construction and operating costs of some new fossil and renewable plants, and the subsequent retirement of plants that were relatively more costly to operate.
- In the Reference case, transmission and distribution costs increase by 18% and 24%, respectively, as a result of replacing aging infrastructure and upgrading the grid to integrate wind and solar capacity.

Combined-cycle and solar photovoltaic are the most economically attractive generating technologies—

Levelized cost of electricity and levelized avoided cost of electricity by technology and region, 2023 online year (Reference case)
2018 dollars per megawatthour



Note: See more information in EIA's LCOE/LACE report on EIA.gov

—when considering the overall cost to build and operate a plant and the value of the plant to the power system

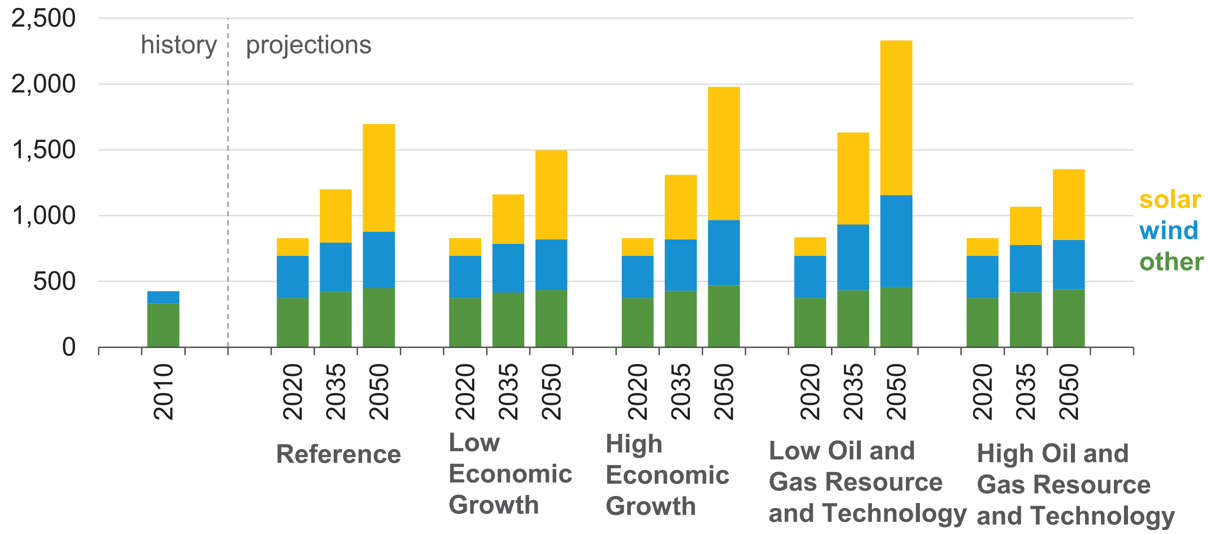
- The levelized cost of electricity (LCOE) indicates the average revenue per unit of generation needed for a generating plant to be economically viable. When compared with the levelized avoided cost of electricity (LACE), or expected average revenue realized by that plant, a rough estimate of economic viability for that generating technology can be determined.

- The solid, colored points on the figure demonstrate that projects tend to be built in regions where value (LACE) exceeds costs (LCOE). Expected revenues from advanced natural gas-fired combined-cycle and solar photovoltaic generating technologies are generally greater than or equal to projected costs across the most electricity market regions in 2023. Correspondingly, these two technologies show the greatest projected growth through the middle of the next decade.

- The figure indicates a few regions where the value of wind is approaching costs, and these regions see new wind capacity builds, primarily in advance of the phase-out of the production tax credit (PTC), through the early part of the next decade. However, the potential wind sites with the most favorable value-to-cost ratios are largely exploited before the PTC expires, with a several-years lag needed for wind values to recover. Markets for wind rebound faster under conditions with higher natural gas prices or faster growth in electricity demand.

Increases in renewables generation is led by solar and wind—

Renewables electricity generation (all sectors) by case
billion kilowatthours

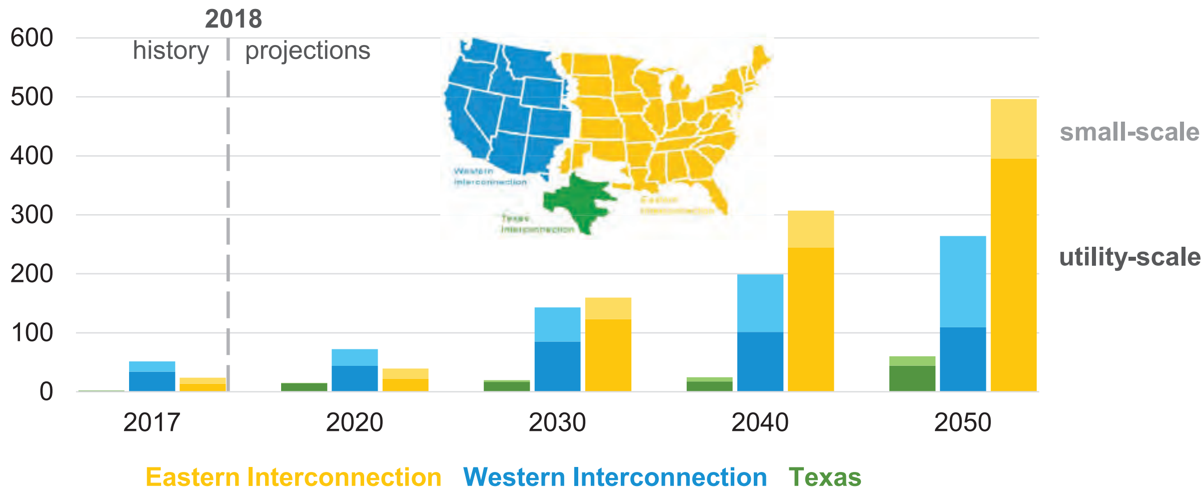


—which grows most quickly in the High Economic Growth and Low Oil and Gas Resource and Technology cases

- Renewables generation increases more than 130% through the end of the projection period in the Reference case, reaching nearly 1,700 billion kilowatthours (BkWh) by 2050.
- Increases in wind and solar generation lead the growth in renewables generation throughout the projection period across all cases, accounting for nearly 900 BkWh (about 90%) of total renewables growth in the Reference case.
- The extended tax credits account for much of the accelerated growth in the near term. Solar photovoltaic (PV) growth continues through the projection period as a result of solar PV costs continuing to decrease.
- In the High Oil and Gas Resource and Technology case, low natural gas prices limit the growth of renewables in favor of natural gas-fired generation. Renewables generation is nearly 350 BkWh lower than in the Reference case in 2050, but this increase is still more than 60% higher than 2018 levels.
- In the Low Economic Growth case, electricity demand is lower than in the Reference case. Because renewables are a marginal source of new capacity additions, this lower level of demand results in nearly 200 BkWh less renewables generation by 2050 compared with the Reference case.

Solar generation grows for both utility- and small-scale sectors—

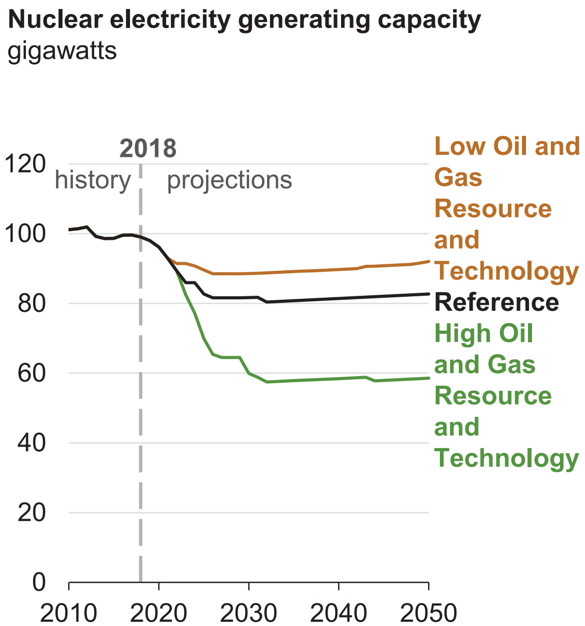
Solar photovoltaic electricity generation by region (Reference case)
billion kilowatthours

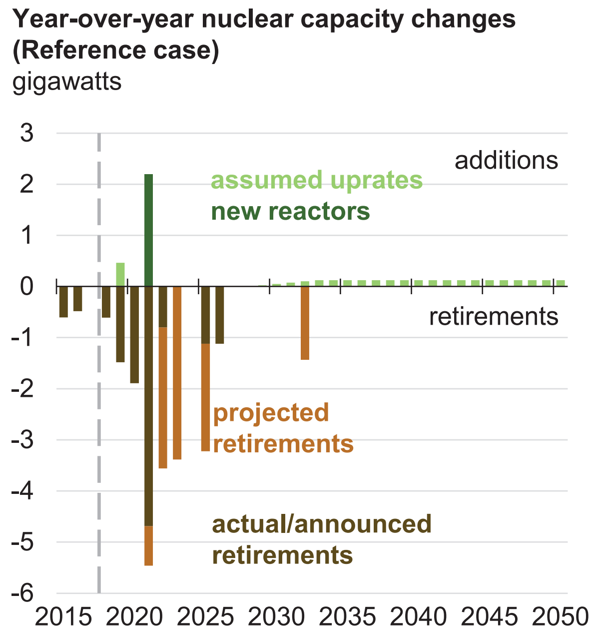


—but at different relative rates across the interconnections

- Electricity generation from solar photovoltaic (PV) in all sectors grows to 15% of total U.S. electricity generation from all technologies by 2050 in the Reference case, and it is composed of more utility-scale systems (66%) than small-scale systems (34%).
- In the Western Interconnection, the growth in solar PV generation comes mostly from small-scale systems, increasing from 34% of the share in 2018 to 57% in 2050.
- Solar PV generation in Texas and in the Eastern Interconnection is produced mostly from utility-scale systems throughout the projection period, averaging 80% for Texas and 76% for the Eastern Interconnection.
- During the projection period, Texas increases its share of U.S. PV generation from 4% in 2018 to 8% in 2050, while the Eastern Interconnection increases its share from 32% to 59%. The share of U.S. PV generation from the Western Interconnection decreases from 64% to 33% during the same period.

Nuclear capacity retirements accelerate with lower natural gas prices—





—as a result of declining revenue in competitive wholesale power markets

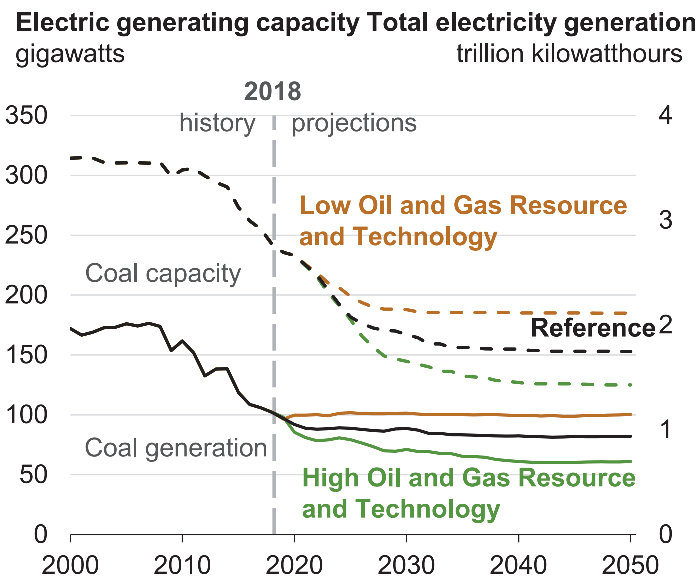
- The Reference case projects a steady decline of 17% in nuclear electric generating capacity from 99 gigawatts (GW) in 2018 to 83 GW in 2050. No new plant additions occur beyond 2021, and existing plants have 2 GW of uprates starting in 2030.

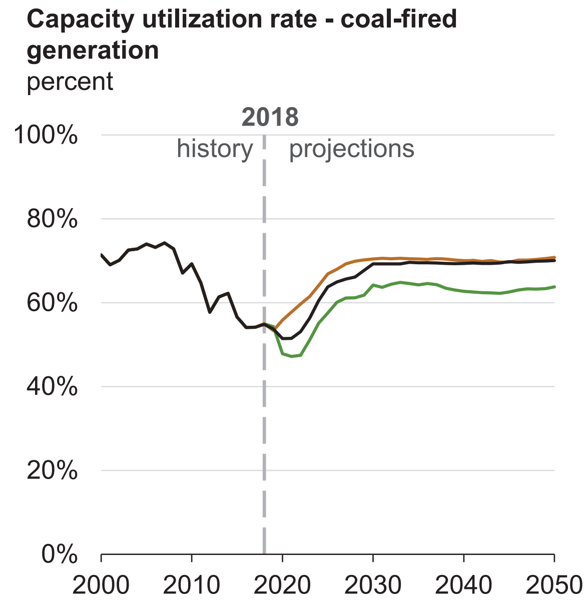
- Projected nuclear retirements are driven by declining revenues resulting from low growth in electricity load and from increasing competition from low-cost natural gas and declining-cost renewables. Smaller, single-reactor nuclear plants with higher average operating costs are most affected, particularly those plants operating in regions with deregulated wholesale power markets and in states without a Zero Emission Credit policy.

- Lower natural gas prices in the High Oil and Gas Resource and Technology case lead to lower wholesale power market revenues for nuclear power plant operators, accelerating an additional 24 GW of nuclear capacity closing by 2050 compared with the Reference case.

- Higher natural gas prices in the Low Oil and Gas Resource and Technology case decrease the financial risks to nuclear power plant operators, resulting in 8 GW fewer retirements and an additional 1 GW of new, unplanned nuclear capacity through 2050 compared with the Reference case.

Coal-fired generating capacity retires at a faster pace than generation in the Reference case—





—as capacity factors for coal-fired units improve over time as a result of less efficient units retiring and natural gas prices increasing

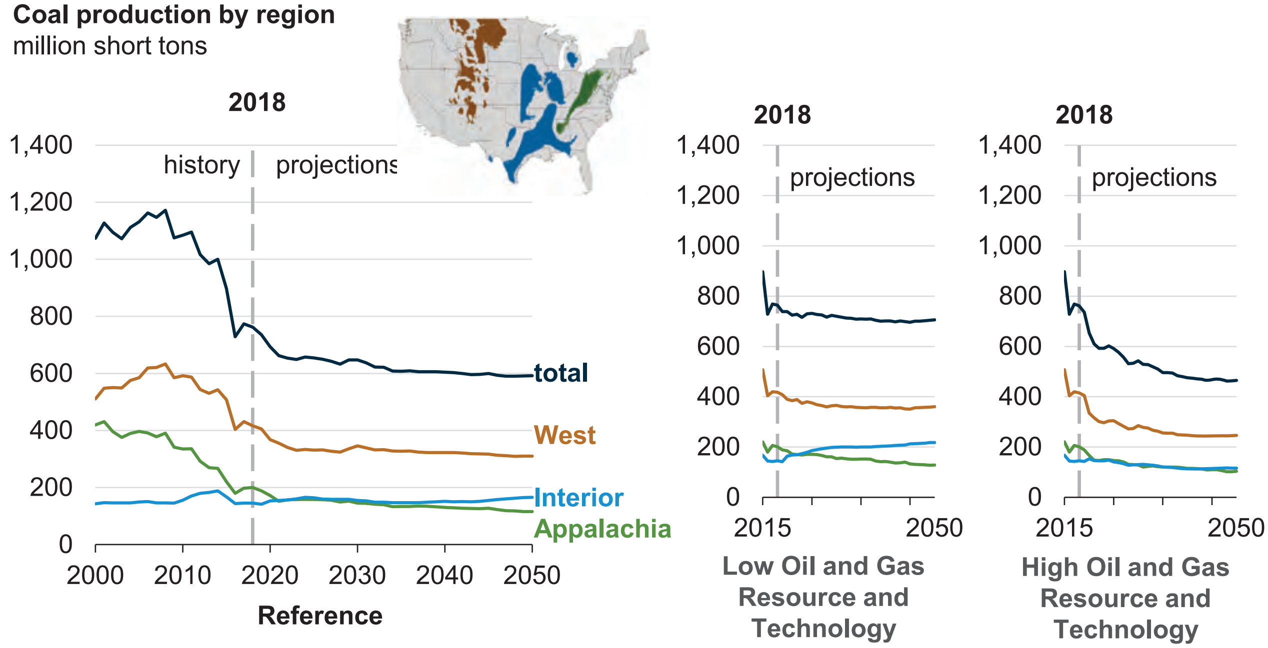
- Coal-fired generating capacity decreases by 86 gigawatts (GW) (or 36%) between 2018 and 2035 as a result of competitively priced natural gas and increasing renewables generation before leveling off near 155 GW in the Reference case by 2050.

- Between 2018 and 2035, coal-fired generation decreases by 18% in the Reference case while natural gas prices increase, and the utilization rate of the remaining coal-fired capacity returns to 70%, which is a similar level to that in the early 2000s. In the High Oil and Gas Resource and Technology case, coal-fired generation decreases by 36% while lower natural gas prices limit the utilization rate of the coal fleet to about 64%.

- Higher natural gas prices in the Low Oil and Gas Resource and Technology case slow the pace of coal power plant retirements by approximately 30 GW in 2035 compared with the Reference case, which has 185 GW of coal capacity still in service in 2050. Conversely, lower natural gas prices in the High Oil and Gas Resource and Technology case increase coal-fired power plant retirements by 24 GW in 2035, with 125 GW of remaining coal-fired capacity by 2050.

Coal production decreases through 2035 because of retiring coal-fired electric generating capacity—

Coal production by region
million short tons



—before stabilizing as a result of higher natural gas prices increasing the utilization of coal-fired electric generating capacity

- U.S. coal production in the Reference case continues to decline, from 762 million short tons (MMst) in 2018 to 608 MMst in 2035, before later stabilizing. This decline is in response to coal-fired generating unit retirements and competitive price pressure from natural gas and renewables.

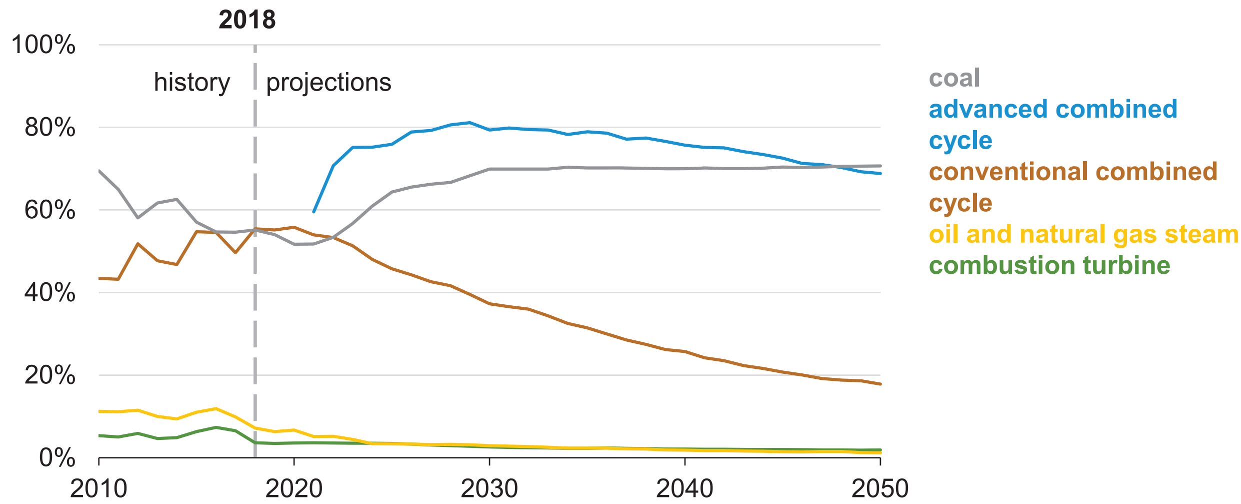
- In the Interior region of the United States, coal production in the Reference case grows by 20 MMst between 2018 and 2050, while production in the Appalachia and the West regions declines by 85 MMst and 106 MMst, respectively.

- In the Low Oil and Gas Resource and Technology case, Interior region coal production in 2050 is 52 MMst (31%) higher than in the Reference case, compared with higher estimates of 13 MMst (11%) in Appalachia and 50 MMst (16%) in the West region.

- In the High Oil and Gas Resource and Technology case, lower natural gas prices result in lower West region coal production in 2050 of 64 MMst (21%) relative to the Reference case, compared with lower regional coal production levels of 12 MMst (11%) in Appalachia and 50 MMst (30%) in the Interior.

Lower operating costs and higher efficiencies result in advanced natural gas-fired combined-cycle capacity factors of 80% by 2030—

Utilization of fossil-fired capacity (Reference case)
percent



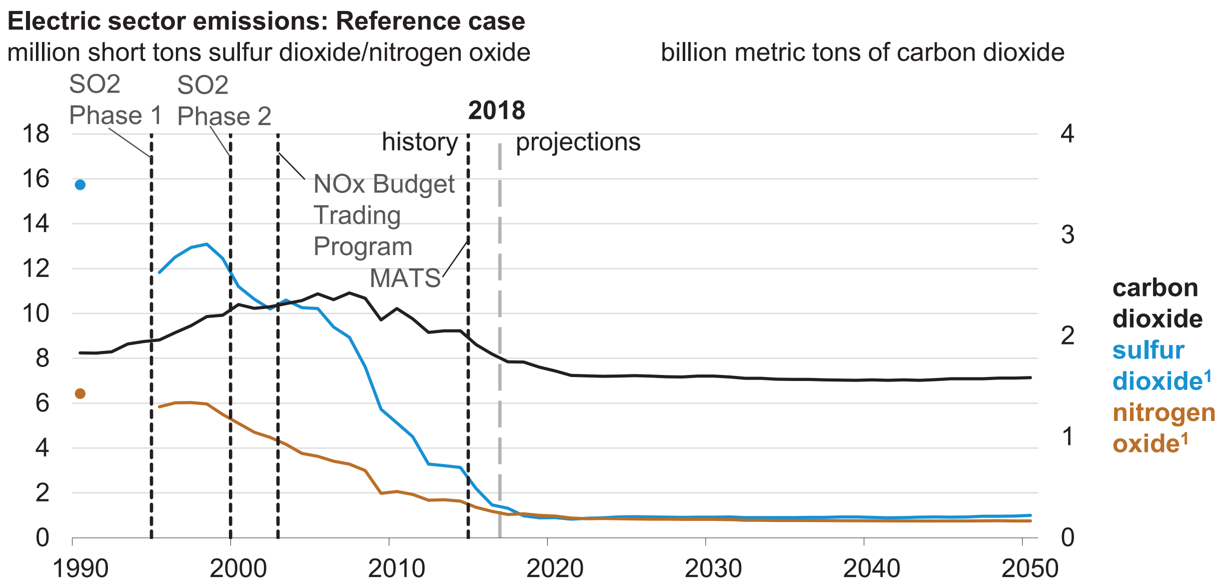
—but then decline over time as natural gas prices increase relative to coal prices

- Lower natural gas prices and reduced capital costs of new natural gas-fired combined-cycle (CC) generating units shift fossil fuel electric generation use during the next decade. Beginning in 2020—the first year of availability—new, advanced CC natural gas-fired units have the highest projected capacity factors of all technologies, averaging 76% between 2025 and 2050. With their lower efficiency, conventional CC units decline in utilization, from 56% in 2020 to 18% by 2050, still remaining higher than combustion turbines but much lower than their designed operating rates.

- New, larger CC designs result in substantial economies of scale for this technology. In line with the April 2018 PJM Report, *PJM Cost of New Entry*, developed for PJM's next generating capacity auction, the cost per unit of installed capacity for the advanced CC design will be 25% to 30% lower compared with older CC units. Through 2050, 235 gigawatts of advanced CC technology is installed.

- The utilization rates of coal and conventional CC will be nearly the same (at about 50%) in the near term. However, the projected installation of advanced CC and the retirement of less efficient coal-fired units contributes to their eventual divergence in 2050, and the remaining coal-fired unit utilization rates recover to 71% while conventional CC utilization rates fall to nearly 20%. Over the long term, coal-fired unit and advanced CC unit utilization rates converge at approximately 70%.

Electric sector emissions in the United States closely track decreasing dependence on coal—



[1]Annual sulfur dioxide and nitrogen oxide data unavailable prior to 1995

—with carbon dioxide, sulfur dioxide, and nitrogen oxide emissions generally flat going forward

- Any future changes in emissions will be tied to the level of coal-fired generation because EIA's Reference case only incorporates policies that are current laws (including tax credits and air regulations). Coal-fired generation is sensitive to projected natural gas prices.

- Changes in air emissions from power plants in recent years have generally followed the compliance requirements and deadlines specified under the Clean Air Act Amendments of 1990 (CAAA 1990). For sulfur dioxide (SO2), these include the phased implementation of the acid rain cap-and-trade program (Title IV) with deadlines for Phase I and II in 1995 and 2000. For nitrogen oxides (NOx), the key deadline was in 2003, when the Environmental Protection Agency expanded the NOx Budget Trading Program (Title I) to include most states east of the Mississippi. For air toxics (Title III), the initial compliance deadline for the Mercury and Air Toxics Standards (MATS) arrived in April 2015. Finally, emissions of carbon dioxide (CO2) have followed evolving state standards for renewable portfolios or regional caps on CO2.

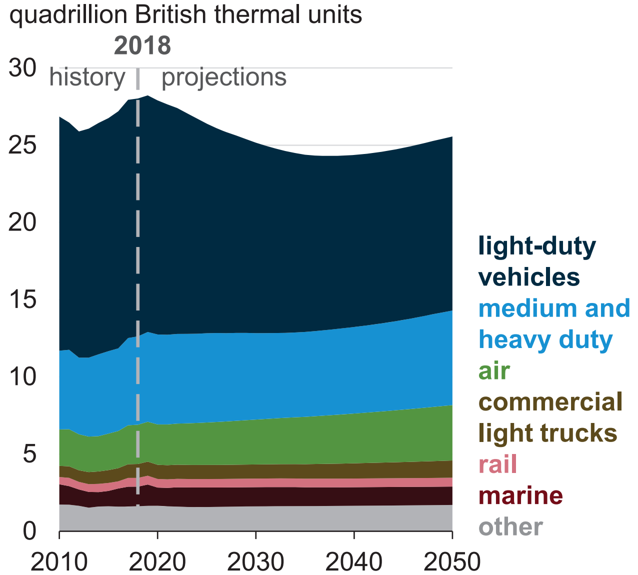
- Once the CAAA 1990 programs are implemented, and in the absence of additional federal regulations on CO2, the level of emissions remains relatively unchanged in the Reference case from 2018 to 2050, despite a 30% increase in generation during the projection period.

Transportation

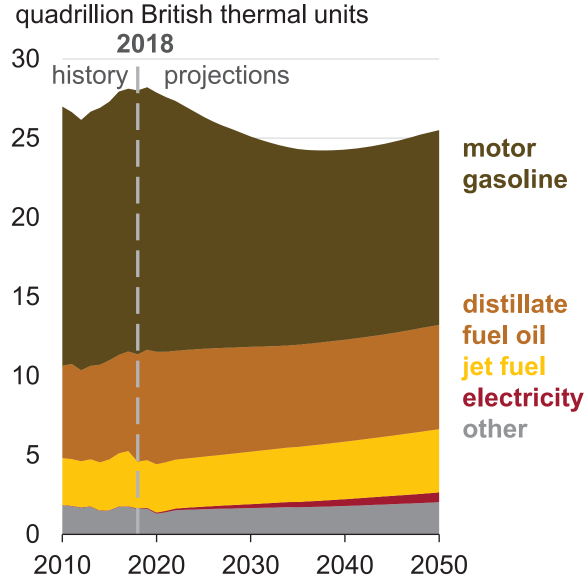
Transportation energy consumption peaks in 2019 in the Reference case because rising fuel efficiency more than offsets the effects of increases in total travel and freight movements, but this trend reverses toward the end of the projection period.

Transportation energy consumption declines between 2019 and 2037 in the Reference case—

Transportation sector consumption (by type) (Reference case)
quadrillion British thermal units



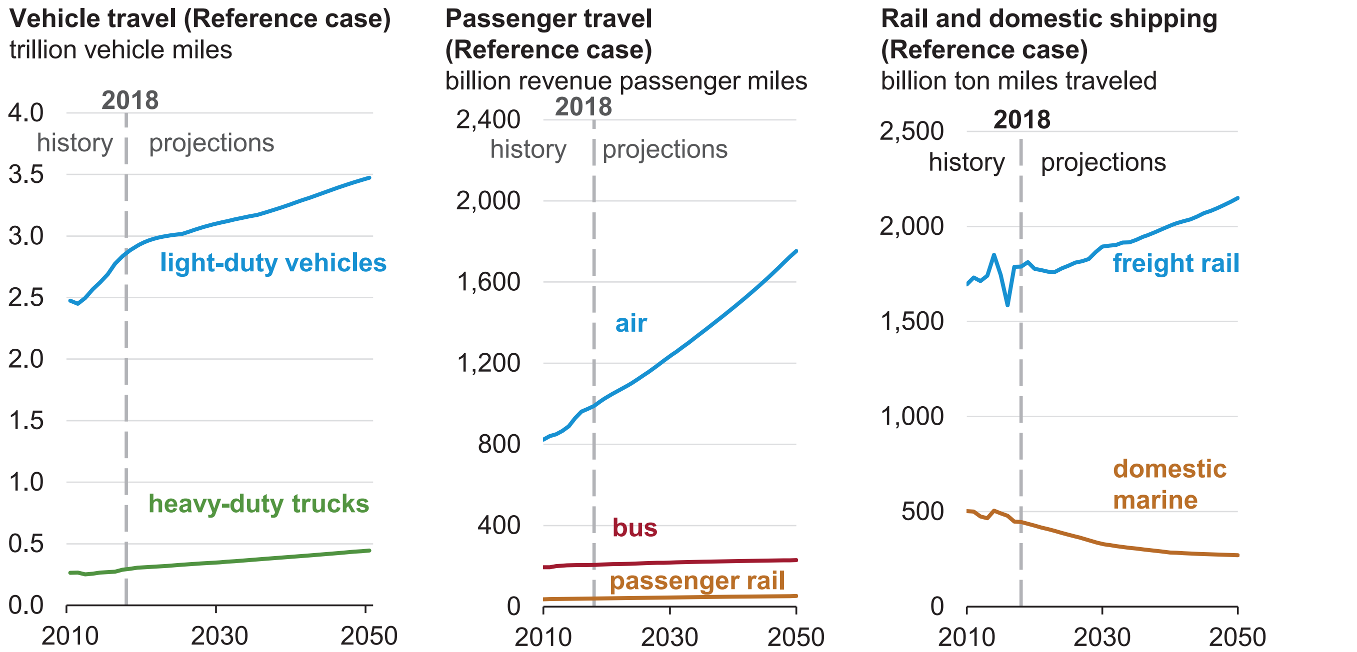
Transportation sector consumption (by fuel) (Reference case)
quadrillion British thermal units



—because increases in fuel economy more than offset growth in vehicle miles traveled

- Increases in fuel economy standards temper growth in U.S. motor gasoline consumption, which decreases by 26% between 2018 and 2050.
- Increases in fuel economy standards result in heavy-duty vehicle energy consumption and related diesel use remaining at approximately the same level in 2050 as in 2018, despite rising economic activity that increases the demand of freight truck travel.
- Excluding electricity (which starts from a comparatively low base), jet fuel consumption grows more than any other transportation fuel during the projection period, rising 35% from 2018 to 2050. This growth arises from increases in air transportation outpacing increases in aircraft fuel efficiency.
- Motor gasoline and distillate fuel oil's combined share of total transportation energy consumption decreases from 84% in 2018 to 74% in 2050 as the use of alternative fuels increases.
- Continued growth of on-road travel increases energy use later in the projection period because current fuel economy and greenhouse gas standards require no additional efficiency increases for new light-duty vehicles after 2025 and for new heavy-duty vehicles after 2027.

Passenger travel increases across all transportation modes in the Reference case through 2050—



—and freight movement increases across all categories except domestic marine

- Light-duty vehicle miles traveled increase by 20% in the Reference case, growing from 2.9 trillion miles in 2018 to 3.5 trillion miles in 2050 as a result of rising incomes and growing population.

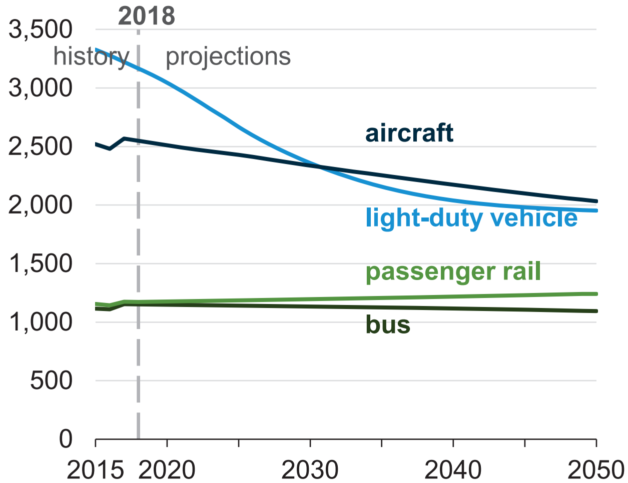
- Truck vehicle miles traveled, the dominant mode of freight movement in the United States, grows by 52%, from 397 billion miles in 2018 to 601 billion miles in 2050 as a result of increased economic activity. Freight rail ton-miles grow by 20% during the same period, led primarily by rising industrial output. However, U.S. coal shipments, which are primarily via rail, decline slightly.

- Air travel grows 77% from 990 billion revenue passenger miles to 1,753 billion revenue passenger miles between 2018 and 2050 in the Reference case because of increased demand for global connectivity and rising personal incomes. Bus and passenger rail travel increase 11% and 31%, respectively.

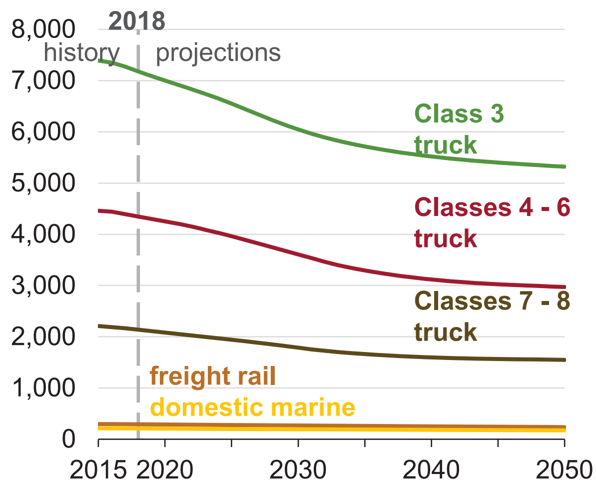
- Domestic marine shipments decline modestly during the projection period, continuing a historical trend related to logistical and economic competition with other freight modes.

Energy intensity decreases across most transportation modes in the Reference case—

Passenger mode energy intensity (Reference case)
British thermal unit per passenger-mile



Freight mode energy intensity (Reference case)
British thermal unit per ton-mile



Note: Energy intensity is the energy required for a travel metric. In the graphs above, energy intensity is calculated for passenger modes in British thermal unit (Btu) per passenger-mile (energy to move a passenger one mile) and for freight modes in Btu per ton-mile (energy to move a ton of freight one mile).

—because of policy, economic factors, and technology

- Energy use per passenger-mile of travel in light-duty vehicles declines nearly 40% between 2018 and 2050 as newer, more fuel-efficient vehicles enter the market, including both more efficient conventional gasoline vehicles and highly efficient alternatives such as battery electric vehicles. Light-duty vehicle energy efficiencies are affected by current federal fuel economy and greenhouse gas emission standards.

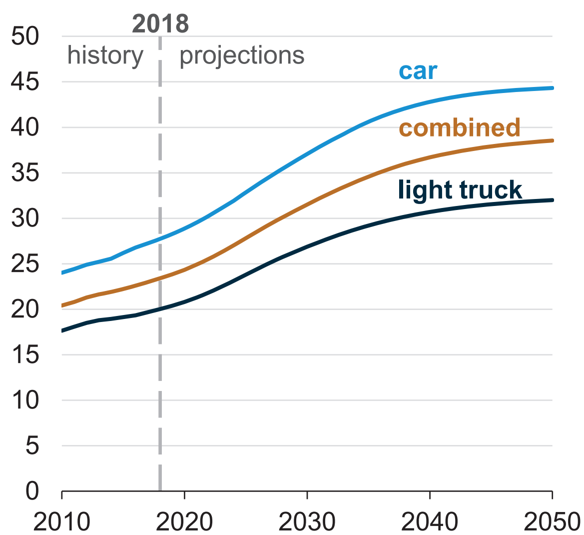
- Energy use per passenger-mile of travel in aircraft decreases because of the economically driven adoption of energy-efficient technology and practices. Energy use per passenger-mile of travel on passenger rail and buses, already relatively energy-efficient modes of travel per passenger-mile, remains relatively constant.

- Energy use per ton-mile of travel by freight modes decreases, led by increases in the fuel economy of heavy-duty trucks across all weight classes as the second phase of heavy-duty vehicle efficiency and greenhouse gas standards takes full effect in 2027.

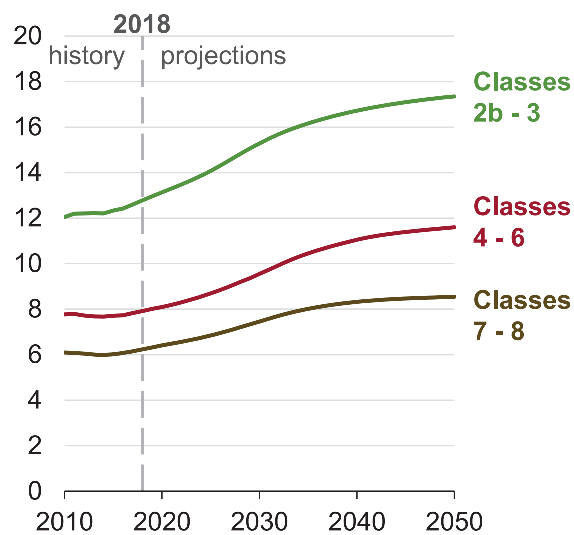
- Gains in energy efficiency offset increases in travel for passenger and freight modes. These efficiency gains decrease energy use by light-duty vehicles and freight trucks later in the projection and temper the rise in energy use by other transportation modes.

Fuel economy of all on-road vehicles increases in the Reference case—

Light-duty fuel economy (Reference case)
miles per gallon (all vehicles)



Heavy-duty fuel economy (Reference case)
miles per gallon (all vehicles)



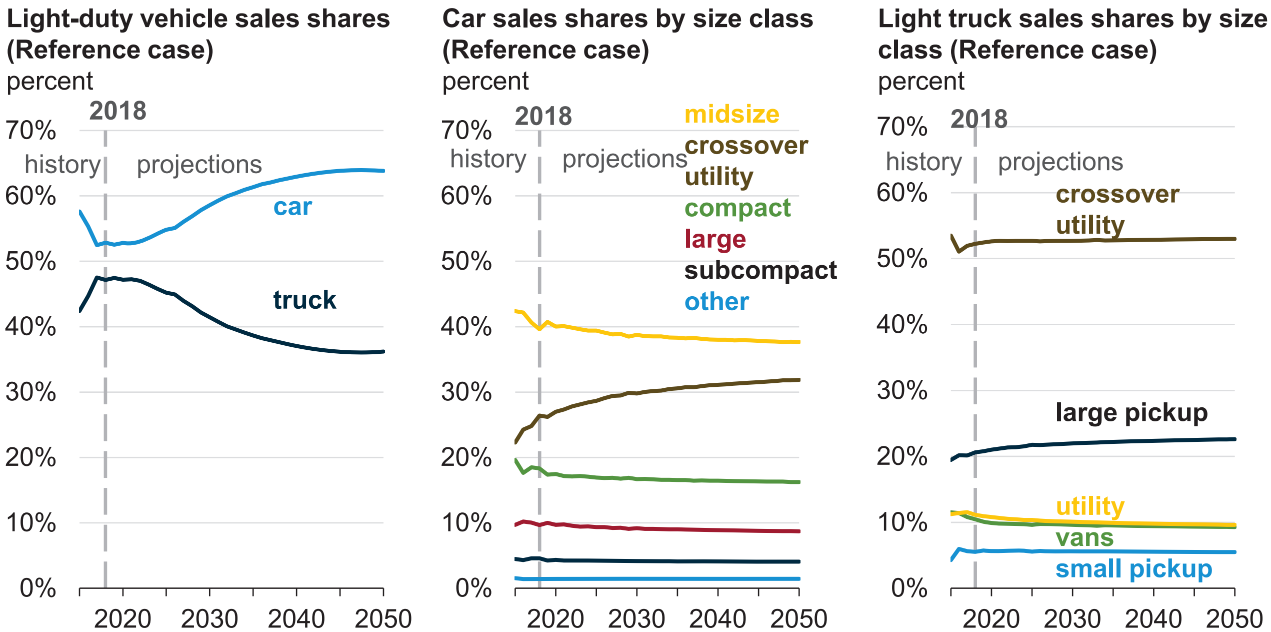
—across all vehicle types throughout the projection period

- The fuel economy of light-duty vehicles in use from 2018 to 2050 increases by 60% for cars and by 60% for light trucks in the Reference case. Across all light-duty vehicles, fuel efficiency improves by 65% from 2018 to 2050 as newer, more fuel-efficient vehicles enter the market, including a higher share of cars, which are more efficient than light trucks.

- Fuel economy of the heavy-duty vehicles in use improves across all weight classes as the second phase of heavy-duty vehicle efficiency and greenhouse gas standards takes full effect in 2027.

- Gains in fuel economy temper heavy-duty vehicle energy consumption growth and decrease light-duty vehicle energy consumption. After 2040, increasing vehicle travel outweighs fuel economy improvements, leading to increases in fuel demand.

Sales of more fuel-efficient cars and light-truck crossover utility vehicles increase—



—but traditional vehicle types maintain significant market share through 2050

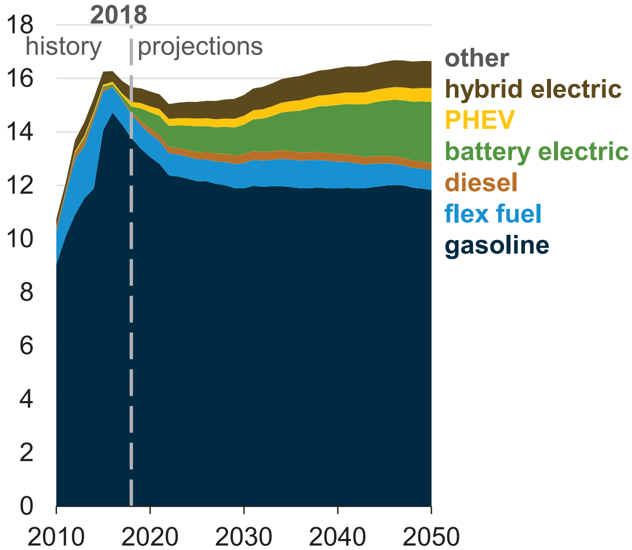
- Passenger cars gain light-duty vehicle market share relative to light-duty trucks because they have higher fuel efficiency in periods when motor gasoline prices increase and because crossover utility vehicles, often classified as passenger cars, may replace lower fuel economy light-truck classified utility vehicles as a result of increasing availability and popularity.

- Light trucks lose light-duty vehicle market share and see a shift away from traditional vans and utility vehicles toward crossover utility vehicles that are classified as higher fuel economy light trucks.

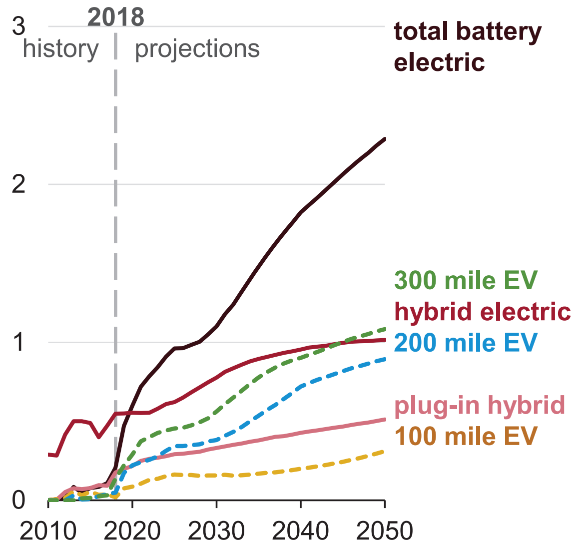
- Combined car and light truck classified crossover utility vehicles reach 40% of new light-duty vehicle sales in 2050, largely taking away sales from traditional compact, midsize, and large cars and from truck-based sport utility vehicles.

Alternative and electric vehicles gain market share in the Reference case—

Light-duty vehicle sales by fuel type (Reference case)
millions of vehicles



New vehicle sales of battery powered vehicles (Reference case)
millions of vehicles



—but gasoline vehicles remain the dominant vehicle type through 2050

- The combined share of sales attributable to gasoline and flex-fuel vehicles (which use gasoline blended with up to 85% ethanol) declines from 93% in 2018 to 75% in 2050 because of the growth in battery electric vehicle (BEV), plug-in hybrid electric vehicle (PHEV), and hybrid electric vehicle sales.

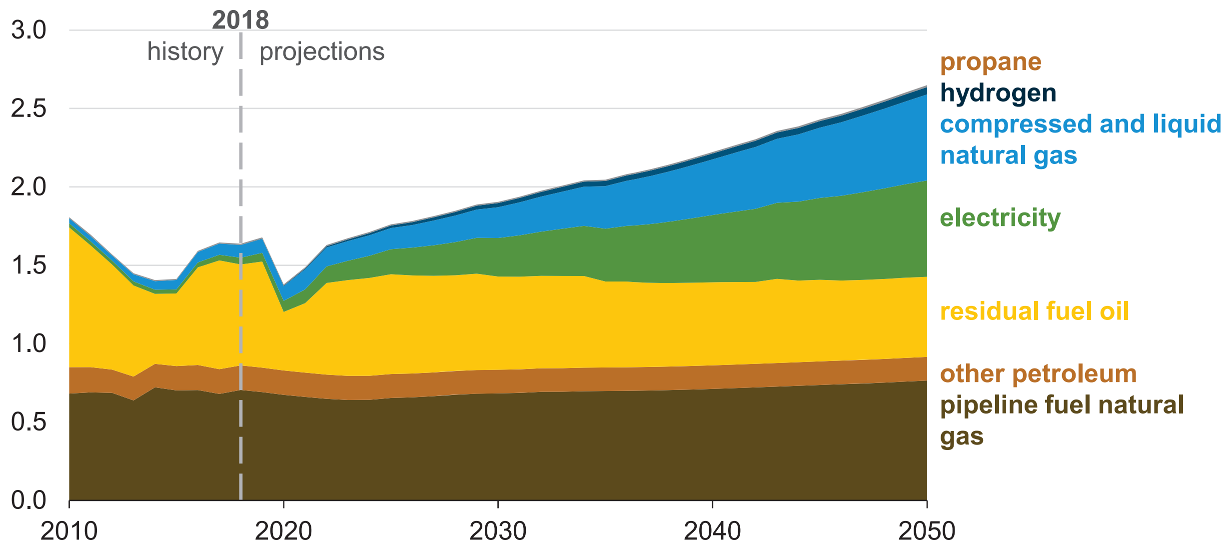
- California's Zero-Emission Vehicle regulation, which nine additional states have adopted, requires a minimum percentage of vehicle sales of BEV and PHEV. In 2025, the year the regulation and new federal fuel economy standards go into full effect, projected sales of BEV and PHEV reach 1.3 million, or about 8% of projected total vehicle sales in the Reference case.

- Sales of the longer ranged 200- and 300-mile BEVs grow during the entire projection period, tempering sales of the shorter-range 100-mile BEV and PHEV.

- New vehicles of all fuel types show significant improvements in fuel economy because of compliance with increasing fuel economy standards. New vehicle fuel economy rises by 43% from 2018 to 2050.

Consumption of transportation fuels grows considerably in the Reference case between 2018 and 2050—

Transportation sector consumption of minor petroleum and alternative fuels (Reference case)
quadrillion British thermal units



—because of increased use of electricity and natural gas

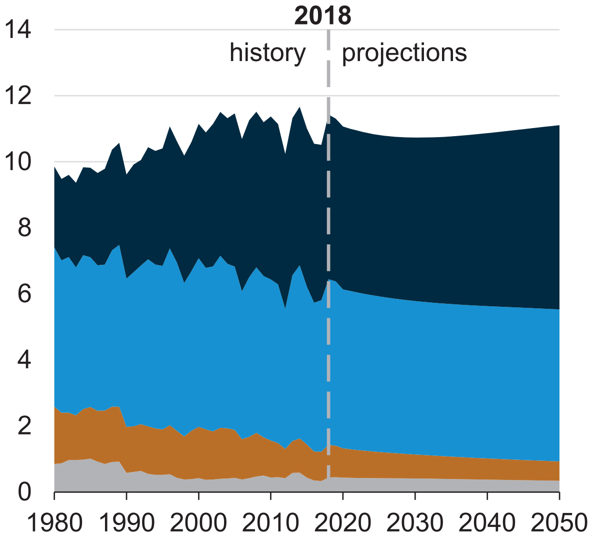
- Electricity use in the transportation sector increases sharply after 2020 in the Reference case because of the projected rise in the sale of new battery electric and plug-in hybrid-electric light-duty vehicles.
- Natural gas consumption increases during the entire projection period because of growing use in heavy-duty vehicles and freight rail.
- In the later years of the projection period, liquefied natural gas is used in the maritime industry as an alternative to burning high-sulfur residual fuel oil to meet the new standards set for marine fuels under the International Convention for the Prevention of Pollution from Ships (MARPOL convention).

Buildings

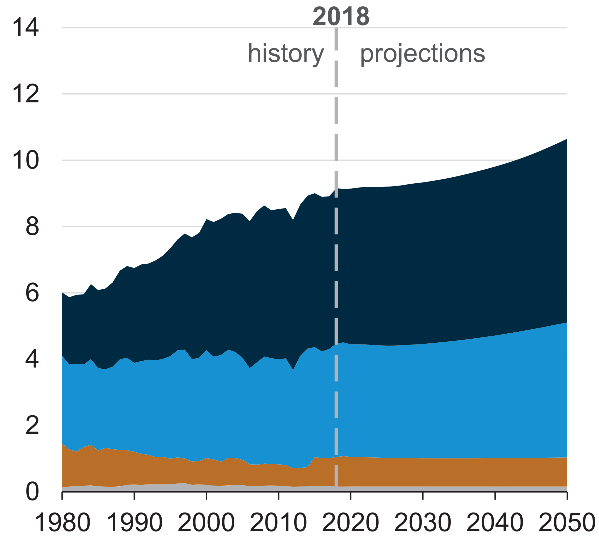
Delivered energy consumption and on-site generation in the residential and commercial buildings sectors are expected to grow through 2050 in the Reference case. At the same time, increasing demand for electricity and natural gas is partially offset by advances in energy efficiency.

Residential and commercial energy consumption grows slowly in the Reference case—

Residential sector energy consumption (Reference case)
quadrillion British thermal units



Commercial sector energy consumption (Reference case)
quadrillion British thermal units



electricity **natural gas** **petroleum and other liquids** **other**

—accounting for changes to energy efficiency standards and technological advances

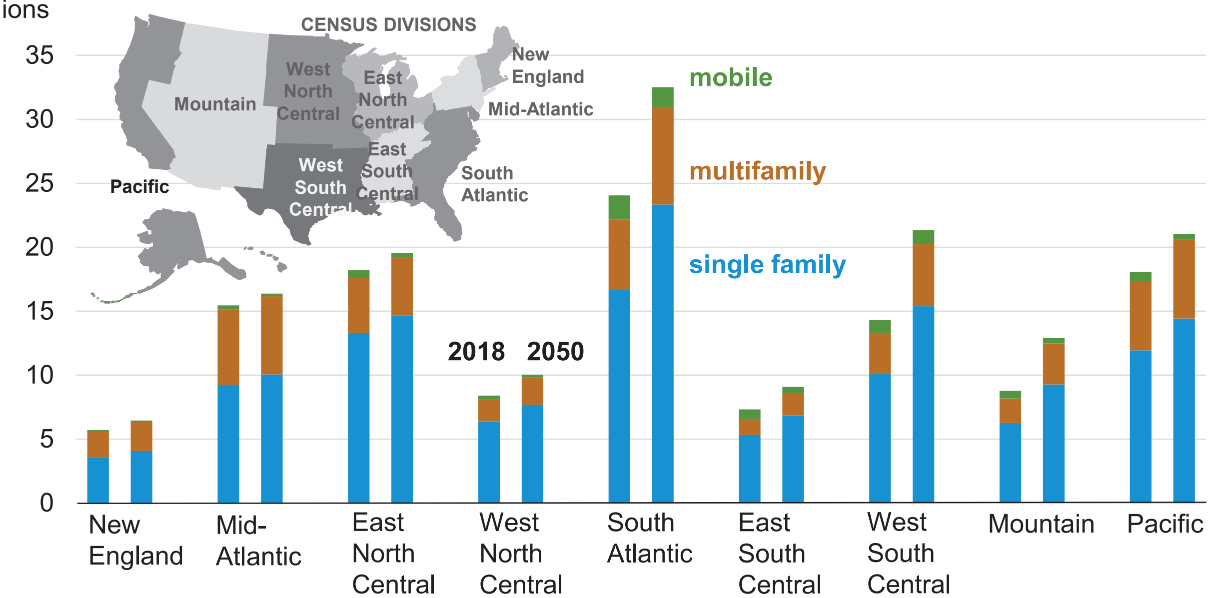
- In the AEO2019 Reference case, delivered energy consumption for buildings increases by 0.2% per year from 2018 to 2050, as growth outpaces energy efficiency improvements later in the projection period. Residential delivered energy consumption decreases by 0.1% per year to 2050 and commercial delivered energy consumption rises by 0.5% per year. Together, residential and commercial buildings account for 27% of U.S. total delivered energy consumption during the projection period.

- Electricity consumption grows in both sectors as a result of increased demand for electricity-using appliances, devices, and equipment. During the projection period, consumption of purchased electricity increases by 0.4% and 0.5% per year in the residential and commercial sectors, respectively.

- Natural gas consumption by commercial buildings grows by 0.5% per year from 2018 to 2050, led by increased natural gas-driven distributed generation (combined heat and power). Consumption of natural gas in the residential sector falls by 0.3% per year as its use for space heating continues to decline.

Residential housing stocks continue to grow—

Residential housing units (Reference case)
millions

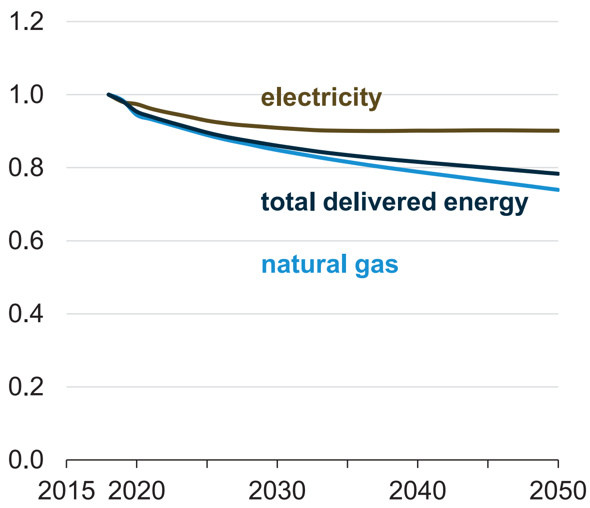


—especially in warmer regions with higher space cooling demand

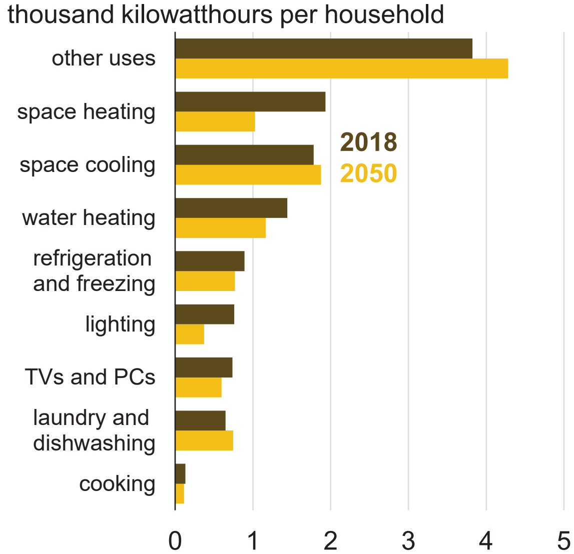
- The number of U.S. households increases by an average of 0.7% per year from 2018 through 2050, with single-family homes growing most quickly at 0.8% per year. Mobile home stocks decrease by 0.8% per year and are the only category not expected to grow.
- Cooling-dominated West South Central, South Atlantic, and East South Central census divisions all experience average annual housing stock growth that exceeds the national average.
- The size of housing units also continue to grow; the national average floorspace per home increases 0.3% per year from 1,779 square feet in 2018 to 1,978 square feet in 2050.

Residential energy intensity decreases in the Reference case—

Residential delivered energy intensity index (Reference case)
2018=1.0



Residential purchased electricity intensity (Reference case)
thousand kilowatthours per household



—although changes in electricity consumption vary by end use

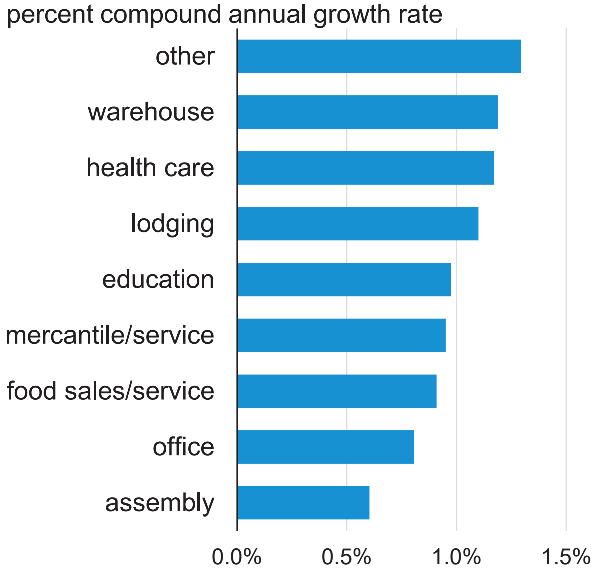
- Total delivered residential energy intensity, defined as annual delivered energy use per household, decreases by 22% from 2018 to 2050 as the number of households grows faster than energy use. The main factors contributing to this decline include gains in appliance efficiency, on-site electricity generation (e.g., solar photovoltaic), utility energy efficiency rebates, increasing residential natural gas prices, and lower space heating demand based on historical trends and a continued population shift to warmer regions.

- Lighting electricity consumption per household declines faster than other electric end uses as a result of compliance with minimum performance requirements of the Energy Independence and Security Act of 2007. The federal standards effectively eliminate low-efficacy incandescent lamps, replacing them with more energy-efficient light-emitting diodes (LEDs) and compact fluorescent lamps (CFLs) by 2020. Energy efficiency incentives also accelerate LED and CFL penetration before 2020. In 2050, purchased electricity intensity for lighting is 51% lower than in 2018.

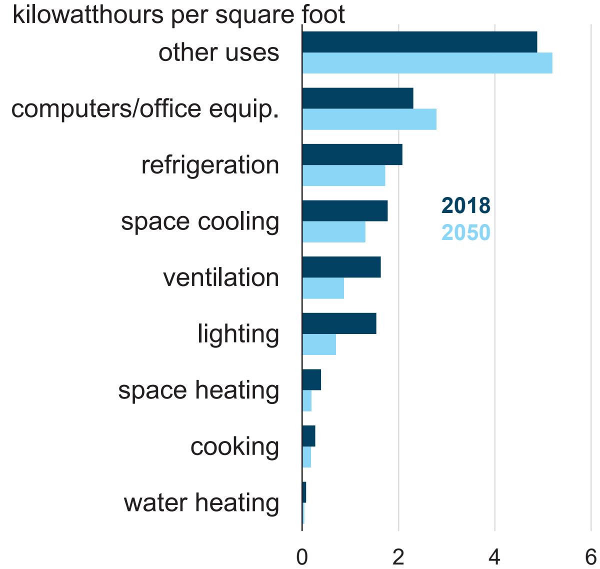
- As near-term appliance standards result in efficiency gains beyond those caused by market forces and technological change, electricity intensity declines the most quickly before 2030.

Commercial energy consumption growth is limited because of increased appliance and lighting efficiencies—

Commercial floorspace growth (Reference case)
percent compound annual growth rate



Purchased electricity consumption intensity (Reference case)
kilowatthours per square foot



—but growing floorspace and expanding information technology needs drive an overall increase in electricity consumption

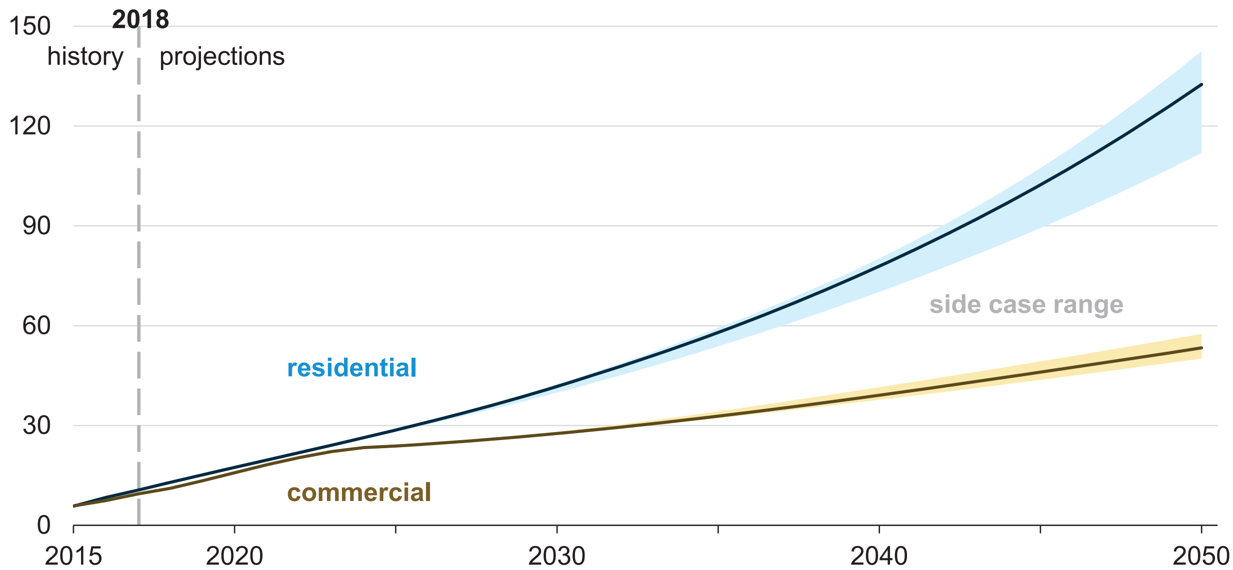
- Commercial floorspace grows by an average 1% per year in the Reference case through the projection period, reflecting rising economic output. Some of the fastest-growing building types, including health care and lodging, are also among the most energy-intensive.

- Commercial electricity intensity, defined as electricity consumption per square foot of commercial floorspace, declines at an average 0.4% per year from 2018 to 2050. Lighting accounts for the steepest intensity decline among the major end uses, as falling costs and energy efficiency incentives lead efficient light-emitting diodes to displace linear fluorescent lighting as the dominant commercial lighting technology by 2030.

- Improved appliance efficiency and a population shift to warmer regions of the United States cause commercial electricity consumption for space heating, water heating, and ventilation to decline by 29% from 2018 to 2050. This population shift causes space cooling intensity to decrease less rapidly, and commercial space cooling electricity consumption remains flat during the projection period.

- Although the United States has no federal building energy code, state- and local-level building codes also reduce energy used for heating and cooling in commercial buildings.

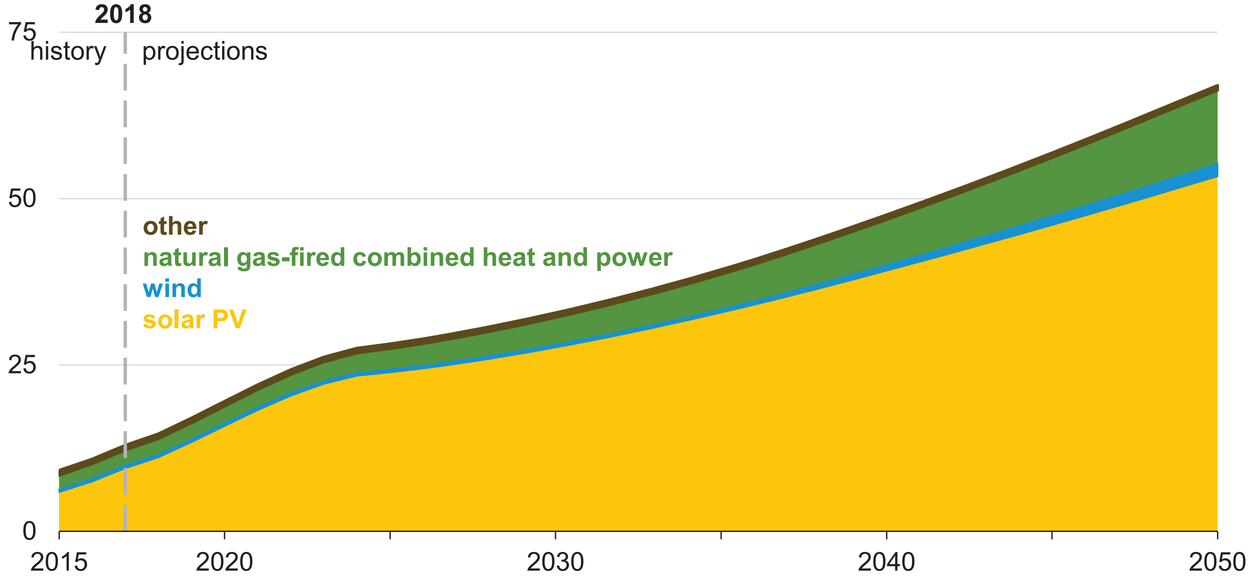
Rooftop solar PV adoption grows between 2018 and 2050—



—with residential growth outpacing commercial growth in later years

- Residential solar photovoltaic (PV) capacity increases by an average of 8% annually from 2018 through 2050 in the Reference case compared with the commercial sector's 5% per year average growth.
- PV costs decline most rapidly before 2030, despite the phasedown in the federal business Investment Tax Credit (ITC) from 30% in 2019 to 10% in 2022 and the four-year Section 201 tariff levied on PV cells and modules in 2018. Declining installation costs and stable retail electricity rates drive steady commercial PV adoption.
- Rising incomes, declining system costs, and social influences accelerate the adoption of residential PV. Adoption rates in the High and Low Economic Growth cases vary the most from the Reference case.
- Aside from installed PV costs, PV growth is sensitive to electricity prices, which vary by up to 11% in 2050 in the High and Low Oil and Gas Resource Technology cases relative to the Reference case for both the residential and commercial sectors.

Combined heat and power and other non-solar sources account for less than one-quarter of commercial on-site capacity in 2018—



—but they grow by more than 4% per year, driven by equipment cost declines and near-term tax credits

- Non-photovoltaic (PV) technologies such as combined heat and power (CHP) and distributed wind account for 24% of commercial distributed generation capacity in 2018. Although the growth is much slower than for commercial PV, these technologies grow from 3.5 gigawatts of capacity in 2018 to 13.6 gigawatts of capacity by 2050 in the Reference case.

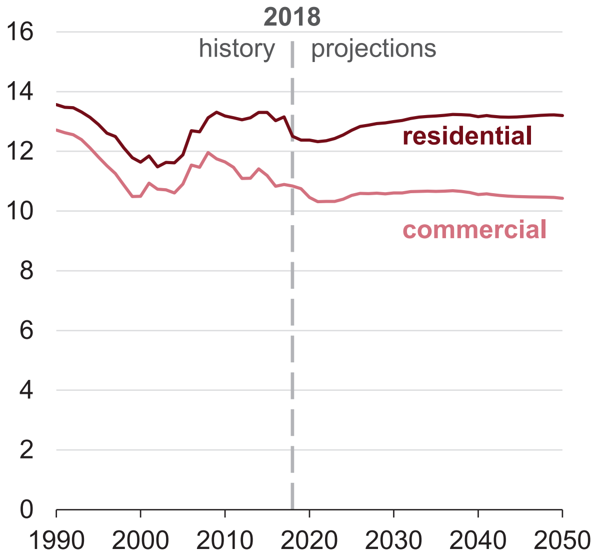
- Apart from PV, natural gas-fired CHP (i.e., conventional turbine, microturbine, reciprocating engine, and fuel cell) capacity expands the most quickly at an average of 5% per year. Its growth is a result of low equipment costs throughout the projection period.

- The installed cost of commercial wind equipment falls by 30% between 2018 and 2050, resulting in an average growth in capacity of 4% per year during this period.

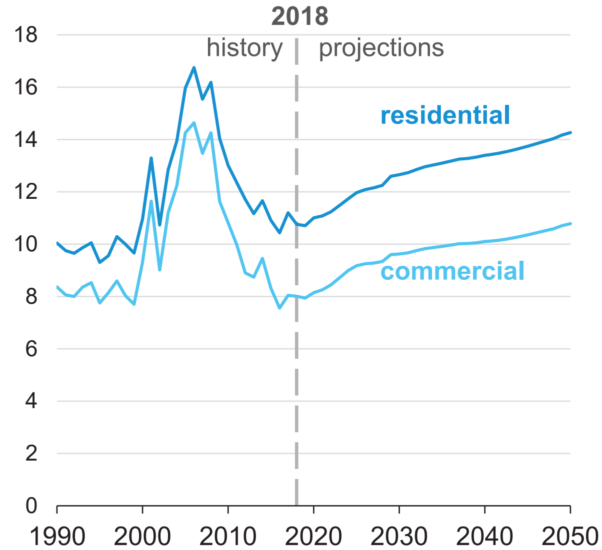
- The 2018 Bipartisan Budget Act extends the Investment Tax Credit provisions for qualifying CHP and small wind equipment (defined as wind turbines with a capacity less than 100 kW) beginning construction before January 1, 2022. These tax credits drive further growth in non-PV distributed generation in the short term.

Residential and commercial electricity prices remain flat during the projection period—

Electricity prices (Reference case)
2018 cents per kilowatthour



Natural gas prices (Reference case)
2018 dollars per thousand cubic feet



—while natural gas prices rise, moderating natural gas consumption

- Electricity prices fall in the near term, primarily because utilities pass along savings from lower taxes under the Tax Cuts and Jobs Act of 2017, but also because they replace more costly power plants with new plants that are less expensive to construct and operate. Lower prices encourage more consumption in the near term in both sectors, although near-term efficiency standards and population shifts to warmer areas of the country moderate this trend.

- Natural gas prices in both the residential and commercial sectors increase steadily by an average of 0.9% per year during the projection period. Increasing natural gas prices decrease consumption in the residential sector and moderate consumption growth in the commercial sector.

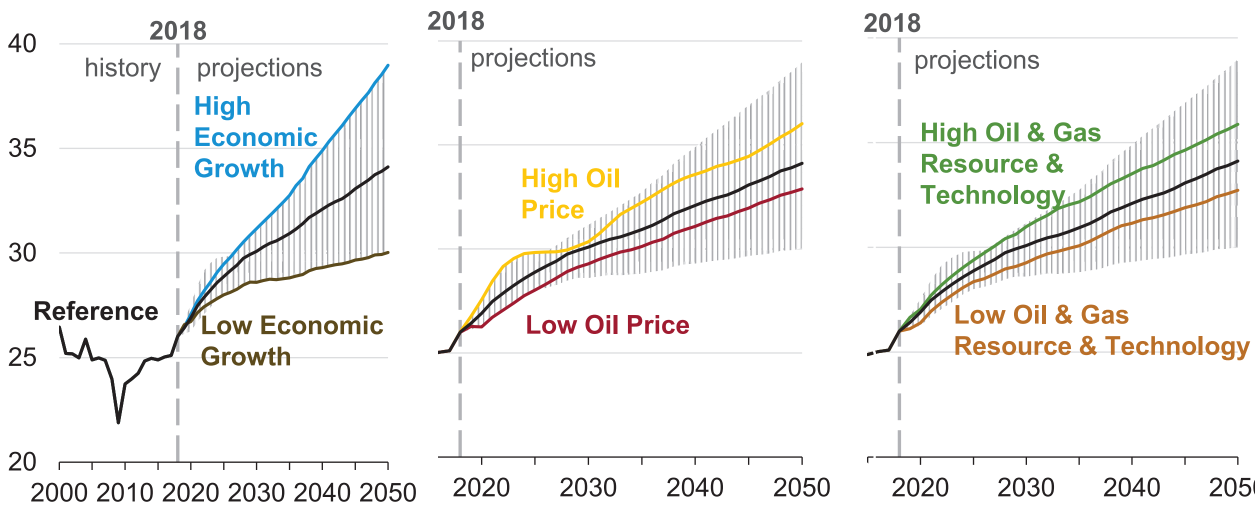
- Despite increasing natural gas prices, commercial natural gas consumption still grows an average of 0.5% per year during the projection period. This growth is driven in part by increased distributed generation and combined heat and power. Commercial natural gas-driven generating capacity in 2050 grows to nearly five times its 2018 level.

Industrial

Energy consumption in the industrial sector increases between 2018 and 2050 across all cases. Increases in industrial energy use from increasing shipments are partially offset by efficiency gains. Consumption of all energy sources except coal increases, while coal consumption declines.

Consumption of delivered industrial energy grows in all cases—

Industrial delivered energy consumption
quadrillion British thermal units



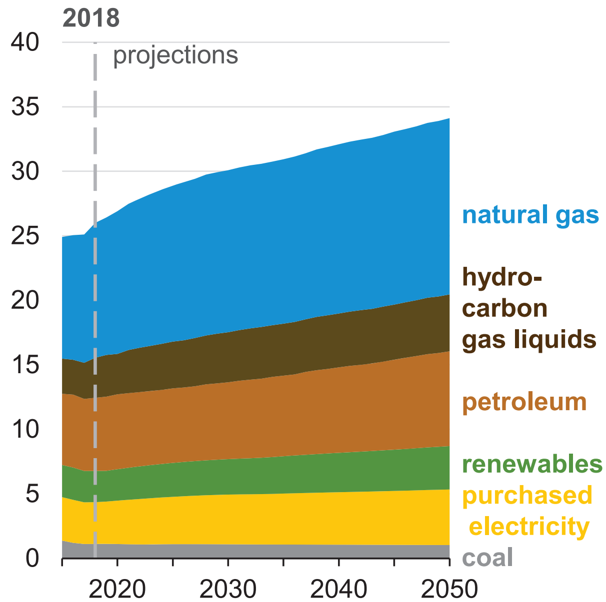
Note: The hatched area on each graph denotes the range between minimum and maximum values among all six side cases for that year.

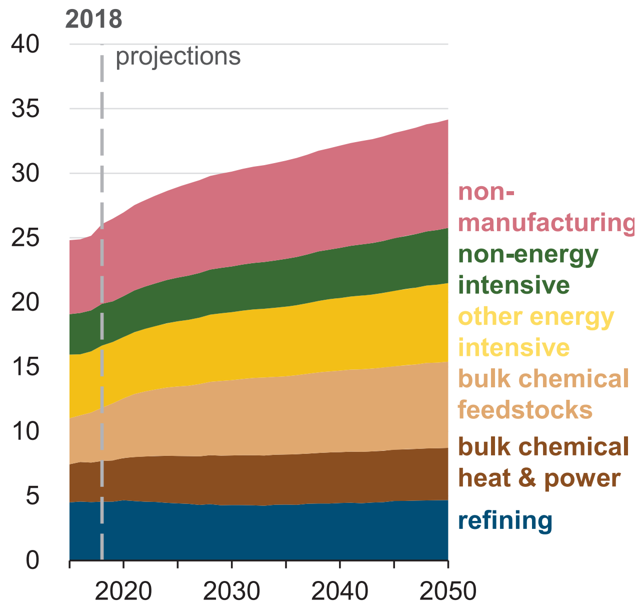
—driven by economic growth and affected by low prices and resource availability

- U.S. industrial delivered energy consumption in the Reference case grows 31% from 26 quadrillion British thermal units (Btu) to 34 quadrillion Btu between 2018 and 2050.
- By the mid-2020s, industrial energy consumption is highest in the High Economic Growth case, reaching 39 quadrillion Btu in 2050, a 50% increase from 2018. With a faster growing economy, more industrial output such as in food and fabricated metal products increases industrial energy use.
- Initially, industrial energy consumption in the High Oil Price case exceeds consumption in the other cases as a result of higher demand for U.S. products and increased energy use for natural gas liquefaction. After this period, consumption expenditures and investment decline because higher crude oil prices effectively lower income, as well as output growth and energy consumption growth.
- Energy consumption in the High Oil and Gas Resource Technology case is higher than in the Reference case as a result of increased crude oil and natural gas resources and improved extraction technologies that increase energy demand in the mining industry.

Industrial sector energy consumption increases at a similar rate for most fuels in the Reference case—

Industrial energy consumption by energy source and subsector (Reference case)
quadrillion British thermal units





—and bulk chemicals and nonmanufacturing are the fastest-growing industries

- Total industrial delivered energy consumption grows 0.9% per year on average from 2018 to 2050 in the Reference case. All fuels, except coal, have a similar growth rate, declining slightly during the projection period. Industrial energy consumption grows more slowly than economic growth because of increasing energy efficiency.

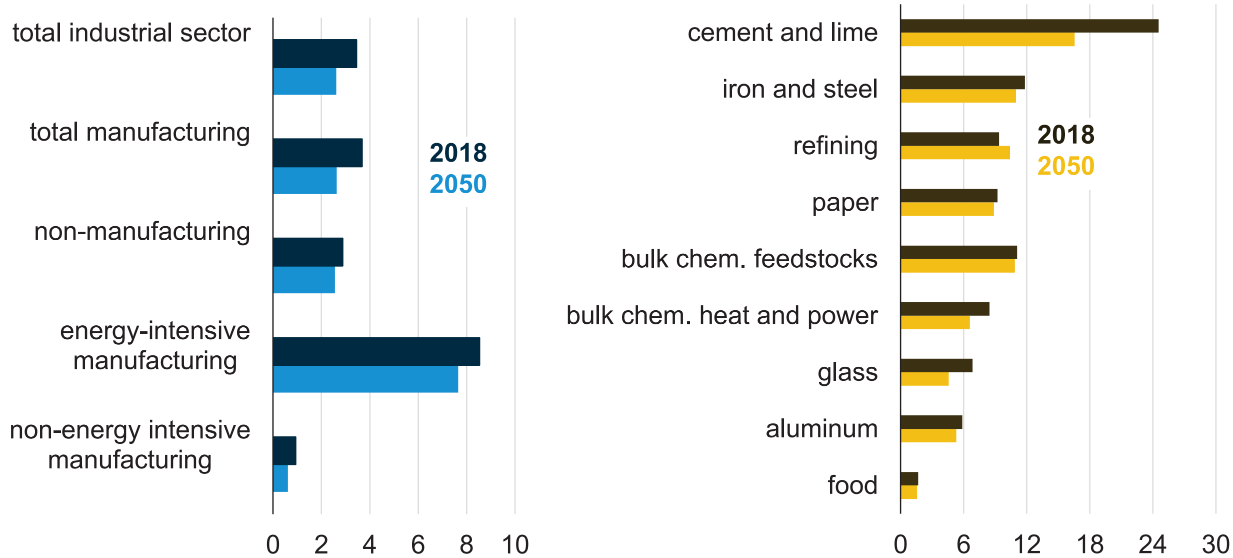
- Natural gas and petroleum (including hydrocarbon gas liquids) account for most delivered industrial energy consumption. Hydrocarbon gas liquids such as ethane are used as feedstock for bulk chemical production and are a major source of growth in the industrial use of petroleum.

- Energy consumption in the bulk chemicals industry, including both heat and power and feedstocks, accounts for about 30% of total industrial energy consumption and grows at 1.2% per year.

- Nonmanufacturing industries' energy consumption grows 1.0% per year from 2018 to 2050. While energy use to liquefy natural gas for export grows at 5.0% per year, construction energy consumption grows relatively quickly at 1.2% per year. Agriculture energy consumption growth is much slower because of relatively slow distillate growth. Distillate is used for off-road vehicles.

In the Reference case, energy intensities decline in almost all energy-intensive industries—

Energy intensity by subsector and energy intensive manufacturing industry (Reference case)
trillion British thermal units per billion 2009 dollar shipments



—reflecting efficiency gains in existing capacity and implementation of new, more energy-efficient technologies

- Energy intensity in the industrial sector (energy consumption per dollar of output) declines by 0.9% per year on average from 2018 to 2050 in the Reference case. In manufacturing, energy intensity declines as a result of increased energy efficiency of new capital equipment and a shift in the share of production away from energy-intensive industries toward non-energy intensive industries, such as metal-based durables.

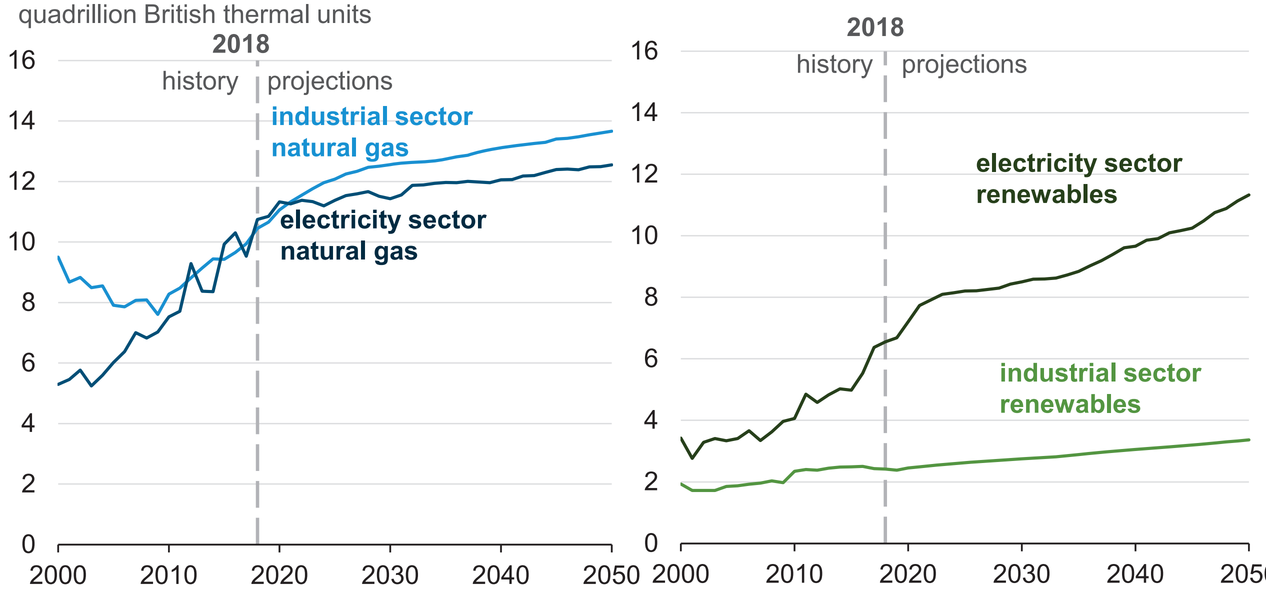
- Although the energy-intensive manufacturing industries' energy intensity declines by a little more than 10%, the non-energy-intensive manufacturing industries see a decline three times faster between 2018 and 2050 because these non-energy intensive manufacturing industries use less heat. Cement and lime intensity declines the most during the projection period, because, to some extent, the dry cement manufacturing process replaces the more energy-intensive wet process during the projection period.

- For some industries, large amounts of combined heat and power generation (CHP) may mask some efficiency gains. CHP generation losses are included in industry energy consumption, but purchased electricity generation losses are included in the electricity sector.

In the Reference case, industrial natural gas use exceeds electricity sector natural gas use—

Natural gas and renewables consumption in the industrial and electric power sectors (Reference case)

quadrillion British thermal units



—while industrial renewables consumption declines relative to renewables consumption in the electricity sector

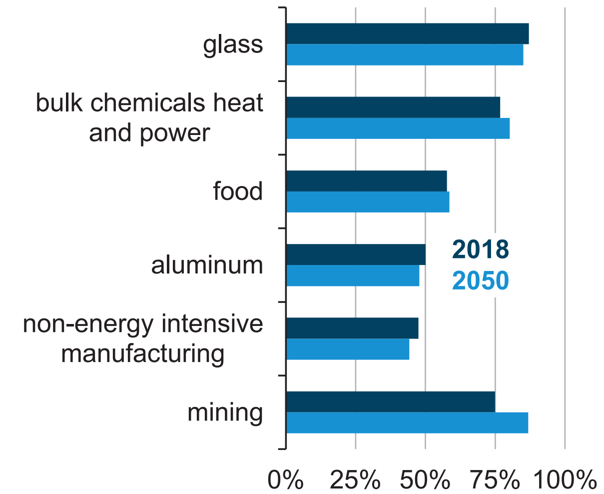
- After consuming about the same amount of natural gas as the electricity sector through the 2010s, the industrial sector uses relatively more natural gas after the mid-2020s. Increased natural gas use for heat and power, as lease and plant fuel, and increased energy use for liquefaction lead to higher growth in the industrial sector than in the electricity sector.

- Growth in natural gas-fired electricity slows relative to historical growth rates as a result of the widespread adoption of natural gas-fired generation in previous years. Natural gas replaced coal as the dominant generation fuel by 2015. In addition, electricity from renewables will increase more rapidly than in the past. Both factors slow the future growth of natural-gas fired generation relative to recent years.

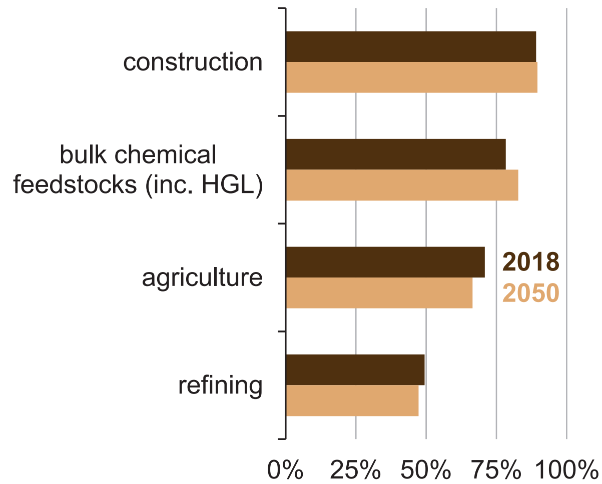
- Renewables consumption, including municipal solid waste, in the industrial sector and electricity sector diverges between 2018 and 2050. Renewables consumption grows nearly twice as fast in the electricity sector (1.7% per year) than in the industrial sector (1.0% per year) during the projection period. In a few industries—notably food, paper, and wood—renewables already account for a substantial share of total consumption. Other industries, such as bulk chemicals and steel, cannot economically consume renewables.

Several industries continue to use natural gas for a large share of their energy needs in the Reference case—

Natural gas share of energy used for high relative natural gas consumers (Reference case)
percent of total



Petroleum share of energy used for high relative petroleum consumers (Reference case)
percent of total



—while fewer industries rely more on petroleum

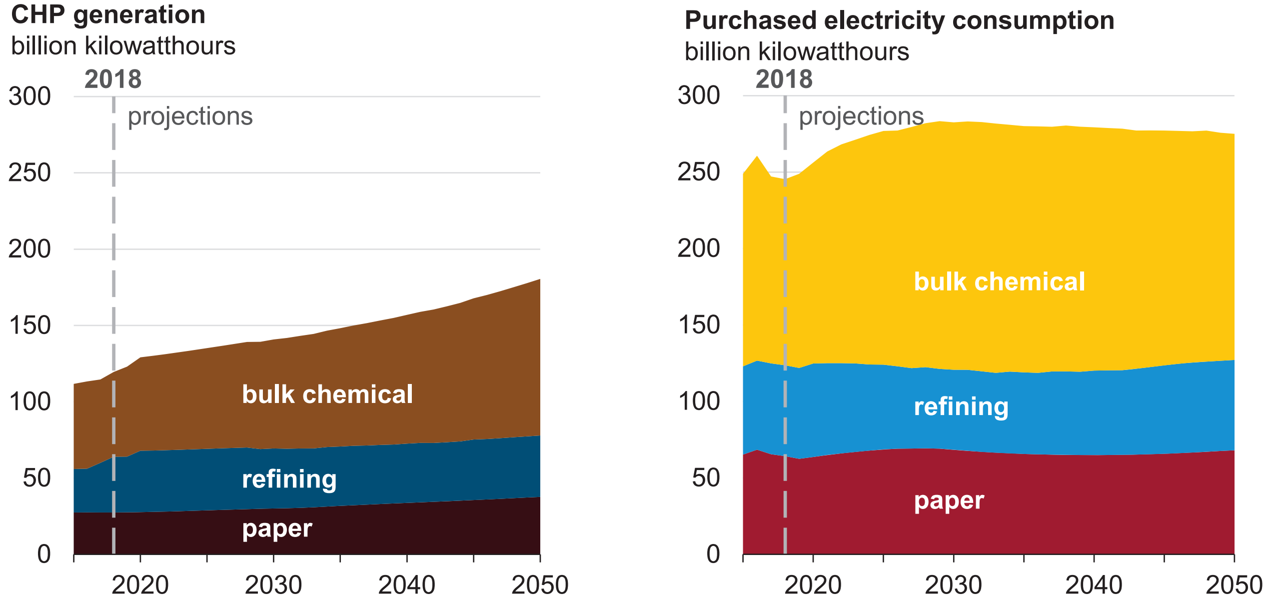
- In the Reference case, four energy-intensive manufacturing industries, the entire non-energy intensive manufacturing subsector, and the mining industry used natural gas for more than 40% of their fuel needs. Combined, these industries consumed 7.2 quadrillion British thermal units (Btu) in 2018, or about 70% of total industrial natural gas consumption. These industries consume 10.0 quadrillion Btu of natural gas in 2050.

- These industries use natural gas in different ways. The glass industry uses natural gas for high temperature furnaces. Food and bulk chemicals heat and power use natural gas for heating, steam production, and power generation. The aluminum industry uses natural gas in electric arc furnaces. Non-energy intensive industries use natural gas for heating and cooling buildings. Mining uses natural gas for lease and plant fuel and for a new use—energy to liquefy natural gas for export.

- Four industries use petroleum for more than 40% of their energy needs. Combined, these industries consume 8.8 quadrillion Btu of petroleum in 2018, or about 90% of total industrial consumption, and consumption grows to 11.8 quadrillion Btu in 2050. Agriculture and construction use petroleum mostly for off-road vehicles, while refining uses petroleum, such as still gas, for heat and power. More than 75% of total bulk chemical feedstocks are petroleum products (including hydrocarbon gas liquids).

Self-generation from combined heat and power (CHP), especially for bulk chemicals, grows—

CHP and purchased electricity consumption for three industries with most installed CHP (Reference case)



—even though electricity purchases for major CHP users remain flat during the projection period in the Reference case

- Electricity generation from CHP in bulk chemicals, refining, and paper—industries with the most CHP—grows 1.3% per year, from 120 billion kilowatthours (kWh) in 2018 to 181 billion kWh in 2050.
- Bulk chemicals, refining, and paper use the most CHP because they are large industries with high heating needs, and steam is available to use for generation. In 2018, the ratio of CHP generation to purchased electricity is approximately 50% in these industries. By 2050, this ratio climbs to 65%, largely as a result of CHP growth in the bulk chemicals industry.
- While the bulk chemicals industry CHP generation is 90% natural gas-fired or more, the refining and paper industries use sizeable quantities of other fuels. Most paper industry CHP generation is fired by renewables such as black liquor (a byproduct of the pulping process). The refinery industry also uses still gas, a byproduct fuel, for CHP generation. About two-thirds of refining generation is natural gas-fired.
- Of the remaining industries, food and steel have substantial, but much less, CHP than bulk chemicals, paper, and refining. Most other industries have little or no CHP.

References

Commonly used acronyms and abbreviations in this report

AEO = Annual Energy Outlook
b = barrel(s)
BEV = battery-electric vehicle
b/d = barrels per day
bkWh = billion kilowatthours
Btu = British thermal unit(s)
CFL = compact fluorescent lamp
CHP = combined heat and power
CO2 = carbon dioxide
EIA = U.S. Energy Information Administration
gal = gallon(s)
GDP = gross domestic product
GW = gigawatt(s)
HGL = hydrocarbon gas liquid(s)
ITC = Investment Tax Credit
kWh = kilowatthour(s)
LED = light-emitting diode
LNG = liquefied natural gas
MARPOL = *marine pollution*, the International Convention for the Prevention of Pollution from Ships
MMBtu = million British thermal units
MMst = million short tons
NEMS = National Energy Modeling System
NGPL = natural gas plant liquids
PHEV = plug-in hybrid electric vehicle
PTC = production tax credit
PV = photovoltaic
Tcf = trillion cubic feet
ZEV = zero-emission vehicle

Graph sources

In general:

- Projected values are sourced from:
  - *Short-Term Energy Outlook*, October 2018
  - Projections: EIA, AEO2019 National Energy Modeling System (runs: ref2019.d111618a, highprice.d111618a, lowprice.d111618a, highmacro.d111618a, lowmacro.d111618a, highrt.d111618a, lowrt.d111618a)
- Historical data are sourced from:
  - *Monthly Energy Review* (and supporting databases), September 2018
  - IHS Markit, Macroeconomic, Industry, and Employment models, May 2018

The history in some graphs are based off of other sources. For source information for specific graphs published in this document, contact annualenergyoutlook@eia.gov.

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For more information

U.S. Energy Information Administration homepage | https://www.eia.gov/

Short-Term Energy Outlook | https://www.eia.gov/outlooks/steo/report/

Annual Energy Outlook | https://www.eia.gov/outlooks/aeo/

International Energy Outlook | https://www.eia.gov/outlooks/ieo/

Monthly Energy Review | https://www.eia.gov/totalenergy/data/monthly/

Today in Energy | https://www.eia.gov/todayinenergy/

Table V.B2.—Additional Economic Factors (Cont.)

Calendar year	Average annual unemployment rate[a]	Annual percentage change[b] in— Labor force[c]	Total employment[d]	Real GDP[e]	Average annual interest rate Nominal[f]	Real[g]
Intermediate:						
2018	4.4	1.1	1.1	2.7	2.7	0.1
2019	4.9	1.3	.9	2.6	3.4	.2
2020	5.3	1.3	.8	2.6	3.9	.8
2021	5.5	1.0	.7	2.5	4.3	1.3
2022	5.5	.7	.7	2.4	4.6	1.7
2023	5.5	.7	.7	2.4	4.9	2.0
2024	5.5	.7	.7	2.4	5.1	2.3
2025	5.5	.6	.6	2.3	5.2	2.5
2026	5.5	.6	.6	2.2	5.3	2.6
2027	5.5	.6	.6	2.2	5.3	2.7
2030	5.5	.5	.5	2.1	5.3	2.7
2035	5.5	.4	.4	2.1	5.3	2.7
2040	5.5	.5	.5	2.1	5.3	2.7
2045	5.5	.5	.5	2.2	5.3	2.7
2050	5.5	.5	.5	2.1	5.3	2.7
2055	5.5	.5	.5	2.1	5.3	2.7
2060	5.5	.4	.4	2.1	5.3	2.7
2065	5.5	.4	.4	2.0	5.3	2.7
2070	5.5	.4	.4	2.1	5.3	2.7
2075	5.5	.5	.5	2.1	5.3	2.7
2080	5.5	.5	.5	2.1	5.3	2.7
2085	5.5	.5	.5	2.1	5.3	2.7
2090	5.5	.4	.4	2.1	5.3	2.7
2095	5.5	.4	.4	2.0	5.3	2.7

THE 2018 ANNUAL REPORT OF THE BOARD OF TRUSTEES OF THE FEDERAL OLD-AGE AND SURVIVORS INSURANCE AND FEDERAL DISABILITY INSURANCE TRUST FUNDS

COMMUNICATION

FROM

THE BOARD OF TRUSTEES, FEDERAL OLD-AGE AND SURVIVORS INSURANCE AND FEDERAL DISABILITY INSURANCE TRUST FUNDS

TRANSMITTING

THE 2018 ANNUAL REPORT OF THE BOARD OF TRUSTEES OF THE FEDERAL OLD-AGE AND SURVIVORS INSURANCE AND FEDERAL DISABILITY INSURANCE TRUST FUNDS

LETTER OF TRANSMITTAL

BOARD OF TRUSTEES OF THE
FEDERAL OLD-AGE AND SURVIVORS INSURANCE AND
FEDERAL DISABILITY INSURANCE TRUST FUNDS,
Washington, D.C., June 5, 2018

HON. PAUL D. RYAN,
Speaker of the House of Representatives.

HON. MICHAEL R. PENCE,
President of the Senate.

DEAR MR. SPEAKER AND MR. PRESIDENT:

We have the honor of transmitting to you the 2018 Annual Report of the Board of Trustees of the Federal Old-Age and Survivors Insurance and Federal Disability Insurance Trust Funds, the 78th such report.

Respectfully,

Steven T. Mnuchin

STEVEN T. MNUCHIN,
Secretary of the Treasury,
and Managing Trustee of the Trust Funds.

R. ALEXANDER ACOSTA,
Secretary of Labor,
and Trustee.

ALEX M. AZAR II,
Secretary of Health and Human Services,
and Trustee.

NANCY A. BERRYHILL,
Acting Commissioner
of Social Security, and Trustee.

VACANT,
Public Trustee.

VACANT,
Public Trustee.

Mark J. Warshawsky

MARK J. WARSHAWSKY,
Deputy Commissioner
for Retirement and Disability Policy,
Social Security Administration,
and Acting Secretary, Board of Trustees.

CONTENTS

THE 2018 ANNUAL REPORT OF THE BOARD OF TRUSTEES OF THE FEDERAL OLD-AGE AND SURVIVORS INSURANCE AND FEDERAL DISABILITY INSURANCE TRUST FUNDS

I. INTRODUCTION

The Old-Age, Survivors, and Disability Insurance (OASDI) program makes monthly income available to insured workers and their families at retirement, death, or disability. The OASDI program consists of two parts. Retired workers, their families, and survivors of deceased workers receive monthly benefits under the Old-Age and Survivors Insurance (OASI) program. Disabled workers and their families receive monthly benefits under the Disability Insurance (DI) program.

The Social Security Act established the Board of Trustees to oversee the financial operations of the OASI and DI Trust Funds. The Board is composed of six members. Four members serve by virtue of their positions in the Federal Government: the Secretary of the Treasury, who is the Managing Trustee; the Secretary of Labor; the Secretary of Health and Human Services; and the Commissioner of Social Security. The President appoints and the Senate confirms the other two members to serve as public representatives. These two positions are currently vacant. The Deputy Commissioner of the Social Security Administration serves as Secretary of the Board.

The Social Security Act requires that the Board, among other duties, report annually to the Congress on the actuarial status and financial operations of the OASI and DI Trust Funds. The 2018 report is the 78th such report.

II. OVERVIEW

A. HIGHLIGHTS

This section summarizes the report's major findings.

In 2017

At the end of 2017, the OASDI program was providing benefit payments[1] to about 62 million people: 45 million retired workers and dependents of retired workers, 6 million survivors of deceased workers, and 10 million disabled workers and dependents of disabled workers. During the year, an estimated 174 million people had earnings covered by Social Security and paid payroll taxes on those earnings. Total expenditures in 2017 were $952 billion. Total income was $997 billion, which consisted of $911 billion in non-interest income and $85 billion in interest earnings. Asset reserves held in special issue U.S. Treasury securities grew from $2,848 billion at the beginning of the year to $2,892 billion at the end of the year.

Short-Range Results

Under the Trustees' intermediate assumptions, Social Security's total cost is projected to exceed its total income in 2018 for the first time since 1982, and remain higher throughout the projection period. Social Security's cost has exceeded its non-interest income since 2010. For 2018, cost for the program is projected to exceed total income by $2 billion and non-interest income by $85 billion. As a result, asset reserves will decline during 2018. Reserves are also projected to decline throughout the remainder of the short-range period.

To illustrate the actuarial status of the Social Security program as a whole, the operations of the OASI and DI funds are often shown on a combined basis as OASDI. However, by law, the two funds are separate entities and therefore the combined fund operations and reserves are hypothetical.

The reserves of the combined OASI and DI Trust Funds along with projected program income are adequate to cover projected program cost over the next 10 years under the intermediate assumptions. The ratio of reserves to annual cost declines from 288 percent at the beginning of 2018 to 137 percent at the beginning of 2027. By remaining at or above 100 percent, the combined OASI and DI Trust Funds therefore satisfy the short-range test of financial adequacy.[2] Considered separately, the OASI Trust Fund also satisfies the

[1] The definitions of "benefit payments" and other terms appear in the Glossary.

[2] The test of short-range financial adequacy for a trust fund is met if (1) the estimated trust fund ratio is at least 100 percent at the beginning of the period and remains at or above 100 percent throughout the 10-year short-range period or (2) the ratio is initially less than 100 percent, reaches at least 100 percent within 5 years (without reserve depletion at any time during this period) and remains at or above 100 percent throughout the remainder of the 10-year short-range period.

test, but the DI Trust Fund does not. For last year's report, the Trustees projected that combined reserves would be 287 percent of annual cost at the beginning of 2018 and 148 percent at the beginning of 2027. The combined reserves are projected to decrease from $2,892 billion at the beginning of 2018 to $2,189 billion at the end of 2027.

Long-Range Results

Under the Trustees' intermediate assumptions, OASDI cost is projected to exceed total income throughout the projection period, and the dollar level of the hypothetical combined trust fund reserves declines until reserves become depleted in 2034.[1] Figure II.D2 shows the implications of reserve depletion for the combined OASI and DI Trust Funds. Considered separately, the DI Trust Fund reserves become depleted in 2032 and the OASI Trust Fund reserves become depleted in 2034. In last year's report, the projected reserve depletion years were 2034 for OASDI, 2028 for DI, and 2035 for OASI.

The change in the reserve depletion date for DI is largely due to continuing favorable experience for DI applications and benefit awards. Disability applications have been declining steadily since 2010, and the total number of disabled-worker beneficiaries in current payment status has been falling since 2014. For this report, ultimate disability incidence rate assumptions are unchanged from the last report. However, this year's report has lower incidence rates over the first few years of the projection period, and a gradual rise from recent low levels, reaching the ultimate DI incidence rates by the end of the short-range period. In addition, average benefit levels for disabled-worker beneficiaries were lower than expected in 2017, and are expected to be lower in the future. Disabled-worker average benefit levels were somewhat elevated in 2011 through 2016 due to reduced numbers of hearings decisions (where monthly benefit levels tend to be relatively low), as the number of applicants awaiting a hearing increased. In 2017, hearings decisions increased, thus restoring a more normal, and somewhat lower, average benefit level for disabled workers newly awarded benefits in 2017. See page 38 for more details on these changes in DI projections. These changes, which are partially offset by lower payroll tax revenue in the near term, are primarily responsible for the change in the DI reserve depletion

[1] Combined trust fund reserves are clearly hypothetical after one fund becomes depleted, because under current law the funds cannot borrow from each other. For example, if the DI Trust Fund reserves were to become depleted in 2032 as is currently projected, the operations of the OASI and DI Trust Funds, shown in this report on a hypothetical combined basis, would not reflect the aggregated operation of the OASI Trust Fund and the DI Trust Fund because part of the DI benefits could not be paid without a change in the law. Implicitly, the values shown for the hypothetical combined trust funds assume the law will have been changed to permit the transfer of resources between funds as needed.

date from early in 2028 in last year's report to late in 2032 in this year's report.

Projected OASDI cost increases more rapidly than projected non-interest income through 2039 primarily because the retirement of the baby-boom generation will increase the number of beneficiaries much faster than the number of covered workers increases, as subsequent lower-birth-rate generations replace the baby-boom generation at working ages. From 2040 to 2052, the cost rate (the ratio of program cost to taxable payroll) generally declines because the aging baby-boom generation is gradually replaced at retirement ages by subsequent lower-birth-rate generations. Thereafter, increases in life expectancy cause OASDI cost to increase generally relative to non-interest income, but more slowly than between 2010 and 2039.

The projected OASDI annual cost rate increases from 13.81 percent of taxable payroll for 2018 to 16.83 percent for 2039 and to 17.68 percent for 2092, a level that is 4.32 percent of taxable payroll more than the projected income rate (the ratio of non-interest income to taxable payroll) for 2092. For last year's report, the Trustees estimated the OASDI cost for 2092 at 17.84 percent, or 4.53 percent of payroll more than the annual income rate for that year. Expressed in relation to the projected gross domestic product (GDP), OASDI cost generally rises from 4.9 percent of GDP for 2018 to about 6.1 percent by 2038, then declines to 5.9 percent by 2052, and then generally increases to 6.1 percent by 2092.

For the 75-year projection period, the actuarial deficit is 2.84 percent of taxable payroll, increased from 2.83 percent of taxable payroll in last year's report. The closely-related open group unfunded obligation for OASDI over the 75-year period is 2.68 percent of taxable payroll, increased from 2.66 percent of payroll in last year's report. The open group unfunded obligation for OASDI over the 75-year period is $13.2 trillion in present value and is $0.7 trillion more than the measured level of $12.5 trillion a year ago. If the assumptions, methods, starting values, and the law had all remained unchanged, the actuarial deficit would have increased to 2.88 percent of taxable payroll, and the unfunded obligation would have risen to about 2.72 percent of taxable payroll and $13.1 trillion in present value due to the change in the valuation date. The remaining changes in the actuarial deficit and the unfunded obligation are due to the combined effects of changes in the law, methods, starting values, and assumptions.

To illustrate the magnitude of the 75-year actuarial deficit, consider that for the combined OASI and DI Trust Funds to remain fully solvent throughout the 75-year projection period: (1) revenues would have to increase by an amount equivalent to an immediate and permanent payroll tax rate increase of 2.78 percentage points[1] to 15.18 percent, (2) scheduled benefits would have to be reduced by an amount equivalent to an immediate and permanent reduction of about 17 percent applied to all current and future beneficiaries, or about 21 percent if the reductions were applied only to those who become initially eligible for benefits in 2018 or later; or (3) some combination of these approaches would have to be adopted.

If substantial actions are deferred for several years, the changes necessary to maintain Social Security solvency would be concentrated on fewer years and fewer generations. Much larger changes would be necessary if action is deferred until the combined trust fund reserves become depleted in 2034. For example, maintaining 75-year solvency with changes that begin in 2034 would require: (1) an increase in revenues by an amount equivalent to a permanent 3.87 percentage point payroll tax rate increase to 16.27 percent starting in 2034, (2) a reduction in scheduled benefits by an amount equivalent to a permanent 23 percent reduction in all benefits starting in 2034, or (3) some combination of these approaches would have to be adopted.

Conclusion

Under the intermediate assumptions, DI Trust Fund asset reserves are projected to become depleted in 2032, at which time continuing income to the DI Trust Fund would be sufficient to pay 96 percent of DI scheduled benefits. The OASI Trust Fund reserves are projected to become depleted in 2034, at which time OASI income would be sufficient to pay 77 percent of OASI scheduled benefits.

The Trustees also project that annual cost for the OASDI program will exceed total income (including interest) throughout the projection period under the intermediate assumptions. The projected hypothetical combined OASI and DI Trust Fund asset reserves become depleted and unable to pay scheduled benefits in full on a timely basis in 2034. At the time of depletion of these combined reserves, continuing income to the combined trust funds would be sufficient to pay 79 percent of scheduled benefits. Lawmakers have a broad continuum of policy options that would close or reduce Social Security's long-term financing shortfall. Cost estimates for many such policy options are available at www.ssa.gov/OACT/solvency/provisions/.

[1] The necessary tax rate of 2.78 percent differs from the 2.84 percent actuarial deficit for two reasons. First, the necessary tax rate is the rate required to maintain solvency throughout the period that does not result in any trust fund reserve at the end of the period, whereas the actuarial deficit incorporates an ending trust fund reserve equal to 1 year’s cost. Second, the necessary tax rate reflects a behavioral response to tax rate changes, whereas the actuarial deficit does not. In particular, the calculation of the necessary tax rate assumes that an increase in payroll taxes results in a small shift of wages and salaries to forms of employee compensation that are not subject to the payroll tax.

Overview

The Trustees recommend that lawmakers address the projected trust fund shortfalls in a timely way in order to phase in necessary changes gradually and give workers and beneficiaries time to adjust to them. Implementing changes sooner rather than later would allow more generations to share in the needed revenue increases or reductions in scheduled benefits and could preserve more trust fund reserves to help finance future benefits. Social Security will play a critical role in the lives of 63 million beneficiaries and 175 million covered workers and their families during 2018. With informed discussion, creative thinking, and timely legislative action, Social Security can continue to protect future generations.

B. TRUST FUND FINANCIAL OPERATIONS IN 2017

Table II.B1 shows the income, expenditures, and asset reserves for the OASI, the DI, and the combined OASI and DI Trust Funds in calendar year 2017.

Table II.B1.—Summary of 2017 Trust Fund Financial Operations
[In billions]

	OASI	DI	OASDI
Asset reserves at the end of 2016	$2,801.3	$46.3	$2,847.7
Total income in 2017	825.6	171.0	996.6
Net payroll tax contributions	706.5	167.1	873.6
Reimbursement from General Fund of the Treasury	[a]	[a]	[a]
Taxation of benefits	35.9	2.0	37.9
Interest	83.2	1.9	85.1
Total expenditures in 2017	806.7	145.8	952.5
Benefit payments	798.7	142.8	941.5
Railroad Retirement financial interchange	4.3	.2	4.5
Administrative expenses	3.7	2.8	6.5
Net increase in asset reserves in 2017	19.0	25.1	44.1
Asset reserves at the end of 2017	2,820.3	71.5	2,891.8

[a] Less than $50 million.

Note: Totals do not necessarily equal the sums of rounded components.

In 2017, net payroll tax contributions accounted for 88 percent of total trust fund income. Net payroll tax contributions consist of taxes paid by employees, employers, and the self-employed on earnings covered by Social Security. These taxes are paid on covered earnings up to a specified maximum annual amount, which was $127,200 in 2017. Table II.B2 shows the payroll tax rates for 2017.

Four percent of OASI and DI combined Trust Fund income in 2017 came from subjecting up to 50 percent of Social Security benefits to Federal personal income taxation for beneficiaries with income (including half of benefits and all non-taxable interest received) exceeding specified levels. Interest earned on invested trust fund asset reserves accounted for 9 percent of OASDI income. The remaining income to the combined OASI and DI Trust Funds, less than 0.01 percent, came from reimbursements from the General Fund of the Treasury.[1]

[1] Public Laws 111-312, 112-78, and 112-96 account for most of the reimbursement for the year. These acts specified General Fund reimbursement for temporary reductions in revenue due to reduced payroll tax rates for employees and for self-employed workers for 2011 and 2012.

Overview

The Department of the Treasury invests trust fund reserves in interest-bearing securities issued by the U.S. Government. In 2017, the combined trust fund reserves earned interest at an effective annual rate of 3.0 percent.

Almost 99 percent of expenditures from the combined OASI and DI Trust Funds in 2017 were retirement, survivor, and disability benefits totaling $941.5 billion. A net payment of $4.5 billion was made to the Railroad Retirement Social Security Equivalent Benefit Account from the combined OASI and DI Trust Funds, which was about 0.5 percent of total OASDI expenditures. The administrative expenses of the Social Security program were $6.5 billion, which was about 0.7 percent of total expenditures.

The trust fund investments provide the basis for paying benefits. Combined trust fund reserves increased by $44.1 billion for 2017 because income to each fund, including interest earned on trust fund reserves, exceeded total expenditures. At the end of 2017, the combined reserves of the OASI and the DI Trust Funds were $2,892 billion, or 288 percent of estimated expenditures[1] for 2018. In comparison, the combined reserves at the end of 2016 were 299 percent of actual expenditures for 2017.

Table II.B2.—Payroll Tax Contribution Rates for 2017
[In percent]

	OASI	DI	OASDI
Payroll tax contribution rate for employees	5.015	1.185	6.20
Payroll tax contribution rate for employers	5.015	1.185	6.20
Payroll tax contribution rate for self-employed persons	10.030	2.370	12.40

Note: Section 833 of Public Law 114-74, the Bipartisan Budget Act of 2015, requires a temporary reallocation of the payroll tax rates between the OASI and DI Trust Funds. For earnings in calendar years 2016 through 2018, this section increases from 1.80 percent to 2.37 percent the portion of the total 12.40 percent OASDI payroll tax that is directed to the DI Trust Fund. There is a corresponding decrease in the portion of the tax rates directed to the OASI Trust Fund for these years.

[1] Estimated expenditures are based on the intermediate set of assumptions.

C. ASSUMPTIONS ABOUT THE FUTURE

The future income and expenditures of the OASI and DI Trust Funds will depend on many factors, including the size and characteristics of the population receiving benefits, the level of monthly benefit amounts, the size of the workforce, and the level of covered workers' earnings. These factors will depend in turn on future birth rates, death rates, immigration, marriage and divorce rates, retirement-age patterns, disability incidence and termination rates, employment rates, productivity gains, wage increases, inflation, interest rates, and many other demographic, economic, and program-specific factors.

Table II.C1 presents key demographic, economic, and programmatic assumptions for three alternative scenarios. The intermediate assumptions reflect the Trustees' best estimates of future experience. Therefore, most of the figures in this overview present outcomes under the intermediate assumptions only. Any projection of the future is, of course, uncertain. For this reason, the Trustees also present results under low-cost and high-cost alternatives to provide a range of possible future experience. The actual future costs are unlikely to be as extreme as those portrayed by the low-cost or high-cost projections. A separate section on the uncertainty of the projections, beginning on page 18, highlights the implications of these alternative scenarios.

The Trustees reexamine the assumptions each year in light of recent experience and new information. This annual review helps to ensure that the Trustees' assumptions provide the best estimate of future possibilities.

Table II.C1.—Long-Range Values[a] of Key Assumptions for the 75-year Projection Period

Long-range assumptions	Intermediate	Low-cost	High-cost
Demographic:			
Total fertility rate (children per woman), for 2027 and later	2.0	2.2	1.8
Average annual percentage reduction in total age-sex-adjusted death rates from 2017 to 2092	.77	.41	1.15
Average annual net immigration (in thousands) for 2018 to 2092	1,272	1,607	952
Economic:			
Average annual percentage change in:			
Productivity (total U.S. economy), for 2028 and later	1.68	1.98	1.38
Average wage in covered employment from 2028 to 2092	3.80	5.02	2.58
Consumer Price Index (CPI-W), for 2021 and later	2.60	3.20	2.00
Average annual real-wage differential (percent) for 2028 to 2092	1.20	1.82	.58
Unemployment rate (percent, age-sex-adjusted), for 2027 and later	5.5	4.5	6.5
Annual trust fund real interest rate (percent), for 2028 and later	2.7	3.2	2.2
Programmatic:			
Disability incidence rate (per 1,000 exposed, age-sex-adjusted) in 2092	5.4	4.3	6.4
Disability recovery rate (per 1,000 beneficiaries, age-sex-adjusted) in 2092	10.3	12.5	8.2

[a] See chapter V for details, including historical and projected values.

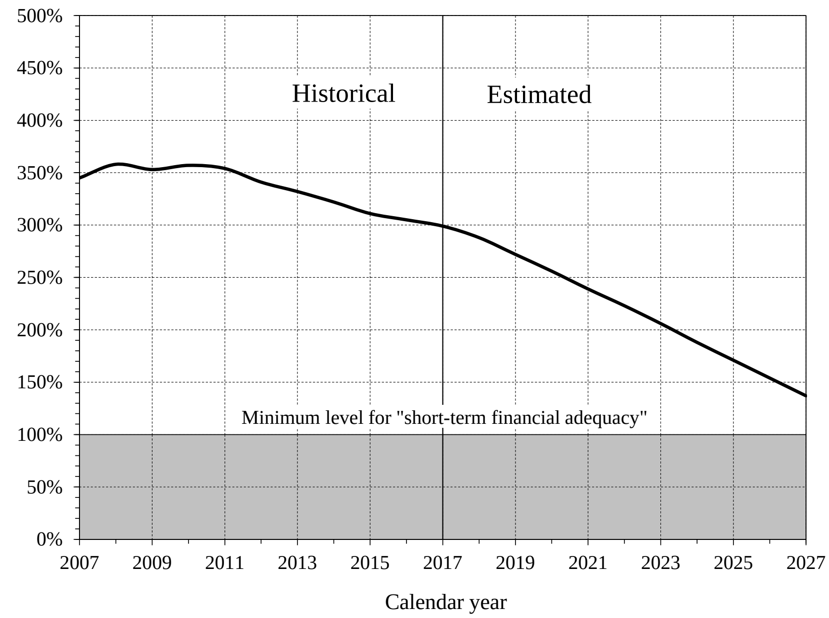
D. PROJECTIONS OF FUTURE FINANCIAL STATUS

Short-Range Actuarial Estimates

For the short-range period (2018 through 2027), the Trustees measure financial adequacy by comparing projected asset reserves at the beginning of each year to projected program cost for that year under the intermediate set of assumptions. Maintaining a trust fund ratio of 100 percent or more—that is, reserves at the beginning of each year at least equal to projected cost for the year—is a good indication that the trust fund can cover most short-term contingencies. The projected trust fund ratios under the intermediate assumptions for the OASI Trust Fund exceed 100 percent throughout the short-range period. Therefore, OASI satisfies the Trustees' short-term test of financial adequacy. The DI Trust Fund fails the Trustees' short-term test of financial adequacy. The Trustees estimate that the DI trust fund ratio was at 48 percent at the beginning of 2018. The projected DI trust fund ratio increases to 62 percent at the beginning of 2019, largely due to the temporary payroll tax rate reallocation for 2016 through 2018 from OASI to DI enacted in the Bipartisan Budget Act of 2015, and then declines through the end of the short-range period. On a combined basis, OASDI also satisfies the Trustees' short-term test of financial adequacy. Figure II.D1 shows that the trust fund ratio for the combined OASI and DI Trust Funds declines consistently after 2010, but remains above 100 percent throughout the short-range period.

Projected OASDI cost exceeds total income (including interest) in 2018 and throughout the short-range period. In addition, the combined OASI and DI Trust Fund reserves will decline in 2018 and throughout the short-range period. The trust fund ratio also declines throughout the short-range period, as shown in figure II.D1.

Figure II.D1.—Short-Range OASI and DI Combined Trust Fund Ratio
[Asset reserves as a percentage of annual cost, under Intermediate Assumptions]



Long-Range Actuarial Estimates

The Trustees use three types of measures to assess the actuarial status of the program over the next 75 years: (1) annual cash-flow measures, including income rates, cost rates, and balances; (2) trust fund ratios; and (3) summary measures such as actuarial balances and open group unfunded obligations. The Trustees express these measures as percentages of taxable payroll, as percentages of gross domestic product (GDP), or in dollars. The Trustees also present summary measures over the infinite horizon in appendix F. The infinite horizon values, which are subject to much greater uncertainty, provide an additional indication of Social Security's very-long-run financial condition.

The Trustees also apply a test of long-range close actuarial balance each year. To satisfy the test, a trust fund must meet two conditions: (1) the trust fund satisfies the test of short-range financial adequacy, and (2) the trust fund ratio stays above zero throughout the 75-year projection period, such that benefits would be payable in a timely manner throughout the period. The

OASI, DI, and combined OASI and DI Trust Funds all fail the test of long-range close actuarial balance under the intermediate assumptions.

Annual Income Rates, Cost Rates, and Balances

Figure II.D2 illustrates the year-by-year relationship among OASDI income (excluding interest), cost (including scheduled benefits), and expenditures (including payable benefits) for the full 75-year period (2018 through 2092). The figure shows all values as percentages of taxable payroll. Under the intermediate assumptions, demographic factors would by themselves cause the projected cost rate to rise rapidly for the next two decades before leveling off in about 2035. However, the recent recession temporarily depressed taxable earnings and increased the number of beneficiaries, which in turn sharply, but temporarily, increased the cost rate starting in 2009. From a peak in 2013, the cost rate declines through 2017 under the economic recovery and thereafter returns to a gradually rising trend. The projected income rate is stable at about 13 percent throughout the 75-year period.

Annual OASDI cost exceeded non-interest income in 2010 for the first time since 1983. The Trustees project that cost will continue to exceed non-interest income throughout the 75-year valuation period. Beginning in 2018, cost exceeds total income, and combined OASI and DI Trust Fund reserves diminish until they become depleted in 2034. After trust fund reserve depletion, continuing income is sufficient to support expenditures at a level of 79 percent of program cost for the rest of 2034, declining to 74 percent for 2092. Figure II.D2 depicts OASDI operations as a combined whole. However, under current law, the differences between scheduled and payable benefits would begin at different times for the program's two trust funds: in 2032 for DI and in 2034 for OASI.

Figure II.D2.—OASDI Income, Cost, and Expenditures as Percentages of Taxable Payroll
[Under Intermediate Assumptions]

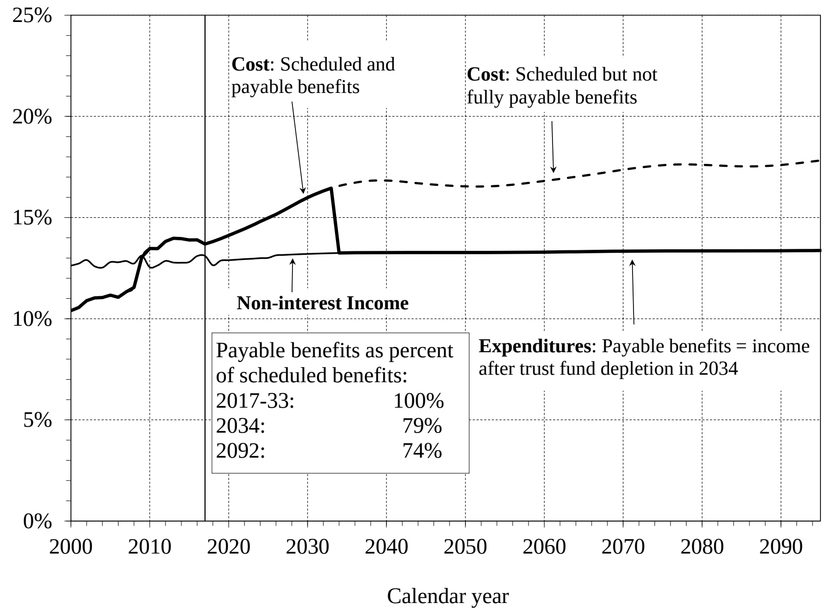
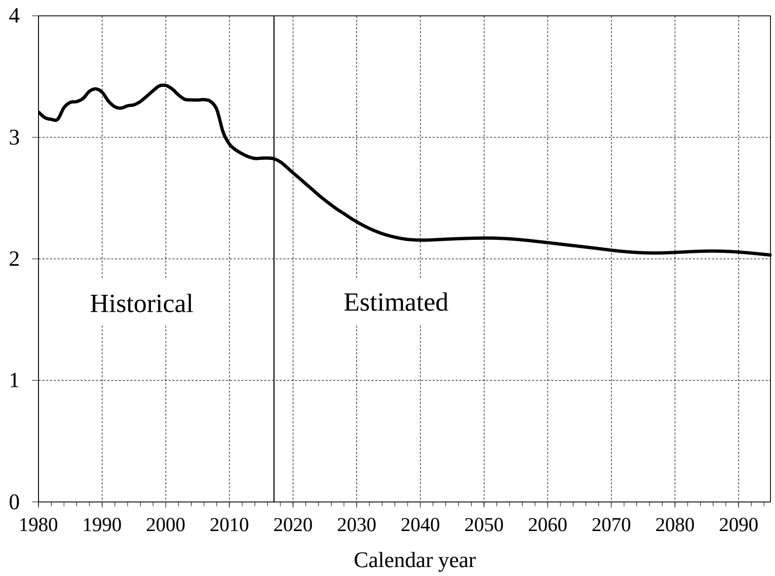


Figure II.D3 shows the estimated number of covered workers per OASDI beneficiary. Figures II.D2 and II.D3 illustrate the inverse relationship between cost rates and the number of workers per beneficiary. In particular, the projected future increase in the cost rate reflects a projected decline in the number of covered workers per beneficiary. There were about 2.8 workers for every OASDI beneficiary in 2017. This ratio had been stable, remaining between 3.2 and 3.4 from 1974 through 2008, and has declined since then due to the economic recession and the beginning of the demographic shift that will continue to drive this ratio down over the next 20 years. The Trustees project that the ratio of workers to beneficiaries will continue to decline due to this demographic shift, as workers of lower-birth-rate generations replace workers of the baby-boom generation. The ratio of workers to beneficiaries reaches 2.2 by 2035 when the baby-boom generation will have largely retired, and will generally decline very gradually thereafter due to increasing longevity.

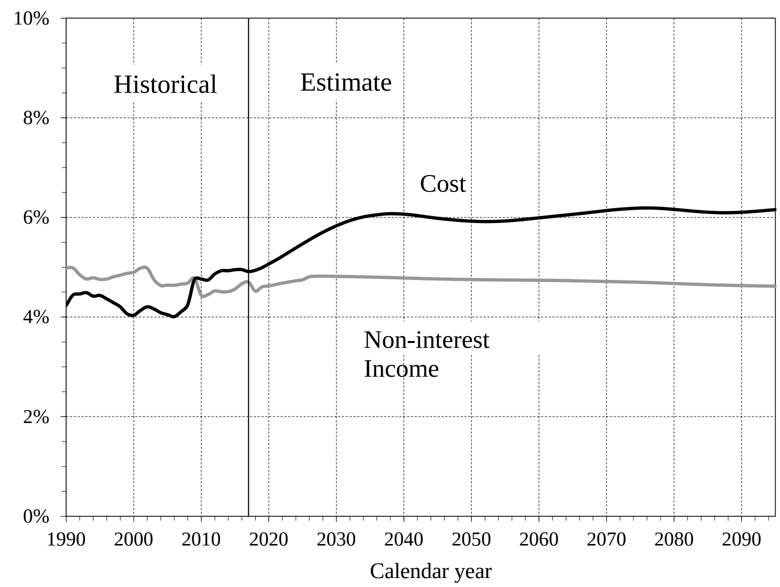
Overview

Figure II.D3.—Number of Covered Workers Per OASDI Beneficiary
[Under Intermediate Assumptions]



Another important way to look at Social Security's future is to view its annual cost and non-interest income as a share of U.S. economic output (GDP). As shown in figure II.D4, the Trustees project that Social Security's cost as a percent of GDP will grow from 4.9 percent in 2018 to about 6.1 percent by 2038, then decline to 5.9 percent by 2052, and generally increase thereafter to 6.1 percent by 2092. Social Security's non-interest income is projected to drop to 4.5 percent in 2018, then increase to about 4.8 percent of GDP by 2028. Thereafter, non-interest income as a percent of GDP declines gradually, to about 4.6 percent by 2092, because the Trustees expect the share of employee compensation provided as noncovered fringe benefits to increase gradually.

Figure II.D4.—OASDI Cost and Non-interest Income as a Percentage of GDP
[Under Intermediate Assumptions]



Trust Fund Ratios

The trust fund ratio is defined as the asset reserves at the beginning of a year expressed as a percentage of the cost during the year. The trust fund ratio thus represents the proportion of a year's cost which could be paid solely with the reserves at the beginning of the year. Table II.D1 displays the projected maximum trust fund ratios during the long-range period for the OASI, DI, and combined OASI and DI funds. The table also shows the year of maximum projected trust fund ratio during the long-range projection period (2018 through 2092) and the year of trust fund asset reserve depletion. Each trust fund ratio has been generally declining in recent years. OASI reached a peak level of 402 in 2011, DI will reach a peak level of 62 in 2019, and OASDI reached a peak level of 358 in 2008.

Table II.D1.—Projected Maximum Trust Fund Ratios During the Long-Range Period and Trust Fund Reserve Depletion Dates
[Under Intermediate Assumptions]

	OASI	DI	OASDI
Maximum projected trust fund ratio (percent).	330	62	288
Year attained.	2018	2019	2018
Projected year of trust fund reserve depletion	2034	2032	2034

Summary Measures

The actuarial balance is a summary measure of the program's financial status through the end of the 75-year valuation period. The actuarial balance measure includes the trust fund asset reserves at the beginning of the period, all cost and income during the valuation period, and the cost of reaching a target trust fund reserve of one year's cost by the end of the period. Therefore, the actuarial balance is essentially the difference between the present values of income and cost from 1937 through the end of the valuation period. Actuarial balance is expressed as a percentage of the taxable payroll for the 75-year valuation period. A negative actuarial balance is called an actuarial deficit. The actuarial deficit represents the average amount of change in income or cost that is needed throughout the valuation period in order to achieve actuarial balance.

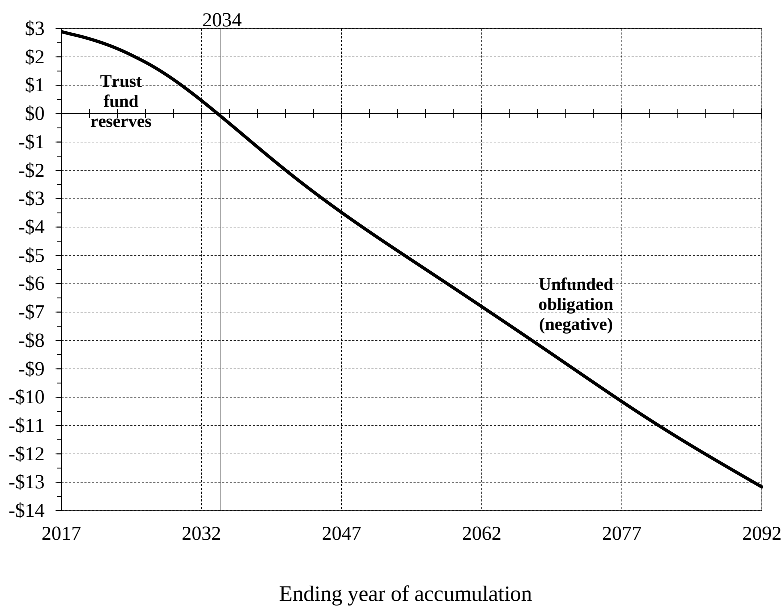
In this report, the actuarial deficit for the combined OASI and DI Trust Funds under the intermediate assumptions is 2.84 percent of taxable payroll. The actuarial deficit was 2.83 percent in the 2017 report. If the assumptions, methods, starting values, and the law had all remained unchanged from last year, the actuarial deficit would have increased to 2.88 percent of payroll solely due to advancing the valuation period by 1 year.

Another way to illustrate the projected financial shortfall of the OASDI program is to examine the cumulative present value of scheduled income less cost. Figure II.D5 shows the present value of cumulative OASDI income less cost from the inception of the program through each of the years from 2017 to 2092. A positive value represents the present value of trust fund reserves at the end of the selected year. A negative value is the unfunded obligation through the selected year. The asset reserves of the combined trust funds were \$2.9 trillion at the end of 2017. The trust fund reserves decline on a present value basis after 2017, but remain positive through 2033. However, after 2033 this cumulative amount becomes negative, which means that the combined OASI and DI Trust Funds have a net unfunded obligation through each year after 2033. Through the end of 2092, the combined funds have a present-value unfunded obligation of \$13.2 trillion. If the assumptions, methods, starting values, and the law had all remained unchanged from last year, the unfunded obligation would have risen to about \$13.1 trillion due to the change in the valuation date.

This unfunded obligation represents 2.68 percent of taxable payroll (increased from 2.66 percent in last year's report) and 1.0 percent of GDP (increased from 0.9 percent in last year's report) for the 75-year valuation period. The unfunded obligation as a share of taxable payroll (2.68 percent) and the actuarial deficit (2.84 percent) are similar measures, but differ because the actuarial deficit includes the cost of having an ending trust fund reserve equal to 1 year's cost.

Figures II.D2, II.D4, and II.D5 show that the program's financial condition is worsening at the end of the projection period. Trends in annual balances and cumulative values toward the end of the 75-year period provide an indication of the program's ability to maintain solvency beyond 75 years. Consideration of summary measures alone for a 75-year period can lead to incorrect perceptions and to policy prescriptions that do not achieve sustainable solvency.[1]

Figure II.D5.—Cumulative Scheduled OASDI Income Less Cost, From Program Inception Through Years 2017-2092
[Present value as of January 1, 2018, in trillions, under Intermediate Assumptions]



Appendix F presents summary measures over the infinite horizon. The infinite horizon values provide an additional indication of Social Security's financial condition for the period beginning with the inception of the program and extending indefinitely into the future, but results are subject to

[1] Sustainable solvency for the financing of the program under a specified set of assumptions has been achieved when the projected trust fund ratio is positive throughout the 75-year projection period and is either stable or rising at the end of the period.

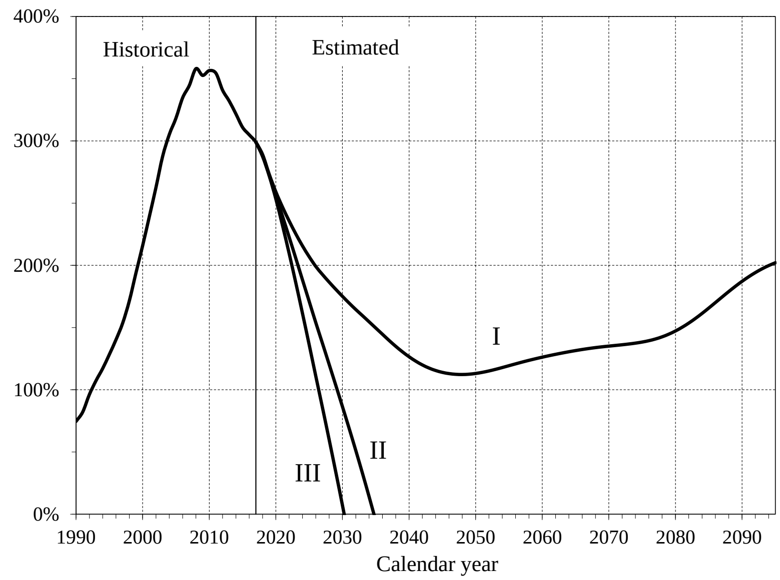
much greater uncertainty. Extending the horizon beyond 75 years increases the measured unfunded obligation. Through the infinite horizon, the unfunded obligation, or shortfall, is equivalent to 4.0 percent of future taxable payroll or 1.3 percent of future GDP.

Uncertainty of the Projections

Significant uncertainty surrounds the intermediate assumptions. The Trustees use several methods to help illustrate that uncertainty.

A first approach uses alternative scenarios reflecting low-cost (alternative I) and high-cost (alternative III) sets of assumptions. Figure II.D6 shows the projected trust fund ratios for the combined OASI and DI Trust Funds under the intermediate, low-cost, and high-cost assumptions. The figure indicates that the combined trust funds are projected to become depleted in 2034 under the intermediate alternative, remain above 100 percent of annual cost throughout the projection period under the low-cost alternative, and become depleted in 2030 under the high-cost alternative. The low-cost alternative includes a higher ultimate total fertility rate, slower improvement in mortality, a higher real-wage differential, a higher ultimate real interest rate, a higher ultimate annual change in the CPI, and a lower unemployment rate. The high-cost alternative, in contrast, includes a lower ultimate total fertility rate, more rapid improvement in mortality, a lower real-wage differential, a lower ultimate real interest rate, a lower ultimate annual change in the CPI, and a higher unemployment rate. These alternatives are not intended to suggest that all parameters would be likely to differ from the intermediate values in the specified directions, but are intended to illustrate the effect of clearly defined scenarios that are, on balance, very favorable or unfavorable for the program's financial status. Actual future costs are unlikely to be as extreme as those portrayed by the low-cost or high-cost projections. The method for constructing the low-cost and high-cost projections does not lend itself to estimating the probability that actual experience will lie within or outside the range they define.

Figure II.D6.—Long-Range OASI and DI Combined Trust Fund Ratios Under Alternative Scenarios
[Asset reserves as a percentage of annual cost]

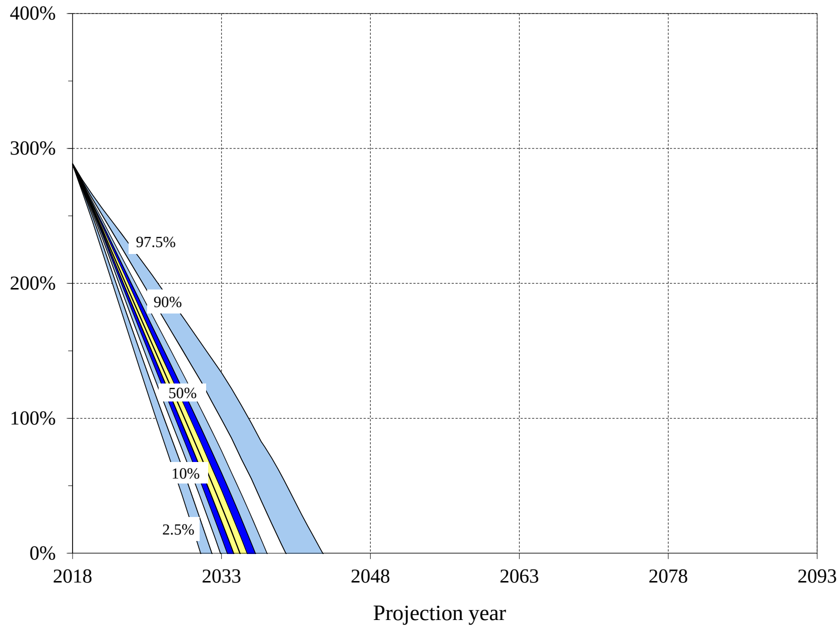


Appendix D of this report presents long-range sensitivity analysis for the OASDI program. By varying one parameter at a time, sensitivity analysis provides a second approach for illustrating the uncertainty surrounding projections into the future.

A third approach uses 5,000 independently generated stochastic simulations that reflect randomly assigned annual values for most of the key parameters. These simulations produce a distribution of projected outcomes and corresponding probabilities that future outcomes will fall within or outside a given range. The results of the stochastic simulations, discussed in more detail in appendix E, suggest that trust fund reserve depletion (i.e., the point at which the trust fund ratio reaches zero) is very likely by mid-century. In particular, figure II.D7 suggests that based on these stochastic simulations, trust fund asset reserves will become depleted between 2030 and 2043 with a 95-percent confidence.

The stochastic results suggest that trust fund ratios as high as the low-cost alternative are very unlikely. However, the relationship between the stochastic results and the low-cost and high-cost alternatives may change as the methodology for the stochastic simulations is further developed. As noted in appendix E, future improvements and refinements are expected to be more likely to expand than to reduce the indicated range of uncertainty.

Figure II.D7.—Long-Range OASI and DI Combined Trust Fund Ratios From Stochastic Modeling



Changes From Last Year's Report

The projected long-range OASDI actuarial deficit increased from 2.83 percent of taxable payroll for last year's report to 2.84 percent of taxable payroll for this year's report. The change in the 75-year projection period alone would have increased the actuarial deficit to 2.88 percent. Changes in law, methods, starting values, and assumptions combined to decrease the actuarial deficit by 0.04 percent of taxable payroll. For a detailed description of the specific changes identified in table II.D2, see section IV.B.6.

Table II.D2.—Reasons for Change in the 75-Year Actuarial Balance, Based on Intermediate Assumptions
[As a percentage of taxable payroll]

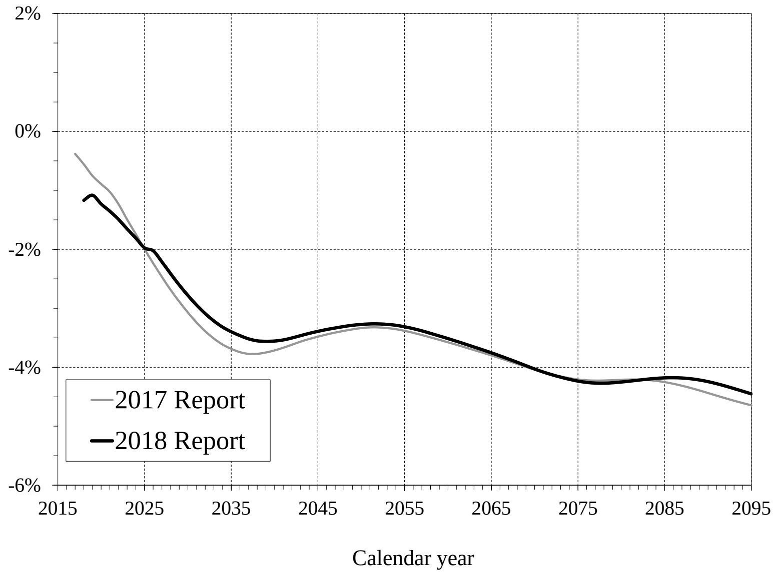
Item	OASI	DI	OASDI
Shown in last year's report:			
Income rate	11.97	1.87	13.84
Cost rate	14.56	2.11	16.67
Actuarial balance	**-2.59**	**-.24**	**-2.83**
Changes in actuarial balance due to changes in:			
Legislation / Regulation	.00	.00	.00
Valuation period[a]	-.05	-.01	-.06
Demographic data and assumptions	.00	-.01	-.01
Economic data and assumptions	-.01	.00	-.01
Disability data and assumptions	-.01	.02	.01
Methods and programmatic data	.02	.03	.05
Total change in actuarial balance	-.05	.03	-.02
Shown in this report:			
Actuarial balance	**-2.63**	**-.21**	**-2.84**
Income rate	11.99	1.86	13.84
Cost rate	14.62	2.07	16.69

[a] The change in the 75-year valuation period from last year's report to this report means that the 75-year actuarial balance now includes the relatively large negative annual balance for 2092. This change in the valuation period results in a larger long-range actuarial deficit. The actuarial deficit includes the trust fund reserve at the beginning of the projection period.

Note: Totals do not necessarily equal the sums of rounded components.

Figure II.D8 compares this year's projections of annual balances (non-interest income minus cost) to those in last year's report. The annual balances in this year's report are lower (more negative) through 2024, noticeably higher from 2025 until about 2060, very similar from 2060 until about 2085, and then higher for the remainder of the projection period. For the full 75-year projection period, the annual balances average 0.06 percentage point higher. See page 79 for details.

Figure II.D8.—OASDI Annual Balances: 2017 and 2018 Trustees Reports
[As a percentage of taxable payroll, under the intermediate assumptions]



E. CONCLUSION

Under current law, the projected cost of Social Security increases faster than projected income through 2039 primarily because the ratio of workers paying taxes to beneficiaries receiving benefits will decline as the baby-boom generation ages and is replaced at working ages with subsequent lower birth-rate generations. While the effects of the aging baby boom and subsequent lower birth rates will have stabilized after 2039, annual cost will continue to grow faster than income, but to a lesser degree, reflecting continuing increases in life expectancy. Based on the Trustees' intermediate assumptions, Social Security's cost exceeds total income throughout the 75-year projection period.

The OASI Trust Fund and the DI Trust Fund are projected to have sufficient reserves to pay full benefits on time until 2034 and 2032, respectively. Legislative action will be needed to prevent reserve depletion in those years. In the absence of such legislation, continuing income to the trust funds at the time of reserve depletion would be sufficient to pay 77 percent of OASI benefits and 96 percent of DI benefits.

Social Security's combined trust funds would cover full payment of scheduled benefits on a timely basis until the trust fund reserves become depleted in 2034. (Full payment of benefits until combined reserve depletion in 2034 implicitly assumes that the law will have been changed to permit the transfer of funds between OASI and DI as needed.) At that time, projected continuing income to the combined trust funds equals about 79 percent of the program cost. By 2092, continuing income equals about 74 percent of the program cost.

The 75-year actuarial deficit for the combined trust funds under the intermediate assumptions is 2.84 percent of taxable payroll, increased from the 2.83 percent deficit in last year's report. To illustrate the magnitude of the deficit, consider that for the combined OASI and DI Trust Funds to remain fully solvent throughout the 75-year projection period: (1) revenues would have to be increased by an amount equivalent to an immediate and permanent payroll tax rate increase of 2.78 percentage points to 15.18 percent; (2) scheduled benefits would have to be reduced by an amount equivalent to an immediate and permanent reduction of about 17 percent applied to all current and future beneficiaries, or about 21 percent if the reductions were applied only to those who become initially eligible for benefits in 2018 or later; or (3) some combination of these approaches would have to be adopted. If actions are deferred for several years, the changes necessary to maintain Social Security solvency become concentrated on fewer years and fewer generations.

If lawmakers design legislative solutions only to eliminate the overall actuarial deficit without consideration of year-by-year financing, then a substantial financial imbalance could remain at the end of the period, and the long-range sustainability of program financing could still be in doubt. Sustainable solvency for the financing of the program under a specified set of assumptions is achieved when the projected trust fund ratio is positive throughout the long-range period and is either stable or rising at the end of the period. Making changes now that achieve sustainable solvency could avoid the need for later legislative changes.

Lawmakers have a broad continuum of policy options that would close or reduce Social Security's long-term financing shortfall. Cost estimates for many such policy options are available at www.ssa.gov/OACT/solvency/provisions/. Broadly speaking, the approaches that lawmakers can take include increasing revenues from workers and employers by raising the tax rate or the maximum level of taxable earnings, or by dedicating revenues from other sources; lowering benefits for some or all beneficiaries by changing certain program parameters; or a combination of these approaches. There are countless variations on these options, including those that vary the timing, magnitude, and other specifics of the changes under consideration.

The Trustees recommend that lawmakers address the projected trust fund shortfalls in a timely way in order to phase in necessary changes gradually and give workers and beneficiaries time to adjust to them. Implementing changes sooner rather than later would allow more generations to share in the needed revenue increases or reductions in scheduled benefits and could preserve more trust fund reserves to help finance future benefits. Social Security will play a critical role in the lives of 63 million beneficiaries and 175 million covered workers and their families during 2018. With informed discussion, creative thinking, and timely legislative action, Social Security can continue to protect future generations.

For further information related to the contents of this report, see the following websites:

- www.ssa.gov/OACT/tr/2018/
- www.ssa.gov/OACT/solvency/provisions/
- www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/ReportsTrustFunds/
- www.treasury.gov/resource-center/economic-policy/ss-medicare/Pages/Soc-Sec-and-Medicare.aspx

III. FINANCIAL OPERATIONS OF THE TRUST FUNDS AND LEGISLATIVE CHANGES IN THE LAST YEAR

A. OPERATIONS OF THE OLD-AGE AND SURVIVORS INSURANCE (OASI) AND DISABILITY INSURANCE (DI) TRUST FUNDS, IN CALENDAR YEAR 2017

This section presents detailed information on the operations of the OASI and DI Trust Funds[1] during calendar year 2017. Chapter IV provides projections for calendar years 2018 through 2095.

1. OASI Trust Fund

Table III.A1 presents a statement of the income and disbursements of the Federal Old-Age and Survivors Insurance Trust Fund in calendar year 2017, and of the asset reserves in the fund at the beginning and end of the calendar year. As shown in this table, total trust fund receipts in 2017 amounted to $825.6 billion, while disbursements totaled $806.7 billion, an increase in trust fund reserves during 2017 of $19.0 billion.

Total receipts during calendar year 2017 included $709.2 billion in payroll tax contributions. These contributions include initial appropriations of payroll taxes, made on an estimated basis, and adjustments to appropriations for prior years to reflect actual tax receipts. The OASI fund paid the General Fund $2.7 billion for the estimated amount of employee payroll-tax refunds, partially offsetting these gross contributions. Employees who work for more than one employer during a year and pay contributions on total earnings in excess of the contribution and benefit base are eligible for such refunds. Net payroll tax contributions were therefore $706.5 billion in 2017.

Net reimbursements from the General Fund of the Treasury amounted to $17 million in 2017. As shown in the table, adjustments to prior year receipts based on Public Law 111-312, the Tax Relief, Unemployment Insurance Reauthorization, and Job Creation Act of 2010, Public Law 112-78, the Temporary Payroll Tax Cut Continuation Act of 2011, and Public Law 112-96, the Middle Class Tax Relief and Job Creation Act of 2012, account for most of the reimbursement for the year, or about $11 million. These acts specified General Fund reimbursement for temporary reductions in employee and self-employment payroll taxes for earnings in 2011 and 2012.

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[1] See www.ssa.gov/oact/ProgData/fundsQuery.html.

The remaining $6 million of the reimbursements from the General Fund in 2017 was almost entirely due to the provisions of Public Law 110-246, the Food, Conservation, and Energy Act of 2008. This act specified General Fund reimbursement for reductions in self-employment payroll taxes.

Income to the OASI Trust Fund based on the taxation of OASI benefits amounted to $35.9 billion in 2017. As first required by the 1983 Social Security Amendments, this income comes from two separate sources: (1) Federal income taxation on up to 50 percent of an individual's or couple's OASI benefits under certain circumstances, and (2) a tax withheld from the benefits paid to certain nonresident alien beneficiaries. For the direct Federal income tax portion, Treasury transfers estimated amounts to the OASI Trust Fund in advance at the beginning of each calendar quarter. Treasury makes subsequent adjustments based on the actual amounts shown on annual income tax records. There were no such adjustments made in 2017. The amount of income from direct Federal income taxation on OASI benefits constituted approximately 99 percent of income from benefit taxation. The remaining one percent of the income from benefit taxation is the amounts withheld from the benefits paid to nonresident aliens.

In 2017, the OASI Trust Fund earned $83.2 billion in net interest, which consisted of: (1) interest earned on the investments held by the trust fund, (2) interest on adjustments in the allocation of administrative expenses between the trust fund and the General Fund account for the Supplemental Security Income program, (3) interest arising from the revised allocation of administrative expenses among the trust funds, and (4) interest on certain reimbursements to the trust fund.

The remaining receipts, about $374 thousand, consisted of gifts received under the provisions authorizing the deposit of monetary gifts or bequests in the trust funds.

Table III.A1.—Operations of the OASI Trust Fund, Calendar Year 2017
[In millions]

Total asset reserves, December 31, 2016		$2,801,349
Receipts:		
Net payroll tax contributions:		
Payroll tax contributions[a]	$709,246	
Payments from the General Fund of the Treasury for payroll tax contributions subject to refund[a]	-2,741	
Net payroll tax contributions[a]		706,505
Reimbursements from the General Fund:		
Reduction in payroll tax contributions due to P.L. 111-312, P.L. 112-78, and P.L. 112-96[a]	11	
Reimbursements directed by P.L. 110-246	6	
Payroll tax credits due to P.L. 98-21[a]	[b]	
Net General Fund reimbursements[a]		17
Income based on taxation of benefit payments:		
Withheld from benefit payments to nonresident aliens	207	
All other, not subject to withholding	35,670	
Total income from taxation of benefits		35,877
Investment income and interest adjustments:		
Interest on investments	83,230	
Interest adjustments[c]	1	
Total investment income and interest adjustments		83,231
Gifts		[b]
Total receipts		825,630
Disbursements:		
Benefit payments:		
Monthly benefits and lump-sum death payments[d]	798,722	
Reimbursement from the General Fund for unnegotiated checks	-36	
Payment for costs of vocational rehabilitation services for disabled beneficiaries	6	
Net benefit payments[d]		798,692
Financial interchange with the Railroad Retirement "Social Security Equivalent Benefit Account"		4,316
Administrative expenses:		
Costs incurred by:		
Social Security Administration	3,044	
Department of the Treasury	632	
Offsetting miscellaneous receipts	-10	
Miscellaneous reimbursements from the General Fund[e]	-4	
Net administrative expenses		3,661
Total disbursements		806,669
Net increase in asset reserves		18,961
Total invested assets	2,820,368	
Undisbursed balances[f]	-59	
Total asset reserves, December 31, 2017		2,820,309

[a] Includes adjustments for prior calendar years.

[b] Between -$0.5 and $0.5 million.

[c] Includes: (1) interest on adjustments in the allocation of administrative expenses between the trust fund and the General Fund account for the Supplemental Security Income program, (2) interest arising from the revised allocation of administrative expenses among the trust funds, and (3) interest on certain reimbursements to the trust fund.

[d] Includes net reductions for the recovery of overpayments.

[e] Reimbursements for costs incurred in performing certain legislatively mandated activities not directly related to administering the OASI program.

[f] A negative balance represents a situation where the actual program cash expenditures exceeded the amount of invested securities of the OASI Trust Fund that were redeemed to pay for such expenditures. In this situation, future redemption of additional invested securities will be required to pay for this shortfall.

Note: Totals do not necessarily equal the sums of rounded components.

Of the $806.7 billion in total OASI disbursements in 2017, $798.7 billion were for net benefit payments, including recovered overpayments, reimbursements from the General Fund for unnegotiated checks, and the reimbursable costs of vocational rehabilitation services.[1] Net benefit payments increased by 3.9 percent from calendar year 2016 to calendar year 2017. This increase is due primarily to: (1) an increase in the average number of beneficiaries during the year and (2) an increase in the average monthly benefit amount. The increase in the average benefit amount in 2017 was due in part to the automatic cost-of-living benefit increase of 0.3 percent which became effective for December 2016 under the automatic-adjustment provisions in section 215(i) of the Social Security Act. In addition, new beneficiaries tend to have higher monthly benefit amounts than previous beneficiary cohorts.

The Railroad Retirement Act requires an annual financial interchange between the Railroad Retirement program and the OASDI program. The purpose of the interchange is to put the OASI and DI Trust Funds in the same financial position in which they would have been had railroad employment always been covered directly by Social Security. The Railroad Retirement Board and the Social Security Administration calculated an interchange of $4.3 billion from the OASI Trust Fund to the Social Security Equivalent Benefit Account for June 2017.

The remaining $3.7 billion of disbursements from the OASI Trust Fund were for net administrative expenses. The Social Security Administration charges administrative expenses incurred to administer the OASI program directly to the trust fund on an estimated basis. Periodically, as actual expenses are recorded, adjustments are made to the allocations of administrative expenses for prior periods. These adjustments affect the OASI Trust Fund, the DI Trust Fund, the Hospital Insurance (HI) Trust Fund, the Supplementary Medical Insurance (SMI) Trust Fund, and the General Fund account for the Supplemental Security Income program, and include appropriate interest adjustments. As described earlier, the trust fund accounting records such interest adjustments under investment income.

For 2017, the cost incurred by the Social Security Administration to administer the OASI program was 83 percent of OASI net administrative expenses. The Social Security Administration charged such costs to the trust fund in the amount of $3.0 billion in 2017. In addition, the Department of the Treasury charged the trust fund $0.6 billion in 2017 for services provided in

[1] Vocational rehabilitation services under the OASI program are furnished to disabled widow(er) beneficiaries and to those children of retired or deceased workers who receive benefits based on disabilities that began before age 22. The trust funds reimburse the providers of such services only in those cases where the services contributed to the successful rehabilitation of the beneficiary.

administering the OASI program. A relatively small offset to administrative expenses of $10 million in 2017 represents income from miscellaneous receipts due to the trust fund, which may include refunds, penalties, fees, and other receipts.

Finally, the General Fund of the Treasury makes net reimbursements for administrative costs incurred by the Social Security Administration in performing legislatively mandated activities that are not directly related to the OASI program. These reimbursements include $3 million in costs associated with union activities related to administering the OASI program and $2 million in costs of providing information to participants in certain pension plans in 2017. These miscellaneous reimbursements round to $4 million in 2017.

The asset reserves shown for the OASI Trust Fund at the end of calendar year 2017 totaled $2,820.3 billion, consisting of $2,820.4 billion in U.S. Government obligations and, as an offset, an extension of credit of $59 million against securities to be redeemed within the first few days of the following year. The effective annual rate of interest earned by the reserves in the OASI Trust Fund during calendar year 2017 was 3.0 percent, slightly lower than the 3.1 percent earned during calendar year 2016. Table VI.A4, presented in appendix A, shows a detailed listing of OASI Trust Fund holdings by type of security, interest rate, and year of maturity at the end of calendar years 2016 and 2017.

By law, the Department of the Treasury must invest trust fund reserves in interest-bearing securities backed by the full faith and credit of the United States Government. The securities currently held by the OASI Trust Fund are entirely special issue securities sold by the Treasury only to the trust funds. These special issues are of two types: short-term certificates of indebtedness and longer-term bonds. Daily trust fund receipts are invested in the short-term certificates of indebtedness which mature on the next June 30 following the date of issue. The trust fund normally acquires long-term special-issue bonds when special issue securities of either type mature on June 30 and must be reinvested. The amount of long-term bonds acquired on June 30 is equal to the amount of special issue securities maturing (including accrued interest earnings), plus tax receipts for that day, less amounts required to meet expenditures on that day.

Section 201(d) of the Social Security Act provides that the obligations issued for purchase by the OASI and DI Trust Funds shall have maturities fixed with due regard for the needs of the funds. The usual practice has been to reinvest the maturing special issue securities, as of each June 30, so that the value of the securities maturing in each of the next 15 years are approximately equal. Accordingly, the Department of the Treasury, in consultation with the Chief Actuary of the Social Security Administration, selected the amounts and maturity dates of the special-issue bonds purchased on June 30, 2017, so that the maturity dates of the total portfolio of special issue securities were spread evenly over the 15-year period 2018 through 2032. The bonds purchased on that date have an interest rate of 2.250 percent, reflecting the average market yield, as of the last business day of the prior month, on all of the outstanding marketable U.S. obligations that are due or callable more than 4 years in the future. Table III.A7 shows additional details on the investment transactions during 2017, including the amounts of bonds purchased on June 30, 2017.

2. DI Trust Fund

Table III.A2 presents a statement of the income and disbursements of the Federal Disability Insurance Trust Fund in calendar year 2017, and of the asset reserves in the fund at the beginning and end of the calendar year.

Line entries in the DI statement are similar to those in the OASI statement. The explanations of the OASI entries generally apply to DI as well.

Of the $171.0 billion in total receipts, $167.1 billion was net payroll tax contributions.

Of the $145.8 billion of total disbursements, $142.8 billion was net benefit payments. The total level of net benefit payments in 2017 was essentially unchanged from total net benefit payments paid in 2016, largely due to a decrease in the number of beneficiaries, and an offsetting increase in average benefit amounts. Non-interest income, and total income, exceeded total disbursements in 2017 due primarily to the temporary reallocation of the payroll tax rate from OASI to DI for years 2016 through 2018. DI total disbursements exceeded non-interest income from 2005 to 2015, and exceeded total income to the trust fund from 2009 to 2015.

Table III.A2.—Operations of the DI Trust Fund, Calendar Year 2017
[In millions]

Total asset reserves, December 31, 2016		$46,338
Receipts:		
Net payroll tax contributions:		
Payroll tax contributions[a]	$167,730	
Payments from the General Fund of the Treasury for payroll tax contributions subject to refund[a]	-642	
Net payroll tax contributions[a]		167,087
Reimbursements from the General Fund:		
Reduction in payroll tax contributions due to P.L. 111-312, P.L. 112-78, and P.L. 112-96[a]	2	
Reimbursements directed by P.L. 110-246	1	
Payroll tax credits due to P.L. 98-21[a]	[b]	
Net General Fund reimbursements[a]		3
Income based on taxation of benefit payments:		
Withheld from benefit payments to nonresident aliens	4	
All other, not subject to withholding	1,969	
Total income from taxation of benefits		1,973
Investment income and interest adjustments:		
Interest on investments	1,886	
Interest adjustments[c]	2	
Total investment income and interest adjustments		1,888
Gifts		—
Total receipts		170,951
Disbursements:		
Benefit payments:		
Monthly benefits[d]	142,740	
Reimbursement from the General Fund for unnegotiated checks	-19	
Payment for costs of vocational rehabilitation services for disabled beneficiaries	86	
Net benefit payments[d]		142,806
Financial interchange with the Railroad Retirement "Social Security Equivalent Benefit Account"		207
Administrative expenses:		
Costs incurred by:		
Social Security Administration	2,668	
Department of the Treasury	119	
Offsetting miscellaneous receipts	[b]	
Demonstration projects	12	
Miscellaneous reimbursements from the General Fund[e]	-3	
Net administrative expenses		2,796
Total disbursements		145,809
Net increase in asset reserves		25,142
Total invested assets	71,624	
Undisbursed balances[f]	-144	
Total asset reserves, December 31, 2017		71,480

[a] Includes adjustments for prior calendar years.

[b] Between -$0.5 and $0.5 million.

[c] Includes: (1) interest on adjustments in the allocation of administrative expenses between the trust fund and the General Fund account for the Supplemental Security Income program, (2) interest arising from the revised allocation of administrative expenses among the trust funds, and (3) interest on certain reimbursements to the trust fund.

[d] Includes net reductions for the recovery of overpayments.

[e] Reimbursements for costs incurred in performing legislatively mandated activities not directly related to administering the DI program.

[f] A negative balance represents a situation where the actual program cash expenditures exceeded the amount of invested securities of the DI Trust Fund that were redeemed to pay for such expenditures. In this situation, future redemption of additional invested securities will be required to pay for this shortfall.

Note: Totals do not necessarily equal the sums of rounded components.

During 2017, the reserves in the DI Trust Fund increased by $25.1 billion, from $46.3 billion at the end of 2016 to $71.5 billion at the end of 2017. This $71.5 billion consisted of $71.6 billion in U.S. Government obligations and, as an offset, an extension of credit of $144 million against securities to be redeemed within the first few days of the following year. The effective annual rate of interest earned by the asset reserves in the DI Trust Fund during calendar year 2017 was 3.2 percent, somewhat lower than the 3.6 percent earned during calendar year 2016. Table VI.A5 shows a detailed listing of DI Trust Fund holdings by type of security, interest rate, and year of maturity at the end of calendar years 2016 and 2017.

Section 201(d) of the Social Security Act provides that the Treasury securities issued for purchase by the OASI and DI Trust Funds shall have maturities fixed with due regard for the needs of the funds. Each year, bond purchases for each trust fund are made on June 30, taking into account the projected reserve depletion date in the most recently issued Trustees Report. The usual practice has been to reinvest the maturing special issue securities, as of each June 30, so that the values of the securities maturing in each of the next 15 years are approximately equal. However, as of June 2017, the Trustees projected that the reserves in the DI Trust Fund would be depleted within 15 years. Therefore, the Department of the Treasury, in consultation with the Chief Actuary of the Social Security Administration, selected the amounts and maturity dates of the DI special-issue bonds purchased on June 30, 2017, so that the bonds would mature over the 6-year period 2018-23. The bonds purchased have an interest rate of 2.250 percent, reflecting the average market yield, as of the last business day of the prior month, on the outstanding marketable U.S. obligations that are due or callable more than 4 years in the future. As of June 30, 2017, most of the invested asset reserves of the DI Trust Fund had maturity dates of June 30 in 2022 and 2023, so this investment approach required that all bond purchases on June 30, 2017 be split over the maturity dates of June 30, 2018 through June 30, 2021. Table III.A7 shows details on investment transactions during 2017.

3. OASI and DI Trust Funds, Combined

Table III.A3 presents a statement of the operations of the OASI and DI Trust Funds on a hypothetical combined basis.[1] The entries in this table represent the sums of the corresponding values from tables III.A1 and III.A2. The two preceding subsections that cover OASI and DI provide a description of the nature of these income and expenditure transactions.

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[1] The OASI and DI Trust Funds are distinct legal entities which operate independently. To illustrate the actuarial status of the program as a whole, the fund operations are often combined on a hypothetical basis.

Table III.A3.—Operations of the Combined OASI and DI Trust Funds, Calendar Year 2017
[In millions]

Total asset reserves, December 31, 2016		$2,847,687
Receipts:		
Net payroll tax contributions:		
Payroll tax contributions[a]	$876,976	
Payments from the General Fund of the Treasury for payroll tax contributions subject to refund[a]	-3,384	
Net payroll tax contributions[a]		873,592
Reimbursements from the General Fund:		
Reduction in payroll tax contributions due to P.L. 111-312, P.L. 112-78, and P.L. 112-96[a]	13	
Reimbursements directed by P.L. 110-246	7	
Payroll tax credits due to P.L. 98-21[a]	[b]	
Net General Fund reimbursements[a]		20
Income based on taxation of benefit payments:		
Withheld from benefit payments to nonresident aliens	211	
All other, not subject to withholding	37,639	
Total income from taxation of benefits		37,850
Investment income and interest adjustments:		
Interest on investments	85,116	
Interest adjustments[c]	3	
Total investment income and interest adjustments		85,119
Gifts		[b]
Total receipts		996,581
Disbursements:		
Benefit payments:		
Monthly benefits and lump-sum death payments[d]	941,461	
Reimbursement from the General Fund for unnegotiated checks	-55	
Payment for costs of vocational rehabilitation services for disabled beneficiaries	93	
Net benefit payments[d]		941,499
Financial interchange with the Railroad Retirement "Social Security Equivalent Benefit Account"		4,522
Administrative expenses:		
Costs incurred by:		
Social Security Administration	5,711	
Department of the Treasury	751	
Offsetting miscellaneous receipts	-11	
Demonstration projects	12	
Miscellaneous reimbursements from the General Fund[e]	-7	
Net administrative expenses		6,457
Total disbursements		952,478
Net increase in asset reserves		44,103
Total invested assets	2,891,992	
Undisbursed balances[f]	-203	
Total asset reserves, December 31, 2017		2,891,789

[a] Includes adjustments for prior calendar years.
[b] Between -$0.5 and $0.5 million.
[c] Includes: (1) interest on adjustments in the allocation of administrative expenses between the trust funds and the General Fund account for the Supplemental Security Income program, (2) interest arising from the revised allocation of administrative expenses among the trust funds, and (3) interest on certain reimbursements to the trust funds.
[d] Includes net reductions for the recovery of overpayments.
[e] Reimbursements for costs incurred in performing certain legislatively mandated activities not directly related to administering the OASI and DI programs.
[f] A negative balance represents a situation where the actual program cash expenditures exceeded the amount of invested securities of the OASI and DI Trust Funds that were redeemed to pay for such expenditures. In this situation, future redemption of additional invested securities will be required to pay for this shortfall.

Note: Totals do not necessarily equal the sums of rounded components.

Table III.A4 compares estimates of total income and total expenditures for calendar year 2017 from the intermediate projections in the 2013 through 2017 Trustees Reports to the corresponding actual amounts for 2017.

Table III.A4.—Comparison of Actual Calendar Year 2017 Trust Fund Operations With Estimates Made in Prior Reports, Based on Intermediate Assumptions[a]
[Amounts in billions]

	Total income[b]		Total cost	
	Amount	Difference from actual (percent)	Amount	Difference from actual (percent)
OASI Trust Fund:				
Estimate in 2013 report	$940.2	13.9	$879.6	9.0
Estimate in 2014 report	909.7	10.2	861.1	6.7
Estimate in 2015 report	893.9	8.3	848.2	5.1
Estimate in 2016 report	826.3	.1	812.9	.8
Estimate in 2017 report	839.8	1.7	807.2	.1
Actual amount	825.6	—	806.7	—
DI Trust Fund:				
Estimate in 2013 report	[c]	[c]	166.6	14.3
Estimate in 2014 report	[c]	[c]	161.2	10.6
Estimate in 2015 report	[c]	[c]	158.6	8.8
Estimate in 2016 report	170.3	-.4	152.7	4.7
Estimate in 2017 report	174.0	1.8	148.0	1.5
Actual amount	171.0	—	145.8	—
OASI and DI Trust Funds, combined:				
Estimate in 2013 report	1,077.1	8.1	1,046.3	9.8
Estimate in 2014 report	1,042.7	4.6	1,022.3	7.3
Estimate in 2015 report	1,025.5	2.9	1,006.8	5.7
Estimate in 2016 report	996.6	[d]	965.5	1.4
Estimate in 2017 report	1,013.8	1.7	955.2	.3
Actual amount	996.6	—	952.5	—

[a] Percentage differences are calculated prior to rounding.
[b] "Actual" income for 2017 reflects adjustments to payroll tax contributions for prior calendar years (see appendix A for description of these adjustments). "Estimated" income also includes such adjustments, but on an estimated basis.
[c] In the annual reports for each year 2013 through 2015, the DI Trust Fund was projected to become depleted in calendar year 2016 under the intermediate assumptions. Under those circumstances, scheduled benefits could not be paid in full on a timely basis, so that certain projected items of income such as income from taxing benefits and interest on trust fund reserves could not be meaningfully projected. Accordingly, total DI Trust Fund income was not reported for 2017 in those earlier reports. Following the tax rate reallocation enacted in the Bipartisan Budget Act of 2015, the DI Trust Fund was not projected to become depleted until after 2017 in the 2016 and 2017 reports, and thus an estimate for total income was reported. Appendix A presents a detailed description of the components of income and cost, along with complete historical values.
[d] Between -0.05 and 0.05 percent.

Note: Totals do not necessarily equal the sums of rounded components.

A number of factors contribute to differences between estimates and subsequent actual amounts, including: (1) actual values for key demographic, economic, and other variables that differ from earlier assumed levels; and (2) legislation that was enacted or other administrative initiatives that were finalized after the Trustees completed their estimates.

At the end of calendar year 2017, the OASDI program was providing monthly benefits to about 61.9 million people. The OASI Trust Fund was providing benefits to about 51.5 million people and the DI Trust Fund was providing benefits to about 10.4 million people. The number of people receiving benefits from the OASI Trust Fund grew by 2.4 percent while the number of people receiving DI benefits fell by 1.9 percent during calendar year 2017. These changes reflect the gradual aging of the population, with the earliest cohorts of the baby-boom generation now moving above normal retirement age, where DI benefits are no longer applicable. Table III.A5 shows the estimated distributions of benefit payments in calendar years 2016 and 2017, by type of beneficiary, for each trust fund separately.

Table III.A5.—Distribution of Benefit Payments by Type of Beneficiary or Payment, Calendar Years 2016 and 2017
[Amounts in millions]

	Calendar year 2016		Calendar year 2017	
	Amount	Percentage of total	Amount	Percentage of total
Total OASDI benefit payments	$911,335	100.0	$941,461	100.0
OASI benefit payments	768,633	84.3	798,722	84.8
DI benefit payments	142,703	15.7	142,740	15.2
OASI benefit payments, total	768,633	100.0	798,722	100.0
Monthly benefits:				
Retired workers and auxiliaries	651,280	84.7	680,233	85.2
Retired workers	616,003	80.1	644,181	80.7
Spouses	29,895	3.9	30,493	3.8
Children	5,382	.7	5,559	.7
Survivors of deceased workers	117,148	15.2	118,279	14.8
Aged widows and widowers	93,383	12.1	94,307	11.8
Disabled widows and widowers	2,373	.3	2,375	.3
Parents	21	[a]	20	[a]
Children	19,805	2.6	20,048	2.5
Widowed mothers and fathers caring for child beneficiaries	1,568	.2	1,529	.2
Lump-sum death payments	204	[a]	210	[a]
DI benefit payments, total	142,703	100.0	142,740	100.0
Disabled workers	133,644	93.7	133,871	93.8
Spouses	570	.4	551	.4
Children	8,489	5.9	8,318	5.8

[a] Less than 0.05 percent.

Note: Benefits are monthly benefits and lump-sum death payments. Totals do not necessarily equal the sums of rounded components.

Net administrative expenses of the OASI and DI Trust Funds in calendar year 2017 totaled $6.5 billion, equal to 0.7 percent each of total expenditures and non-interest income. Table III.A6 shows corresponding percentages for each trust fund separately and for OASDI as a whole for the last 5 years.

Table III.A6.—Administrative Expenses as a Percentage of Non-interest Income and of Total Expenditures, Calendar Years 2013-2017

	OASI Trust Fund		DI Trust Fund		OASI and DI Trust Funds, combined	
Calendar year	Non-interest income	Total expenditures	Non-interest income	Total expenditures	Non-interest income	Total expenditures
2013	0.5	0.5	2.6	1.9	0.8	0.7
2014	.5	.4	2.6	2.0	.8	.7
2015	.5	.4	2.4	1.9	.7	.7
2016	.5	.4	1.7	1.9	.7	.7
2017	.5	.5	1.7	1.9	.7	.7

The acquisition and redemption of securities during calendar year 2017 changed the invested reserves of the OASI and DI Trust Funds. Table III.A7 presents investment transactions for each fund separately and combined.

Table III.A7.—Trust Fund Investment Transactions, Calendar Year 2017
[In millions]

	OASI Trust Fund	DI Trust Fund	OASI and DI Trust Funds, combined
Invested asset reserves, December 31, 2016[a]	$2,801,406	$46,481	$2,847,887
Acquisitions:			
Special issue securities:			
Certificates of indebtedness	788,330	171,296	959,626
Bonds[b]	212,059	28,071	240,130
Total acquisitions	1,000,389	199,366	1,199,756
Redemptions:			
Special issue securities:			
Certificates of indebtedness	790,352	164,902	955,254
Bonds	191,075	9,321	200,396
Total redemptions	981,427	174,223	1,155,650
Net increase in invested asset reserves	18,963	25,143	44,105
Invested asset reserves, December 31, 2017[a]	2,820,368	71,624	$2,891,992

[a] Invested asset reserves differ from total asset reserves by the amount of undisbursed balances. See tables VI.A4 and VI.A5 for details.
[b] Purchased on June 30, 2017. The interest rate on these purchases was 2.250 percent.
Note: Investments are shown at par value. Totals do not necessarily equal the sums of rounded components.

B. SOCIAL SECURITY AMENDMENTS SINCE THE 2017 REPORT

Since the Trustees submitted the 2017 report to Congress, the rescission of one policy and the enactment of one law are expected to have notable effects on the financial status of the OASDI program.

The Deferred Action for Childhood Arrivals, or DACA, policy was implemented on June 15, 2012 and rescinded by the Administration on September 5, 2017. The original policy enabled certain other-than-lawful-permanent-resident immigrants who entered the United States as children to receive employment authorization. Rescission of DACA will reduce the number of authorized workers and projected payroll tax income slightly; however, fewer of these individuals will receive benefits in the longer term. As a result, the elimination of DACA has a small but significant net negative financial impact over the short-range projection period and a negligible net negative effect over the long-range projection period.

The Tax Cuts and Jobs Act, Public Law 115-97, was enacted on December 22, 2017. This law will have several effects on the actuarial status of the OASDI program. The law reduces tax rates for individuals, alters the tax brackets and their indexing, and repeals the individual mandate of the Patient Protection and Affordable Care Act. The repeal of the individual mandate is expected to cause some individuals to drop their employer sponsored health insurance, which is estimated to increase OASDI covered wages and taxable payroll slightly. The tax rate and tax bracket changes will affect income to the trust funds from taxation of Social Security benefits. Because the law reduces tax rates through 2025, and the tax bracket thresholds will grow more slowly in the future due to the change in indexing, income from taxation of benefits relative to last year’s report is decreased through 2025 and increased thereafter. In addition, temporary changes for certain small businesses will have effects on reported self-employment income. As a whole, the law has a significant net negative effect on the financial status of the OASDI program over the short-range projection period and a negligible net positive effect over the long-range projection period.

Sections IV.A.4 and IV.B.6 of this report provide further description of the magnitude of effects on the financial status of the OASDI program.

IV. ACTUARIAL ESTIMATES

This chapter presents actuarial estimates of the future financial condition of the Social Security program. These estimates show the income, cost, and asset reserves or unfunded obligation of the OASI and DI Trust Funds: (1) in dollars over the 10-year short-range period; and (2) as a percentage of taxable payroll, as a percentage of gross domestic product, and in present-value dollars over the 75-year long-range period. In addition, the chapter discusses a variety of measures of the adequacy of current program financing. This report distinguishes between: (1) the cost (obligations) of the program, which includes all future benefits scheduled under current law; and (2) expenditures (disbursements), which include actual payments for the past plus only the portion of projected program cost that would be payable with the financing provisions in current law.

This chapter presents the estimates and measures of trust fund financial adequacy for the short-range period (2018 through 2027) first, followed by estimates and measures of actuarial status for the long-range period (2018 through 2092). Summary measures are also provided for trust fund status over the infinite horizon. As described in chapter II of this report, these estimates depend upon a broad set of demographic, economic, and programmatic factors. This chapter presents estimates under three sets of assumptions to show a wide range of possible outcomes, because assumptions related to these factors are subject to uncertainty. The intermediate set of assumptions, designated as alternative II, reflects the Trustees' best estimate of future experience; the low-cost alternative I is significantly more optimistic and the high-cost alternative III is significantly more pessimistic for the trust funds' future financial outlook. The tables of this report show the intermediate estimates first, followed by the low-cost and high-cost estimates. Chapter V describes these three sets of assumptions, along with the actuarial methods used to produce the estimates. Appendix D and appendix E present two additional methods to illustrate the uncertainty of the projections. Appendix D presents sensitivity analyses of the effects of variation in individual factors and appendix E presents probability distributions generated by a stochastic model.

In this report, the DI Trust Fund reserve depletion date is again extended, as it was for the last two reports. The experience for disability beneficiaries and benefit levels following the last economic recession has not followed expectations, so substantial revisions have been required in the reports of 2016, 2017, and 2018.

In 2014, initial disability applications to the states' Disability Determination Services (DDS) dropped by 4.2 percent. For the 2015 report, the Trustees assumed that applications would drop by another 1.0 percent in 2015, but the decline was actually 4.7 percent. This larger-than-anticipated decline in applications extended reserve depletion by about one year, in addition to the six-year extension due to the reallocation of tax rates included in the Bipartisan Budget Act of 2015. Together, these changes extended the DI Trust Fund reserve depletion year from 2016 for the 2015 report to 2023 for the 2016 report. The change in the reserve depletion date due to DI application experience in the 2016 report was relatively modest, because the Trustees had assumed a 9.1 percent rebound in applications for 2016. However, applications instead dropped again in 2016, by 7.2 percent. Largely on this basis, the 2017 report assumed a more gradual rise in applications after the very low level in 2016, with an increase of only 2.6 percent for 2017. This more gradual path resulted in an additional five-year extension of the projected DI reserve depletion date, to 2028 for the 2017 report.

However, applications once again dropped in 2017, by 4.2 percent, a yet lower starting point. For this report, the Trustees have assumed a steeper rise in applications and incidence rates in order to reach the unchanged ultimate levels of incidence rates by 2027. Even with this steep rise, applications and incidence rates are lower in this year's report than in last year's report for much of the first ten years of the projection period. The extension of the reserve depletion date from 2028 to 2032 for this report owes largely to this further drop in applications in 2017, partially mitigated by the more rapid rebound to the ultimate assumed level.

A further mitigating factor is that SSA expects to reduce the number of disability claims that are pending an Administrative Law Judge hearing over the next several years. The reduction has already begun, with the number of disability claims pending a hearing dropping somewhat in 2017. This effort to reduce the number of cases pending a hearing halted a steady rise in pending cases that started in 2011 in the wake of the recession. SSA projects that the number of cases pending a hearing will be reduced to the minimum level for cases in process, thus eliminating the "backlog" by the end of 2021. While this increase in hearings decisions through 2021 will tend to elevate benefit awards and incidence rates temporarily, it will also change the balance between benefit awards made at the DDS and at the hearings. This is significant, because the average monthly benefit level for claims awarded at hearings tends to be lower than for claims awarded earlier at the DDS. While the number of pending hearings was increasing between 2011 and 2016, and relatively few hearings decisions were made, benefit awards were made disproportionately from the earlier adjudicative DDS stages, so the average benefit level was relatively high. With the number of pending hearings dropping in 2017, at about the pace of declining initial disability applications, a more normal balance between hearing and earlier DDS awards has been restored. For 2017 and later, average awarded monthly benefit levels have been reduced somewhat below the levels anticipated in the 2017 report, because that report did not fully take into account the temporarily elevated level of recent average awarded monthly benefit amounts.

The effects of these factors related to disabled-worker beneficiaries and benefit levels, which are partially offset by lower payroll tax revenue in the near term, extended the projected year of DI Trust Fund reserve depletion another four years, to 2032.

A. SHORT-RANGE ESTIMATES

The Trustees consider the trust funds to be solvent at any point in time if the funds can pay scheduled benefits in full on a timely basis. A standard measure for assessing solvency is the "trust fund ratio," which is the reserves in a fund at the beginning of a year (not including advance tax transfers) expressed as a percentage of the cost during the year. A positive trust fund ratio indicates that the trust fund was solvent at the end of the prior year. The trust fund ratio represents the proportion of a year's cost which the reserves available at the beginning of that year can cover. The Trustees assume that a trust fund ratio of 100 percent of annual program cost provides a reasonable "contingency reserve." Maintaining a reasonable contingency reserve is important because the trust funds do not have borrowing authority. After reserves are depleted, the trust funds would be unable to pay benefits in full on a timely basis if annual revenue were less than annual cost. Unexpected events, such as severe economic recessions, can quickly diminish reserves. In such cases, a reasonable contingency reserve can maintain the ability to pay scheduled benefits while giving lawmakers time to address possible changes to the program.

The test of short-range financial adequacy applies to the OASI and DI Trust Funds individually and combined on a hypothetical basis.[1] If the estimated trust fund ratio is at least 100 percent at the beginning of the projection period, the test requires that it remain at or above 100 percent throughout the 10-year period. If the ratio is initially less than 100 percent, then it must reach at least 100 percent within 5 years (without reserve depletion at any time during this period) and then remain at or above 100 percent throughout the remainder of the 10-year period. This test is applied using the estimates based on the intermediate assumptions. If either trust fund fails this test, then program solvency in the next 10 years is in question, and lawmakers should take prompt action to improve short-range financial adequacy.

[1] The OASI and DI Trust Funds are distinct legal entities which operate independently. To illustrate the actuarial status of the program as a whole, the fund operations are often combined on a hypothetical basis.

1. Operations of the OASI Trust Fund

This subsection presents estimates, based on the assumptions described in chapter V, of the operations and financial status of the OASI Trust Fund for the period 2018 through 2027. These estimates assume that there are no further changes in the statutory provisions and regulations under which the OASDI program currently operates beyond the changes since last year's report indicated in section III.B.[1]

Estimates of the OASI Trust Fund operations presented in Table IV.A1 indicate that the asset reserves of the OASI Trust Fund are projected to decrease in all years after 2019 under the intermediate assumptions, increase in all years after 2018 under the low-cost assumptions, and decrease in all years through 2027 under the high-cost assumptions. Trust fund ratios decline throughout the 10-year projection period under all three sets of assumptions. Based on the intermediate assumptions, the reserves of the OASI Trust Fund continue to exceed 100 percent of annual cost through 2027. Consequently, the OASI Trust Fund satisfies the test of short-range financial adequacy. See figure IV.A1 for an illustration of these results.

Table IV.A1.—Operations of the OASI Trust Fund, Calendar Years 2013-2027[a]

[Dollar amounts in billions]

	Income					Cost[b]				Asset Reserves[b]		
Calendar year	Total	Net payroll tax contributions	GF reimbursements[c]	Taxation of benefits[d]	Net interest	Total	Scheduled benefits	Administrative costs	RRB interchange	Net increase during year	Amount at end of year	Trust fund ratio[e]
Historical data:												
2013 . .	$743.8	$620.8	$4.2	$20.7	$98.1	$679.5	$672.1	$3.4	$3.9	$64.3	$2,674.0	384
2014 . .	769.4	646.2	.4	28.0	94.8	714.2	706.8	3.1	4.3	55.2	2,729.2	374
2015 . .	801.6	679.5	.3	30.6	91.2	750.5	742.9	3.4	4.3	51.0	2,780.3	364
2016 . .	797.5	678.8	.1	31.6	87.0	776.4	768.6	3.5	4.3	21.1	2,801.3	358
2017 . .	825.6	706.5	[f]	35.9	83.2	806.7	798.7	3.7	4.3	19.0	2,820.3	347
Intermediate:												
2018 . .	828.2	714.5	[f]	33.1	80.6	853.6	845.5	3.3	4.7	-25.4	2,794.9	330
2019 . .	918.1	802.4	[f]	36.5	79.2	908.5	900.3	3.3	4.8	9.7	2,804.6	308
2020 . .	964.4	845.0	[f]	40.4	79.0	971.9	963.8	3.2	4.9	-7.6	2,797.0	289
2021 . .	1,011.6	888.8	[f]	44.5	78.3	1,036.9	1,028.6	3.4	4.9	-25.3	2,771.7	270
2022 . .	1,060.7	934.6	[f]	48.5	77.6	1,106.5	1,097.8	3.6	5.2	-45.9	2,725.8	250
2023 . .	1,111.7	981.3	[f]	52.8	77.7	1,180.1	1,171.1	3.8	5.2	-68.4	2,657.5	231
2024 . .	1,166.0	1,030.7	[f]	57.4	78.0	1,257.4	1,248.2	3.9	5.3	-91.4	2,566.1	211
2025 . .	1,220.0	1,080.1	[f]	62.3	77.6	1,337.1	1,327.7	4.1	5.3	-117.1	2,449.0	192
2026 . .	1,287.4	1,132.0	[f]	78.0	77.5	1,419.6	1,410.0	4.2	5.5	-132.3	2,316.7	173
2027 . .	1,343.7	1,182.4	[f]	84.5	76.8	1,506.4	1,496.6	4.3	5.5	-162.7	2,154.0	154
Low-cost:												
2018 . .	835.3	720.8	[f]	33.0	81.4	852.9	844.9	3.3	4.7	-17.7	2,802.7	331
2019 . .	951.9	831.3	[f]	36.6	83.9	912.0	903.9	3.3	4.8	39.9	2,842.6	307
2020 . .	1,023.1	893.9	[f]	40.8	88.4	981.8	973.7	3.3	4.9	41.3	2,883.9	290
2021 . .	1,095.0	957.2	[f]	45.1	92.8	1,051.9	1,043.5	3.5	4.9	43.1	2,927.0	274
2022 . .	1,170.0	1,022.2	[f]	49.4	98.4	1,127.4	1,118.5	3.7	5.1	42.6	2,969.6	260

[1] The estimates shown in this subsection reflect 12 months of scheduled benefits in each year of the short-range projection period. In practice, the actual payment dates have at times shifted over calendar year boundaries as a result of the statutory requirement for early delivery of benefit payments when the normal check delivery date is a Saturday, Sunday, or legal public holiday.

Table IV.A1.—Operations of the OASI Trust Fund, Calendar Years 2013-2027[a] (Cont.)
[Dollar amounts in billions]

	Income					Cost[b]				Asset Reserves[b]		
Calendar year	Total	Net payroll tax contributions	GF reimbursements[c]	Taxation of benefits[d]	Net interest	Total	Scheduled benefits	Administrative costs	RRB interchange	Net increase during year	Amount at end of year	Trust fund ratio[e]
2023 . .	$1,249.1	$1,089.3	f	$54.0	$105.8	$1,207.8	$1,198.6	$4.0	$5.2	$41.4	$3,010.9	246
2024 . .	1,333.7	1,160.2	f	59.0	114.5	1,292.9	1,283.4	4.2	5.3	40.8	3,051.8	233
2025 . .	1,421.5	1,233.2	f	64.4	124.0	1,381.4	1,371.7	4.4	5.4	40.1	3,091.8	221
2026 . .	1,527.0	1,310.5	f	81.0	135.5	1,474.3	1,464.2	4.6	5.5	52.8	3,144.6	210
2027 . .	1,625.2	1,388.9	f	88.2	148.1	1,573.0	1,562.7	4.8	5.5	52.3	3,196.9	200
High-cost:												
2018 . .	823.3	710.2	f	33.1	80.0	854.1	846.1	3.3	4.7	-30.8	2,789.5	330
2019 . .	876.4	764.7	f	36.3	75.5	903.1	895.0	3.3	4.9	-26.7	2,762.8	309
2020 . .	897.8	786.9	f	39.8	71.0	958.5	950.3	3.2	5.0	-60.7	2,702.1	288
2021 . .	924.3	814.0	f	43.7	66.6	1,018.2	1,009.9	3.3	4.9	-93.9	2,608.2	265
2022 . .	952.2	843.6	f	47.4	61.3	1,082.0	1,073.3	3.5	5.2	-129.7	2,478.4	241
2023 . .	981.3	873.7	f	51.4	56.2	1,148.9	1,140.1	3.6	5.2	-167.7	2,310.8	216
2024 . .	1,012.1	905.4	f	55.6	51.1	1,218.9	1,209.9	3.7	5.3	-206.8	2,104.0	190
2025 . .	1,042.7	937.1	f	60.1	45.5	1,290.1	1,281.1	3.8	5.3	-247.4	1,856.6	163
2026 . .	1,085.8	970.0	f	74.8	40.9	1,363.0	1,353.8	3.9	5.4	-277.2	1,579.4	136
2027 . .	1,115.7	999.7	f	80.7	35.3	1,438.6	1,429.3	3.9	5.4	-322.9	1,256.4	110

[a] Appendix A presents a detailed description of the components of income and cost, along with complete historical values.

[b] Amounts for 2015 and 2016 are adjusted to include in 2016 operations those benefit payments regularly scheduled in the law to be paid on January 3, 2016, which were actually paid on December 31, 2015 as required by the statutory provision for early benefit payments when the normal delivery date is on a weekend or holiday. Such shifts in payments across calendar years have occurred in the past and will occur periodically in the future whenever January 3rd falls on a Sunday. In order to provide a consistent perspective on trust fund operations over time, all trust fund operations in each year reflect the 12 months of benefits that are regularly scheduled for payment in that year.

[c] Includes reimbursements from the General Fund of the Treasury to the OASI Trust Fund for: (1) the cost of benefits to certain uninsured persons who attained age 72 before 1968; (2) the cost of payroll tax credits provided to employees in 1984 and self-employed persons in 1984-89 by Public Law 98-21; (3) the cost in 2009-17 of excluding certain self-employment earnings from SECA taxes under Public Law 110-246; and (4) payroll tax revenue forgone under the provisions of Public Laws 111-147, 111-312, 112-78, and 112-96.

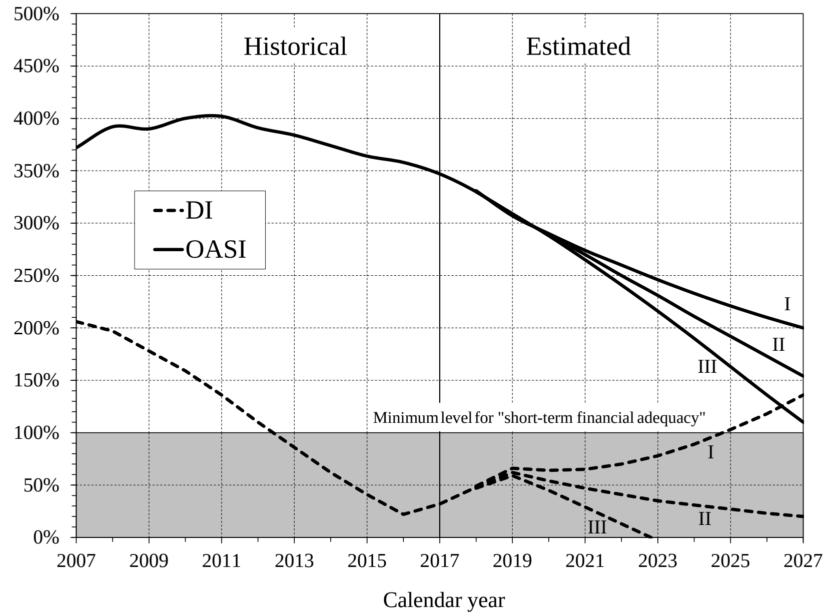
[d] Revenue from taxation of benefits is the amount that would be assessed on benefit amounts scheduled in the law.

[e] The "Trust fund ratio" column represents reserves at the beginning of a year (which are identical to reserves at the end of the prior year shown in the "Amount at end of year" column) as a percentage of cost for the year.

[f] Between -$50 million and $50 million.

Note: Totals do not necessarily equal the sums of rounded components.

Figure IV.A1.—Short-Range OASI and DI Trust Fund Ratios
[Asset reserves as a percentage of annual cost]



The estimated income shown in table IV.A1 increases annually under each set of assumptions throughout the short-range projection period, with the exception of a small decrease in 2018 for the high-cost alternative. The estimated increases in income result primarily from the projected increases in OASDI taxable earnings. Employment increases in every year through 2027 for all three alternatives, with the exception of small decreases in covered employment in 2019 and 2020 for the high-cost alternative: the number of persons with taxable earnings increases under alternatives I, II, and III from 173 million during calendar year 2017 to about 189 million, 185 million, and 181 million, respectively, in 2027. The total annual amount of taxable earnings increases in every year through 2027 for each alternative. Total earnings increase from $6,983 billion in 2017 to $13,196 billion, $11,229 billion, and $9,491 billion in 2027, on the basis of alternatives I, II, and III, respectively. These increases in taxable earnings are due primarily to: (1) projected increases in employment levels as the working age population increases; (2) trend increases in average earnings in covered employment (reflecting both real growth and price inflation); (3) increases in the contribution and benefit base under the automatic-adjustment provisions; and (4) growth in employment and average earnings, temporarily higher than trend, as the economy continues to recover from the severe economic downturn that began in late 2007.

Interest earnings contribute to the overall projected level of trust fund income during this period. Interest income declines generally at a slow rate under the intermediate assumptions and much faster under the high-cost assumptions, and increases generally under the low-cost assumptions, due to the net effects of changes in reserve levels and the patterns of projected interest rates. Under the intermediate assumptions, interest also declines as a share of total OASI Trust Fund income reaching 6 percent of total trust fund income for 2027, as compared to 10 percent for 2017.

Rising OASI cost from 2017 through 2027 reflects automatic benefit increases as well as the upward trend in the number of beneficiaries and in the average monthly earnings underlying benefits. The steady growth in the number of OASI beneficiaries since 2009 and the expected future growth result both from the increase in the aged population and from the increase in the proportion of the population that is eligible for benefits.

The Treasury invests OASI income in financial securities, generally special public-debt obligations of the U.S. Government. The revenue used to make these purchases flows to the General Fund of the Treasury. The trust fund earns interest on these securities, and the Treasury invests the proceeds from maturing securities in new securities if not immediately needed to pay program costs. Program expenditures require the redemption of trust fund securities, generally prior to maturity, to cover the payments made by the General Fund of the Treasury on behalf of the trust fund.[1]

2. Operations of the DI Trust Fund

Table IV.A2 shows the estimated operations and financial status of the DI Trust Fund during calendar years 2018 through 2027 under the three sets of assumptions, together with values for actual experience during 2013 through 2017. Non-interest income for DI is much higher in 2016 through 2018 than in 2015, due to the temporary payroll tax rate reallocation from OASI to DI. As a result, DI Trust Fund reserves increase in 2018 under each alternative. After returning to the ultimate allocation of tax rates in 2019, non-interest income is again less than DI cost except under the low-cost alternative. Non-interest income increases steadily thereafter under each alternative, due to most of the same factors described previously for the OASI Trust Fund. DI cost grows steadily throughout the period under each alternative. Under the intermediate assumptions, reserves decline after 2018, but remain positive through 2027. Under the high-cost assumptions, DI reserves decline after 2018 until depletion in the fourth quarter of 2022. Under the low-cost assumptions, reserves increase throughout the short-range projection period except for a small decrease in 2019.

[1] For an explanation of the interrelationship between the Medicare and Social Security trust funds and the overall Federal budget, see appendix F of the 2018 Medicare Trustees Report.

Table IV.A2.—Operations of the DI Trust Fund, Calendar Years 2013-2027[a]

[Dollar amounts in billions]

	Income					Cost[b]				Asset Reserves[b]		
Calendar year	Total	Net payroll tax contributions	GF reimbursements[c]	Taxation of benefits[d]	Net interest	Total	Scheduled benefits	Administrative costs	RRB interchange	Net increase during year	Amount at end of year	Trust fund ratio[e]
Historical data:												
2013 . . .	$111.2	$105.4	$0.7	$0.4	$4.7	$143.4	$140.1	$2.8	$0.6	-$32.2	$90.4	86
2014 . . .	114.9	109.7	.1	1.7	3.4	145.1	141.7	2.9	.4	-30.2	60.2	62
2015 . . .	118.6	115.4	[f]	1.1	2.1	146.6	143.4	2.8	.4	-28.0	32.3	41
2016 . . .	160.0	157.4	[f]	1.2	1.4	145.9	142.8	2.8	.4	14.1	46.3	22
2017 . . .	171.0	167.1	[f]	2.0	1.9	145.8	142.8	2.8	.2	25.1	71.5	32
Intermediate:												
2018 . . .	172.9	168.8	[f]	1.5	2.6	149.3	146.3	2.8	.2	23.7	95.2	48
2019 . . .	143.2	138.6	[f]	1.7	3.0	153.0	150.1	2.8	.1	-9.8	85.3	62
2020 . . .	148.1	143.5	[f]	1.8	2.8	157.2	154.2	2.8	.2	-9.1	76.2	54
2021 . . .	155.4	150.9	[f]	2.0	2.5	163.0	159.7	3.1	.2	-7.6	68.7	47
2022 . . .	163.1	158.7	[f]	2.1	2.3	169.2	165.6	3.4	.1	-6.1	62.6	41
2023 . . .	171.0	166.6	[f]	2.3	2.1	176.5	172.7	3.7	.1	-5.4	57.2	35
2024 . . .	179.5	175.0	[f]	2.5	2.0	184.3	180.3	3.9	.1	-4.9	52.3	31
2025 . . .	187.9	183.4	[f]	2.7	1.8	193.2	188.9	4.2	.1	-5.3	47.0	27
2026 . . .	197.2	192.2	[f]	3.3	1.7	202.5	197.9	4.5	.1	-5.3	41.7	23
2027 . . .	205.9	200.8	[f]	3.6	1.5	212.1	207.3	4.7	.1	-6.2	35.5	20
Low-cost:												
2018 . . .	174.7	170.3	[f]	1.5	2.8	147.1	144.1	2.8	.2	27.5	99.0	49
2019 . . .	149.0	143.5	[f]	1.7	3.8	149.9	147.0	2.8	.1	-.9	98.1	66
2020 . . .	157.8	151.8	[f]	1.8	4.2	153.2	150.3	2.8	.2	4.5	102.6	64
2021 . . .	169.3	162.5	[f]	1.9	4.8	158.0	154.7	3.1	.1	11.3	113.9	65
2022 . . .	181.5	173.6	[f]	2.0	5.9	163.2	159.6	3.4	.1	18.3	132.2	70
2023 . . .	194.5	185.0	[f]	2.2	7.3	169.5	165.6	3.8	.1	25.0	157.3	78
2024 . . .	208.5	197.0	[f]	2.3	9.2	176.4	172.3	4.1	.1	32.1	189.3	89
2025 . . .	223.4	209.4	[f]	2.5	11.5	184.5	180.1	4.4	.1	38.9	228.2	103
2026 . . .	240.0	222.5	[f]	3.2	14.3	193.2	188.4	4.7	.1	46.8	275.0	118
2027 . . .	257.0	235.9	[f]	3.4	17.7	202.3	197.2	5.1	.1	54.6	329.7	136

Table IV.A2.—Operations of the DI Trust Fund, Calendar Years 2013-2027[a] (Cont.)
[Dollar amounts in billions]

	Income					Cost[b]				Asset Reserves[b]		
Calendar year	Total	Net payroll tax contributions	GF reimbursements[c]	Taxation of benefits[d]	Net interest	Total	Scheduled benefits	Administrative costs	RRB interchange	Net increase during year	Amount at end of year	Trust fund ratio[e]
High-cost:												
2018 . . .	$171.8	$167.8	f	$1.6	$2.4	$151.5	$148.5	$2.8	$0.2	$20.3	$91.8	47
2019 . . .	136.2	132.1	f	1.7	2.3	156.0	153.1	2.8	.1	-19.8	72.0	59
2020 . . .	137.4	133.6	f	1.9	1.9	160.6	157.6	2.8	.2	-23.3	48.7	45
2021 . . .	141.5	138.2	f	2.0	1.3	167.3	164.1	3.1	.2	-25.8	22.9	29
2022 . . .	g	143.2	f	2.2	g	174.1	170.7	3.3	.2	g	g	13
2023 . . .	g	148.4	f	2.3	g	182.0	178.3	3.5	.1	g	g	g
2024 . . .	g	153.8	f	2.5	g	190.2	186.3	3.8	.1	g	g	g
2025 . . .	g	159.1	f	2.8	g	199.3	195.2	4.0	.1	g	g	g
2026 . . .	g	164.7	f	3.4	g	208.7	204.4	4.2	.1	g	g	g
2027 . . .	g	169.8	f	3.7	g	218.2	213.7	4.4	.1	g	g	g

[a] The DI Trust Fund reserves become depleted in the fourth quarter of 2022 under the high-cost assumptions. For any period during which reserves would be depleted, scheduled benefits could not be paid in full on a timely basis, income from taxing benefits would be less than would apply to scheduled benefits, and interest on trust fund reserves would be negligible. Appendix A presents a detailed description of the components of income and cost, along with complete historical values.
[b] Amounts for 2015 and 2016 are adjusted to include in 2016 operations those benefit payments regularly scheduled in the law to be paid on January 3, 2016, which were actually paid on December 31, 2015 as required by the statutory provision for early benefit payments when the normal delivery date is on a weekend or holiday. Such shifts in payments across calendar years have occurred in the past and will occur periodically in the future whenever January 3rd falls on a Sunday. In order to provide a consistent perspective on trust fund operations over time, all trust fund operations in each year reflect the 12 months of benefits that are regularly scheduled for payment in that year.
[c] Includes reimbursements from the General Fund of the Treasury to the DI Trust Fund for: (1) the cost of payroll tax credits provided to employees in 1984 and self-employed persons in 1984-89 by Public Law 98-21; (2) the cost in 2009-17 of excluding certain self-employment earnings from SECA taxes under Public Law 110-246; and (3) payroll tax revenue forgone under the provisions of Public Laws 111-147, 111-312, 112-78, and 112-96.
[d] Revenue from taxation of benefits is the amount that would be assessed on benefit amounts scheduled in the law.
[e] The "Trust fund ratio" column represents reserves at the beginning of a year (which are identical to reserves at the end of the prior year shown in the "Amount at end of year" column) as a percentage of cost for the year.
[f] Between -$50 million and $50 million.
[g] While the fund is depleted, values under current law would reflect permissible expenditures only, which would be less than the cost of scheduled benefits shown in this table.

Note: Totals do not necessarily equal the sums of rounded components.

For the future, DI cost is projected to increase in part due to increases in average benefit levels resulting from: (1) automatic benefit increases and (2) projected increases in the amounts of average monthly earnings on which benefits are based. Future changes in DI cost also reflect changes in the number of DI beneficiaries in current-payment status. In 2017, the number of DI beneficiaries in current-payment status continued the declining trend of the prior three years. Under the intermediate assumptions, that number of DI beneficiaries is projected to drop further through the end of 2018, remain around the same level through 2020, then increase through the remainder of the short-range projection period. The increases after 2020 are at a much slower rate than was experienced on average from 1990 to 2010, due in large part to long-anticipated demographic trends and expected economic conditions, and in part to an expected continuation of recent low incidence rates through the first few years of the short-range period as discussed in section V.C.5.

At the beginning of calendar year 2017, the reserves of the DI Trust Fund represented 32 percent of annual cost. During 2017, DI income substantially exceeded cost, and the estimated trust fund ratio for the beginning of 2018 increased to about 48 percent. Under the intermediate assumptions, the temporary reallocation of the payroll tax rate from OASI to DI causes DI total income to exceed cost in 2018, and reserves to increase to a level of 62 percent of annual cost at the beginning of 2019. Thereafter, cost exceeds total income throughout the short-range projection period and trust fund reserves steadily decline.

Because the reserves of the DI Trust Fund at the beginning of 2018 were less than the estimated annual cost for 2018, and are projected to remain below annual cost throughout the short-range period under the intermediate assumptions, the DI Trust Fund fails the Trustees' test of short-range financial adequacy.

3. Operations of the Combined OASI and DI Trust Funds

Table IV.A3 shows the estimated operations and status of the combined OASI and DI Trust Funds for calendar years 2018 through 2027 under the three alternatives, together with actual experience in 2013 through 2017. Income and cost for the OASI Trust Fund represent over 80 percent of the corresponding amounts for the combined OASI and DI Trust Funds. Therefore, based on the relative strength of the OASI Trust Fund over the next 10 years, the combined OASI and DI Trust Funds would have sufficient financial resources to pay all scheduled benefits through the end of the short-range period, although it is important to note that under current law, one trust fund cannot share financial resources with another trust fund. In addition, the combined OASI and DI Trust Funds would satisfy the test of short-range financial adequacy.

Table IV.A3.—Operations of the Combined OASI and DI Trust Funds, Calendar Years 2013-2027[a]
[Dollar amounts in billions]

	Income					Cost[b]				Asset Reserves[b]		
Calendar year	Total	Net payroll tax contributions	GF reimbursements[c]	Taxation of benefits[d]	Net interest	Total	Scheduled benefits	Administrative costs	RRB interchange	Net increase during year	Amount at end of year	Trust fund ratio[e]
Historical data:												
2013 . .	$855.0	$726.2	$4.9	$21.1	$102.8	$822.9	$812.3	$6.2	$4.5	$32.1	$2,764.4	332
2014 . .	884.3	756.0	.5	29.6	98.2	859.2	848.5	6.1	4.7	25.0	2,789.5	322
2015 . .	920.2	794.9	.3	31.6	93.3	897.1	886.3	6.2	4.7	23.0	2,812.5	311
2016 . .	957.5	836.2	.1	32.8	88.4	922.3	911.4	6.2	4.7	35.2	2,847.7	305
2017 . .	996.6	873.6	[f]	37.9	85.1	952.5	941.5	6.5	4.5	44.1	2,891.8	299

Table IV.A3.—Operations of the Combined OASI and DI Trust Funds, Calendar Years 2013-2027[a] (Cont.)
[Dollar amounts in billions]

	Income					Cost[b]				Asset Reserves[b]		
Calendar year	Total	Net payroll tax contributions	GF reimbursements[c]	Taxation of benefits[d]	Net interest	Total	Scheduled benefits	Administrative costs	RRB interchange	Net increase during year	Amount at end of year	Trust fund ratio[e]
Intermediate:												
2018 . .	$1,001.1	$883.4	[f]	$34.6	$83.1	$1,002.8	$991.8	$6.2	$4.9	-$1.7	$2,890.1	288
2019 . .	1,061.4	941.0	[f]	38.2	82.2	1,061.5	1,050.5	6.1	5.0	-.2	2,889.9	272
2020 . .	1,112.5	988.5	[f]	42.2	81.8	1,129.2	1,118.0	6.1	5.1	-16.7	2,873.2	256
2021 . .	1,167.0	1,039.7	[f]	46.4	80.9	1,199.9	1,188.3	6.5	5.1	-32.9	2,840.3	239
2022 . .	1,223.7	1,093.3	[f]	50.6	79.8	1,275.7	1,263.4	7.0	5.3	-51.9	2,788.4	223
2023 . .	1,282.8	1,147.9	[f]	55.0	79.8	1,356.5	1,343.8	7.4	5.4	-73.8	2,714.6	206
2024 . .	1,345.5	1,205.7	[f]	59.8	80.0	1,441.8	1,428.5	7.8	5.4	-96.3	2,618.4	188
2025 . .	1,407.9	1,263.5	[f]	65.0	79.4	1,530.2	1,516.6	8.2	5.4	-122.4	2,496.0	171
2026 . .	1,484.6	1,324.2	[f]	81.3	79.1	1,622.1	1,607.9	8.7	5.6	-137.5	2,358.5	154
2027 . .	1,549.6	1,383.2	[f]	88.1	78.3	1,718.5	1,703.9	9.1	5.6	-169.0	2,189.5	137
Low-cost:												
2018 . .	1,010.0	891.1	[f]	34.6	84.3	1,000.1	989.0	6.2	4.9	9.9	2,901.7	289
2019 . .	1,100.9	974.9	[f]	38.3	87.7	1,061.9	1,050.9	6.1	4.9	39.0	2,940.7	273
2020 . .	1,180.9	1,045.7	[f]	42.6	92.6	1,135.0	1,123.9	6.1	5.0	45.8	2,986.5	259
2021 . .	1,264.3	1,119.7	[f]	47.0	97.6	1,209.9	1,198.2	6.7	5.0	54.4	3,040.9	247
2022 . .	1,351.4	1,195.7	[f]	51.4	104.3	1,290.5	1,278.1	7.2	5.3	60.9	3,101.8	236
2023 . .	1,443.6	1,274.3	[f]	56.2	113.1	1,377.2	1,364.2	7.7	5.3	66.4	3,168.2	225
2024 . .	1,542.2	1,357.2	[f]	61.3	123.7	1,469.3	1,455.7	8.2	5.4	72.9	3,241.1	216
2025 . .	1,644.9	1,442.6	[f]	66.9	135.4	1,566.0	1,551.8	8.8	5.5	78.9	3,320.1	207
2026 . .	1,767.1	1,533.1	[f]	84.1	149.9	1,667.5	1,652.6	9.3	5.6	99.6	3,419.6	199
2027 . .	1,882.2	1,624.8	[f]	91.6	165.8	1,775.3	1,759.8	9.8	5.6	106.9	3,526.5	193
High-cost:												
2018 . .	995.1	878.1	[f]	34.7	82.4	1,005.6	994.6	6.2	4.9	-10.5	2,881.3	288
2019 . .	1,012.6	896.8	[f]	38.0	77.8	1,059.1	1,048.1	6.1	5.0	-46.5	2,834.8	272
2020 . .	1,035.1	920.5	[f]	41.7	72.9	1,119.1	1,107.9	6.1	5.1	-84.0	2,750.8	253
2021 . .	1,065.8	952.3	[f]	45.7	67.9	1,185.5	1,174.0	6.4	5.1	-119.7	2,631.1	232
2022 . .	1,098.0	986.8	[f]	49.6	61.6	1,256.1	1,244.0	6.8	5.3	-158.1	2,473.0	209
2023 . .	1,131.2	1,022.1	[f]	53.7	55.4	1,330.9	1,318.4	7.1	5.4	-199.7	2,273.3	186
2024 . .	1,166.2	1,059.2	[f]	58.1	48.9	1,409.1	1,396.2	7.4	5.4	-242.8	2,030.4	161
2025 . .	1,200.8	1,096.2	[f]	62.9	41.7	1,489.4	1,476.2	7.7	5.4	-288.6	1,741.9	136
2026 . .	1,248.4	1,134.7	[f]	78.3	35.3	1,571.7	1,558.2	8.0	5.5	-323.4	1,418.5	111
2027 . .	1,281.5	1,169.5	[f]	84.4	27.6	1,656.8	1,643.0	8.3	5.5	-375.3	1,043.2	86

[a] Appendix A presents a detailed description of the components of income and cost, along with complete historical values.

[b] Amounts for 2015 and 2016 are adjusted to include in 2016 operations those benefit payments regularly scheduled in the law to be paid on January 3, 2016, which were actually paid on December 31, 2015 as required by the statutory provision for early benefit payments when the normal delivery date is on a weekend or holiday. Such shifts in payments across calendar years have occurred in the past and will occur periodically in the future whenever January 3rd falls on a Sunday. In order to provide a consistent perspective on trust fund operations over time, all trust fund operations in each year reflect the 12 months of benefits that are regularly scheduled for payment in that year.

[c] Includes reimbursements from the General Fund of the Treasury to the OASI and DI Trust Funds for: (1) the cost of benefits to certain uninsured persons who attained age 72 before 1968; (2) the cost of payroll tax credits provided to employees in 1984 and self-employed persons in 1984-89 by Public Law 98-21; (3) the cost in 2009-17 of excluding certain self-employment earnings from SECA taxes under Public Law 110-246; and (4) payroll tax revenue forgone under the provisions of Public Laws 111-147, 111-312, 112-78, and 112-96.

[d] Revenue from taxation of benefits is the amount that would be assessed on benefit amounts scheduled in the law.

[e] The "Trust fund ratio" column represents reserves at the beginning of a year (which are identical to reserves at the end of the prior year shown in the "Amount at end of year" column) as a percentage of cost for the year.

[f] Between -$50 million and $50 million.

Note: Totals do not necessarily equal the sums of rounded components.

4. Factors Underlying Changes in 10-Year Trust Fund Ratio Estimates From Last Year's Report

Table IV.A4 presents an analysis of the factors underlying the changes in the intermediate estimates over the short-range projection period for the OASI, DI, and the combined funds from last year's report to this report.

In the 2017 report under intermediate assumptions, the trust fund ratio for OASI reached 187 percent at the beginning of 2026—the tenth projection year for that report. The change in the short-range valuation period alone, from 2017 through 2026 to 2018 through 2027, lowered the estimated trust fund ratio for the tenth year by 19 percentage points, to 168 percent. All other changes to reflect modifications in law and regulations since last year's report, the most recent data, adjustments to the assumptions for future years, and changes in projection methods combined for a net decrease in the ratio for the tenth projection year of 14 percentage points. Therefore, the total change in the 10th-year projected trust fund ratio from last year's report to this year's report is a reduction of 33 percentage points to 154 percent.

The Tax Cuts and Jobs Act of 2017 (P.L. 115-97) and the assumed discontinuation of the DACA program together reduced the projected tenth year OASI trust fund ratio by 6 percentage points, primarily due to lower projected tax income. Changes in demographic assumptions over the short-range period increased the projected tenth-year trust fund ratio for OASI by 3 percentage points. Changes in economic data and assumptions, primarily the effect of decreases in estimated payroll tax revenue, along with effects from lower projected interest rates and lower cost-of-living adjustments that largely offset each other, caused a net reduction in the OASI trust fund ratio of 16 percentage points by the beginning of 2027. Incorporating recent programmatic data resulted in an increase of 5 percentage points in the tenth year OASI trust fund ratio. This increase was primarily due to recent data showing that retired workers have been starting benefits at later ages, which in turn led to lower beneficiary counts throughout the short-range period, with only partially offsetting increases in average monthly benefit levels. Finally, the tenth year trust fund ratio was not affected significantly by changes in the short-range methodology for this report.

Table IV.A4 also shows corresponding estimates of the factors underlying the changes in the financial projections for the DI Trust Fund and for the combined OASI and DI Trust Funds.

The 4-percentage-point increase in the DI trust fund ratio from the beginning of 2026 in last year's report to the beginning of 2027 in this year's report is the net effect of increases and decreases from the factors described above for the OASI Trust Fund, combined with a large increase of 31 points due to programmatic data and assumptions, predominantly the lower estimated disabled-worker incidence rates early in the short-range projection period. Disability applications have been declining steadily since 2010, and the total number of disabled-worker beneficiaries in current payment status has been falling since 2014. In last year's report, the number of disabled-worker beneficiaries was projected to remain essentially the same at 8.8 million from the end of 2016 to the end of 2017. In fact, the number dropped below 8.7 million by the end of 2017. For this report, ultimate disability incidence rate assumptions are unchanged from the last report. However, this year's report has lower incidence rates over the first few years of the short-range period, and a gradual rise from recent low levels, reaching the ultimate DI incidence rates by the end of the short-range period. In addition, average awarded monthly benefit levels for disabled-worker beneficiaries were lower than expected in 2017, and are expected to be lower in the future. Disabled-worker average awarded monthly benefit levels were somewhat elevated in 2011 through 2016 due to reduced numbers of hearings decisions (where monthly benefit levels tend to be relatively low), as the number of applicants awaiting a hearing increased. In 2017, hearings decisions increased, thus restoring a more normal, and somewhat lower, average benefit level for disabled workers newly awarded benefits in 2017. See page 38 for more details on these changes in DI projections.

Table IV.A4.—Reasons for Change in Trust Fund (Unfunded Obligation) Ratios at the Beginning of the Tenth Year of Projection Under Intermediate Assumptions
[In percent]

Item	OASI Trust Fund	DI Trust Fund	OASI and DI Trust Funds, combined
Trust fund ratio shown in last year's report for calendar year 2026	187	16	165
Change in trust fund ratio due to changes in:			
Legislation and regulations	-6	-3	-5
Valuation period	-19	-7	-18
Demographic data and assumptions	3	[a]	2
Economic data and assumptions	-16	-17	-16
Programmatic data and assumptions	5	31	9
Projection methods and data	[a]	[a]	[a]
Total change in trust fund ratio	-33	4	-28
Trust fund ratio shown in this report for calendar year 2027	154	20	137

[a] Between -0.5 and 0.5 percent.

Note: Totals do not necessarily equal the sums of rounded components.

B. LONG-RANGE ESTIMATES

The Trustees use three types of financial measures to assess the actuarial status of the Social Security trust funds under the financing approach specified in current law: (1) annual cash-flow measures, including income rates, cost rates, and balances; (2) trust fund ratios; and (3) summary measures such as actuarial balances and unfunded obligations.

The difference between the annual income rate and annual cost rate, both expressed as percentages of taxable payroll, is the annual balance. The level and trend of the annual balances at the end of the 75-year projection period are factors that the Trustees use to assess the financial condition of the program.

The trust fund ratio for a year is the proportion of the year's projected cost that could be paid with funds available at the beginning of the year. Critical factors considered by the Trustees in assessing actuarial status include: (1) the level and year of maximum trust fund ratio, (2) the year of depletion of the fund reserves and the percent of scheduled benefits that is still payable after reserves are depleted, and (3) the stability of the trust fund ratio at the end of the long-range period.

Solvency at any point in time requires that sufficient financial resources are available to pay all scheduled benefits at that time. Solvency is generally indicated by a positive trust fund ratio. "Sustainable solvency" for the financing of the program under a specified set of assumptions has been achieved when the projected trust fund ratio is positive throughout the 75-year projection period and is either stable or rising at the end of the period.

Summarized measures for any period indicate whether projected income is sufficient, on average, for the whole period. Summarized measures can only indicate the solvency status of a fund for the end of the period. The Trustees summarize the total income and cost over valuation periods that extend through 75 years and over the infinite horizon.[1] This section presents two summarized measures: the actuarial balance and the open group unfunded obligation. The actuarial balance indicates the size of any surplus or shortfall as a percentage of the taxable payroll over the period. The open group unfunded obligation indicates the size of any shortfall in present-value dollars.

This section also includes additional information that the Trustees use to assess the financial status of the Social Security program, including: (1) a comparison of the number of beneficiaries to the number of covered workers,

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[1] See appendix F.

(2) the test of long-range close actuarial balance, and (3) the reasons for the change in the actuarial balance from the last report.

1. Annual Income Rates, Cost Rates, and Balances

The concepts of income rate and cost rate, expressed as percentages of taxable payroll, are important in the consideration of the long-range actuarial status of the trust funds. The annual income rate is the ratio of all non-interest income to the OASDI taxable payroll for the year. Non-interest income includes payroll taxes, taxes on scheduled benefits, and any General Fund transfers or reimbursements. The OASDI taxable payroll consists of the total earnings subject to OASDI taxes with some relatively small adjustments.[1] The annual cost rate is the ratio of the cost of the program to the taxable payroll for the year. The cost includes scheduled benefits, administrative expenses, net interchange with the Railroad Retirement program, and payments for vocational rehabilitation services for disabled beneficiaries. For any year, the income rate minus the cost rate is the "balance" for the year.

Table IV.B1 presents a comparison of the estimated annual income rates and cost rates by trust fund and alternative. Table IV.B2 shows the separate components of the annual income rates.

Under the intermediate assumptions, the Trustees project that the OASI income rate will increase from 10.30 percent of payroll for 2018 to 11.03 percent of payroll for 2019. The projected OASI income rate is low for 2018 because of the payroll tax rate reallocation of 0.57 percentage point from OASI to DI for 2016 through 2018, as enacted in the Bipartisan Budget Act of 2015. After returning to the pre-reallocation level for 2019, the income rate generally rises at a very gradual rate to 11.52 percent of taxable payroll for 2092. Income from taxation of benefits causes a gradual increase in the OASI income rate for two main reasons: (1) total scheduled benefits are rising faster than payroll; and (2) the benefit-taxation threshold amounts are fixed (not indexed), and therefore an increasing share of total benefits will be subject to tax as incomes and benefits rise. There is also a one-time upward shift in the income rate, from 11.19 percent of payroll for 2025 to 11.31 percent of payroll for 2026, because of increased taxation of benefits due to expiration of the personal income tax provisions in Public Law 115-97, the Tax Cuts and Jobs Act.

[1] Adjustments include adding deemed wage credits based on military service for 1983-2001 and reflecting the lower effective tax rates (as compared to the combined employee-employer rate) that apply to multiple-employer "excess wages." Lower rates also applied to net earnings from self-employment before 1984 and to income from tips before 1988.

From 2018 to 2037, the OASI cost rate rises rapidly because the retirement of the baby-boom generation will continue to increase the number of beneficiaries much faster than the number of workers increases, as subsequent lower-birth-rate generations replace the baby-boom generation at working ages. From 2038 to 2052, the cost rate declines because the aging baby-boom generation is gradually replaced at retirement ages by the subsequently lower-birth-rate generation born between 1966 and 1989. After 2052, the projected OASI cost rate rises through 2078 and then fluctuates, reaching 15.48 percent of taxable payroll for 2092, with the increase primarily because of projected reductions in death rates at older ages.

Projections of income rates under the low-cost and high-cost sets of assumptions are similar to those projected for the intermediate assumptions, because income rates are largely a reflection of the payroll tax rates specified in the law, with the changes from taxation of benefits noted above. In contrast, OASI cost rates for the low-cost and high-cost assumptions are significantly different from those projected for the intermediate assumptions. For the low-cost assumptions, the OASI cost rate decreases through 2019, and then rises until it peaks in 2036 at 12.60 percent of payroll. The cost rate then declines to 11.56 percent for 2055, rises to 11.74 percent for 2071, and declines again to 11.18 percent for 2088 before rising to 11.30 percent for 2092, at which point the income rate reaches 11.26 percent. For the high-cost assumptions, the OASI cost rate rises throughout the 75-year period. It rises relatively rapidly through about 2039 because of the aging of the baby-boom generation. Thereafter, the cost rate continues to rise and reaches 21.97 percent of payroll for 2092, at which point the income rate reaches 11.92 percent.

The pattern of the projected OASI annual balance is important in the analysis of the financial condition of the program. Under the intermediate assumptions, the annual balance is negative throughout the projection period. This annual deficit is temporarily higher for years 2016 through 2018 because of the 0.57-percentage-point payroll tax rate reallocation from OASI to DI. After returning to the pre-reallocation tax rates in 2019, the annual deficit then rises relatively rapidly from 0.91 percent for 2019 to 3.41 percent for 2038. It then declines to 2.99 percent of payroll for 2052, and generally rises thereafter, reaching 3.96 percent of taxable payroll for 2092.

Under the low-cost assumptions, after the 2016-2018 payroll tax rate reallocation period, the OASI annual deficit generally rises from 0.56 percent of payroll for 2019 to 1.30 percent of payroll for 2035. Then the annual deficit generally declines until it becomes a positive annual balance for 2085. The annual balance turns negative again for 2092, at which point the deficit is 0.04 percent of payroll. Under the high-cost assumptions, the OASI balance generally worsens throughout the projection period. Annual deficits rise to

1.77 percent for 2020, 6.48 percent for 2050, and 10.05 percent of payroll for 2092.

Table IV.B1.—Annual Income Rates, Cost Rates, and Balances, Calendar Years 1990-2095
[As a percentage of taxable payroll]

Calendar year	OASI Income rate[a]	OASI Cost rate[b]	OASI Balance[b]	DI Income rate[a]	DI Cost rate[b]	DI Balance[b]	OASDI Income rate[a]	OASDI Cost rate[b]	OASDI Balance[b]
Historical data:									
1990	11.47	9.65	1.82	1.18	1.09	0.10	12.65	10.74	1.91
1995	10.65	10.23	.42	1.87	1.44	.43	12.52	11.67	.85
2000	10.85	8.98	1.87	1.78	1.42	.36	12.62	10.40	2.23
2005	10.96	9.31	1.65	1.84	1.85	-.02	12.80	11.16	1.63
2006	10.96	9.18	1.78	1.83	1.88	-.05	12.79	11.06	1.73
2007	11.01	9.44	1.57	1.84	1.88	-.04	12.85	11.32	1.53
2008	10.90	9.54	1.37	1.83	2.01	-.19	12.73	11.55	1.18
2009	11.23	10.74	.50	1.88	2.31	-.43	13.11	13.05	.06
2010	10.75	11.06	-.30	1.79	2.41	-.62	12.54	13.47	-.92
2011	10.84	11.04	-.21	1.80	2.42	-.62	12.64	13.47	-.83
2012	11.05	11.35	-.30	1.81	2.47	-.66	12.86	13.82	-.96
2013	10.97	11.54	-.57	1.81	2.44	-.63	12.78	13.98	-1.20
2014	10.96	11.60	-.64	1.81	2.36	-.55	12.77	13.96	-1.19
2015	11.00	11.62	-.62	1.80	2.27	-.47	12.80	13.89	-1.09
2016	10.71	11.70	-.99	2.39	2.20	.19	13.10	13.90	-.80
2017	10.67	11.60	-.92	2.43	2.10	.33	13.10	13.69	-.59
Intermediate:									
2018	10.30	11.75	-1.46	2.35	2.06	.29	12.64	13.81	-1.17
2019	11.03	11.94	-.91	1.84	2.01	-.17	12.87	13.95	-1.08
2020	11.08	12.16	-1.08	1.82	1.97	-.15	12.89	14.12	-1.23
2021	11.10	12.33	-1.23	1.82	1.94	-.12	12.92	14.27	-1.35
2022	11.13	12.52	-1.40	1.82	1.91	-.09	12.95	14.44	-1.49
2023	11.14	12.72	-1.57	1.82	1.90	-.08	12.97	14.62	-1.66
2024	11.17	12.91	-1.74	1.82	1.89	-.07	12.99	14.80	-1.81
2025	11.19	13.09	-1.91	1.82	1.89	-.07	13.01	14.98	-1.98
2026	11.31	13.27	-1.96	1.83	1.89	-.06	13.13	15.16	-2.02
2027	11.33	13.47	-2.14	1.83	1.90	-.07	13.15	15.36	-2.21
2030	11.37	14.09	-2.72	1.83	1.89	-.07	13.20	15.98	-2.78
2035	11.42	14.71	-3.28	1.83	1.95	-.12	13.25	16.65	-3.40
2040	11.44	14.83	-3.39	1.83	2.00	-.17	13.27	16.83	-3.56
2045	11.43	14.59	-3.15	1.83	2.07	-.24	13.27	16.66	-3.39
2050	11.43	14.44	-3.01	1.84	2.10	-.27	13.27	16.54	-3.27
2055	11.44	14.46	-3.02	1.84	2.13	-.29	13.28	16.59	-3.31
2060	11.46	14.70	-3.24	1.84	2.11	-.27	13.29	16.81	-3.51
2065	11.48	14.95	-3.47	1.84	2.12	-.28	13.31	17.07	-3.75
2070	11.50	15.23	-3.74	1.84	2.13	-.29	13.34	17.36	-4.03
2075	11.51	15.48	-3.96	1.84	2.11	-.27	13.35	17.59	-4.23
2080	11.52	15.49	-3.97	1.84	2.11	-.28	13.36	17.61	-4.25
2085	11.51	15.37	-3.86	1.84	2.16	-.32	13.35	17.53	-4.18
2090	11.52	15.40	-3.89	1.84	2.20	-.36	13.35	17.60	-4.24
2095	11.53	15.63	-4.10	1.84	2.20	-.36	13.37	17.82	-4.45
First year balance becomes negative and remains negative throughout the 75-year projection period			2010			2019			2010

Table IV.B1.—Annual Income Rates, Cost Rates, and Balances, Calendar Years 1990-2095 (Cont.)
[As a percentage of taxable payroll]

Calendar year	OASI Income rate[a]	OASI Cost rate[b]	OASI Balance[b]	DI Income rate[a]	DI Cost rate[b]	DI Balance[b]	OASDI Income rate[a]	OASDI Cost rate[b]	OASDI Balance[b]
Low-cost:									
2018	10.24	11.59	-1.35	2.34	2.00	0.34	12.58	13.59	-1.01
2019	11.01	11.56	-.56	1.84	1.90	-.06	12.85	13.46	-.62
2020	11.04	11.60	-.56	1.81	1.81	[c]	12.86	13.41	-.55
2021	11.06	11.61	-.55	1.81	1.74	.07	12.88	13.35	-.48
2022	11.08	11.66	-.58	1.82	1.69	.13	12.90	13.35	-.45
2023	11.09	11.72	-.63	1.82	1.64	.17	12.91	13.36	-.45
2024	11.11	11.79	-.67	1.82	1.61	.21	12.93	13.39	-.46
2025	11.12	11.84	-.72	1.82	1.58	.24	12.94	13.42	-.48
2026	11.22	11.89	-.67	1.82	1.56	.26	13.04	13.45	-.41
2027	11.23	11.96	-.73	1.82	1.54	.28	13.06	13.50	-.45
2030	11.27	12.33	-1.06	1.82	1.49	.34	13.09	13.81	-.72
2035	11.30	12.60	-1.30	1.82	1.46	.36	13.12	14.06	-.94
2040	11.30	12.44	-1.14	1.82	1.45	.37	13.12	13.89	-.76
2045	11.28	11.98	-.70	1.82	1.47	.35	13.10	13.45	-.35
2050	11.27	11.67	-.41	1.82	1.46	.36	13.09	13.13	-.05
2055	11.26	11.56	-.29	1.82	1.46	.36	13.09	13.02	.07
2060	11.27	11.63	-.36	1.82	1.44	.38	13.09	13.07	.03
2065	11.28	11.69	-.41	1.82	1.44	.39	13.10	13.12	-.02
2070	11.28	11.74	-.46	1.82	1.44	.39	13.11	13.17	-.07
2075	11.28	11.72	-.43	1.82	1.42	.40	13.10	13.14	-.03
2080	11.27	11.50	-.23	1.82	1.43	.39	13.09	12.92	.17
2085	11.25	11.23	.02	1.82	1.47	.35	13.08	12.70	.38
2090	11.25	11.22	.04	1.82	1.50	.32	13.08	12.72	.36
2095	11.27	11.45	-.18	1.82	1.50	.32	13.09	12.95	.14
First year balance becomes negative and remains negative throughout the 75-year projection period			2092			[d]			[d]
High-cost:									
2018	10.33	11.87	-1.54	2.35	2.11	.25	12.69	13.98	-1.29
2019	11.06	12.47	-1.41	1.85	2.15	-.31	12.91	14.63	-1.72
2020	11.11	12.88	-1.77	1.82	2.16	-.34	12.93	15.04	-2.11
2021	11.15	13.24	-2.09	1.82	2.18	-.35	12.97	15.41	-2.44
2022	11.18	13.58	-2.40	1.82	2.19	-.36	13.01	15.76	-2.76
2023	11.21	13.92	-2.71	1.83	2.20	-.38	13.03	16.12	-3.09
2024	11.24	14.25	-3.02	1.83	2.22	-.40	13.07	16.48	-3.41
2025	11.26	14.57	-3.31	1.83	2.25	-.42	13.09	16.82	-3.73
2026	11.40	14.87	-3.47	1.83	2.28	-.44	13.24	17.15	-3.91
2027	11.43	15.22	-3.79	1.84	2.31	-.47	13.27	17.53	-4.26

Table IV.B1.—Annual Income Rates, Cost Rates, and Balances, Calendar Years 1990-2095 (Cont.)
[As a percentage of taxable payroll]

Calendar year	OASI Income rate[a]	OASI Cost rate[b]	OASI Balance[b]	DI Income rate[a]	DI Cost rate[b]	DI Balance[b]	OASDI Income rate[a]	OASDI Cost rate[b]	OASDI Balance[b]
High-cost (Cont.):									
2030	11.49	16.16	-4.66	1.84	2.37	-0.53	13.33	18.53	-5.20
2035	11.57	17.23	-5.66	1.84	2.52	-.68	13.41	19.75	-6.34
2040	11.61	17.79	-6.18	1.84	2.66	-.82	13.46	20.45	-6.99
2045	11.63	17.94	-6.31	1.85	2.83	-.98	13.48	20.77	-7.29
2050	11.65	18.13	-6.48	1.85	2.92	-1.07	13.50	21.05	-7.55
2055	11.67	18.45	-6.77	1.85	2.99	-1.14	13.53	21.44	-7.91
2060	11.71	18.99	-7.28	1.85	3.00	-1.14	13.57	21.99	-8.42
2065	11.75	19.58	-7.82	1.86	3.02	-1.17	13.61	22.60	-8.99
2070	11.80	20.28	-8.48	1.86	3.05	-1.19	13.66	23.33	-9.67
2075	11.85	21.01	-9.16	1.86	3.02	-1.16	13.70	24.03	-10.33
2080	11.88	21.50	-9.62	1.86	3.01	-1.15	13.74	24.50	-10.77
2085	11.90	21.73	-9.83	1.86	3.03	-1.17	13.76	24.75	-11.00
2090	11.91	21.89	-9.98	1.86	3.06	-1.20	13.77	24.95	-11.18
2095	11.93	22.10	-10.18	1.86	3.07	-1.21	13.78	25.17	-11.38
First year balance becomes negative and remains negative throughout the 75-year projection period			2010			2019			2010

[a] Income rates include certain reimbursements from the General Fund of the Treasury.
[b] Benefit payments scheduled to be paid on January 3 are actually paid on December 31 as required by the statutory provision for early delivery of benefit payments when the normal payment delivery date is a Saturday, Sunday, or legal public holiday. For comparability with the values for historical years and the projections in this report, all trust fund operations and asset reserves reflect the 12 months of benefits scheduled for payment each year.
[c] Between 0 and 0.005 percent of taxable payroll.
[d] The annual balance is projected to be negative for a temporary period and return to positive levels before the end of the projection period.

Notes:
1. The income rate excludes interest income.
2. Revisions of taxable payroll may change some historical values.
3. Totals do not necessarily equal the sums of rounded components.

Under the intermediate assumptions, the projected DI cost rate declines from 2.06 percent for 2018 to 1.89 percent for 2025, and remains relatively stable through 2032. After 2032, the DI cost rate increases gradually to 2.13 percent for 2055. From 2055 to 2077, the DI cost rate stays relatively stable before increasing slowly to 2.20 percent of payroll for 2092. The projected DI income rate decreases from 2.35 percent of payroll for 2018 to 1.84 for 2019. Between 2016 and 2018, the income rate is higher due to the temporary payroll tax rate reallocation. Thereafter, the income rate remains relatively stable, reaching 1.84 percent for 2092. The annual balance is positive for years 2016 through 2018, reflecting the reallocation. Thereafter, the annual deficit reappears, generally declines from 0.17 percent for 2019 to a low of 0.06 percent for 2029, and then generally increases to 0.36 percent for 2092.

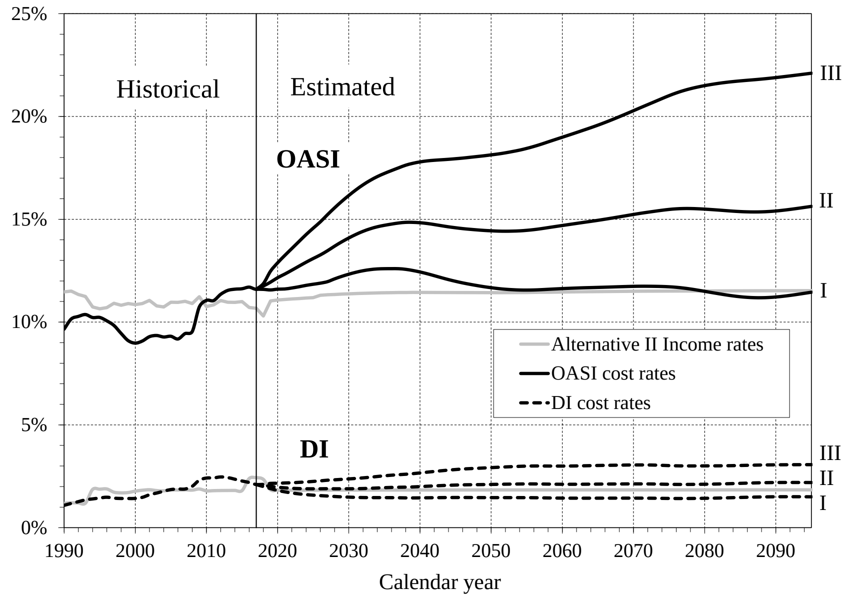
Under the low-cost assumptions, the projected DI cost rate declines from 2.00 percent of payroll for 2018 to 1.45 percent for 2039, and remains relatively stable thereafter, reaching 1.51 percent for 2092. The annual balance is positive for 2018, negative for 2019, and positive throughout the remainder of the long-range period. Under the high-cost assumptions, the DI cost rate generally rises throughout the projection period, reaching 3.06 percent for 2092. The annual deficit is negative from 2019 through the remainder of the projection period, reaching 0.31 percent for 2019, 1.07 percent for 2050, and 1.20 percent for 2092.

Figure IV.B1 shows the patterns of the historical and projected OASI and DI annual cost rates. Annual DI cost rates rose substantially between 1990 and 2010 in large part due to: (1) aging of the working population as the baby-boom generation moved from ages 25-44 in 1990, where disability prevalence is low, to ages 45-64 in 2010, where disability prevalence is much higher; (2) a substantial increase in the percentage of women insured for DI benefits as a result of increased and more consistent rates of employment; and (3) increased disability incidence rates for women to a level similar to those for men by 2010. After 2010, all of these factors stabilize, and therefore the DI cost rate stabilizes also. Annual OASI cost rates follow a similar pattern to that for DI, but displaced 20 to 25 years later, because the baby-boom generation enters retirement ages 20 to 25 years after entering prime disability ages. Figure IV.B1 shows only the income rates for alternative II because the variation in income rates by alternative is very small. Income rates generally increase slowly for each of the alternatives over the long-range period. Taxation of benefits, which is a relatively small portion of income, is the main source of both the increases in the income rate and the variation among the alternatives. Increases in income from taxation of benefits reflect: (1) increases in the total amount of benefits scheduled to be paid and (2) the increasing share of individual benefits that will be subject to taxation because benefit taxation threshold amounts are not indexed.

Table IV.B1 shows the annual balances for OASI, DI, and OASDI. The pattern of the annual balances is important to the analysis of the financial condition of the Social Security program as a whole. As seen in figure IV.B1, the magnitude of each of the positive balances is the distance between the appropriate cost-rate curve and the income-rate curve above it. The magnitude of each of the deficits is the distance between the appropriate cost-rate curve and the income-rate curve below it. Annual balances follow closely the pattern of annual cost rates after 1990 because the payroll tax rate does not change for the OASDI program, with only small variations in the allocation between DI and OASI except for the 2016-2018 payroll tax rate reallocation.

In the future, the costs of OASI, DI, and the combined OASDI programs as a percentage of taxable payroll are unlikely to fall outside the range encompassed by alternatives I and III because alternatives I and III define a wide range of demographic and economic conditions.

Figure IV.B1.—Long-Range OASI and DI Annual Income Rates and Cost Rates
[As a percentage of taxable payroll]



Long-range OASDI cost and income are most often expressed as percentages of taxable payroll. However, the Trustees also present cost and income as shares of gross domestic product (GDP), the value of goods and services produced during the year in the United States. Under alternative II, the Trustees project OASDI cost to increase from about 4.9 percent of GDP for 2018 to a peak of about 6.1 percent for 2038. After 2038, OASDI cost as a percentage of GDP declines to a low of about 5.9 percent for 2052 and thereafter generally increases slowly, reaching about 6.1 percent by 2092. Appendix G presents full estimates of income and cost relative to GDP.

Table IV.B2 contains historical and projected annual income rates and their components by trust fund and alternative. The annual income rates consist of the scheduled payroll tax rates, the rates of income from taxation of scheduled benefits, and the rates of income from General Fund reimbursements. Projected income from taxation of benefits increases over time for reasons discussed on page 52. Historical General Fund reimbursements include temporary reductions in revenue due to reduced payroll tax rates and certain other miscellaneous items.

Table IV.B2.—Components of Annual Income Rates, Calendar Years 1990-2095
[As a percentage of taxable payroll]

	OASI				DI				OASDI			
Calendar year	Payroll tax	Taxation of benefits[a]	General Fund Reimbursements[b]	Total[c]	Payroll tax	Taxation of benefits[a]	General Fund Reimbursements[b]	Total[c]	Payroll tax	Taxation of benefits[a]	General Fund Reimbursements[b]	Total[c]
Historical data:												
1990 . .	11.29	0.21	-0.03	11.47	1.21	0.01	-0.03	1.18	12.50	0.21	-0.06	12.65
1995 . .	10.46	.19	-.01	10.65	1.87	.01	-.01	1.87	12.33	.20	-.01	12.52
2000 . .	10.56	.29	[d]	10.85	1.78	.02	-.02	1.78	12.34	.31	-.02	12.62
2005 . .	10.68	.29	-.01	10.96	1.81	.02	[d]	1.84	12.49	.31	-.01	12.80
2006 . .	10.65	.31	[d]	10.96	1.81	.02	[d]	1.83	12.46	.34	[d]	12.79
2007 . .	10.68	.33	[d]	11.01	1.81	.03	[d]	1.84	12.50	.35	[d]	12.85
2008 . .	10.61	.29	[d]	10.90	1.80	.02	[d]	1.83	12.42	.31	[d]	12.73
2009 . .	10.85	.38	[d]	11.23	1.84	.04	[d]	1.88	12.70	.42	[d]	13.11
2010 . .	10.30	.42	.04	10.75	1.75	.04	.01	1.79	12.05	.45	.05	12.54
2011 . .	8.82	.41	1.61	10.84	1.50	.03	.27	1.80	10.32	.44	1.88	12.64
2012 . .	8.86	.47	1.72	11.05	1.51	.01	.29	1.81	10.37	.48	2.01	12.86
2013 . .	10.54	.35	.07	10.97	1.79	.01	.01	1.81	12.33	.36	.08	12.78
2014 . .	10.50	.45	.01	10.96	1.78	.03	[d]	1.81	12.28	.48	.01	12.77
2015 . .	10.52	.47	[d]	11.00	1.79	.02	[d]	1.80	12.31	.49	.01	12.80
2016 . .	10.23	.48	[d]	10.71	2.37	.02	[d]	2.39	12.60	.49	[d]	13.10
2017 . .	10.16	.52	[d]	10.67	2.40	.03	[d]	2.43	12.56	.54	[d]	13.10
Intermediate:												
2018 . .	9.84	.46	[d]	10.30	2.33	.02	[d]	2.35	12.17	.48	[d]	12.64
2019 . .	10.55	.48	[d]	11.03	1.82	.02	[d]	1.84	12.37	.50	[d]	12.87
2020 . .	10.57	.51	[d]	11.08	1.79	.02	[d]	1.82	12.37	.53	[d]	12.89
2021 . .	10.57	.53	[d]	11.10	1.80	.02	[d]	1.82	12.37	.55	[d]	12.92
2022 . .	10.58	.55	[d]	11.13	1.80	.02	[d]	1.82	12.37	.57	[d]	12.95
2023 . .	10.58	.57	[d]	11.14	1.80	.02	[d]	1.82	12.37	.59	[d]	12.97
2024 . .	10.58	.59	[d]	11.17	1.80	.03	[d]	1.82	12.38	.61	[d]	12.99
2025 . .	10.58	.61	[d]	11.19	1.80	.03	[d]	1.82	12.37	.64	[d]	13.01
2026 . .	10.58	.73	[d]	11.31	1.80	.03	[d]	1.83	12.37	.76	[d]	13.13
2027 . .	10.57	.76	[d]	11.33	1.80	.03	[d]	1.83	12.37	.79	[d]	13.15
2030 . .	10.57	.80	[d]	11.37	1.80	.03	[d]	1.83	12.37	.83	[d]	13.20
2035 . .	10.57	.85	[d]	11.42	1.80	.04	[d]	1.83	12.37	.89	[d]	13.25
2040 . .	10.57	.87	[d]	11.44	1.80	.04	[d]	1.83	12.37	.91	[d]	13.27
2045 . .	10.57	.86	[d]	11.43	1.80	.04	[d]	1.83	12.37	.90	[d]	13.27
2050 . .	10.57	.86	[d]	11.43	1.80	.04	[d]	1.84	12.37	.90	[d]	13.27
2055 . .	10.57	.87	[d]	11.44	1.80	.04	[d]	1.84	12.37	.91	[d]	13.28
2060 . .	10.57	.89	[d]	11.46	1.80	.04	[d]	1.84	12.37	.93	[d]	13.29
2065 . .	10.57	.90	[d]	11.48	1.80	.04	[d]	1.84	12.37	.95	[d]	13.31
2070 . .	10.57	.93	[d]	11.50	1.80	.04	[d]	1.84	12.37	.97	[d]	13.34
2075 . .	10.57	.94	[d]	11.51	1.80	.04	[d]	1.84	12.37	.98	[d]	13.35
2080 . .	10.57	.95	[d]	11.52	1.80	.04	[d]	1.84	12.37	.99	[d]	13.36
2085 . .	10.57	.94	[d]	11.51	1.80	.04	[d]	1.84	12.37	.98	[d]	13.35
2090 . .	10.57	.94	[d]	11.52	1.80	.04	[d]	1.84	12.37	.99	[d]	13.35
2095 . .	10.57	.96	[d]	11.53	1.80	.04	[d]	1.84	12.37	1.00	[d]	13.37
Low-cost:												
2018 . .	9.80	.45	[d]	10.24	2.31	.02	[d]	2.34	12.11	.47	[d]	12.58
2019 . .	10.54	.46	[d]	11.01	1.82	.02	[d]	1.84	12.36	.49	[d]	12.85
2020 . .	10.56	.48	[d]	11.04	1.79	.02	[d]	1.81	12.36	.50	[d]	12.86
2021 . .	10.56	.50	[d]	11.06	1.79	.02	[d]	1.81	12.36	.52	[d]	12.88
2022 . .	10.57	.51	[d]	11.08	1.79	.02	[d]	1.82	12.36	.53	[d]	12.90
2023 . .	10.57	.52	[d]	11.09	1.79	.02	[d]	1.82	12.36	.54	[d]	12.91
2024 . .	10.58	.54	[d]	11.11	1.80	.02	[d]	1.82	12.37	.56	[d]	12.93
2025 . .	10.57	.55	[d]	11.12	1.79	.02	[d]	1.82	12.36	.57	[d]	12.94
2026 . .	10.57	.65	[d]	11.22	1.80	.03	[d]	1.82	12.37	.68	[d]	13.04
2027 . .	10.56	.67	[d]	11.23	1.79	.03	[d]	1.82	12.36	.70	[d]	13.06

Table IV.B2.—Components of Annual Income Rates, Calendar Years 1990-2095 (Cont.)
[As a percentage of taxable payroll]

	OASI				DI				OASDI			
Calendar year	Payroll tax	Taxation of benefits[a]	General Fund Reimbursements[b]	Total[c]	Payroll tax	Taxation of benefits[a]	General Fund Reimbursements[b]	Total[c]	Payroll tax	Taxation of benefits[a]	General Fund Reimbursements[b]	Total[c]
Low-cost (Cont.):												
2030 . .	10.57	0.70	[d]	11.27	1.79	0.03	[d]	1.82	12.36	0.73	[d]	13.09
2035 . .	10.57	.73	[d]	11.30	1.79	.03	[d]	1.82	12.36	.76	[d]	13.12
2040 . .	10.57	.73	[d]	11.30	1.79	.03	[d]	1.82	12.36	.76	[d]	13.12
2045 . .	10.57	.71	[d]	11.28	1.79	.03	[d]	1.82	12.36	.74	[d]	13.10
2050 . .	10.57	.70	[d]	11.27	1.79	.03	[d]	1.82	12.36	.73	[d]	13.09
2055 . .	10.57	.70	[d]	11.26	1.79	.03	[d]	1.82	12.36	.73	[d]	13.09
2060 . .	10.57	.71	[d]	11.27	1.79	.03	[d]	1.82	12.36	.73	[d]	13.09
2065 . .	10.57	.71	[d]	11.28	1.79	.03	[d]	1.82	12.36	.74	[d]	13.10
2070 . .	10.57	.72	[d]	11.28	1.79	.03	[d]	1.82	12.36	.75	[d]	13.11
2075 . .	10.57	.72	[d]	11.28	1.79	.03	[d]	1.82	12.36	.75	[d]	13.10
2080 . .	10.57	.70	[d]	11.27	1.79	.03	[d]	1.82	12.36	.73	[d]	13.09
2085 . .	10.57	.69	[d]	11.25	1.79	.03	[d]	1.82	12.36	.72	[d]	13.08
2090 . .	10.57	.69	[d]	11.25	1.79	.03	[d]	1.82	12.36	.72	[d]	13.08
2095 . .	10.57	.70	[d]	11.27	1.79	.03	[d]	1.82	12.36	.73	[d]	13.09
High-cost:												
2018 . .	9.87	.46	[d]	10.33	2.33	.02	[d]	2.35	12.21	.48	[d]	12.69
2019 . .	10.56	.50	[d]	11.06	1.83	.02	[d]	1.85	12.39	.52	[d]	12.91
2020 . .	10.58	.54	[d]	11.11	1.80	.03	[d]	1.82	12.37	.56	[d]	12.93
2021 . .	10.58	.57	[d]	11.15	1.80	.03	[d]	1.82	12.38	.59	[d]	12.97
2022 . .	10.59	.59	[d]	11.18	1.80	.03	[d]	1.82	12.38	.62	[d]	13.01
2023 . .	10.58	.62	[d]	11.21	1.80	.03	[d]	1.83	12.38	.65	[d]	13.03
2024 . .	10.59	.65	[d]	11.24	1.80	.03	[d]	1.83	12.39	.68	[d]	13.07
2025 . .	10.58	.68	[d]	11.26	1.80	.03	[d]	1.83	12.38	.71	[d]	13.09
2026 . .	10.58	.82	[d]	11.40	1.80	.04	[d]	1.83	12.38	.85	[d]	13.24
2027 . .	10.58	.85	[d]	11.43	1.80	.04	[d]	1.84	12.37	.89	[d]	13.27
2030 . .	10.58	.92	[d]	11.49	1.80	.04	[d]	1.84	12.38	.96	[d]	13.33
2035 . .	10.58	.99	[d]	11.57	1.80	.04	[d]	1.84	12.38	1.03	[d]	13.41
2040 . .	10.58	1.03	[d]	11.61	1.80	.05	[d]	1.84	12.38	1.08	[d]	13.46
2045 . .	10.58	1.05	[d]	11.63	1.80	.05	[d]	1.85	12.38	1.10	[d]	13.48
2050 . .	10.58	1.07	[d]	11.65	1.80	.05	[d]	1.85	12.38	1.12	[d]	13.50
2055 . .	10.58	1.09	[d]	11.67	1.80	.06	[d]	1.85	12.38	1.15	[d]	13.53
2060 . .	10.58	1.13	[d]	11.71	1.80	.06	[d]	1.85	12.38	1.19	[d]	13.57
2065 . .	10.58	1.17	[d]	11.75	1.80	.06	[d]	1.86	12.38	1.23	[d]	13.61
2070 . .	10.58	1.22	[d]	11.80	1.80	.06	[d]	1.86	12.38	1.28	[d]	13.66
2075 . .	10.58	1.27	[d]	11.85	1.80	.06	[d]	1.86	12.38	1.33	[d]	13.70
2080 . .	10.58	1.30	[d]	11.88	1.80	.06	[d]	1.86	12.38	1.36	[d]	13.74
2085 . .	10.58	1.32	[d]	11.90	1.80	.06	[d]	1.86	12.38	1.38	[d]	13.76
2090 . .	10.58	1.33	[d]	11.91	1.80	.06	[d]	1.86	12.38	1.39	[d]	13.77
2095 . .	10.58	1.35	[d]	11.93	1.80	.06	[d]	1.86	12.38	1.41	[d]	13.78

[a] Revenue from taxation of benefits is the amount that would be assessed on benefit amounts scheduled in the law.

[b] Includes payroll tax revenue forgone under the provisions of Public Laws 111-147, 111-312, 112-78, and 112-96, and other miscellaneous reimbursements.

[c] Values exclude interest income.

[d] Between -0.005 and 0.005 percent of taxable payroll.

Note: Totals do not necessarily equal the sums of rounded components.

2. Comparison of Workers to Beneficiaries

Under the intermediate assumptions, the Trustees project the OASDI cost rate will rise rapidly between 2018 and 2035, primarily because the number of beneficiaries rises much more rapidly than the number of covered workers as the baby-boom generation retires. The ratio of OASDI beneficiaries to workers is dominated by the OASI program because all workers eventually die or retire, but only a relatively small minority become disabled. The trends described below are primarily due to demographic changes and thus affect the DI program roughly 20 years earlier than the OASI and OASDI programs. The baby-boom generation had lower fertility rates than their parents, and the Trustees expect that lower fertility rates will persist for all future generations; therefore, the ratio of OASDI beneficiaries to workers will rise rapidly and reach a permanently higher level after the baby-boom generation retires. Due to increasing longevity, the ratio of beneficiaries to workers will generally rise slowly thereafter. Table IV.B3 provides a comparison of the numbers of covered workers and beneficiaries.

Table IV.B3.—Covered Workers and Beneficiaries, Calendar Years 1945-2095

Calendar year	Covered workers[a] (in thousands)	Beneficiaries[b] (in thousands)			Covered workers per OASDI beneficiary	OASDI beneficiaries per 100 covered workers
		OASI	DI	OASDI[c]		
Historical data:						
1945	46,390	1,106	-	1,106	41.9	2
1950	48,280	2,930	-	2,930	16.5	6
1955	65,066	7,564	-	7,564	8.6	12
1960	72,371	13,740	522	14,262	5.1	20
1965	80,539	18,509	1,648	20,157	4.0	25
1970	92,963	22,618	2,568	25,186	3.7	27
1975	100,193	26,998	4,125	31,123	3.2	31
1980	112,651	30,384	4,734	35,117	3.2	31
1985	120,442	32,763	3,874	36,636	3.3	30
1990	133,013	35,255	4,204	39,459	3.4	30
1995	140,819	37,364	5,731	43,096	3.3	31
2000	154,756	38,556	6,606	45,162	3.4	29
2005	159,169	39,961	8,172	48,133	3.3	30
2006	161,736	40,435	8,428	48,863	3.3	30
2007	163,500	40,863	8,739	49,603	3.3	30
2008	162,868	41,355	9,065	50,420	3.2	31
2009	157,852	42,385	9,475	51,860	3.0	33
2010	157,218	43,440	9,958	53,398	2.9	34
2011	158,763	44,388	10,428	54,816	2.9	35
2012	160,920	45,377	10,799	56,176	2.9	35
2013	163,236	46,517	10,954	57,471	2.8	35
2014	165,541	47,603	10,971	58,574	2.8	35
2015	168,399	48,663	10,881	59,543	2.8	35
2016	171,287	49,811	10,728	60,539	2.8	35
2017	173,568	50,962	10,517	61,480	2.8	35
Intermediate:						
2018	175,271	52,271	10,379	62,651	2.8	36
2020	177,759	55,305	10,358	65,662	2.7	37
2025	183,205	63,004	10,779	73,783	2.5	40
2030	186,845	69,865	11,208	81,073	2.3	43
2035	189,588	74,745	11,763	86,507	2.2	46

Table IV.B3.—Covered Workers and Beneficiaries, Calendar Years 1945-2095 (Cont.)

Calendar year	Covered workers[a] (in thousands)	Beneficiaries[b] (in thousands) OASI	DI	OASDI[c]	Covered workers per OASDI beneficiary	OASDI beneficiaries per 100 covered workers
2040	192,984	77,164	12,420	89,584	2.2	46
2045	197,749	78,151	13,234	91,385	2.2	46
2050	202,747	79,599	13,793	93,393	2.2	46
2055	207,617	81,787	14,299	96,086	2.2	46
2060	212,005	84,838	14,537	99,375	2.1	47
Intermediate (Cont.):						
2065	216,214	87,904	14,905	102,809	2.1	48
2070	220,775	91,292	15,299	106,591	2.1	48
2075	225,927	94,659	15,543	110,202	2.1	49
2080	231,541	96,822	15,958	112,780	2.1	49
2085	237,387	98,392	16,637	115,028	2.1	48
2090	243,033	100,911	17,306	118,218	2.1	49
2095	248,351	104,546	17,708	122,254	2.0	49
Low-cost:						
2018	175,775	52,257	10,334	62,590	2.8	36
2020	179,916	55,231	10,095	65,326	2.8	36
2025	186,769	62,714	9,936	72,650	2.6	39
2030	191,039	69,187	9,849	79,036	2.4	41
2035	194,666	73,577	9,970	83,547	2.3	43
2040	199,745	75,462	10,236	85,697	2.3	43
2045	207,156	75,937	10,709	86,646	2.4	42
2050	215,162	76,949	11,054	88,004	2.4	41
2055	223,043	78,846	11,421	90,268	2.5	40
2060	230,486	81,672	11,644	93,315	2.5	40
2065	238,073	84,522	12,023	96,545	2.5	41
2070	246,626	87,644	12,480	100,124	2.5	41
2075	256,510	90,638	12,881	103,519	2.5	40
2080	267,374	92,409	13,477	105,886	2.5	40
2085	278,549	93,944	14,360	108,304	2.6	39
2090	289,356	97,316	15,215	112,531	2.6	39
2095	299,775	102,580	15,780	118,360	2.5	39
High-cost:						
2018	175,364	52,284	10,424	62,708	2.8	36
2020	174,673	55,367	10,615	65,982	2.6	38
2025	179,634	63,299	11,600	74,898	2.4	42
2030	182,805	70,617	12,580	83,197	2.2	46
2035	184,821	76,084	13,549	89,633	2.1	48
2040	186,633	79,150	14,575	93,725	2.0	50
2045	188,731	80,781	15,734	96,515	2.0	51
2050	190,796	82,783	16,505	99,288	1.9	52
2055	192,731	85,351	17,124	102,475	1.9	53
2060	194,199	88,680	17,335	106,014	1.8	55
2065	195,261	91,961	17,613	109,574	1.8	56
2070	196,160	95,626	17,834	113,460	1.7	58
2075	197,070	99,368	17,770	117,138	1.7	59
2080	198,056	101,911	17,799	119,710	1.7	60
2085	199,240	103,463	18,008	121,471	1.6	61
2090	200,435	104,868	18,286	123,154	1.6	61
2095	201,510	106,487	18,438	124,925	1.6	62

[a] Workers who are paid at some time during the year for employment on which OASDI taxes are due.
[b] Beneficiaries with monthly benefits in current-payment status as of June 30.
[c] This column is the sum of OASI and DI beneficiaries. A small number of beneficiaries receive benefits from both funds.

Notes:
1. The number of beneficiaries does not include uninsured individuals who received benefits under Section 228 of the Social Security Act. The General Fund of the Treasury reimbursed the trust funds for the costs of most of these individuals.
2. Historical covered worker and beneficiary data are subject to revision.
3. Totals do not necessarily equal the sums of rounded components.

The effect of the demographic shift under the three alternatives on the OASDI cost rates is clear when one considers the projected number of OASDI beneficiaries per 100 covered workers. Compared to the 2017 level of 35 beneficiaries per 100 covered workers, the Trustees project that this ratio rises to 46 by 2035 under the intermediate assumptions because the growth in beneficiaries greatly exceeds the growth in workers. By 2095, this projected ratio rises further under the intermediate and high-cost assumptions, reaching 49 under the intermediate assumptions and 62 under the high-cost assumptions. Under the low-cost assumptions, this ratio rises to 43 by 2035 and then generally declines, reaching 39 by 2095. Figure IV.B2 shows beneficiaries per 100 covered workers.

For each alternative, the curve in figure IV.B2 is strikingly similar to the corresponding cost-rate curve in figure IV.B1. This similarity emphasizes the extent to which the cost rate is determined by the age distribution of the population. The cost rate is essentially the product of the number of beneficiaries and their average benefit, divided by the product of the number of covered workers and their average taxable earnings. For this reason, the pattern of the annual cost rates is similar to that of the annual ratios of beneficiaries to workers.

Figure IV.B2.—Number of OASDI Beneficiaries Per 100 Covered Workers

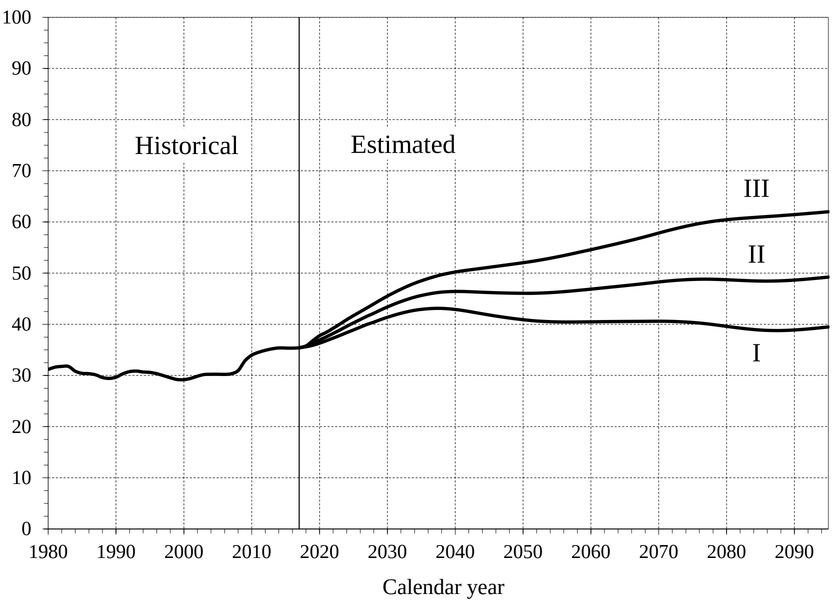


Table IV.B3 also shows the number of covered workers per OASDI beneficiary, which was about 2.8 for 2017. Under the intermediate assumptions, this ratio declines generally throughout the long-range period, reaching 2.2 for 2035 and 2.0 by 2095. Under the low-cost assumptions, this ratio declines to 2.3 for 2035, generally rises from 2035 through 2055, and remains relatively stable at 2.5 through 2095. Under the high-cost assumptions, this ratio decreases steadily to 1.6 by 2095.

3. Trust Fund Ratios and Test of Long-Range Close Actuarial Balance

Trust fund ratios are critical indicators of the adequacy of the financial resources of the Social Security program. The trust fund ratio for a year is the amount of asset reserves in a fund at the beginning of a year expressed as a percentage of the cost for the year. Under present law, the OASI and DI Trust Funds do not have the authority to borrow other than in the form of advance tax transfers, which are limited to expected taxes for the current calendar month. If reserves held in either trust fund become depleted during a year, and continuing tax revenues fall short of the cost of scheduled benefits, then full scheduled benefits would not be payable on a timely basis. For this reason, the trust fund ratio is a very critical financial measure.

The trust fund ratio serves an additional important purpose in assessing the actuarial status of the program. If the projected trust fund ratio is positive throughout the period and is either level or increasing at the end of the period, then projected adequacy for the long-range period is likely to continue for subsequent reports. Under these conditions, the program has achieved sustainable solvency.

Table IV.B4 shows the Trustees' projections of trust fund ratios by alternative, without regard to advance tax transfers that would be effected, for the separate and combined OASI and DI Trust Funds. The table also shows the years of trust fund reserve depletion and the percentage of scheduled benefits that would be payable thereafter, by alternative.

Under the intermediate assumptions, the OASI trust fund ratio is projected to decline from 330 percent at the beginning of 2018 until the trust fund reserves become depleted late in 2034 (as compared to early 2035 for last year's report), at which time 77 percent of scheduled benefits would be payable. The DI trust fund ratio is 48 percent at the beginning of 2018. The 0.57-percentage-point reallocation of payroll tax rate (for 2016 through 2018) from OASI to DI increases the trust fund ratio to 62 percent at the beginning of 2019. After 2019, the trust fund ratio declines until the trust fund reserves become depleted in 2032 (4 years later than projected in last year's report), at which time 96 percent of scheduled benefits would be payable.

Under the intermediate assumptions, the trust fund ratio for the combined OASI and DI Trust Funds declines from 288 percent at the beginning of 2018 until the combined fund reserves become depleted in 2034 (the same year as projected in last year's report), at which time 79 percent of scheduled benefits would be payable.

Under the low-cost assumptions, the trust fund ratio for the DI program increases from 49 percent at the beginning of 2018 to 66 percent at the beginning of 2019, again reflecting the temporary payroll tax rate reallocation. The DI trust fund ratio is then stable through 2021 and thereafter increases through the end of the long-range projection period, reaching the extremely high level of 2,194 percent for 2093. For the OASI program, the trust fund ratio declines steadily, from 331 percent for 2018 until the reserves become depleted in 2062, at which time 97 percent of scheduled benefits would be payable. For the combined OASDI program, the trust fund ratio declines from 289 percent for 2018 to a low of 112 percent in 2048, then rises thereafter, reaching 197 percent by 2093. Because the trust fund ratio is positive throughout the projection period and increasing at the end of the period, under the low-cost assumptions, the DI program and the combined OASDI program achieve sustainable solvency.

Under the high-cost assumptions, the OASI trust fund ratio declines continually until reserves become depleted in 2030, at which time 69 percent of scheduled benefits would still be payable. The DI trust fund ratio increases from 47 percent for 2018 to 59 percent for 2019 because of the payroll tax rate reallocation, but reserves decline quickly after that and become depleted in 2022. At that time, 83 percent of scheduled benefits would still be payable. The combined OASI and DI trust fund ratio declines from 288 percent for 2018 until reserves become depleted in 2030, at which time 70 percent of scheduled benefits would still be payable.

The Trustees project trust fund reserve depletion within the 75-year projection period with the exceptions of the combined OASI and DI Trust Funds and the DI Trust Fund under the low-cost assumptions. It is therefore very likely that lawmakers will need to increase income, reduce program costs, or both, in order to maintain solvency for the trust funds. The stochastic projections discussed in appendix E suggest that trust fund reserve depletion is highly probable by mid-century.

Even under the high-cost assumptions, however, the combined OASI and DI Trust Fund reserves on hand plus their estimated future income are sufficient to fully cover their combined cost until 2030. Under the intermediate assumptions, the combined starting fund reserves plus estimated future income are sufficient to fully cover cost until 2034. In the 2017 report, the Trustees projected that the combined trust fund reserves would become depleted in 2029 and 2034 under the high-cost and intermediate assumptions, respectively, and would achieve sustainable solvency under the low-cost assumptions.

Table IV.B4.—Trust Fund Ratios, Calendar Years 2018-2095[a]
[In percent]

Calendar year	Intermediate			Low-cost			High-cost		
	OASI	DI	OASDI	OASI	DI	OASDI	OASI	DI	OASDI
2018	330	48	288	331	49	289	330	47	288
2019	308	62	272	307	66	273	309	59	272
2020	289	54	256	290	64	259	288	45	253
2021	270	47	239	274	65	247	265	29	232
2022	250	41	223	260	70	236	241	13	209
2023	231	35	206	246	78	225	216	b	186
2024	211	31	188	233	89	216	190	b	161
2025	192	27	171	221	103	207	163	b	136
2026	173	23	154	210	118	199	136	b	111
2027	154	20	137	200	136	193	110	b	86
2030	97	10	86	172	203	175	28	b	7
2035	b	b	b	128	335	150	b	b	b
2040	b	b	b	85	479	127	b	b	b
2045	b	b	b	53	613	114	b	b	b
2050	b	b	b	33	756	113	b	b	b
2055	b	b	b	20	904	119	b	b	b
2060	b	b	b	8	1,079	126	b	b	b
2065	b	b	b	b	1,256	132	b	b	b
2070	b	b	b	b	1,435	135	b	b	b
2075	b	b	b	b	1,636	138	b	b	b
2080	b	b	b	b	1,819	147	b	b	b
2085	b	b	b	b	1,953	166	b	b	b
2090	b	b	b	b	2,088	187	b	b	b
2095	b	b	b	b	2,275	202	b	b	b
Trust fund reserves permanently become depleted in	2034	2032	2034	2062	c	c	2030	2022	2030
Payable benefits as percent of scheduled benefits:									
At the time of permanent reserve depletion	77	96	79	97	c	c	69	83	70
For 2092	73	83	74	100	c	c	51	60	52

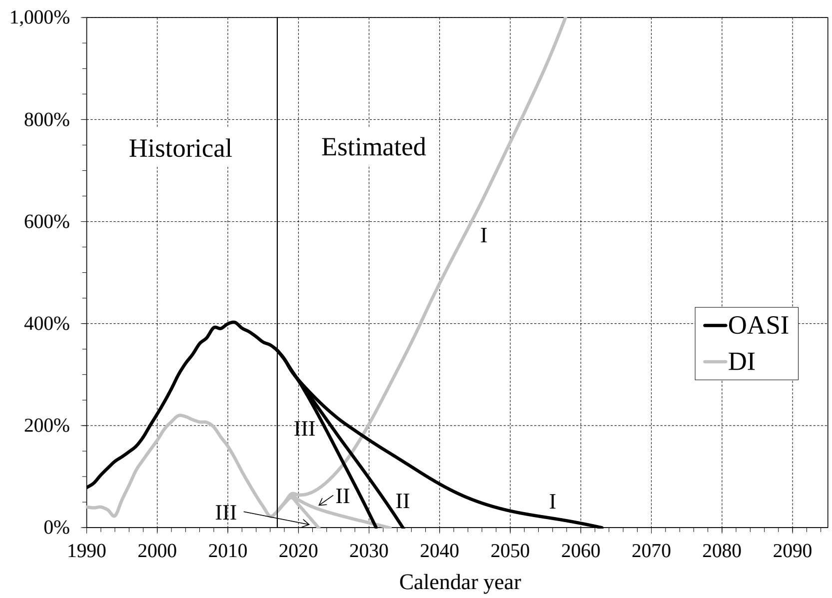
[a] Benefit payments scheduled to be paid on January 3 are actually paid on December 31 as required by the statutory provision for early delivery of benefit payments when the normal payment delivery date is a Saturday, Sunday, or legal public holiday. For comparability with the values for historical years and the projections in this report, all trust fund ratios reflect the 12 months of benefits scheduled for payment each year.
[b] Trust fund reserves would be depleted at the beginning of this year.
[c] Trust fund reserves would not be depleted within the projection period.

Note: The definition of trust fund ratio appears in the Glossary. The ratios shown for the combined trust funds for years after reserve depletion of either the DI or OASI Trust Fund are hypothetical.

Since 2013, when the Trustees modified the test of long-range close actuarial balance, the standard for each trust fund requires meeting two conditions: (1) the test of short-range financial adequacy is satisfied; and (2) the trust fund ratios stay above zero throughout the 75-year projection period, allowing scheduled benefits to be paid in a timely manner throughout the period. Both the long-range test and the short-range test are applied based on the intermediate set of assumptions. As discussed in section IV.A, the DI Trust Fund fails the test of short-range financial adequacy because the trust fund ratio does not reach 100 percent at any time during the 10-year period. Under the intermediate assumptions, the OASI Trust Fund reserves become depleted in 2034, DI Trust Fund reserves become depleted in 2032, and the combined OASI and DI Trust Fund reserves become depleted in 2034. Therefore, the OASI, DI, and combined OASI and DI Trust Funds all fail the test of long-range close actuarial balance.

Figure IV.B3 illustrates the trust fund ratios for the separate OASI and DI Trust Funds for each of the alternative sets of assumptions. DI Trust Fund status is more uncertain than OASI Trust Fund status because there is a high degree of uncertainty associated with future disability prevalence. A graph of the trust fund ratios for the combined trust funds appears in figure II.D6.

Figure IV.B3.—Long-Range OASI and DI Trust Fund Ratios
[Asset reserves as a percentage of annual cost]



4. Summarized Income Rates, Summarized Cost Rates, and Actuarial Balances

Summarized values for the full 75-year period are useful in analyzing the program's long-range financial adequacy over the period as a whole, both under present law and under proposed modifications to the law. All annual amounts included in a summarized value are present-value discounted to the valuation date. It is important to note that the actuarial balance indicates the solvency status of the fund only for the very end of the period.

Table IV.B5 presents summarized income rates, summarized cost rates, and actuarial balances for 25-year, 50-year, and 75-year valuation periods. Summarized income rates are the sum of the present value of non-interest income for a period (which includes scheduled payroll taxes, the projected income from the taxation of scheduled benefits, and reimbursements from the General Fund of the Treasury) and the starting trust fund asset reserves, expressed as a percentage of the present value of taxable payroll over the period. Under current law, the total OASDI payroll tax rate will remain at 12.4 percent in the future. In contrast, the Trustees expect income from taxation of benefits, expressed as a percentage of taxable payroll, to increase in most years of the long-range period for the reasons discussed earlier on page 52. Summarized cost rates are the sum of the present value of cost for a period (which includes scheduled benefits, administrative expenses, net interchange with the Railroad Retirement program, and payments for vocational rehabilitation services for disabled beneficiaries) and the present value of the cost of reaching a target trust fund of 100 percent of annual cost at the end of the period, expressed as a percentage of the present value of taxable payroll over the period.

The actuarial balance for a valuation period is equal to the difference between the summarized income rate and the summarized cost rate for the period. An actuarial balance of zero for any period indicates that cost for the period could be met for the period as a whole (but not necessarily at all points within the period), with a remaining trust fund reserve at the end of the period equal to 100 percent of the following year's cost. A negative actuarial balance for a period indicates that the present value of income to the program plus the existing trust fund is less than the present value of the cost of the program plus the cost of reaching a target trust fund reserve of 1 year's cost by the end of the period. Generally, a trust fund is deemed to be adequately financed for a period if the actuarial balance is zero or positive, meaning that the reserves at the end of the period are at least equal to annual cost. Note that solvency is possible with a small negative actuarial balance where reserves are still positive.[1]

[1] A program is solvent over any period for which the trust fund maintains a positive level of asset reserves. In contrast, the actuarial balance for a period includes the cost of having a target fund equal to 100 percent of the following year's cost at the end of the period. Therefore, if a program ends the period with reserves that are positive but not sufficient to cover the following year's costs, it will be solvent at the end of the period and yet still have a small negative actuarial balance for that period.

Table IV.B5 contains summarized rates for the intermediate, low-cost, and high-cost assumptions. The low-cost and high-cost assumptions define a wide range of possibilities. Financial outcomes as good as the low-cost scenario or as bad as the high-cost scenario are unlikely to occur.

For the 25-year valuation period, the OASDI program has an actuarial balance of 0.09 percent of taxable payroll under the low-cost assumptions, -1.77 percent under the intermediate assumptions, and -3.90 percent under the high-cost assumptions. These balances indicate that the program is adequately financed for the 25-year valuation period under only the low-cost assumptions.

For the 50-year valuation period, the OASDI program has actuarial balances of 0.08 percent under the low-cost assumptions, -2.45 percent under the intermediate assumptions, and -5.55 percent under the high-cost assumptions. These actuarial balances mean that the OASDI program is adequately financed for the 50-year valuation period under only the low-cost assumptions.

For the entire 75-year valuation period, the combined OASDI program has actuarial balances of 0.13 percent of taxable payroll under the low-cost assumptions, -2.84 percent under the intermediate assumptions, and -6.62 percent under the high-cost assumptions. These balances indicate that the combined OASDI program is adequately financed for the 75-year valuation period under only the low-cost assumptions.

Assuming the intermediate assumptions accurately capture future demographic and economic trends, solvency for the program over the next 75 years could be restored using a variety of approaches. For example, revenues could be increased in a manner equivalent to an immediate and permanent increase in the combined Social Security payroll tax rate from 12.40 percent to 15.18 percent (a relative increase of 22.4 percent), cost could be reduced in a manner equivalent to an immediate and permanent reduction in scheduled benefits of about 17 percent, or some combination of approaches could be used.

However, eliminating the actuarial deficit for the next 75-year valuation period requires raising payroll taxes or lowering benefits by more than is required just to achieve solvency, because the actuarial deficit includes the cost of attaining a target trust fund equal to 100 percent of annual program cost by the end of the period. The actuarial deficit could be eliminated for the 75-year period by increasing revenues in a manner equivalent to an immediate and permanent increase in the combined payroll tax from 12.40 percent to 15.35 percent (a relative increase of 23.8 percent),[1] reducing cost in a manner equivalent to an immediate reduction in scheduled benefits of about 18 percent, or some combination of approaches could be used.

Under the intermediate assumptions, the OASDI program has large annual deficits toward the end of the long-range period that are increasing and reach 4.32 percent of payroll for 2092 (see table IV.B1). These large deficits indicate that annual cost continues to exceed non-interest income after 2092, so continued adequate financing would require larger changes than those needed to maintain solvency for the 75-year period. Over the period extending through the infinite horizon, the actuarial deficit is 4.0 percent of payroll under the intermediate assumptions.

Table IV.B5.—Components of Summarized Income Rates and Cost Rates, Calendar Years 2018-2092
[As a percentage of taxable payroll]

	Summarized income rate			Summarized cost rate			
Valuation period	Non-interest income	Beginning asset reserves[a]	Total	Cost[a]	Ending target fund[a]	Total	Actuarial balance
OASI:							
Intermediate:							
2018-42.	11.30	1.41	12.71	13.78	0.56	14.34	-1.63
2018-67.	11.37	.77	12.14	14.16	.24	14.40	-2.26
2018-92.	11.41	.57	11.99	14.48	.14	14.62	-2.63
Low-cost:							
2018-42.	11.21	1.28	12.49	12.17	.48	12.65	-.16
2018-67.	11.25	.68	11.92	11.95	.21	12.16	-.24
2018-92.	11.26	.48	11.74	11.82	.12	11.94	-.20
High-cost:							
2018-42.	11.40	1.60	13.00	15.66	.65	16.31	-3.31
2018-67.	11.52	.91	12.43	16.91	.29	17.20	-4.76
2018-92.	11.60	.70	12.31	17.89	.17	18.06	-5.75
DI:							
Intermediate:							
2018-42.	1.85	.04	1.88	1.94	.08	2.02	-.14
2018-67.	1.84	.02	1.86	2.02	.03	2.05	-.19
2018-92.	1.84	.01	1.86	2.05	.02	2.07	-.21
Low-cost:							
2018-42.	1.84	.03	1.87	1.56	.06	1.61	.26
2018-67.	1.83	.02	1.85	1.51	.03	1.53	.32
2018-92.	1.83	.01	1.84	1.49	.02	1.51	.33
High-cost:							
2018-42.	1.86	.04	1.90	2.39	.10	2.49	-.59
2018-67.	1.86	.02	1.88	2.63	.04	2.67	-.79
2018-92.	1.86	.02	1.87	2.72	.02	2.74	-.87

[1] The indicated increase in the payroll tax rate of 2.95 percent is somewhat larger than the 2.84 percent 75-year actuarial deficit because the indicated increase reflects a behavioral response to tax rate changes. In particular, the calculation assumes that an increase in payroll taxes results in a small shift of wages and salaries to forms of employee compensation that are not subject to the payroll tax.

Table IV.B5.—Components of Summarized Income Rates and Cost Rates, Calendar Years 2018-2092 (Cont.)
[As a percentage of taxable payroll]

	Summarized income rate			Summarized cost rate			
Valuation period	Non-interest income	Beginning asset reserves[a]	Total	Cost[a]	Ending target fund[a]	Total	Actuarial balance
OASDI:							
Intermediate:							
2018-42.	13.14	1.45	14.59	15.72	0.64	16.36	-1.77
2018-67.	13.22	.79	14.01	16.18	.28	16.45	-2.45
2018-92.	13.25	.59	13.84	16.52	.16	16.69	-2.84
Low-cost:							
2018-42.	13.05	1.31	14.36	13.72	.54	14.26	.09
2018-67.	13.08	.69	13.77	13.46	.23	13.69	.08
2018-92.	13.09	.50	13.59	13.31	.14	13.45	.13
High-cost:							
2018-42.	13.26	1.64	14.89	18.05	.75	18.80	-3.90
2018-67.	13.38	.93	14.31	19.54	.33	19.87	-5.55
2018-92.	13.46	.72	14.18	20.61	.19	20.80	-6.62

[a] Benefit payments scheduled to be paid on January 3 are actually paid on December 31 as required by the statutory provision for early delivery of benefit payments when the normal payment delivery date is a Saturday, Sunday, or legal public holiday. For comparability with the values for historical years and the projections in this report, all trust fund operations and asset reserves reflect the 12 months of benefits scheduled for payment each year.

Note: Totals do not necessarily equal the sums of rounded components.

5. Open Group Unfunded Obligation

Consistent with practice since 1965, this report focuses on a 75-year open group valuation to evaluate the long-run financial status of the OASDI program. The open group valuation includes non-interest income and cost for past, current, and future participants through the year 2092. The open group unfunded obligation measures the adequacy of financing over the period as a whole for a program financed on a pay-as-you-go basis. On this basis, payroll taxes and scheduled benefits for all participants are included through 2092.

The open group unfunded obligation increased from $12.5 trillion shown in last year's report to $13.2 trillion in this report. If there had been no changes in starting values, assumptions, laws, or methods for this report, then the open group unfunded obligation would have increased to $13.1 trillion solely due to the change in the valuation period. This expected increase in the unfunded obligation occurs because: (1) the unfunded obligation is now discounted to January 1, 2018, rather than to January 1, 2017, which tends to increase the unfunded obligation by the annual nominal interest rate; and (2) the unfunded obligation now includes an additional year (2092). However, changes in the law, assumptions, methods, and starting values resulted in a net $0.1 trillion increase in the unfunded obligation.

The 75-year unfunded obligation is equivalent to 2.68 percent of future OASDI taxable payroll and 1.0 percent of GDP through 2092. These percentages were 2.66 and 0.9, respectively, for last year's report. The 75-year unfunded obligation as a percentage of taxable payroll is less than the actuarial deficit, because the unfunded obligation excludes the cost of having an ending target trust fund value.

The actuarial deficit was 2.83 percent of payroll in last year's report, and was expected to increase to a deficit of 2.88 percent of payroll solely due to the change in the valuation period. Changes in the law, assumptions, methods, and starting values combined to account for a 0.04 percent decrease (improvement) in the actuarial deficit to 2.84 percent of payroll. For additional details on these changes, see section IV.B.6.

Table IV.B6 presents the components and the calculation of the long-range (75-year) actuarial balance under the intermediate assumptions. The present value of future cost less future non-interest income over the long-range period, minus the amount of trust fund asset reserves at the beginning of the projection period, is \$13.2 trillion for the OASDI program. This amount is the 75-year "open group unfunded obligation" (see row H). The actuarial deficit (which is the negative of the actuarial balance) combines this unfunded obligation with the present value of the ending target trust fund and expresses the total as a percentage of the present value of the taxable payroll for the period. The present value of future non-interest income minus cost, plus starting trust fund reserves, minus the present value of the ending target trust fund, is -\$14.0 trillion for the OASDI program.

Table IV.B6.—Components of 75-Year Actuarial Balance and Unfunded Obligation Under Intermediate Assumptions

Item	OASI	DI	OASDI
Present value as of January 1, 2018 (in billions):			
A. Payroll tax revenue	\$51,912	\$8,864	\$60,776
B. Reimbursements from general revenue	[a]	[a]	[a]
C. Taxation of benefits revenue	4,128	184	4,312
D. Non-interest income (A + B + C)	56,040	9,048	65,088
E. Cost	71,088	10,057	81,146
F. Cost minus non-interest income (E - D)	15,048	1,009	16,057
G. Trust fund asset reserves at start of period	2,820	71	2,892
H. Open group unfunded obligation (F - G)	12,228	938	13,166
I. Ending target trust fund[b]	697	99	795
J. Income minus cost, plus reserves at start of period, minus ending target trust fund (D - E + G - I = - H - I)	-12,925	-1,036	-13,961
K. Taxable payroll	491,078	491,078	491,078
Percent of taxable payroll:			
Actuarial balance (100 × J ÷ K)	-2.63	-.21	-2.84

[a] Less than \$0.5 billion.
[b] The calculation of the actuarial balance includes the cost of accumulating a target trust fund reserve equal to 100 percent of annual cost at the end of the period.

Note: Totals do not necessarily equal the sums of rounded components.

Consideration of summary measures alone (such as the actuarial balance and open group unfunded obligation) for a 75-year period can lead to incorrect perceptions and to policy prescriptions that do not achieve sustainable solvency. These concerns can be addressed by considering the trend in trust fund ratios toward the end of the period. (See the discussion of "sustainable solvency" beginning on page 51.)

Another measure of trust fund finances, discussed in appendix F, is the infinite horizon unfunded obligation, which takes account of all annual balances, even those after 75 years. The extension of the time period past 75 years assumes that the current-law OASDI program and the demographic and economic trends used for the 75-year projection continue indefinitely. This infinite horizon unfunded obligation is estimated to be 4.0 percent of taxable payroll or 1.3 percent of GDP. These percentages were 4.2 and 1.4, respectively, for last year's report. Of course, the degree of uncertainty associated with estimates increases substantially for years further in the future.

6. Reasons for Change in Actuarial Balance From Last Report

Table IV.B7 shows the effects of changes on the long-range actuarial balance under the intermediate assumptions, by category, between last year's report and this report.

Table IV.B7.—Reasons for Change in the 75-Year Actuarial Balance, Based on Intermediate Assumptions
[As a percentage of taxable payroll]

Item	OASI	DI	OASDI
Shown in last year's report:			
Income rate	11.97	1.87	13.84
Cost rate	14.56	2.11	16.67
Actuarial balance	**-2.59**	**-.24**	**-2.83**
Changes in actuarial balance due to changes in:			
Legislation / Regulation	.00	.00	.00
Valuation period[a]	-.05	-.01	-.06
Demographic data and assumptions	.00	-.01	-.01
Economic data and assumptions	-.01	.00	-.01
Disability data and assumptions	-.01	.02	.01
Methods and programmatic data	.02	.03	.05
Total change in actuarial balance	-.05	.03	-.02
Shown in this report:			
Actuarial balance	**-2.63**	**-.21**	**-2.84**
Income rate	11.99	1.86	13.84
Cost rate	14.62	2.07	16.69

[a] The change in the 75-year valuation period from last year's report to this report means that the 75-year actuarial balance now includes the relatively large negative annual balance for 2092. This change in the valuation period results in a larger long-range actuarial deficit. The actuarial deficit includes the trust fund reserve at the beginning of the projection period.

Note: Totals do not necessarily equal the sums of rounded components.

Actuarial Estimates

If the law, data, assumptions, and methods had all remained unchanged from last year’s Trustees Report, the long-range OASDI actuarial balance would have decreased (become more negative) by 0.06 percent of taxable payroll solely due to the change in the valuation period. However, as described below, projections in this report also reflect changes in law, data, assumptions, and methods. These changes, including the change in the valuation period, combine to decrease the long-range OASDI actuarial balance from -2.83 percent of taxable payroll in last year’s report to -2.84 percent in this report.

Since the last report, there have been no new laws, regulations, or policy changes that are expected to have significant long-range financial effects on the OASDI program. However, this year’s report does incorporate two notable changes with negligible effects on the actuarial balance. First, estimates in this report reflect the assumption that the 2012 Deferred Action for Childhood Arrivals (DACA) program will be phased out over the next 2 years after having been rescinded by the Administration on September 5, 2017. Last year's report assumed that the 2012 DACA program would continue indefinitely. Incorporating the phase-out of DACA has a negligible negative effect on the long-range actuarial balance for this year’s report. Second, Public Law 115-97, the Tax Cuts and Jobs Act, was enacted on December 22, 2017. There are two aspects of this law with notable effects on the OASDI program. The repeal of the individual mandate of the Patient Protection and Affordable Care Act is expected to cause some individuals to drop their employer sponsored health insurance, which is estimated to increase OASDI covered wages and taxable payroll slightly. The changes to income tax rates and brackets are expected to have small effects, reducing income from taxation of benefits through 2025 and increasing it thereafter. The combined effects of the Tax Cuts and Jobs Act increase the long-range actuarial balance for this report by a negligible positive amount.

As mentioned above, changing the 75-year valuation period from 2017 through 2091 for last year’s report to 2018 through 2092 for this report decreases the projected long-range OASDI actuarial balance by 0.06 percent of taxable payroll. This decrease is mainly the result of including the relatively large negative annual balance for 2092 in this year’s 75-year projection period. Note that the actuarial balance calculation includes trust fund asset reserves at the beginning of the projection period. These reserves at the start of the period reflect the program’s net financial flows for all past years up to the start of the projection period, including 2017.

All changes in demographic data and assumptions combine to decrease the long-range OASDI actuarial balance by 0.01 percent of taxable payroll. Ultimate demographic assumptions are unchanged from those in last year’s report, with the exception of one minor change to the ultimate immigration assumptions. In particular, the ultimate number of assumed lawful-permanent-resident (LPR) immigrants has been decreased by 10,000 per year in the future due to clarification from the Department of Homeland Security (DHS) regarding the implementation of the 2014 executive actions on immigration. One of these executive actions was intended to increase the number of entrepreneur green cards issued. Therefore, beginning with the 2015 report, the Trustees assumed an increase of 10,000 LPR immigrants per year. DHS recently clarified that this executive action was never implemented, and the Trustees assume it will not be implemented. Therefore, the earlier assumption is being reversed for this report. This change is expected to have a negligible effect on the actuarial balance.

This year's report also includes one change to the near-term demographic assumption for the total fertility rate. Last year's report included a rise in the projected total fertility rate to a level of 2.05 for 2023. This rise reflected the assumption that the drop in the total fertility rate below 2.0 during the recent economic downturn was, in part, a deferral in childbearing that would be partially offset during the latter stages of the economic recovery. However, as the economic recovery has continued to near completion, and more recent data have not shown a recovery in fertility rates, it seems more likely that this persistent drop in the total fertility rate represents a loss of potential births rather than just a deferral for this period. Therefore, this year's report eliminates the temporary rise in the total fertility rate above the ultimate assumed level. This change decreases the actuarial balance by 0.05 percent of taxable payroll.

Four demographic data updates had significant effects on the long-range OASDI actuarial balance. First, final fertility (birth) data for 2016 indicate somewhat lower birth rates than were assumed in last year's report for 2016. These updated data result in slightly lower birth rates during the transition period to the ultimate levels, decreasing the actuarial balance by 0.03 percent of taxable payroll. Second, incorporating 2015 mortality data for ages under 65 from the National Center for Health Statistics (NCHS) and preliminary 2015 mortality data for ages 65 and older from Medicare experience resulted in higher death rates for all future years than were projected in last year's report. These higher death rates increase (improve) the actuarial balance by 0.05 percent of taxable payroll. Third, this year's estimates incorporate updated LPR immigration data from DHS, which decreases the actuarial balance by 0.01 percent of taxable payroll. Fourth, updates to historical population data and other minor data updates combine to increase the actuarial balance by 0.04 percent of taxable payroll. The majority of this change is due to updated historical estimates of the other-than-LPR population for 2014 and 2015, and the resulting effects on the projection of labor force, employment, covered workers, and beneficiaries.

Changes in economic data and assumptions combine to decrease the long-range OASDI actuarial balance by 0.01 percent of payroll. Ultimate economic assumptions are unchanged from those in last year's report. However, primarily due to slow growth in labor productivity for 2010 through 2017 and low unemployment rates in 2017, the estimated level of potential GDP is reduced for this report by about 1 percent in 2017 and throughout the projection period. This lower estimated level of potential GDP means that cumulative growth in actual GDP is 1 percent less over the remainder of the projected recovery, and thus decreases the actuarial balance by 0.02 percent of taxable payroll. In addition, near-term interest rates were decreased for this report, reflecting a more gradual path for the rise to the ultimate real interest rate. These lower near-term interest rates decrease the actuarial balance by 0.02 percent of payroll. Other changes to data and near-term economic assumptions, including an extended recovery from lower-than-expected ratios for 2016 and 2017 of labor compensation to GDP and taxable payroll to GDP to the unchanged ultimate ratios, combine for a net increase in the actuarial balance of 0.03 percent of taxable payroll.

Although ultimate disability assumptions are unchanged from those in last year's report, changes in recent disability data and near-term assumptions increase the long-range OASDI actuarial balance by 0.01 percent of taxable payroll. Recent data have shown lower levels of disability applications and awards than expected in last year's report. Based on this experience, estimated disabled-worker incidence rates are reduced for this report over the first few years of the short-range period. This year's report also incorporates lower average benefit levels for disabled workers newly awarded benefits in 2017 and in the future. These changes are primarily responsible for the change in the DI reserve depletion date from 2028 in last year's report to 2032 in this year's report. The short-range effects are noted in section IV.A.4.

The projections in this report also reflect several methodological improvements and updates of program-specific data. These methodological changes, programmatic data updates, and interactions combine to increase the long-range OASDI actuarial balance by 0.05 percent of taxable payroll. Descriptions of six significant methodological changes and programmatic data updates follow.

First, this year's report includes an improvement to the method for projecting mortality rates by marital status. The new method smooths the rates at older ages, utilizing recent data from NCHS and the American Community Survey, rather than older data from the Census Bureau and NCHS. This methodological improvement increases the actuarial balance by 0.01 percent of taxable payroll.

Second, the labor force participation rate model has been updated to improve the method for projecting educational attainment among women in age groups 45-49 and 50-54. This change better reflects recent increases in educational attainment among women entering these two age groups and results in an increase in their labor force participation. In turn, this leads to an increase in covered workers and taxable payroll over the projection period, which increases the actuarial balance by 0.02 percent of taxable payroll.

The third significant change is an increase in the assumed ultimate retired-worker prevalence rate for women at age 70. This year's report increases the percentage of fully insured women (excluding those who are receiving a disability or widow benefit) who are assumed to be in receipt of a retired-worker benefit at age 70 from 99.0 percent in last year's report to 99.5 percent in this year's report, to be the same as the percentage assumed for men. This change increases the number of female retired workers, thus decreasing the actuarial balance by 0.02 percent of payroll.

The fourth significant change is in the long-range model for projecting average benefit levels of retired-worker and disabled-worker beneficiaries newly entitled for benefits. This model uses a large sample of 10 percent of all newly entitled retired-worker beneficiaries in a recent year. The sample used in the 2017 report was for worker beneficiaries newly entitled in 2013. This year's report uses the results from worker beneficiaries newly entitled in 2015. In addition, the method used to estimate earnings histories for retired-worker beneficiaries becoming newly entitled in each year after 2017 has been expanded to better match targeted average taxable earnings levels for each of nine birth cohorts (those becoming entitled at ages 62 through 70 in a year). Together, the changes in the sample data and the model for projecting average benefits for newly-entitled worker beneficiaries increase the actuarial balance by 0.05 percent of payroll.

Fifth, recent data and estimates provided by the Office of Tax Analysis (OTA) at the Department of the Treasury indicate higher ultimate levels of revenue from taxation of OASDI benefits than projected in last year's report, independent of the changes due to the recently-enacted Tax Cuts and Jobs Act. These higher levels are primarily due to changes OTA made in their modeling, resulting in a larger share of benefits being subject to income tax. The increase in ultimate projected ratios of income tax on benefits to benefit amounts results in an increase in the actuarial balance of 0.03 percent of taxable payroll.

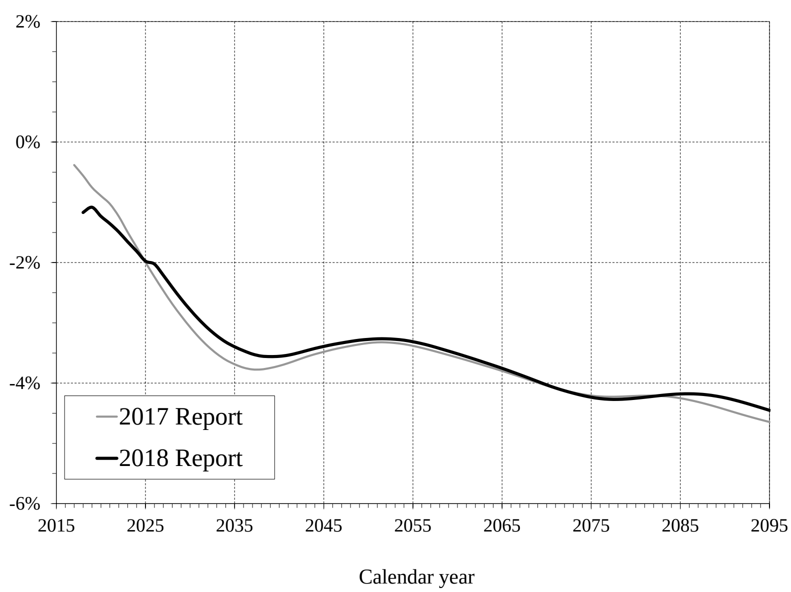
Actuarial Estimates

The sixth significant change consists of methodological improvements in the modeling of retroactive benefit payments for newly awarded disabled-worker beneficiaries. This year's projections incorporate both a better data source for determining the total number of months of retroactive benefits for newly awarded disabled-worker beneficiaries and a new adjustment factor which better aligns projected months of disabled-worker retroactive benefit entitlement with observed historical experience. These methodology changes combine to increase the actuarial balance by 0.02 percent of payroll.

In addition to these six significant methodological changes and programmatic data updates, changes in starting levels and projected levels of OASI and DI beneficiaries and benefit amounts over the first 10 years of the projection period, updating other programmatic data, other small methodological improvements, and interactions among the various method changes and updates to programmatic experience combine to decrease the long-range OASDI actuarial balance by 0.05 percent of taxable payroll.

Figure IV.B4 compares the annual cash-flow balances for this report and the prior year's report for the combined OASDI program over the long-range (75-year) projection period. The figure illustrates the annual effects of the changes described earlier in this section.

Figure IV.B4.—OASDI Annual Balances: 2017 and 2018 Trustees Reports
[As a percentage of taxable payroll, under Intermediate Assumptions]



The annual balances in this year's report are lower (more negative) through 2024, noticeably higher from 2025 until about 2060, very similar from 2060 until about 2085, and then higher for the remainder of the projection period. For the full 75-year projection period, the annual balances average 0.06 percentage point higher. The lower annual balances in the near term for this year's report are primarily due to lower projected payroll tax revenue for those years, which is caused by several factors. First, the Bureau of Economic Analysis (BEA) published revised data in July 2017 showing that the ratio of labor compensation to GDP for 2016 was 2.1 percent below the level used for the 2017 report. BEA also published data for 2017 indicating that the ratio of labor compensation to GDP was 3.1 percent below the level projected for the 2017 report. Second, based on a complete year of IRS earnings data, the ratio of OASDI effective taxable payroll to GDP for 2016 was 1.7 percent below the level projected for the 2017 report. Based on IRS data through the first half of 2017, the ratio of OASDI effective taxable payroll to GDP for 2017 is now estimated to be 2.0 percent lower than projected for the 2017 report. Third, for this year's report, the ratios of labor compensation to GDP and taxable payroll to GDP are projected to gradually return by 2027 to about the same levels as assumed for the 2017 report. Fourth, this year's report assumes a lower level of labor productivity and potential GDP from the start of the projection period, and therefore reflects slower actual GDP growth in the first ten years of the projection period. Finally, this year's report incorporates negative payroll tax revenue adjustments in 2018, due to overestimated revenue transferred to the trust funds in 2017.

These near-term economic effects are offset by 2025 and then exceeded due to the sunset after 2025 of certain legislative changes, and due to demographic effects, most significantly higher assumed mortality rates throughout the projection period and lower assumed fertility rates in the near-term. The higher mortality rates improve the annual balances by a small amount at first, increasing slowly over the next 35 years, and then remaining relatively level. The lower fertility rates lead to fewer workers and lower income from payroll taxes, which decreases the annual balances as compared to those in last year's report; however, these lower fertility rates in the near-term also lead to fewer individuals receiving benefits, which causes an increase in the annual balances that more than offsets the reduction from fewer workers after about 2085. For 2091, the projected annual deficit is 4.28 percent of taxable payroll in this report, compared to 4.48 percent in last year's report.

V. ASSUMPTIONS AND METHODS UNDERLYING ACTUARIAL ESTIMATES

The future income and cost of the OASDI program will depend on many demographic, economic, and program-specific factors. Trust fund income will depend on how these factors affect the size and composition of the working population as well as the level and distribution of earnings. Similarly, program cost will depend on how these factors affect the size and composition of the beneficiary population as well as the general level of benefits.

The Trustees make basic assumptions for several of these factors based on analysis of historical trends, historical conditions, and expected future conditions. These factors include fertility, mortality, immigration, marriage, divorce, productivity, inflation, average earnings, unemployment, real interest rates, and disability incidence and termination. Other factors depend on these basic assumptions. These other, often interdependent, factors include total population, life expectancy, labor force participation, gross domestic product, and program-specific factors. Each year the Trustees reexamine these assumptions and methods in light of new information and make appropriate revisions. The assumptions for this report were selected by the beginning of February 2018.

Future levels of these factors and their interrelationships are inherently uncertain. To address these uncertainties, this report uses three sets of assumptions, designated as intermediate (alternative II), low-cost (alternative I), and high-cost (alternative III). The intermediate set represents the Trustees' best estimate of the future course of the population and the economy. With regard to the net effect on the actuarial status of the OASDI program, the low-cost set is more optimistic and the high-cost set is more pessimistic. The low-cost and high-cost sets of assumptions reflect significant potential changes in the interrelationships among factors, as well as changes in the values for individual factors.

While it is unlikely that all of the factors and interactions will differ in the specified directions from the intermediate values, many combinations of individual differences in the factors could have a similar overall effect. Outcomes with overall long-range cost as low as the low-cost scenario or as high as the high-cost scenario are very unlikely. This report also includes a section on sensitivity analysis, where factors are changed one at a time (see appendix D), and a section on stochastic projections, which provides a probability distribution of possible future outcomes, with all factors being varied around the intermediate alternative (see appendix E).

Readers should interpret with care the estimates based on the three sets of alternative assumptions. These estimates are not specific predictions of the future financial status of the OASDI program. Rather, they provide a reasonable range of future income and cost bounded by two plausible, albeit very unlikely, demographic and economic scenarios.

All of the key demographic, economic, and program-specific assumptions reach their long-range ultimate values within the next 25 years. For extrapolations beyond the 75-year long-range period, the ultimate levels or trends reached by the end of the 75-year period remain unchanged. The assumed ultimate values represent average annual experience or growth rates. Actual future values will exhibit fluctuations or cyclical patterns, as in the past.

The following sections briefly discuss the various assumptions and methods used in making the estimates of trust fund actuarial status, which are the focus of this report.[1] There are, of course, many interrelationships among these factors that are important but are beyond the scope of this discussion.

A. DEMOGRAPHIC ASSUMPTIONS AND METHODS

This section of the report provides a brief overview of the demographic historical data and the assumptions used for the projections.

1. Fertility Assumptions

Birth rates by single year of age, for women aged 14 to 49,[2] are the basis for the fertility assumptions. These rates apply to the total number of women, across all marital statuses, in the midyear population at each age. Table V.A1 displays the historical and projected total fertility rates.[3]

Historically, birth rates in the United States have fluctuated widely. The total fertility rate decreased from 3.31 children per woman at the end of World War I (1918) to 2.15 during the Great Depression (1936). After 1936, the total fertility rate rose to 3.68 in 1957 and then fell to 1.74 by 1976. After

[1] Actuarial Studies published by the Office of the Chief Actuary, Social Security Administration, contain further details about the assumptions, methods, and actuarial estimates. A complete list of available studies may be found at www.ssa.gov/OACT/NOTES/actstud.html. To obtain copies of such studies or of this report, please submit a request at www.ssa.gov/OACT/request.html. This entire report, along with supplemental year-by-year tables and additional documentation on assumptions and methods, may be found at www.ssa.gov/OACT/TR/2018/.

[2] Birth rates at age 14 include births to women aged 14 and under, and birth rates at age 49 include births to women aged 49 and over.

[3] The total fertility rate may be interpreted as the average number of children that would be born to a woman in her lifetime if she were to experience, at each age of her life, the birth rate observed in, or assumed for, a specified year, and if she were to survive the entire childbearing period. A rate of about 2.1 would ultimately result in a nearly constant population if immigration and emigration were both zero, and if death rates were to remain at current levels.

1976, the total fertility rate rose above 2.00 by 1990, where it generally remained through 2009, but dropped below 1.90 for 2011 through 2016 and is estimated to be 1.80 in 2017. The recession and slow recovery in employment opportunity are likely contributing reasons for this recent low level.

These variations in the total fertility rate resulted from changes in many factors, including social attitudes, economic conditions, birth-control practices, and the racial/ethnic composition of the population. The Trustees expect future total fertility rates to remain relatively close to recent levels. Certain population characteristics, such as the higher percentages of women who have never married, of women who are divorced, and of young women who are in the labor force, are consistent with continued lower total fertility rates than those experienced during the baby-boom era (1946-65). Based on consideration of these factors, the Trustees assume ultimate total fertility rates of 2.20, 2.00, and 1.80 children per woman for the low-cost, intermediate, and high-cost assumptions, respectively. These ultimate rates are unchanged from last year's report.

For the intermediate assumptions, the projected total fertility rate gradually increases from 2017 through 2027, with somewhat more rapid increases in the middle of the 2017-2027 period. Last year's report included a rise in the projected total fertility rate for the intermediate assumptions to a level of 2.05 in 2023. This rise reflected the assumption that the drop in the total fertility rate below 2.0 during the recent economic downturn was, in part, a deferral in childbearing that would be partially offset during the latter stages of the economic recovery. However, as the economic recovery has continued to near completion, and more recent data have not shown a recovery in fertility rates, it seems more likely that this persistent drop in the total fertility rate represents a loss of potential births rather than just a deferral. Therefore, this year's report eliminates the temporary rise in the total fertility rate above the ultimate assumed level. The assumed low-cost and high-cost total fertility rates trend away from the intermediate path and reach the ultimate values in 2027 and 2023, respectively.

2. Mortality Assumptions

For the projections in this year's report, ultimate average annual percentage reductions in future mortality rates were assumed by age group and cause of death. These assumptions were then used to estimate future central death rates by age group, sex, and cause of death. From these estimated central death rates, probabilities of death by single year of age and sex were calculated.

Historical death rates are calculated for years 1900 through 2015 for ages below 65 (and for all ages for years prior to 1968) using data from the National Center for Health Statistics (NCHS).[1] For ages 65 and over, final Medicare data on deaths for years 1968 through 2014 and preliminary data for 2015 are used.[2] Death rates by cause of death are produced for all ages for years 1979-2015 using data from the NCHS.

The total age-sex-adjusted death rate[3] declined at an average annual rate of 1.03 percent between 1900 and 2015. Between 1979 and 2015, the period for which death rates were analyzed by cause, the total age-sex-adjusted death rate, for all causes combined, declined at an average rate of 0.87 percent per year.

Death rates have declined substantially in the U.S. since 1900, with rapid declines over some periods and slow or no improvement over the other periods. Many factors are responsible for historical reductions in death rates, including medical advances, increased availability of health-care services, and improvements in sanitation and nutrition. Historical death rates generally declined more slowly for older ages and more rapidly for children and infants than for the rest of the population. Between 1900 and 2015, the age-sex-adjusted death rate declined at an average rate of 0.77 percent per year for ages 65 and over, and 3.03 percent per year for ages under 15.

Mortality assumptions differ for the low-cost, intermediate, and high-cost scenarios. Throughout the projection, the low-cost scenario contains annual percentage reductions that are smaller than those in the intermediate scenario, while those in the high-cost scenario are larger. The ultimate annual percentage reductions for each of the three alternatives are the same as those in last year's report.

The trends in the annual reductions in central death rates are calculated for the period from 2005 to 2015 by age group, sex, and cause of death. These trends are the starting reductions for alternative II. For alternatives I and III, 50 and 150 percent of the starting reductions are used, respectively. These annual reductions, by alternative, are assumed to transition rapidly from the starting reductions until they reach the ultimate annual percentage reductions assumed for 2042 and later.

[1] These rates reflect NCHS data on deaths and Census estimates of population.
[2] These rates reflect Medicare data on deaths and enrollments.
[3] Based on the enumerated total population as of April 1, 2010, if that population were to experience the death rates by age and sex for the selected year.

Table V.A1 contains historical and projected age-sex-adjusted death rates for the total population (all ages), for ages under 65, and for ages 65 and over. Age-sex adjustment eliminates the effect of a changing distribution of population by age and sex, allowing the pure effects of changes in death rates to be observed. Under the intermediate assumptions, projected age-sex-adjusted death rates are, in general, slightly higher than the death rates in last year's report for both the age group under 65 and the age group 65 and over. These changes primarily result from incorporating more recent historical data, which continue to show low rates of improvement.

The projected average annual rate of decline for the total age-sex-adjusted death rate is about 0.41 percent, 0.77 percent, and 1.15 percent between 2017 and 2092 for alternatives I, II, and III, respectively. In keeping with the patterns observed in the historical data, the assumed future rates of decline are greater for younger ages than for older ages, but to a substantially lesser degree than in the past. Accordingly, the projected age-sex-adjusted death rates for ages 65 and over decline at average annual rates of about 0.37 percent, 0.68 percent, and 1.01 percent between 2017 and 2092 for alternatives I, II, and III, respectively. The projected age-sex-adjusted death rates for ages under 15 decline at average annual rates of about 0.80 percent, 1.59 percent, and 2.59 percent between 2017 and 2092 for alternatives I, II, and III, respectively.

Demographers express a wide range of views on the likely rate of future decline in death rates. For example, some believe that the long-standing historical tendency for mortality to decline more slowly at the oldest ages will cease in the future. Others believe that biological factors, social factors, and limitations on health care spending may slow future rates of decline in mortality.

The Trustees periodically revise the assumed ultimate rates of decline in mortality based on experience, new conditions, and expert opinion. Evolving trends in health care and lifestyle will determine what modifications to the assumed ultimate rates of decline in mortality will be warranted for future reports.

Table V.A1.—Fertility and Mortality Assumptions,[a] Calendar Years 1940-2095

Calendar year	Total fertility rate[b]	Age-sex-adjusted death rate[c] per 100,000, by age: Total	Under 65	65 and over
Historical data:				
1940	2.23	1,919.8	750.1	9,718.8
1945	2.42	1,716.6	674.8	8,662.9
1950	3.03	1,561.9	570.2	8,173.7
1955	3.50	1,453.8	508.2	7,758.4
1960	3.61	1,454.3	503.2	7,795.4
1965	2.88	1,428.8	495.2	7,653.3
1970	2.43	1,340.0	485.7	7,036.3
1975	1.77	1,204.8	426.6	6,393.6
1980	1.82	1,136.9	384.3	6,154.3
1985	1.83	1,081.0	353.3	5,932.9
1990	2.07	1,021.3	333.6	5,606.3
1995	1.98	1,001.5	317.9	5,559.5
2000	2.05	960.7	281.0	5,492.3
2005	2.06	901.3	270.7	5,105.4
2006	2.11	876.1	267.6	4,933.5
2007	2.12	856.8	261.6	4,825.2
2008	2.07	857.0	258.8	4,845.5
2009	2.00	827.1	255.3	4,639.7
2010	1.93	821.3	248.5	4,640.1
2011	1.89	819.4	249.1	4,621.4
2012	1.87	812.0	248.6	4,568.2
2013	1.85	812.1	249.4	4,563.6
2014	1.86	805.3	251.5	4,497.8
2015	1.85	[d]815.8	255.0	[d]4,555.0
2016	1.82	[e]791.0	[e]245.8	[e]4,425.8
2017	[e]1.80	[e]783.6	[e]243.7	[e]4,383.6
Intermediate:				
2020	1.84	762.4	236.7	4,267.4
2025	1.99	728.9	224.2	4,094.1
2030	2.00	697.7	211.9	3,936.2
2035	2.00	668.4	200.3	3,789.5
2040	2.00	641.1	189.4	3,652.5
2045	2.00	615.5	179.2	3,524.2
2050	2.00	591.5	169.7	3,403.7
2055	2.00	569.0	160.8	3,290.5
2060	2.00	547.9	152.5	3,184.0
2065	2.00	528.1	144.8	3,083.5
2070	2.00	509.4	137.5	2,988.7
2075	2.00	491.8	130.7	2,899.2
2080	2.00	475.2	124.4	2,814.4
2085	2.00	459.5	118.4	2,734.1
2090	2.00	444.7	112.8	2,657.9
2095	2.00	430.7	107.5	2,585.6

Table V.A1.—Fertility and Mortality Assumptions,[a] Calendar Years 1940-2095 (Cont.)

Calendar year	Total fertility rate[b]	Age-sex-adjusted death rate[c] per 100,000, by age: Total	Under 65	65 and over
Low-cost:				
2020	1.91	785.3	243.9	4,395.2
2025	2.15	769.3	237.9	4,312.3
2030	2.20	752.7	231.4	4,228.2
2035	2.20	736.2	224.9	4,145.5
2040	2.20	720.2	218.5	4,065.2
2045	2.20	704.7	212.3	3,987.2
2050	2.20	689.7	206.4	3,911.8
2055	2.20	675.2	200.6	3,838.9
2060	2.20	661.1	195.1	3,768.4
2065	2.20	647.6	189.7	3,700.1
2070	2.20	634.5	184.6	3,634.0
2075	2.20	621.8	179.6	3,569.9
2080	2.20	609.5	174.8	3,507.9
2085	2.20	597.6	170.1	3,447.7
2090	2.20	586.1	165.6	3,389.4
2095	2.20	574.9	161.3	3,332.8
High-cost:				
2020	1.76	737.6	228.6	4,130.9
2025	1.80	684.8	208.8	3,858.9
2030	1.80	638.0	190.3	3,623.4
2035	1.80	596.2	173.6	3,414.2
2040	1.80	558.7	158.6	3,226.4
2045	1.80	525.0	145.2	3,056.8
2050	1.80	494.5	133.3	2,902.8
2055	1.80	466.9	122.6	2,762.7
2060	1.80	441.8	112.9	2,634.5
2065	1.80	418.9	104.3	2,516.9
2070	1.80	398.0	96.4	2,408.7
2075	1.80	378.8	89.3	2,308.7
2080	1.80	361.1	82.9	2,216.1
2085	1.80	344.8	77.0	2,130.1
2090	1.80	329.7	71.7	2,049.9
2095	1.80	315.6	66.8	1,974.9

[a] This table contains basic assumptions along with key summary values that are derived from basic assumptions.
[b] The total fertility rate for any year is the average number of children that would be born to a woman in her lifetime if she were to experience, at each age of her life, the birth rate observed in, or assumed for, the selected year, and if she were to survive the entire childbearing period.
[c] Based on the enumerated total population as of April 1, 2010, if that population were to experience the death rates by age and sex observed in, or assumed for, the selected year.
[d] Estimated.
[e] Estimated, intermediate alternative.

3. Immigration Assumptions

Projections of the total Social Security area population reflect assumptions for annual immigration flows. For this report, four categories of immigration flows are used:

- Lawful permanent resident (LPR) immigration: Persons who enter the Social Security area and are granted LPR status, or who are already in the Social Security area and adjust their status to become LPRs.[1]
- Legal emigration: LPRs and citizens who leave the Social Security area population.
- Other-than-LPR immigration: Persons who enter the Social Security area and stay to the end of the year without being granted LPR status, such as undocumented immigrants, and foreign workers and students entering with temporary visas.
- Other-than-LPR emigration: Other-than-LPR immigrants who leave the Social Security area population or who adjust their status to become LPRs.

Net LPR immigration is the difference between LPR immigration and legal emigration. Net other-than-LPR immigration is the difference between other-than-LPR immigration and other-than-LPR emigration. Total net immigration refers to the sum of net LPR immigration and net other-than-LPR immigration.

Immigration assumptions differ for the low-cost, intermediate, and high-cost scenarios. The low-cost scenario includes higher annual net immigration and the high-cost scenario includes lower annual net immigration. Table V.A2 contains historical and projected levels of various immigration flows.

LPR immigration has increased significantly since World War II, due to various factors and legislative changes, including the Immigration Act of 1965 and the Immigration Act of 1990.

The intermediate alternative assumes that ultimate annual LPR immigration, which includes residents who adjust their status to become LPRs, will be 1,050,000 persons for 2019 and later. Alternative I assumes that ultimate annual LPR immigration will be 1,250,000 persons for 2018 and later, while alternative III assumes that ultimate annual LPR immigration will be 850,000 persons for 2019 and later. For all three alternatives, the ultimate level of LPR immigration is reduced by 10,000 persons from last year's report. This reduction is due to clarification from the Department of Home-

[1] Persons who enter the country with legal visas but without LPR status, such as temporary foreign workers and students, are not included in the "LPR immigration" category.

land Security (DHS) regarding implementation of the 2014 executive actions on immigration.[1]

The assumed ratios of annual legal emigration to LPR immigration are 20, 25, and 30 percent for alternatives I, II, and III, respectively. This range is consistent with the limited historical data for legal emigration from the Social Security area. These ratios are unchanged from last year's report. Under the intermediate alternative, by combining the ultimate annual LPR immigration and legal emigration assumptions, ultimate annual net LPR immigration is about 788,000 persons. For the low-cost and high-cost scenarios, ultimate annual net LPR immigration is 1,000,000 persons and 595,000 persons, respectively.

The estimated number of other-than-LPR immigrants residing in the Social Security area and the annual level of other-than-LPR immigration have been affected significantly by the most recent recession. Although net other-than-LPR immigration was greatly reduced during the economic downturn, it has begun to rise since then. Under the intermediate assumptions, annual other-than-LPR immigration is expected to continue increasing, reflecting a continued recovery from levels experienced during the recession. The ultimate levels of other-than-LPR immigration are unchanged from last year's report: 1,350,000 persons for alternative II, 1,650,000 persons for alternative I, and 1,050,000 persons for alternative III.

Emigration from the other-than-LPR immigrant population includes those who leave the Social Security area and those who adjust their status to become LPRs. This other-than-LPR immigrant population is highly mobile and far more likely to leave the Social Security area than is the citizen or LPR population. However, as other-than-LPR immigrants stay in the country for longer periods of time, they generally become less likely to leave the country.

Under the intermediate assumptions, the total annual number of other-than-LPR immigrants who leave the Social Security area averages about 424,000 through the 75-year projection period. In addition, the ultimate annual number of other-than-LPR immigrants who adjust status to become LPRs is assumed to be 450,000 for the intermediate assumptions. For the low-cost and high-cost scenarios, the total annual number of other-than-LPR emi-

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[1] Prior to this year, the Trustees assumed that there would be an additional 10,000 LPRs annually due to increased usage of the "national interest waiver." This waiver permits certain non-citizens with advanced degrees or exceptional abilities to seek green cards without employer sponsorship if their admission is in the national interest. However, DHS has clarified that this provision has not been implemented, and the Trustees assume it will not be implemented.

grants averages about 501,000 and 332,000, respectively, through the 75-year projection period. The ultimate annual number of people adjusting status to LPR status is assumed to be 550,000 persons and 350,000 persons, for the low-cost and high-cost scenarios, respectively. The ultimate annual number of people adjusting status to become LPRs is one-third as large as the assumed ultimate annual number of the other-than-LPR immigrants entering the Social Security area, and is unchanged from last year's report for all three sets of assumptions.

Under the assumptions described above, the projected size of the other-than-LPR immigrant population grows substantially. This growth reflects the excess of annual immigration over the combined annual numbers of emigrants (including adjustments of status) and deaths that occur within the other-than-LPR immigrant population.

Under the intermediate assumptions, projected net other-than-LPR immigration reaches a peak in 2018, reflecting the recovering economy, then sharply decreases over the next few years, primarily due to the decline in the annual number of other-than-LPR immigrants entering the country, to a stable long-term level. This is followed by a gradual decrease in annual net other-than-LPR immigration starting in 2022, due to the increasing number of other-than-LPR immigrants residing in the Social Security area. Because the number of other-than-LPR immigrants leaving the Social Security area is based on rates of departure, an increase in the number of other-than-LPR immigrants residing in the Social Security area results in an increase in the number who emigrate out of the area. All other components of other-than-LPR immigration and emigration are assumed to be stable after 2022, and thus do not contribute toward any change in annual net other-than-LPR immigration. Under the intermediate assumptions, the projected average annual level of net other-than-LPR immigration over the 75-year projection period is about 484,000 persons. For the low-cost and high-cost assumptions, projected average annual net other-than-LPR immigration is about 607,000 persons and 356,000 persons, respectively.

The projected average annual level of total net immigration (LPR and other-than-LPR, combined) is about 1,272,000 persons per year during the 75-year projection period under the intermediate assumptions. For the low-cost and high-cost assumptions, projected average annual total net immigration is about 1,607,000 persons and 952,000 persons, respectively.

Demographers express a wide range of views about the future course of immigration for the United States. Some believe that net immigration will increase substantially in the future. Others believe that potential immigrants may be increasingly attracted to other countries, that the number of potential immigrants may be lower due to lower birth rates in many countries, or that changes in the law or enforcement of the law will reduce immigration.

Table V.A2.—Immigration Assumptions,[a] Calendar Years 1940-2095
[in thousands]

	LPR immigration				Other-than-LPR immigration[b]				
Calendar year	LPR in	Legal out	Adjustments of status[c d]	Net LPR	Other-than-LPR in	Other-than-LPR out	Adjustments of status[c d]	Net other-than-LPR	Total net immigration
Historical data:									
1940	61	15	-	46	-	-	-	-	-
1945	73	18	-	55	-	-	-	-	-
1950	227	57	-	171	-	-	-	-	-
1955	280	70	-	210	-	-	-	-	-
1960	268	67	-	201	-	-	-	-	-
1965	261	77	49	232	-	-	49	-	-
1970	307	93	65	279	-	-	65	-	-
1975	340	98	53	294	-	-	53	-	-
1980	431	136	112	407	-	-	112	208	614
1985	458	144	119	432	-	-	119	264	696
1990	548	166	114	497	-	-	114	620	1,116
1995	511	192	255	575	-	-	255	557	1,132
2000	482	224	413	672	1,409	294	413	703	1,374
2005	561	290	597	869	1,822	84	597	1,141	2,010
2006	639	303	573	909	1,426	53	573	800	1,709
2007	584	267	482	800	926	373	482	71	871
2008	635	278	478	835	708	985	478	-755	79
2009	633	277	475	832	802	222	475	104	935
2010	622	262	426	786	678	203	426	50	835
2011	647	264	408	791	594	254	408	-69	722
2012	621	255	401	766	687	694	401	-407	359
2013	589	249	409	748	815	494	409	-88	660
2014	627	256	398	769	1,073	364	398	311	1,080
2015	689	271	395	813	1,082	324	395	364	1,177
2016	[e]776	[e]296	[e]408	[e]888	[f]1,450	[e]192	[e]408	[f]849	[f]1,737
2017	[f]700	[f]288	[f]450	[f]863	[f]1,450	[f]231	[f]450	[f]769	[f]1,632
Intermediate:									
2020	600	263	450	788	1,450	290	450	710	1,498
2025	600	263	450	788	1,350	338	450	562	1,349
2030	600	263	450	788	1,350	367	450	533	1,321
2035	600	263	450	788	1,350	393	450	507	1,295
2040	600	263	450	788	1,350	415	450	485	1,272
2045	600	263	450	788	1,350	430	450	470	1,257
2050	600	263	450	788	1,350	441	450	459	1,247
2055	600	263	450	788	1,350	448	450	452	1,239
2060	600	263	450	788	1,350	454	450	446	1,233
2065	600	263	450	788	1,350	459	450	441	1,229
2070	600	263	450	788	1,350	462	450	438	1,225
2075	600	263	450	788	1,350	465	450	435	1,222
2080	600	263	450	788	1,350	467	450	433	1,221
2085	600	263	450	788	1,350	468	450	432	1,219
2090	600	263	450	788	1,350	469	450	431	1,218
2095	600	263	450	788	1,350	470	450	430	1,218

Table V.A2.—Immigration Assumptions,[a] Calendar Years 1940-2095 (Cont.)
[in thousands]

Calendar year	LPR immigration: LPR in	Legal out	Adjustments of status[c d]	Net LPR	Other-than-LPR immigration[b]: Other-than-LPR in	Other-than-LPR out	Adjustments of status[c d]	Net other-than-LPR	Total net immigration
Low-cost:									
2020	700	250	550	1,000	1,750	308	550	892	1,892
2025	700	250	550	1,000	1,650	373	550	727	1,727
2030	700	250	550	1,000	1,650	415	550	685	1,685
2035	700	250	550	1,000	1,650	452	550	648	1,648
2040	700	250	550	1,000	1,650	485	550	615	1,615
2045	700	250	550	1,000	1,650	507	550	593	1,593
2050	700	250	550	1,000	1,650	524	550	576	1,576
2055	700	250	550	1,000	1,650	537	550	563	1,563
2060	700	250	550	1,000	1,650	546	550	554	1,554
2065	700	250	550	1,000	1,650	553	550	547	1,547
2070	700	250	550	1,000	1,650	559	550	541	1,541
2075	700	250	550	1,000	1,650	563	550	537	1,537
2080	700	250	550	1,000	1,650	565	550	535	1,535
2085	700	250	550	1,000	1,650	567	550	533	1,533
2090	700	250	550	1,000	1,650	568	550	532	1,532
2095	700	250	550	1,000	1,650	569	550	531	1,531
High-cost:									
2020	500	255	350	595	850	236	350	264	859
2025	500	255	350	595	1,050	266	350	434	1,029
2030	500	255	350	595	1,050	287	350	413	1,008
2035	500	255	350	595	1,050	306	350	394	989
2040	500	255	350	595	1,050	322	350	378	973
2045	500	255	350	595	1,050	335	350	365	960
2050	500	255	350	595	1,050	343	350	357	952
2055	500	255	350	595	1,050	349	350	351	946
2060	500	255	350	595	1,050	354	350	346	941
2065	500	255	350	595	1,050	358	350	342	937
2070	500	255	350	595	1,050	361	350	339	934
2075	500	255	350	595	1,050	363	350	337	932
2080	500	255	350	595	1,050	365	350	335	930
2085	500	255	350	595	1,050	367	350	333	928
2090	500	255	350	595	1,050	368	350	332	927
2095	500	255	350	595	1,050	369	350	331	926

[a] This table contains basic assumptions along with key summary values that are derived from basic assumptions.

[b] Historical other-than-LPR immigration and emigration estimates depend on a residual method. The Office of the Chief Actuary developed these estimates, as well as the resulting other-than-LPR January 1 stock estimates, for years through 2000. For years 2001 and later, the residual method uses stock estimates. For 2001 through 2004, the stock is set to values that linearly grade from the 2000 stock estimate to the DHS 2005 stock estimate. For 2005 through 2012, DHS provided the stock estimates. Because DHS no longer provides stock estimates after 2012, the 2013 through 2015 stock estimates are developed by the Office of the Chief Actuary, based on the same methods used by DHS.

[c] Estimates do not include persons who attained LPR status under the special one-time provisions of the Immigration Reform and Control Act of 1986.

[d] Adjustments of status are a positive for net LPR immigration and a negative for net other-than-LPR immigration.

[e] Estimated.

[f] Estimated, intermediate alternative.

Note: Totals do not necessarily equal the sums of rounded components.

4. Total Population Estimates

The starting Social Security area population for December 31, 2015, is derived from the Census Bureau's estimate of the residents of the 50 States and D.C. and U.S. Armed Forces overseas. Adjustments are made to reflect mortality assumptions for the aged population since 2010 that are consistent with Medicare and Social Security data, net immigration assumptions for the aged population since 2010, estimates of the net undercount in the 2010 census, inclusion of U.S. citizens living abroad (including residents of U.S. territories), and inclusion of non-citizens living abroad who are insured for Social Security benefits. The Office of the Chief Actuary projects the population in the Social Security area by age, sex, and marital status for December 31 of each year from 2016 through 2095 by combining the assumptions for future fertility, mortality, and immigration with assumptions for marriage and divorce. Previous sections of this chapter present the assumptions for future fertility, mortality, and immigration. Assumptions for future rates of marriage and divorce reflect historical data from the National Center for Health Statistics, the Census Bureau, and selected individual States.

This report presents a July 1 (i.e., midyear) population for each year, which is derived from surrounding December populations. Table V.A3 shows the historical and projected population for July 1 by broad age group, for the three alternatives. It also shows the aged and total dependency ratios (see table footnotes for definitions).

Table V.A3.—Social Security Area Population on July 1 and Dependency Ratios, Calendar Years 1945-2095

	Population (in thousands)				Dependency ratio	
Calendar year	Under 20	20-64	65 and over	Total	Aged[a]	Total[b]
Historical data:						
1945	49,121	88,109	10,900	148,130	0.124	0.681
1950	53,903	92,382	12,769	159,053	.138	.722
1955	63,293	96,207	15,075	174,576	.157	.815
1960	73,074	99,802	17,277	190,153	.173	.905
1965	80,020	104,885	19,071	203,975	.182	.945
1970	81,020	112,991	20,895	214,906	.185	.902
1975	78,629	122,642	23,307	224,578	.190	.831
1980	74,835	134,106	26,309	235,250	.196	.754
1985	72,948	144,577	29,151	246,676	.202	.706
1990	74,797	152,768	31,925	259,491	.209	.699
1995	79,278	160,729	34,318	274,325	.214	.707
2000	82,003	170,181	35,503	287,687	.209	.690
2005	83,982	181,066	37,156	302,204	.205	.669
2006	84,572	183,341	37,722	305,635	.206	.667
2007	85,152	184,971	38,477	308,600	.208	.668
2008	85,548	185,798	39,363	310,709	.212	.672
2009	85,775	186,734	40,243	312,752	.216	.675
2010	85,717	188,355	41,050	315,122	.218	.673
2011	85,417	189,850	42,041	317,308	.221	.671
2012	85,100	190,655	43,446	319,200	.228	.674
2013	84,826	191,268	44,926	321,020	.235	.678
2014	84,717	192,142	46,335	323,194	.241	.682
2015	84,714	193,126	47,773	325,613	.247	.686
2016[c]	84,826	194,181	49,273	328,279	.254	.691
2017[c]	85,040	195,210	50,867	331,117	.261	.696
Intermediate:						
2020	85,645	197,892	55,961	339,497	.283	.716
2025	87,466	200,771	65,052	353,288	.324	.760
2030	89,727	204,114	73,039	366,880	.358	.797
2035	93,414	207,761	77,950	379,125	.375	.825
2040	97,077	212,111	80,654	389,841	.380	.838
2045	98,995	217,721	82,565	399,282	.379	.834
2050	99,955	223,258	85,043	408,256	.381	.829
2055	101,479	227,993	88,261	417,733	.387	.832
2060	103,819	231,979	92,313	428,111	.398	.845
2065	106,687	236,306	96,061	439,053	.407	.858
2070	109,457	240,455	100,056	449,968	.416	.871
2075	111,654	244,664	104,246	460,565	.426	.882
2080	113,364	250,886	106,663	470,913	.425	.877
2085	115,124	257,567	108,651	481,342	.422	.869
2090	117,293	262,799	111,975	492,066	.426	.872
2095	119,775	267,020	116,234	503,029	.435	.884

Table V.A3.—Social Security Area Population on July 1 and Dependency Ratios, Calendar Years 1945-2095 (Cont.)

	Population (in thousands)				Dependency ratio	
Calendar year	Under 20	20-64	65 and over	Total	Aged[a]	Total[b]
Low-cost:						
2020	86,477	198,828	55,844	341,149	0.281	0.716
2025	90,332	203,010	64,627	357,969	.318	.763
2030	95,585	207,665	72,132	375,381	.347	.808
2035	102,416	212,606	76,431	391,453	.359	.841
2040	108,946	218,557	78,470	405,972	.359	.858
2045	112,834	226,833	79,763	419,430	.352	.849
2050	115,312	235,969	81,748	433,029	.346	.835
2055	119,015	244,377	84,630	448,022	.346	.833
2060	124,269	252,015	88,460	464,743	.351	.844
2065	130,349	260,133	92,010	482,492	.354	.855
2070	136,102	268,588	95,752	500,442	.357	.863
2075	140,843	277,929	99,602	518,373	.358	.865
2080	144,896	290,029	101,687	536,613	.351	.850
2085	149,260	302,744	103,668	555,671	.342	.835
2090	154,497	313,305	107,944	575,746	.345	.838
2095	160,318	322,347	113,948	596,613	.353	.851
High-cost:						
2020	84,214	195,839	56,061	336,114	.286	.716
2025	83,880	197,264	65,488	346,632	.332	.757
2030	83,205	199,415	74,020	356,639	.371	.788
2035	83,886	201,910	79,627	365,422	.394	.810
2040	84,888	204,765	83,088	372,740	.406	.820
2045	85,231	207,675	85,695	378,601	.413	.823
2050	85,042	209,685	88,707	383,433	.423	.829
2055	84,783	210,937	92,238	387,958	.437	.839
2060	84,721	211,499	96,424	392,644	.456	.856
2065	84,983	212,274	100,254	397,511	.472	.873
2070	85,414	212,396	104,395	402,204	.492	.894
2075	85,723	211,842	108,830	406,395	.514	.918
2080	85,791	212,665	111,500	409,956	.524	.928
2085	85,758	213,965	113,339	413,062	.530	.931
2090	85,805	214,827	115,298	415,931	.537	.936
2095	85,995	215,256	117,390	418,641	.545	.945

[a] Ratio of the population at ages 65 and over to the population at ages 20-64.
[b] Ratio of the population at ages 65 and over and the population under age 20 to the population at ages 20-64.
[c] Estimated, intermediate alternative.

Notes:
1. Historical data are subject to revision.
2. Totals do not necessarily equal the sums of rounded components.

5. Life Expectancy Estimates

Life expectancy, or the average remaining number of years expected prior to death, is an additional way to summarize the Trustees' mortality assumptions. This report includes life expectancy in two different forms (period and cohort), which are useful for two separate purposes.

- Period life expectancy for a given year uses the actual or expected death rates at each age for that year. It is a useful summary statistic for illustrating the overall level of the death rates experienced in a single year. Period life expectancy for a particular year provides an individual's expected average remaining lifetime at a selected age, assuming no change in death rates after that year. Table V.A4 presents historical and projected life expectancy calculated on a period basis.
- Cohort life expectancy does not use death rates for a single year, but for the series of years in which the individual will actually reach each succeeding age if he or she survives. Cohort life expectancy provides an individual's expected average remaining lifetime at a selected age in a given year, using actual or expected future death rates. Table V.A5 presents historical and projected life expectancy calculated on a cohort basis. Cohort life expectancy is somewhat greater than period life expectancy for a given year because: (1) death rates at any age tend to decline over time; and (2) cohort life expectancy uses death rates from future years, while period life expectancy uses death rates only from the given year.

Life expectancy at a given age reflects death rates at that and all older ages. Period life expectancy is somewhat related to the age-sex-adjusted death rate discussed in section V.A.2. However, life expectancy places far greater weight on death rates at relatively younger ages than those at relatively older ages. Therefore, changes in death rates at younger ages have far greater effects in changing life expectancy over time. It is important to keep this concept in mind when considering trends in life expectancy.

Table V.A4.—Period Life Expectancy[a]

Calendar year	Historical data: At birth, Male	Historical data: At birth, Female	Historical data: At age 65, Male	Historical data: At age 65, Female
1940	61.4	65.7	11.9	13.4
1945	62.9	68.4	12.6	14.4
1950	65.6	71.1	12.8	15.1
1955	66.7	72.8	13.1	15.6
1960	66.7	73.2	12.9	15.9
1965	66.8	73.8	12.9	16.3
1970	67.2	74.9	13.1	17.1
1975	68.7	76.6	13.7	18.0
1980	69.9	77.5	14.0	18.4
1985	71.1	78.2	14.4	18.6
1990	71.8	78.9	15.1	19.1
1995	72.5	79.1	15.4	19.1
2000	74.0	79.4	15.9	19.0
2005	74.8	80.0	16.7	19.5
2006	75.1	80.2	17.0	19.7
2007	75.4	80.5	17.2	19.9
2008	75.5	80.5	17.2	19.9
2009	75.9	80.8	17.5	20.2
2010	76.1	80.9	17.6	20.2
2011	76.2	81.0	17.7	20.2
2012	76.3	81.0	17.8	20.3
2013	76.3	81.1	17.8	20.3
2014	76.3	81.1	17.9	20.4
2015[b] . . .	76.2	81.0	17.8	20.4
2016[c] . . .	76.7	81.3	18.1	20.6
2017[c] . . .	76.8	81.4	18.2	20.7

Calendar year	Intermediate				Low-cost				High-cost			
	At birth		At age 65		At birth		At age 65		At birth		At age 65	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
2020	77.2	81.7	18.4	20.9	76.8	81.4	18.2	20.6	77.6	82.1	18.7	21.1
2025	77.8	82.2	18.8	21.2	77.1	81.6	18.4	20.8	78.6	82.9	19.3	21.6
2030	78.4	82.7	19.1	21.5	77.4	81.9	18.5	21.0	79.5	83.6	19.8	22.1
2035	79.0	83.2	19.5	21.8	77.7	82.1	18.7	21.1	80.4	84.4	20.4	22.6
2040	79.5	83.6	19.8	22.1	78.0	82.4	18.9	21.3	81.2	85.0	20.8	23.0
2045	80.0	84.1	20.1	22.3	78.3	82.6	19.0	21.4	82.0	85.7	21.3	23.4
2050	80.5	84.5	20.4	22.6	78.6	82.9	19.2	21.6	82.7	86.3	21.7	23.8
2055	81.0	84.9	20.7	22.9	78.8	83.1	19.4	21.7	83.4	86.8	22.1	24.2
2060	81.5	85.3	20.9	23.1	79.1	83.3	19.5	21.8	84.0	87.3	22.5	24.5
2065	81.9	85.6	21.2	23.4	79.4	83.5	19.7	22.0	84.6	87.8	22.9	24.9
2070	82.4	86.0	21.5	23.6	79.6	83.8	19.8	22.1	85.2	88.3	23.3	25.2
2075	82.8	86.3	21.7	23.8	79.9	84.0	20.0	22.3	85.8	88.8	23.6	25.5
2080	83.2	86.7	22.0	24.0	80.2	84.2	20.1	22.4	86.3	89.2	24.0	25.9
2085	83.6	87.0	22.2	24.3	80.4	84.4	20.3	22.5	86.8	89.6	24.3	26.2
2090	84.0	87.3	22.5	24.5	80.7	84.6	20.4	22.6	87.3	90.0	24.6	26.5
2095	84.3	87.6	22.7	24.7	80.9	84.8	20.6	22.8	87.7	90.4	25.0	26.7

[a] The period life expectancy at a given age for a given year is the average remaining number of years expected prior to death for a person at that exact age, born on January 1, using the mortality rates for that year over the course of his or her remaining life.
[b] Estimated.
[c] Estimated, intermediate alternative.

Table V.A5.—Cohort Life Expectancy[a]

Calendar year	Intermediate				Low-cost				High-cost			
	At birth[b]		At age 65[c]		At birth[b]		At age 65[c]		At birth[b]		At age 65[c]	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
1940	70.4	76.6	12.7	14.7	70.2	76.4	12.7	14.7	70.6	76.8	12.7	14.7
1945	72.2	78.3	13.0	15.4	72.0	78.0	13.0	15.4	72.5	78.6	13.0	15.4
1950	73.4	79.6	13.1	16.2	73.0	79.1	13.1	16.2	73.9	80.1	13.1	16.2
1955	74.0	80.2	13.1	16.7	73.4	79.6	13.1	16.7	74.6	80.9	13.1	16.7
1960	74.7	80.6	13.2	17.4	74.0	79.8	13.2	17.4	75.6	81.5	13.2	17.4
1965	75.6	81.1	13.5	18.0	74.7	80.2	13.5	18.0	76.8	82.2	13.5	18.0
1970	76.9	82.0	13.8	18.5	75.7	80.9	13.8	18.5	78.2	83.3	13.8	18.5
1975	77.8	82.7	14.2	18.7	76.4	81.5	14.2	18.7	79.4	84.2	14.2	18.7
1980	78.6	83.4	14.7	18.8	77.1	81.9	14.7	18.8	80.5	85.1	14.7	18.8
1985	79.3	83.9	15.4	19.1	77.5	82.3	15.4	19.1	81.4	85.8	15.4	19.1
1990	80.0	84.5	16.1	19.4	78.0	82.7	16.0	19.4	82.3	86.5	16.1	19.4
1995	80.8	85.0	16.7	19.8	78.6	83.1	16.7	19.7	83.3	87.2	16.8	19.8
2000	81.3	85.4	17.5	20.2	78.9	83.3	17.4	20.1	84.0	87.8	17.6	20.3
2005	81.8	85.8	18.1	20.7	79.2	83.6	17.9	20.4	84.7	88.3	18.3	20.9
2006	81.9	85.9	18.2	20.7	79.3	83.6	18.0	20.5	84.8	88.4	18.5	21.1
2007	82.0	86.0	18.3	20.8	79.3	83.7	18.0	20.5	84.9	88.5	18.6	21.2
2008	82.1	86.1	18.4	20.9	79.4	83.7	18.1	20.6	85.1	88.6	18.7	21.3
2009	82.2	86.1	18.5	21.0	79.5	83.8	18.2	20.6	85.2	88.8	18.8	21.4
2010	82.3	86.2	18.5	21.1	79.5	83.8	18.2	20.7	85.4	88.9	19.0	21.5
2011	82.4	86.3	18.6	21.1	79.6	83.9	18.3	20.7	85.5	89.0	19.1	21.6
2012	82.5	86.4	18.7	21.2	79.7	83.9	18.3	20.8	85.6	89.1	19.2	21.7
2013	82.6	86.5	18.8	21.3	79.7	84.0	18.3	20.8	85.7	89.2	19.3	21.8
2014	82.7	86.5	18.9	21.3	79.8	84.0	18.4	20.9	85.9	89.3	19.4	21.9
2015	82.8	86.6	18.9	21.4	79.8	84.1	18.4	20.9	86.0	89.3	19.6	22.0
2016	82.9	86.7	19.0	21.5	79.9	84.1	18.5	20.9	86.1	89.5	19.7	22.2
2017	83.0	86.8	19.1	21.6	79.9	84.2	18.5	21.0	86.2	89.6	19.8	22.3
2020	83.2	87.0	19.3	21.7	80.1	84.3	18.6	21.1	86.6	89.9	20.1	22.6
2025	83.7	87.3	19.6	22.0	80.4	84.5	18.8	21.2	87.2	90.3	20.7	23.0
2030	84.1	87.7	20.0	22.3	80.6	84.7	18.9	21.4	87.7	90.8	21.2	23.5
2035	84.5	88.0	20.3	22.6	80.9	84.9	19.1	21.5	88.2	91.2	21.7	23.9
2040	84.9	88.3	20.6	22.9	81.1	85.1	19.3	21.7	88.7	91.6	22.1	24.3
2045	85.2	88.6	20.9	23.1	81.4	85.3	19.4	21.8	89.2	92.0	22.6	24.7
2050	85.6	88.9	21.2	23.4	81.6	85.5	19.6	22.0	89.7	92.4	23.0	25.1
2055	85.9	89.2	21.4	23.6	81.8	85.7	19.8	22.1	90.1	92.7	23.4	25.4
2060	86.3	89.5	21.7	23.9	82.1	85.9	19.9	22.3	90.5	93.1	23.7	25.8
2065	86.6	89.7	22.0	24.1	82.3	86.1	20.1	22.4	90.9	93.4	24.1	26.1
2070	86.9	90.0	22.2	24.4	82.5	86.3	20.2	22.5	91.3	93.7	24.5	26.4
2075	87.2	90.2	22.5	24.6	82.7	86.4	20.4	22.7	91.7	94.0	24.8	26.7
2080	87.5	90.5	22.7	24.8	82.9	86.6	20.5	22.8	92.0	94.3	25.1	27.0
2085	87.8	90.7	22.9	25.0	83.1	86.8	20.7	22.9	92.4	94.6	25.5	27.3
2090	88.1	91.0	23.2	25.2	83.4	87.0	20.8	23.0	92.7	94.9	25.8	27.6
2095	88.4	91.2	23.4	25.4	83.6	87.1	20.9	23.2	93.0	95.2	26.1	27.9

[a] The cohort life expectancy at a given age for a given year is the average remaining number of years expected prior to death for a person at that exact age, born on January 1, using the mortality rates for the series of years in which the individual will actually reach each succeeding age if he or she survives.

[b] Cohort life expectancy at birth for those born in the calendar year is based on a combination of actual, estimated, and projected death rates for birth years 1940 through 2015. For birth years after 2015, these values depend on estimated and projected death rates.

[c] Age 65 cohort life expectancy for those attaining age 65 in calendar years 1940 though 2014 depends on actual death rates or on a combination of actual, estimated, and projected death rates. After 2014, these values depend on estimated and projected death rates.

B. ECONOMIC ASSUMPTIONS AND METHODS

The three alternative sets of economic assumptions provide a reasonable range for estimating the financial status of the trust funds. The intermediate assumptions reflect the Trustees' consensus expectation of sustained moderate economic growth and their best estimate for other economic parameters. The low-cost assumptions represent a more optimistic outlook: a faster recovery, stronger long-term economic growth, and relatively optimistic levels for other parameters. The high-cost assumptions represent a more pessimistic scenario: weaker economic growth in the near term, interrupted by a recession, slower long-term economic growth, and relatively pessimistic levels for other parameters.

Actual economic data were available through the third quarter of 2017 at the time the assumptions for this report were set. The data indicated that economic activity peaked in the fourth quarter of 2007[1] with the level of gross domestic product (GDP) about 1 percent above the estimated long-term sustainable trend level. A severe recession followed, with a low point in the economic cycle reached in the second quarter of 2009 with GDP about 7 percent below the estimated sustainable trend level. The annual growth rate in real GDP has been positive in all years since then, but not as strong as in most past recoveries. The Trustees project that the economy will return to its sustainable trend level of output within the first 10 years of the projection period and remain on that trend thereafter. However, the speed of the return varies by alternative. The economy is projected to fully return to its sustainable trend level of output in 2025 under the intermediate assumptions, three years later than in last year's report, although it is projected to be within 1 percent of the sustainable trend level by 2019. Under the low-cost assumptions, the economy is projected to return to its sustainable trend level of output by 2022, a year later than in last year's report. Under the high-cost assumptions, the estimated sustainable trend is lower, and the economy has already returned to the sustainable trend. However, due to the assumed recession, GDP is projected to drop to 2.5 percent below the trend level in the second half of 2019, and the subsequent recovery is assumed to return GDP to the sustainable trend in 2027. Complete economic cycles have little effect on the long-range estimates of financial status, so the assumptions do not include cycles beyond the short-range period (2018 through 2027).

The key economic assumptions underlying the three sets of projections of the future financial status of the OASI and DI Trust Funds are discussed in the remainder of this section.

[1] See www.nber.org/cycles/cyclesmain.html.

1. Productivity Assumptions

Total U.S. economy productivity is defined as the ratio of real GDP to hours worked by all workers.[1] The rate of change in total-economy productivity is a major determinant of the growth of average earnings. Over the last five complete economic cycles (1966-73, 1973-79, 1979-89, 1989-2000, and 2000-07, measured peak to peak), the annual increases in total-economy productivity averaged 2.28, 1.08, 1.41, 1.79 and 2.12 percent, respectively. For the period from 1966 to 2007, covering those last five complete economic cycles, the annual increase in total-economy productivity averaged 1.73 percent.

The assumed ultimate annual increases in total-economy productivity are 1.98, 1.68, and 1.38 percent for the low-cost, intermediate, and high-cost assumptions, respectively.[2] These rates of increase are unchanged from the 2017 report.

The average annual rate of change in total-economy productivity from 2007 (the end of the last complete economic cycle) to 2017 is estimated to be 1.00 percent. For the intermediate assumptions, the annual change in productivity is 1.72 percent for 2018, 1.71 percent for 2019, and rises to 1.73 percent for 2021, before declining to its ultimate value of 1.68 percent by 2025. For the low-cost assumptions, the annual change in productivity is 2.27 percent for 2018, then increases to 2.50 percent for 2019, and gradually approaches its ultimate value of 1.98 percent for 2024 and thereafter. For the high-cost assumptions, the annual change in productivity is 1.29 percent for 2018, 0.19 percent for 2019 due to the assumed recession, rebounds to 1.65 percent for 2020, declines to 1.26 percent for 2021, and then averages 1.44 for 2022 through 2027, before reaching its ultimate value of 1.38 percent after 2027.

2. Price Inflation Assumptions

Changes in the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI) directly affect the OASDI program through the automatic cost-of-living benefit increases. Changes in the GDP price index (GDP defla-

[1] Historical levels of real GDP are from the Bureau of Economic Analysis' National Income and Product Accounts. Historical total hours worked are provided by the Bureau of Labor Statistics and cover all U.S. Armed Forces and civilian employment.

[2] These assumptions are consistent with ultimate annual increases in private non-farm business productivity of 2.42, 2.06, and 1.69 percent. Compared to total-economy productivity, private non-farm business productivity is a more widely known concept that excludes the farm, government, non-profit institution, and private household sectors.

tor) affect the nominal levels of GDP, wages, self-employment income, average earnings, and taxable payroll.

The annual increases in the CPI averaged 4.61, 8.54, 5.31, 2.96, and 2.65 percent over the economic cycles 1966-73, 1973-79, 1979-89, 1989-2000, and 2000-07, respectively. The annual increases in the GDP deflator averaged 4.60, 7.52, 4.68, 2.20, and 2.50 percent for the respective economic cycles. For the period from 1966 to 2007, covering the last five complete economic cycles, the annual increases in the CPI and GDP deflator averaged 4.56 and 4.03 percent, respectively. The estimated average annual change from 2007 (the end of the last complete economic cycle) to 2017 is 1.66 percent for the CPI and 1.54 percent for the GDP deflator.

The assumed ultimate annual increases in the CPI are 3.2, 2.6, and 2.0 percent for the low-cost, intermediate, and high-cost assumptions, respectively.[1] These assumptions are unchanged from the 2017 report. For a given rate of growth in average real earnings, a higher price inflation rate results in faster nominal earnings and revenue growth immediately, while the resulting added growth in benefit levels occurs with a delay, causing an overall improvement in the actuarial balance. Similarly, a lower price inflation rate causes an overall decline in the actuarial balance.

The Federal Reserve Board's monetary policy changed in the 1980s toward more vigilance in preventing high inflation. Consistent with the Board's continued emphasis on containing inflation, as indicated by their current target for the Personal Consumption Expenditures (PCE) price index,[2] the Trustees lowered the assumed ultimate annual rate of increase in the CPI for the intermediate assumptions from 4.0 percent for the 1996 report to 2.8 percent for the 2004 through 2013 reports, to 2.7 percent for the 2014 and 2015 reports, and to 2.6 percent for the 2016 through 2018 reports.

For the intermediate assumptions, the annual change in the CPI is 2.23 percent for 2018, 2.50 percent for 2019, and reaches the ultimate growth rate of 2.60 percent for 2020 and later. For the low-cost assumptions, the annual change in the CPI is 2.72 percent for 2018, increases to

[1] The Bureau of Labor Statistics (BLS) produces a series called the Consumer Price Index Research Series Using Current Methods (CPI-U-RS) that approximates the measured rate of inflation over the 1978-2017 period had the method currently used been in effect since 1978. BLS does not revise the CPI values published in earlier years, for which different methods were used. These CPI published values are shown in table V.B1. The Trustees use an adjusted CPI series based on the CPI-U-RS when setting the ultimate price inflation assumption because it provides a time series that is consistent with the current method for computing the CPI.

[2] The Trustees' assumed ultimate annual growth rate for the GDP deflator of 2.2 percent is based on an assumed 2.3 percent annual growth rate for the PCE price index. The Trustees' assumption takes into account the Federal Open Market Committee (FOMC) target, as well as the potential for inflationary shocks during the 2027-2092 projection period.

3.26 percent for 2019, declines to 3.22 percent in 2020, and reaches its ultimate annual growth rate of 3.20 percent for 2021 and later. For the high-cost assumptions, the annual rate of change in the CPI is 1.64 percent for 2018, decreases to 1.49 percent for 2019, rises to 1.92 percent in 2020, and reaches its ultimate annual change of 2.00 percent for 2021 and later.

The annual increase in the GDP deflator differs from the annual increase in the CPI because the two indices are constructed using different computational methods and coverage. The difference between the rate of change in the CPI and the rate of change in the GDP deflator is called the price differential in this report. For the period including 1966 through 2007, covering the last five complete economic cycles, the average annual price differential was 0.54 percentage point. From 2007 (the end of the last complete economic cycle) to 2017, the average annual price differential is estimated to be 0.13 percentage point.

The assumed ultimate price differentials are 0.3, 0.4, and 0.5 percentage point for the low-cost, intermediate, and high-cost alternatives, respectively. Varying the ultimate projected price differential across alternatives recognizes the historical variation in this measure. Accordingly, the assumed ultimate annual increases in the GDP deflator are 2.9 (3.2 less 0.3), 2.2 (2.6 less 0.4), and 1.5 (2.0 less 0.5) percent for the low-cost, intermediate, and high-cost alternatives, respectively. The ultimate price differentials for the three alternatives are unchanged from the 2017 report.

The price differential was -0.24 percentage point for 2013, -0.29 for 2014, -1.49 for 2015, -0.30 in 2016, is estimated to be 0.32 in 2017, and is assumed to be 0.26 for 2018. The negative price differential for 2013 through 2016 primarily reflects a general decline in oil prices. Changes in oil prices affect the CPI much more than the GDP deflator because oil represents a much larger share of U.S. consumption than of U.S. production. For 2018 and later, oil prices are assumed to grow at a relatively stable rate. For the intermediate assumptions, the price differential is 0.44 percentage point for 2019 and 0.40 percentage point for 2020 and later.

3. Average Earnings Assumptions

The average level of nominal earnings in OASDI covered employment for each year has a direct effect on the size of the taxable payroll and on the future level of average benefits. In addition, under the automatic adjustment provisions in the law, growth in the average wage in the U.S. economy directly affects certain parameters used in the OASDI benefit formulas as well as the contribution and benefit base, the exempt amounts under the retirement earnings test, the amount of earnings required for a quarter of coverage, and in certain circumstances, the automatic cost-of-living benefit increases.

Projected growth rates in average covered earnings are derived from projections of the most inclusive measure, average U.S. earnings. Average U.S. earnings is defined as the ratio of the sum of total U.S. wages and net proprietors' income to the sum of total U.S. civilian employment and Armed Forces. The growth rate in average U.S. earnings for any period is equal to the combined growth rates for total U.S. economy productivity, average hours worked, the ratio of earnings to total compensation (which includes fringe benefits), the ratio of total compensation to GDP, and the GDP deflator.

The average annual change in average hours worked was -0.28 percent over the last five complete economic cycles covering the period from 1966 to 2007. The annual change in average hours worked averaged -0.72, -0.54, -0.03, 0.14, and -0.60 percent over the economic cycles 1966-73, 1973-79, 1979-89, 1989-2000, and 2000-07, respectively. From 2007 (the end of the last complete economic cycle) to 2017, the average annual change in average hours worked is estimated to be -0.07 percent.

The assumed ultimate annual rates of change for average hours worked are 0.05, -0.05, and -0.15 percent for the low-cost, intermediate, and high-cost assumptions, respectively. These values are unchanged from the 2017 report.

The average annual change in the ratio of earnings to total compensation was -0.20 percent from 1966 to 2007. Most of this decrease was due to the relative increase in the cost of employer-sponsored group health insurance for wage workers. Assuming that the level of total employee compensation is not affected by the amount of employer-sponsored group health insurance, any increase or decrease in the cost of employer-sponsored group health insurance leads to a commensurate decrease or increase in other components of employee compensation, including wages. Projections of future ratios of earnings to total compensation follow this principle. The Trustees assume that the total amount of future employer-sponsored group health insurance premiums will increase more slowly than in the past due to provisions of the Affordable Care Act of 2010, as described in the 2010 report. Data from the Bureau of Economic Analysis (BEA) indicate that the other significant component of non-wage employee compensation is employer contributions to retirement plans. This component is assumed to grow faster than employee compensation in the future as life expectancy and potential time in retirement increase.

The average annual rates of change in the ratio of wages to employee compensation from 2027 to 2092 are about 0.02, -0.08, and -0.18 percent for the low-cost, intermediate, and high-cost assumptions, respectively. These assumed rates are the same as those assumed for the 2017 report. Under the intermediate assumptions, the ratio of wages to employee compensation declines from 0.810 for 2017 to 0.767 for 2092. The assumed ultimate annual rate of this decline is 0.08 percent, the same as assumed for last year's report, compared with 0.07 percent for the 2016 report, 0.09 percent for the 2015 report, 0.13 percent for the 2014 report, and 0.20 percent for the 2009 report, prior to enactment of the Affordable Care Act of 2010. The ratio of earnings to compensation includes self-employment income both in the numerator and in the denominator. As a result, the rate of decline in earnings to compensation (which, under the intermediate assumptions, averages 0.06 percent from 2027 to 2092) is less than the rate of decline in wages to employee compensation.

The ratio of total compensation (i.e., employee compensation and net proprietors' income) to GDP varies over the economic cycle and with changes in the relative sizes of different sectors of the economy. Over the last five economic cycles from 1966 to 2007, this ratio has averaged 0.627. The ratio declined from 0.648 for 2001 to 0.601 in 2010, increased to 0.610 in 2012, and is 0.608 in 2016. This ratio is assumed to rise as the economy recovers, reaching a level of 0.631 for 2027. For years after 2027, relative sizes of different sectors of the economy are assumed to remain about constant,[1] and therefore the ratio of total compensation to GDP remains at about the 2027 level for each set of assumptions.

The projected average annual growth rate in average nominal U.S. earnings from 2027 to 2092 is about 3.80 percent for the intermediate assumptions. This growth rate reflects the average annual growth rate of approximately -0.06 percent for the ratio of earnings to total compensation, and also reflects the assumed ultimate annual growth rates of 1.68 percent for productivity, -0.05 percent for average hours worked, and 2.20 percent for the GDP deflator. Similarly, the projected average annual growth rates in average nominal U.S. earnings are 5.01 percent for the low-cost assumptions and 2.59 percent for the high-cost assumptions.

Over long periods, the average annual growth rate in the average wage in OASDI covered employment (henceforth the "average covered wage") is expected to be very close to the average annual growth rate in average U.S.

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[1] However, employment in the uniformed military sector has declined in size over the last 40 years, and is assumed to remain at its 2017 level throughout the 75-year projection period.

earnings. The projected average annual growth rates in the average covered wage from 2027 to 2092 are 5.02, 3.80, and 2.58 percent for the low-cost, intermediate, and high-cost assumptions, respectively. The estimated annual rate of change in the average covered wage is 2.88 percent for 2017. For the intermediate assumptions, as the economy continues to recover, the annual rate of change in the average covered wage averages 4.27 percent from 2017 to 2027. Thereafter, the average annual rate of change in the average covered wage is 3.80 percent.

4. Assumed Real-Wage Differential

The real increase in the average covered wage has traditionally been expressed in the form of a real-wage differential—the annual percentage change in the average covered wage minus the annual percentage change in the CPI. For the period from 1966 to 2007, covering the last five complete economic cycles, the real-wage differential averaged 0.88 percentage point, the result of averages of 1.43, 0.04, 0.48, 1.55, and 0.58 percentage points over the economic cycles 1966-73, 1973-79, 1979-89, 1989-2000, and 2000-07, respectively.

For the years 2028-92, the projected average annual real-wage differentials for OASDI covered employment are 1.82, 1.20, and 0.58 percentage points for the low-cost, intermediate, and high-cost assumptions, respectively. The rounded average annual real-wage differentials are unchanged from the 2017 report.

The estimated real-wage differential averaged 0.54 percentage point for 2008 through 2017 (the years since the peak of the last complete economic cycle). The real-wage differential decreased from 3.88 percentage points in 2015 to 0.00 percentage points in 2016, a decline that reflects higher inflation and slower growth in GDP and productivity. For the intermediate assumptions, the wage differential is projected to rise from 0.75 in 2017 to 1.95 in 2020 before gradually declining to its long-run average of 1.20 percentage points for 2028 through 2092. For the low-cost assumptions, the real-wage differential is 2.14 percentage points for 2018, increases to 3.08 percentage points in 2020, and gradually declines to its long-run average of 1.82 percentage points for 2028 through 2092. For the high-cost assumptions, the real-wage differential is 1.36 percentage points for 2018, drops to -1.14 percentage points in 2019 due to the assumed recession, and rises to 1.51 percentage points in 2022 before gradually declining to its long-run average of 0.58 percentage point for 2028 through 2092.

Table V.B1.—Principal Economic Assumptions

Calendar year	Annual percentage change[a] in— Productivity (Total U.S. economy)	Earnings as a percent of compensation	Average hours worked	GDP price index	Average annual wage in covered employment	Consumer Price Index	Real-wage differential[b]
Historical data:							
5-year periods:							
1960 to 1965 . . .	3.28	-0.18	0.15	1.36	3.22	1.24	1.98
1965 to 1970 . . .	2.07	-.31	-.68	4.03	5.84	4.23	1.61
1970 to 1975 . . .	2.08	-.50	-.88	6.60	6.58	6.76	-.22
1975 to 1980 . . .	.95	-.32	-.17	7.19	8.89	8.91	-.04
1980 to 1985 . . .	1.75	-.33	.01	5.21	6.52	5.22	1.29
1985 to 1990 . . .	1.36	-.19	-.06	3.11	4.79	3.83	.96
1990 to 1995 . . .	1.33	-.11	.33	2.44	3.54	3.03	.51
1995 to 2000 . . .	2.31	.28	.14	1.67	5.30	2.43	2.88
2000 to 2005 . . .	2.62	-.41	-.79	2.35	2.68	2.49	.19
2005 to 2010 . . .	1.61	-.08	-.47	1.93	2.50	2.30	.22
2010 to 2015 . . .	.48	.20	.37	1.68	2.96	1.61	1.34
Economic cycles:[c]							
1966 to 1973 . . .	2.28	-.29	-.72	4.60	6.05	4.61	1.43
1973 to 1979 . . .	1.08	-.43	-.54	7.52	8.58	8.54	.04
1979 to 1989 . . .	1.41	-.28	-.03	4.68	5.83	5.31	.48
1989 to 2000 . . .	1.79	.05	.14	2.20	4.50	2.96	1.55
2000 to 2007 . . .	2.12	-.23	-.60	2.50	3.22	2.65	.58
2007 to 2017 . . .	1.00	.03	-.07	1.54	2.20	1.66	.54
Single years:							
2007	.96	-.05	-.29	2.67	4.50	2.88	1.62
2008	.91	-.06	-.75	1.93	2.42	4.09	-1.67
2009	2.88	-.66	-1.86	.79	-1.56	-.67	-.89
2010	2.55	-.10	.56	1.23	2.59	2.07	.53
2011	.10	.28	.93	2.06	3.14	3.56	-.42
2012	.46	.40	-.04	1.84	3.32	2.10	1.22
2013	.43	.01	.25	1.61	1.20	1.37	-.17
2014	.68	.25	.26	1.80	3.70	1.50	2.20
2015	.74	.07	.43	1.08	3.46	-.41	3.88
2016	.18	.06	-.40	1.28	.97	.98	[d]
2017[e]	1.10	.02	-.07	1.81	2.88	2.13	.75
Intermediate:							
2018	1.72	.03	-.06	1.97	3.82	2.23	1.59
2019	1.71	-.03	.01	2.06	4.23	2.50	1.73
2020	1.72	.04	.01	2.20	4.55	2.60	1.95
2021	1.73	.03	[d]	2.20	4.52	2.60	1.92
2022	1.72	-.06	[d]	2.20	4.43	2.60	1.83
2023	1.72	-.07	[d]	2.20	4.38	2.60	1.78
2024	1.71	-.11	-.01	2.20	4.33	2.60	1.73
2025	1.68	-.09	-.03	2.20	4.26	2.60	1.66
2026	1.68	-.08	-.05	2.20	4.20	2.60	1.60
2027	1.68	-.06	-.05	2.20	3.97	2.60	1.37
2027 to 2092 . . .	1.68	-.06	-.05	2.20	3.80	2.60	1.20

Table V.B1.—Principal Economic Assumptions (Cont.)

Calendar year	Productivity (Total U.S. economy)	Earnings as a percent of compensation	Average hours worked	GDP price index	Average annual wage in covered employment	Consumer Price Index	Real-wage differential[b]
	Annual percentage change[a] in—						
Low-cost:							
2018	2.27	0.04	0.08	2.21	4.87	2.72	2.14
2019	2.50	-.02	.23	2.75	6.33	3.26	3.06
2020	2.27	.06	.17	2.92	6.30	3.22	3.08
2021	2.13	.06	.12	2.90	5.99	3.20	2.79
2022	2.00	-.02	.06	2.90	5.49	3.20	2.29
2023	1.97	-.02	.05	2.90	5.35	3.20	2.15
2024	1.98	-.05	.05	2.90	5.32	3.20	2.12
2025	1.98	-.01	.05	2.90	5.38	3.20	2.18
2026	1.98	[d]	.05	2.90	5.41	3.20	2.21
2027	1.98	.02	.05	2.90	5.21	3.20	2.01
2027 to 2092	1.98	.02	.05	2.90	5.02	3.20	1.82
High-cost:							
2018	1.29	.03	-.07	1.65	3.00	1.64	1.36
2019	.19	-.04	-.24	1.15	.34	1.49	-1.14
2020	1.65	.02	-.17	1.42	2.92	1.92	1.00
2021	1.26	-.01	-.10	1.50	3.32	2.00	1.32
2022	1.47	-.11	-.10	1.50	3.51	2.00	1.51
2023	1.47	-.13	-.10	1.50	3.47	2.00	1.47
2024	1.42	-.17	-.12	1.50	3.28	2.00	1.28
2025	1.44	-.16	-.12	1.50	3.27	2.00	1.27
2026	1.44	-.16	-.12	1.50	3.25	2.00	1.25
2027	1.39	-.15	-.13	1.50	2.88	2.00	.88
2027 to 2092	1.38	-.15	-.15	1.50	2.58	2.00	.58

[a] For rows with a single year listed, the value is the annual percentage change from the prior year. For rows with a range of years listed, the value is the compound average annual percentage change.
[b] For rows with a single year listed, the value is the annual percentage change in the average annual wage in covered employment less the annual percentage change in the Consumer Price Index. For rows with a range of years listed, the value is the average of annual values of the real wage differential, beginning with the year following the first year of the range. Values are rounded after all computations.
[c] Economic cycles are shown from peak to peak, except for the last cycle, which is not yet complete.
[d] Greater than -0.005 and less than 0.005.
[e] Historical data are not available for the full year. Estimated values vary slightly by alternative and are shown for the intermediate assumptions.

5. Labor Force and Unemployment Projections

The model used by the Office of the Chief Actuary projects the civilian labor force by age, sex, marital status, and presence of children. Projections of the labor force participation rates reflect changes in disability prevalence, educational attainment, the average level of Social Security retirement benefits, the state of the economy, and the change in life expectancy. The projections also include a "cohort effect," which reflects an upward trend in female participation rates across cohorts born through 1948.

The annual rate of growth in the size of the labor force decreased from an average of about 2.4 percent during the 1966-73 economic cycle and 2.7 percent during the 1973-79 cycle to 1.7 percent during the 1979-89 cycle, 1.3 percent during the 1989-2000 cycle, and 1.0 percent during the 2000-07 cycle. Further slowing of labor force growth is expected to follow from a substantial slowing of growth in the working age population in the future—a consequence of the baby-boom generation reaching retirement ages and succeeding lower-birth-rate cohorts reaching working ages. Under the intermediate assumptions, the labor force is projected to increase by an average of 0.9 percent per year from 2017 to 2027 and 0.5 percent per year over the remainder of the 75-year projection period.

Labor force participation rates are projected with a model that uses demographic and economic assumptions specific to each alternative. More optimistic economic assumptions in the low-cost alternative are consistent with higher labor force participation rates, while demographic assumptions in the low-cost alternative (such as slower improvement in longevity) are consistent with lower labor force participation rates. These economic and demographic influences have largely offsetting effects. Therefore, the projected labor force participation rates do not vary substantially across alternatives.

Historically, labor force participation rates reflect trends in demographics and pensions. Between the mid-1960s and the mid-1980s, labor force participation rates at ages 50 and over declined for males but were fairly stable for females. During this period, the baby-boom generation reached working age and more women entered the labor force. This increasing supply of labor allowed employers to offer attractive early retirement options. Between the mid-1980s and the mid-1990s, participation rates at ages 55 and older roughly stabilized for males and increased for females. Since the mid-1990s, however, participation rates for both sexes at ages 50 and over have generally risen.

Many economic and demographic factors, including longevity, health, disability prevalence, the business cycle, incentives for retirement in Social Security and private pensions, education, and marriage patterns, will influence future labor force participation rates. The Office of the Chief Actuary models some of these factors explicitly. To model the effects of other factors related to increases in life expectancy, projected participation rates are adjusted upward for mid-career and older ages to reflect projected increases in life expectancy. For the intermediate projections, this adjustment increases the total labor force by 2.8 percent for 2092.

For men age 16 and over, the projected age-adjusted labor force participation rates[1] for 2092 are 73.1, 73.2, and 73.1 percent for the low-cost, intermedi-

[1] The Office of the Chief Actuary adjusts the labor force participation rates to the 2011 age distribution of the civilian noninstitutional U.S. population.

ate, and high-cost assumptions, respectively. The low-cost assumptions result in a larger working-age population and a larger labor force when compared to the intermediate assumptions, but a slightly lower labor force participation rate for men. This occurs because the low-cost assumptions include shorter life expectancies and relatively higher numbers of never-married individuals in the population. Shorter life expectancies tend to reduce work at older ages, while labor force participation rates tend to be lower for never-married men and higher for never-married women compared to their married counterparts.[1] For women age 16 and over, the projected age-adjusted labor force participation rates for 2092 are 62.0, 61.4, and 60.5 percent for the low-cost, intermediate, and high-cost assumptions, respectively.

The age-adjusted rates for 2092 are higher under all three alternatives than the age-adjusted rates for 2016 of 70.5 percent for men and 58.0 percent for women (based on actual age-specific rates published by the Bureau of Labor Statistics), primarily due to the Trustees' projected increases in life expectancy. In the first ten years of the projection period, the assumed labor force participation rates increase as the economic recovery draws more people into the labor force. Increasing disability prevalence rates offset these increases somewhat in the intermediate and high-cost assumptions, but a decrease in disability prevalence further contributes to increases in labor force participation in the low-cost assumptions.

The total civilian unemployment rates are presented in table V.B2. For years through 2027, the table presents total civilian rates without adjustment for the changing age-sex distribution of the population. For years after 2027, the table presents age-sex-adjusted rates, using the age-sex distribution of the 2011 civilian labor force. Age-sex-adjusted rates allow for more meaningful comparisons across longer time periods.

The total civilian unemployment rate reflects the projected levels of unemployment for various age-sex groups of the population. Each group's unemployment rate is projected in relation to changes in the economic cycle, as measured by the ratio of actual to potential GDP.[2] For each alternative, the total civilian unemployment rate moves toward the ultimate assumed rate as the economy moves toward the long-range sustainable growth path.

The assumed ultimate age-sex-adjusted unemployment rates are 4.5, 5.5, and 6.5 percent for the low-cost, intermediate, and high-cost assumptions,

[1] The high-cost labor force participation rate is also lower than the intermediate because life expectancy has a non-linear effect on labor force participation rates in the Office of the Chief Actuary's model.

[2] Potential GDP is the level of GDP assuming the economy is operating at the underlying sustainable trend rate of growth.

respectively. These values are unchanged from the 2017 report. Improvements in labor market conditions will eventually draw more nonparticipants back into the labor force and unemployment rate will increase from an estimated 4.4 percent for 2017 to the assumed 5.5 percent for 2021 under the intermediate assumptions. Under the low-cost assumptions, the ultimate unemployment rate is reached in 2020.[1] Under the high-cost assumptions, the ultimate unemployment rate is reached in 2026.

6. Gross Domestic Product Projections

The value of real GDP equals the product of three components: (1) average weekly total employment,[2] (2) productivity, and (3) average hours worked per week. Consequently, the growth rate in real GDP is approximately equal to the sum of the growth rates for total employment, productivity, and average hours worked. For the period from 1966 to 2007, which covers the last five complete economic cycles, the average growth rate in real GDP was 3.1 percent. This average growth rate approximately equals the sum of the average growth rates of 1.6 percent for total employment, 1.7 percent for productivity, and -0.3 percent for average hours worked. The real GDP for 2016 was 12.4 percent above the 2007 level. The estimated real GDP growth from 2016 to 2017 is 2.2 percent.

For the intermediate assumptions, the average annual growth in real GDP is 2.4 percent from 2017 to 2027, the approximate sum of component growth rates of 0.7 percent for total employment, 1.7 percent for productivity, and -0.02 percent for average hours worked. The projected average annual growth in real GDP of 2.4 percent for this period is approximately 0.2 percentage point higher than the underlying sustainable trend rate. This growth of 0.2 percentage point above trend reflects a relatively rapid increase in employment and total economy productivity, and a relatively slow decline in average hours worked, as the economy recovers. After 2027, the assumptions do not explicitly reflect economic cycles. The projected annual growth rate in real GDP combines the projected growth rates for total employment, total U.S. economy productivity, and average hours worked. After 2027, the annual growth in real GDP averages 2.1 percent, based on the projected average annual growth rate of 0.5 percent for total employment and the assumed ultimate growth rates of 1.7 percent for productivity and -0.05 percent for average hours worked. The projected growth rate of real

[1] The assumed ultimate unemployment rate is an age-sex-adjusted rate.

[2] Total employment is the sum of the U.S. Armed Forces and total civilian employment, which depends on the total civilian labor force and unemployment rate.

GDP is slower than the past average growth rate mainly because the working-age population is expected to grow more slowly than in the past.

For the low-cost assumptions, the annual growth in real GDP averages 3.2 percent over the decade ending in 2027. The relatively fast growth is due mostly to high assumed rates of growth for employment and worker productivity. For the high-cost assumptions, the annual growth in real GDP averages 1.6 percent for the decade ending in 2027.

7. Interest Rates

Table V.B2 presents average annual nominal and real interest rates for newly issued trust fund securities. The nominal rate is the average of the nominal interest rates for special U.S. Government obligations issuable to the trust funds in each of the 12 months of the year. Interest for these securities is generally compounded semiannually. The real interest rate is defined as the annual yield rate for investments in these securities divided by the annual rate of growth in the CPI for the first year after issuance. The real rate shown for each year reflects the actual realized (historical) or expected (future) real yield on securities issuable in the prior year.

To develop a reasonable range of assumed ultimate future real interest rates for the three alternatives, the Office of the Chief Actuary examined historical experience for the last five complete economic cycles. For the period from 1966 to 2007, the real interest rate averaged 2.8 percent per year. The real interest rates averaged 1.3, -1.0, 5.2, 4.0, and 2.2 percent per year over the economic cycles 1966-73, 1973-79, 1979-89, 1989-2000, and 2000-07, respectively. The assumed ultimate real interest rates are 3.2 percent, 2.7 percent, and 2.2 percent for the low-cost, intermediate, and high-cost assumptions, respectively. These rates are the same as in the 2017 report.

The actual average annual nominal interest rate was approximately 1.8 percent for 2016, which means that securities newly issued in 2016 would yield 1.8 percent if held one year. Estimated average prices rose from 2016 to 2017 by approximately 2.1 percent. The annual real interest rate for 2017 is -0.3 percent, the approximate difference between the nominal interest rate and the rate of price increase. For the 10-year short-range projection period, projected nominal interest rates depend on changes in the economic cycle and in the CPI. When combined with the ultimate CPI assumptions of 3.2, 2.6, and 2.0 percent, the assumed ultimate real interest rates produce ultimate nominal interest rates of 6.4 percent for the low-cost assumptions, 5.3 percent for the intermediate assumptions, and 4.2 percent for the high-cost assumptions. These nominal rates for newly issued trust fund securities reach their ultimate levels by 2027, the end of the short-range period.

Table V.B2.—Additional Economic Factors

Calendar year	Average annual unemployment rate[a]	Annual percentage change[b] in— Labor force[c]	Total employment[d]	Real GDP[e]	Average annual interest rate Nominal[f]	Real[g]
Historical data:						
5-year periods:						
1960 to 1965.	5.5	1.3	1.6	5.0	4.0	2.5
1965 to 1970.	3.9	2.2	2.1	3.5	5.9	1.0
1970 to 1975.	6.1	2.5	1.5	2.7	6.7	[h]
1975 to 1980.	6.8	2.7	2.9	3.7	8.5	-.9
1980 to 1985.	8.3	1.5	1.5	3.3	12.1	6.9
1985 to 1990.	5.9	1.7	2.0	3.4	8.5	5.1
1990 to 1995.	6.6	1.0	.9	2.6	7.0	4.3
1995 to 2000.	4.6	1.5	1.8	4.3	6.2	3.9
2000 to 2005.	5.4	.9	.7	2.5	4.6	2.4
2005 to 2010.	6.8	.6	-.4	.8	3.8	1.8
2010 to 2015.	7.2	.4	1.3	2.2	2.0	.5
Economic cycles:[i]						
1966 to 1973.	4.6	2.4	2.0	3.6	6.1	1.3
1973 to 1979.	6.8	2.7	2.4	3.0	7.7	-1.0
1979 to 1989.	7.3	1.7	1.7	3.1	10.5	5.2
1989 to 2000.	5.6	1.3	1.3	3.3	6.8	4.0
2000 to 2007.	5.2	1.0	.9	2.4	4.6	2.2
2007 to 2017.	7.0	.5	.5	1.4	2.3	.9
Single years:						
2007	4.6	1.1	1.1	1.8	4.7	1.9
2008	5.8	.8	-.4	-.3	3.6	.6
2009	9.3	-.1	-3.7	-2.8	2.9	4.4
2010	9.6	-.2	-.6	2.5	2.8	.9
2011	8.9	-.2	.6	1.6	2.4	-.7
2012	8.1	.9	1.8	2.2	1.5	.3
2013	7.4	.3	1.0	1.7	1.9	.1
2014	6.2	.3	1.6	2.6	2.3	.4
2015	5.3	.8	1.7	2.9	2.0	2.7
2016	4.9	1.3	1.7	1.5	1.8	1.0
2017[j].	4.4	.7	1.2	2.2	2.3	-.3

Table V.B2.—Additional Economic Factors (Cont.)

Calendar year	Average annual unemployment rate[a]	Annual percentage change[b] in— Labor force[c]	Total employment[d]	Real GDP[e]	Average annual interest rate Nominal[f]	Real[g]
Intermediate:						
2018	4.4	1.1	1.1	2.7	2.7	0.1
2019	4.9	1.3	.9	2.6	3.4	.2
2020	5.3	1.3	.8	2.6	3.9	.8
2021	5.5	1.0	.7	2.5	4.3	1.3
2022	5.5	.7	.7	2.4	4.6	1.7
2023	5.5	.7	.7	2.4	4.9	2.0
2024	5.5	.7	.7	2.4	5.1	2.3
2025	5.5	.6	.6	2.3	5.2	2.5
2026	5.5	.6	.6	2.2	5.3	2.6
2027	5.5	.6	.6	2.2	5.3	2.7
2030	5.5	.5	.5	2.1	5.3	2.7
2035	5.5	.4	.4	2.1	5.3	2.7
2040	5.5	.5	.5	2.1	5.3	2.7
2045	5.5	.5	.5	2.2	5.3	2.7
2050	5.5	.5	.5	2.1	5.3	2.7
2055	5.5	.5	.5	2.1	5.3	2.7
2060	5.5	.4	.4	2.1	5.3	2.7
2065	5.5	.4	.4	2.0	5.3	2.7
2070	5.5	.4	.4	2.1	5.3	2.7
2075	5.5	.5	.5	2.1	5.3	2.7
2080	5.5	.5	.5	2.1	5.3	2.7
2085	5.5	.5	.5	2.1	5.3	2.7
2090	5.5	.4	.4	2.1	5.3	2.7
2095	5.5	.4	.4	2.0	5.3	2.7
Low-cost:						
2018	4.1	1.1	1.5	3.9	3.5	-.4
2019	4.2	1.7	1.5	4.3	4.8	.3
2020	4.5	1.5	1.3	3.8	5.1	1.6
2021	4.6	1.0	.9	3.2	5.4	1.9
2022	4.6	.9	.9	3.0	5.6	2.2
2023	4.6	.8	.8	2.9	5.8	2.4
2024	4.6	.9	.9	2.9	6.1	2.6
2025	4.6	.8	.8	2.8	6.2	2.9
2026	4.6	.7	.7	2.7	6.4	3.0
2027	4.6	.7	.7	2.7	6.4	3.2
2030	4.5	.6	.6	2.6	6.4	3.2
2035	4.5	.6	.6	2.6	6.4	3.2
2040	4.5	.6	.6	2.7	6.4	3.2
2045	4.5	.8	.8	2.8	6.4	3.2
2050	4.5	.8	.8	2.8	6.4	3.2
2055	4.5	.7	.7	2.7	6.4	3.2
2060	4.5	.7	.7	2.7	6.4	3.2
2065	4.5	.7	.7	2.7	6.4	3.2
2070	4.5	.7	.7	2.7	6.4	3.2
2075	4.5	.8	.8	2.8	6.4	3.2
2080	4.5	.8	.8	2.8	6.4	3.2
2085	4.5	.8	.8	2.8	6.4	3.2
2090	4.5	.7	.7	2.7	6.4	3.2
2095	4.5	.7	.7	2.7	6.4	3.2

Table V.B2.—Additional Economic Factors (Cont.)

Calendar year	Average annual unemployment rate[a]	Annual percentage change[b] in— Labor force[c]	Total employment[d]	Real GDP[e]	Average annual interest rate Nominal[f]	Real[g]
High-cost:						
2018	4.5	1.0	0.9	2.2	2.1	0.7
2019	6.4	1.1	-.8	-.9	1.6	.7
2020	7.0	.6	[h]	1.5	2.7	-.3
2021	6.9	.8	.9	2.0	3.4	.7
2022	6.8	.5	.6	2.0	3.7	1.4
2023	6.8	.5	.6	1.9	3.9	1.7
2024	6.7	.5	.6	1.9	4.0	1.9
2025	6.6	.5	.6	1.9	4.1	2.0
2026	6.5	.5	.6	1.9	4.3	2.1
2027	6.5	.5	.5	1.8	4.2	2.3
2030	6.5	.4	.4	1.6	4.2	2.2
2035	6.5	.3	.3	1.6	4.2	2.2
2040	6.5	.3	.3	1.5	4.2	2.2
2045	6.5	.3	.3	1.5	4.2	2.2
2050	6.5	.2	.2	1.5	4.2	2.2
2055	6.5	.2	.2	1.4	4.2	2.2
2060	6.5	.2	.2	1.4	4.2	2.2
2065	6.5	.1	.1	1.3	4.2	2.2
2070	6.5	.1	.1	1.3	4.2	2.2
2075	6.5	.1	.1	1.3	4.2	2.2
2080	6.5	.1	.1	1.3	4.2	2.2
2085	6.5	.1	.1	1.4	4.2	2.2
2090	6.5	.1	.1	1.3	4.2	2.2
2095	6.5	.1	.1	1.3	4.2	2.2

[a] The Office of the Chief Actuary adjusts the civilian unemployment rates for 2028 and later to the age-sex distribution of the civilian labor force in 2011. For years through 2027, the values are the total rates without adjustment for the changing age-sex distribution.

[b] For rows with a single year listed, the value is the annual percentage change from the prior year. For rows with a range of years listed, the value is the compounded average annual percentage change.

[c] The U.S. civilian labor force.

[d] Total U.S. military and civilian employment.

[e] The value of the total output of goods and services in 2009 dollars.

[f] The average of the nominal interest rates, compounded semiannually, for special public-debt obligations issuable to the trust funds in each of the 12 months of the year.

[g] The realized or expected annual real yield for each year on securities issuable in the prior year.

[h] Greater than -0.05 and less than 0.05 percent.

[i] Economic cycles are shown from peak to peak, except for the last cycle, which is not yet complete.

[j] Historical data are not available for the full year. Estimated values vary slightly by alternative and are shown for the intermediate assumptions.

C. PROGRAM-SPECIFIC ASSUMPTIONS AND METHODS

The Office of the Chief Actuary at the Social Security Administration uses a set of models to project future income and cost under the OASDI program. These models rely not only on the demographic and economic assumptions described in the previous sections, but also on a number of program-specific assumptions and methods. Values of many program parameters change from year to year as prescribed by formulas set out in the Social Security Act. These program parameters affect the level of payroll taxes collected and the level of benefits paid. The office uses more complex models to project the numbers of future workers covered under OASDI and the levels of their covered earnings, as well as the numbers of future beneficiaries and the expected levels of their benefits. The following subsections provide descriptions of these program-specific assumptions and methods.

1. Automatically Adjusted Program Parameters

The Social Security Act requires that certain parameters affecting the determination of OASDI benefits and taxes be adjusted annually to reflect changes in particular economic measures. Formulas prescribed in the law, applied to reported statistics, change these program parameters annually. The law bases these automatic adjustments on measured changes in the national average wage index (AWI) and the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI).[1] This section shows values for program parameters adjusted using these indices from the time that these adjustments became effective through 2027. Projected values for future years depend on the economic assumptions described in the preceding section of this report.

Tables V.C1 and V.C2 present the historical and projected values of the CPI-based benefit increases, the AWI series, and the values of many of the wage-indexed program parameters. Each table shows projections under the three alternative sets of economic assumptions. Table V.C1 includes:

- *The annual cost-of-living benefit increase percentages.* The automatic cost-of-living adjustment provisions in the Social Security Act specify increases in OASDI benefits based on increases in the CPI. Volatility in oil prices has resulted in substantial volatility in recent cost-of-living adjustments. A large cost-of-living adjustment for December 2008 was followed by no cost-of-living adjustments for December 2009 and December 2010. More recent volatility in oil prices again affected the

[1] The *Federal Register* publishes details of these indexation procedures annually. Also see www.ssa.gov/OACT/COLA/.

CPI, resulting in no cost-of-living adjustment for December 2015. Cost-of-living adjustments resumed in December 2016. All three sets of assumptions include annual cost-of-living adjustments for all future years.

- *The annual levels of and percentage increases in the AWI.* Under section 215(b)(3) of the Social Security Act, Social Security benefit computations index taxable earnings (for most workers first becoming eligible for benefits in 1979 or later) using the AWI for each year after 1950. This procedure converts a worker's past earnings to approximately average-wage-indexed equivalent values near the time of his or her benefit eligibility. Other program parameters presented in this section that are subject to the automatic-adjustment provisions also rely on the AWI.
- *The wage-indexed contribution and benefit base.* For any year, the contribution and benefit base is the maximum amount of earnings subject to the OASDI payroll tax and creditable toward benefit computation. The Social Security Act defers any increase in the contribution and benefit base if there is no cost-of-living adjustment effective for December of the preceding year. There was no increase in the contribution and benefit base for 2010, 2011, or 2016 because there was no cost-of-living adjustment for the immediate prior December in each case. Under all three sets of assumptions, the contribution and benefit base is projected to increase for all future years.
- *The wage-indexed retirement earnings test exempt amounts.* The exempt amounts are the annual amount of earnings below which beneficiaries do not have benefits withheld. A lower exempt amount applies for years prior to the year of attaining normal retirement age. A higher exempt amount applies beginning with the year in which a beneficiary attains normal retirement age. Starting in 2000, the retirement earnings test no longer applies beginning with the month of attaining normal retirement age. The Social Security Act defers any increase in these exempt amounts if there is no cost-of-living adjustment effective for December of the preceding year. There was no increase in these exempt amounts for 2010, 2011, or 2016 because there was no cost-of-living adjustment for the immediate prior December. Under all three sets of assumptions, the exempt amounts increase for all future years.

Table V.C1.—Cost-of-Living Benefit Increases, Average Wage Index, Contribution and Benefit Bases, and Retirement Earnings Test Exempt Amounts, 1975-2027

Calendar year	Cost-of-living benefit increase[a] (percent)	Average wage index (AWI)[b] Amount	Average wage index (AWI)[b] Increase (percent)	Contribution and benefit base[c]	Retirement earnings test exempt amount Under NRA[d]	Retirement earnings test exempt amount At NRA[e]
Historical data:						
1975	8.0	$8,630.92	7.5	$14,100	$2,520	$2,520
1976	6.4	9,226.48	6.9	15,300	2,760	2,760
1977	5.9	9,779.44	6.0	16,500	3,000	3,000
1978	6.5	10,556.03	7.9	17,700	3,240	4,000
1979	9.9	11,479.46	8.7	22,900	3,480	4,500
1980	14.3	12,513.46	9.0	25,900	3,720	5,000
1981	11.2	13,773.10	10.1	29,700	4,080	5,500
1982	7.4	14,531.34	5.5	32,400	4,440	6,000
1983	3.5	15,239.24	4.9	35,700	4,920	6,600
1984	3.5	16,135.07	5.9	37,800	5,160	6,960
1985	3.1	16,822.51	4.3	39,600	5,400	7,320
1986	1.3	17,321.82	3.0	42,000	5,760	7,800
1987	4.2	18,426.51	6.4	43,800	6,000	8,160
1988	4.0	19,334.04	4.9	45,000	6,120	8,400
1989	4.7	20,099.55	4.0	48,000	6,480	8,880
1990	5.4	21,027.98	4.6	51,300	6,840	9,360
1991	3.7	21,811.60	3.7	53,400	7,080	9,720
1992	3.0	22,935.42	5.2	55,500	7,440	10,200
1993	2.6	23,132.67	.9	57,600	7,680	10,560
1994	2.8	23,753.53	2.7	60,600	8,040	11,160
1995	2.6	24,705.66	4.0	61,200	8,160	11,280
1996	2.9	25,913.90	4.9	62,700	8,280	12,500
1997	2.1	27,426.00	5.8	65,400	8,640	13,500
1998	1.3	28,861.44	5.2	68,400	9,120	14,500
1999	[f]2.5	30,469.84	5.6	72,600	9,600	15,500
2000	3.5	32,154.82	5.5	76,200	10,080	17,000
2001	2.6	32,921.92	2.4	80,400	10,680	25,000
2002	1.4	33,252.09	1.0	84,900	11,280	30,000
2003	2.1	34,064.95	2.4	87,000	11,520	30,720
2004	2.7	35,648.55	4.6	87,900	11,640	31,080
2005	4.1	36,952.94	3.7	90,000	12,000	31,800
2006	3.3	38,651.41	4.6	94,200	12,480	33,240
2007	2.3	40,405.48	4.5	97,500	12,960	34,440
2008	5.8	41,334.97	2.3	102,000	13,560	36,120
2009	.0	40,711.61	-1.5	106,800	14,160	37,680
2010	.0	41,673.83	2.4	106,800	14,160	37,680
2011	3.6	42,979.61	3.1	106,800	14,160	37,680
2012	1.7	44,321.67	3.1	110,100	14,640	38,880
2013	1.5	44,888.16	1.3	113,700	15,120	40,080
2014	1.7	46,481.52	3.5	117,000	15,480	41,400
2015	.0	48,098.63	3.5	118,500	15,720	41,880
2016	.3	48,642.15	1.1	118,500	15,720	41,880
Intermediate:						
2017	[g]2.0	50,020.69	2.8	[g]127,200	[g]16,920	[g]44,880
2018	2.4	51,894.47	3.7	[g]128,400	[g]17,040	[g]45,360
2019	2.7	54,076.92	4.2	132,300	17,520	46,680
2020	2.6	56,534.16	4.5	137,100	18,240	48,360
2021	2.6	59,089.48	4.5	142,800	18,960	50,400
2022	2.6	61,705.86	4.4	149,400	19,800	52,800
2023	2.6	64,405.95	4.4	156,000	20,760	55,080
2024	2.6	67,191.23	4.3	162,900	21,600	57,600
2025	2.6	70,057.16	4.3	170,100	22,560	60,120
2026	2.6	73,003.92	4.2	177,600	23,520	62,640
2027	2.6	75,908.24	4.0	185,100	24,600	65,400

Table V.C1.—Cost-of-Living Benefit Increases, Average Wage Index, Contribution and Benefit Bases, and Retirement Earnings Test Exempt Amounts, 1975-2027 (Cont.)

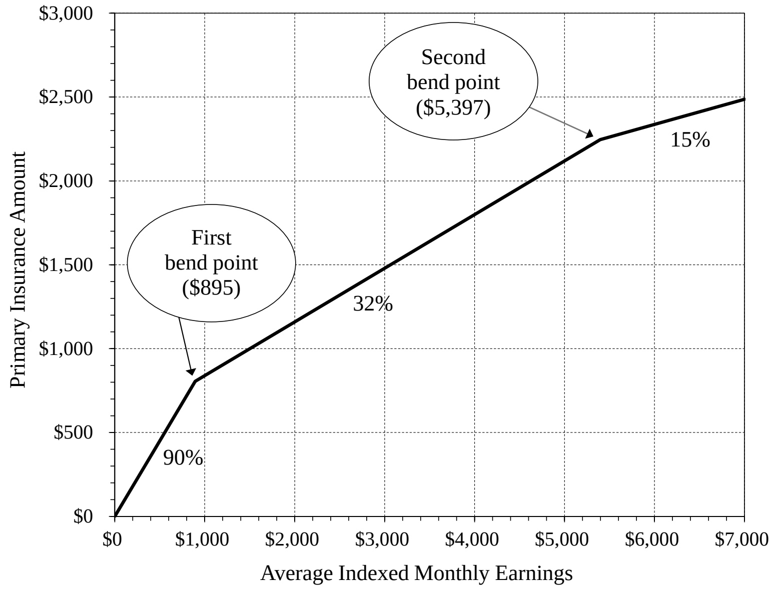
Calendar year	Cost-of-living benefit increase[a] (percent)	Average wage index (AWI) [b] Amount	Average wage index (AWI) [b] Increase (percent)	Contribution and benefit base [c]	Retirement earnings test exempt amount: Under NRA[d]	Retirement earnings test exempt amount: At NRA[e]
Low-cost:						
2017	[g]2.0	$50,031.80	2.9	[g]$127,200	[g]$16,920	[g]$44,880
2018	3.0	52,409.41	4.8	[g]128,400	[g]17,040	[g]45,360
2019	3.5	55,687.90	6.3	132,300	17,520	46,680
2020	3.2	59,194.02	6.3	138,600	18,360	48,840
2021	3.2	62,741.89	6.0	147,000	19,560	51,960
2022	3.2	66,191.66	5.5	156,300	20,760	55,200
2023	3.2	69,734.56	5.4	165,900	21,960	58,560
2024	3.2	73,442.74	5.3	174,900	23,160	61,800
2025	3.2	77,392.43	5.4	184,200	24,480	65,040
2026	3.2	81,576.71	5.4	194,100	25,800	68,520
2027	3.2	85,836.60	5.2	204,600	27,120	72,240
High-cost:						
2017	[g]2.0	50,015.84	2.8	[g]127,200	[g]16,920	[g]44,880
2018	1.6	51,505.66	3.0	[g]128,400	[g]17,040	[g]45,360
2019	1.7	51,740.36	.5	132,300	17,520	46,680
2020	2.0	53,243.84	2.9	136,200	18,000	48,000
2021	2.0	54,994.26	3.3	136,800	18,120	48,240
2022	2.0	56,917.34	3.5	140,700	18,720	49,680
2023	2.0	58,885.61	3.5	145,200	19,320	51,360
2024	2.0	60,812.41	3.3	150,300	19,920	53,160
2025	2.0	62,796.24	3.3	155,700	20,640	54,960
2026	2.0	64,830.08	3.2	160,800	21,360	56,760
2027	2.0	66,699.05	2.9	165,900	21,960	58,560

[a] Effective with benefits payable for June in each year 1975-82, and for December in each year after 1982.
[b] See table VI.G6 for projected dollar amounts of the AWI for years beyond the last year of this table.
[c] Public Law 95-216 specified amounts for 1978-81. Public Law 101-239 changed the indexing procedure and caused slightly higher bases after 1989.
[d] Normal retirement age. See table V.C3 for specific values.
[e] In 1955-82, the retirement earnings test did not apply at ages 72 and over. In 1983-99, the test did not apply at ages 70 and over. Beginning in 2000, the test does not apply beginning with the month of normal retirement age attainment. In the year of normal retirement age attainment, the higher exempt amount applies to earnings prior to the month of normal retirement age attainment. Public Law 95-216 specified amounts for 1978-82. Public Law 104-121 specified amounts for 1996-2002.
[f] Originally determined as 2.4 percent. Pursuant to Public Law 106-554, effectively 2.5 percent.
[g] Actual amount, as determined under automatic-adjustment provisions.

Table V.C2 shows values for other wage-indexed parameters. The table provides historical values from 1978, when indexing of the amount of earnings required for a quarter of coverage first began, through 2018, and also shows projected values through 2027. These other wage-indexed program parameters are:

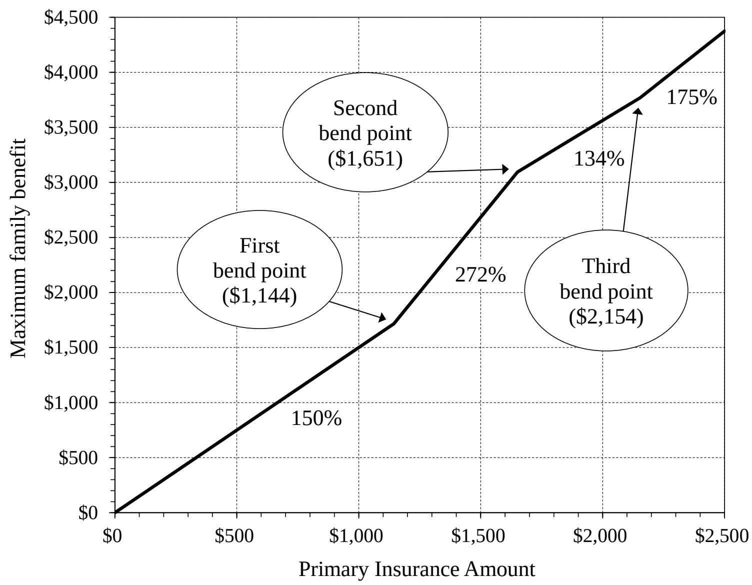
- *The bend points in the formula for computing the primary insurance amount (PIA) for workers who reach age 62, become disabled, or die in a given year.* As figure V.C1 illustrates, these two bend points define three ranges in a worker's average indexed monthly earnings (AIME). The formula for the worker's PIA multiplies a 90, 32, or 15 percent factor by the portion of the worker's AIME that falls within the three respective ranges, and then adds the resulting products together.

Figure V.C1.—Primary-Insurance-Amount Formula for Those Newly Eligible in 2018



- *The bend points in the formula for computing the maximum total amount of monthly benefits payable based on the earnings record of a retired or deceased worker (maximum family benefit).* As figure V.C2 illustrates, these three bend points define four ranges in a worker's PIA. The formula for the maximum family benefit multiplies a 150, 272, 134, or 175 percent factor by the portion of the worker's PIA that falls within the four respective ranges, and then adds the resulting products together.

Figure V.C2.—OASI Maximum-Family-Benefit Formula for Those Newly Eligible in 2018



- *The amount of earnings required in a year to earn a quarter of coverage (QC).* The number and timing of QCs earned determines an individual's insured status—the basic requirement for benefit eligibility under OASDI.
- *The old-law contribution and benefit base—the contribution and benefit base that would have been in effect without enactment of the 1977 amendments.* This old-law base is used in determining special-minimum benefits for certain workers who have many years of low earnings in covered employment. Since 1986, the calculation of OASDI benefits for certain workers who are eligible to receive pensions based on non-covered employment uses the old-law base. In addition, the Railroad Retirement program and the Employee Retirement Income Security Act of 1974 use the old-law base for certain purposes.

Table V.C2.—Values for Selected Wage-Indexed Program Parameters, Calendar Years 1978-2027

Calendar year	AIME bend points in PIA formula[a] First	AIME bend points in PIA formula[a] Second	PIA bend points in OASI maximum-family-benefit formula[b] First	PIA bend points in OASI maximum-family-benefit formula[b] Second	PIA bend points in OASI maximum-family-benefit formula[b] Third	Earnings required for a quarter of coverage	Old-law contribution and benefit base[c]
Historical data:							
1978	[d]	[d]	[d]	[d]	[d]	[e] $250	[e] $17,700
1979	[e] $180	[e] $1,085	[e] $230	[e] $332	[e] $433	260	18,900
1980	194	1,171	248	358	467	290	20,400
1981	211	1,274	270	390	508	310	22,200
1982	230	1,388	294	425	554	340	24,300
1983	254	1,528	324	468	610	370	26,700
1984	267	1,612	342	493	643	390	28,200
1985	280	1,691	358	517	675	410	29,700
1986	297	1,790	379	548	714	440	31,500
1987	310	1,866	396	571	745	460	32,700
1988	319	1,922	407	588	767	470	33,600
1989	339	2,044	433	626	816	500	35,700
1990	356	2,145	455	656	856	520	38,100
1991	370	2,230	473	682	890	540	39,600
1992	387	2,333	495	714	931	570	41,400
1993	401	2,420	513	740	966	590	42,900
1994	422	2,545	539	779	1,016	620	45,000
1995	426	2,567	544	785	1,024	630	45,300
1996	437	2,635	559	806	1,052	640	46,500
1997	455	2,741	581	839	1,094	670	48,600
1998	477	2,875	609	880	1,147	700	50,700
1999	505	3,043	645	931	1,214	740	53,700
2000	531	3,202	679	980	1,278	780	56,700
2001	561	3,381	717	1,034	1,349	830	59,700
2002	592	3,567	756	1,092	1,424	870	63,000
2003	606	3,653	774	1,118	1,458	890	64,500
2004	612	3,689	782	1,129	1,472	900	65,100
2005	627	3,779	801	1,156	1,508	920	66,900
2006	656	3,955	838	1,210	1,578	970	69,900
2007	680	4,100	869	1,255	1,636	1,000	72,600
2008	711	4,288	909	1,312	1,711	1,050	75,900
2009	744	4,483	950	1,372	1,789	1,090	79,200
2010	761	4,586	972	1,403	1,830	1,120	79,200
2011	749	4,517	957	1,382	1,803	1,120	79,200
2012	767	4,624	980	1,415	1,845	1,130	81,900
2013	791	4,768	1,011	1,459	1,903	1,160	84,300
2014	816	4,917	1,042	1,505	1,962	1,200	87,000
2015	826	4,980	1,056	1,524	1,987	1,220	88,200
2016	856	5,157	1,093	1,578	2,058	1,260	88,200
2017	885	5,336	1,131	1,633	2,130	1,300	94,500
2018	895	5,397	1,144	1,651	2,154	1,320	95,400
Intermediate:							
2019	921	5,550	1,176	1,698	2,215	1,360	98,100
2020	955	5,758	1,220	1,762	2,298	1,410	101,700
2021	995	6,000	1,272	1,836	2,394	1,470	106,200
2022	1,041	6,272	1,330	1,919	2,503	1,530	111,000
2023	1,088	6,556	1,390	2,006	2,616	1,600	115,800
2024	1,136	6,846	1,451	2,095	2,732	1,670	121,200
2025	1,185	7,146	1,515	2,187	2,852	1,750	126,300
2026	1,237	7,455	1,580	2,281	2,975	1,820	131,700
2027	1,289	7,773	1,648	2,378	3,102	1,900	137,400

Table V.C2.—Values for Selected Wage-Indexed Program Parameters, Calendar Years 1978-2027 (Cont.)

Calendar year	AIME bend points in PIA formula[a] First	AIME bend points in PIA formula[a] Second	PIA bend points in OASI maximum-family-benefit formula[b] First	PIA bend points in OASI maximum-family-benefit formula[b] Second	PIA bend points in OASI maximum-family-benefit formula[b] Third	Earnings required for a quarter of coverage	Old-law contribution and benefit base[c]
Low-cost:							
2019	$921	$5,551	$1,177	$1,699	$2,215	$1,360	$98,100
2020	965	5,815	1,233	1,779	2,321	1,420	102,900
2021	1,025	6,178	1,310	1,891	2,466	1,510	109,200
2022	1,090	6,567	1,392	2,010	2,621	1,600	116,100
2023	1,155	6,961	1,476	2,130	2,778	1,700	123,000
2024	1,218	7,344	1,557	2,247	2,931	1,790	129,900
2025	1,284	7,737	1,640	2,367	3,088	1,890	136,800
2026	1,352	8,148	1,727	2,493	3,252	1,990	144,000
2027	1,424	8,586	1,820	2,627	3,427	2,100	151,800
High-cost:							
2019	921	5,549	1,176	1,698	2,215	1,360	98,100
2020	948	5,714	1,211	1,749	2,280	1,400	101,100
2021	952	5,740	1,217	1,757	2,291	1,400	101,400
2022	980	5,907	1,252	1,808	2,357	1,440	104,400
2023	1,012	6,101	1,293	1,867	2,435	1,490	108,000
2024	1,048	6,315	1,339	1,932	2,520	1,540	111,600
2025	1,084	6,533	1,385	1,999	2,607	1,600	115,500
2026	1,119	6,747	1,430	2,065	2,693	1,650	119,400
2027	1,156	6,967	1,477	2,132	2,780	1,700	123,300

[a] The formula to compute a PIA is: (1) 90% of AIME below the first bend point, plus (2) 32% of AIME in excess of the first bend point but not in excess of the second, plus (3) 15% of AIME in excess of the second bend point. The bend points are determined based on the first year a beneficiary becomes eligible for benefits.
[b] The formula to compute an OASI family maximum is: (1) 150% of PIA below the first bend point, plus (2) 272% of PIA in excess of the first bend point but not in excess of the second, plus (3) 134% of PIA in excess of the second bend point but not in excess of the third, plus (4) 175% of PIA in excess of the third bend point. This formula also determines family maximums for disabled workers first eligible after 1978 and entitled before July 1980.
[c] Contribution and benefit base that would have been in effect without enactment of the Social Security Amendments of 1977. Public Law 101-239 changed the indexing procedure and caused slightly higher bases after 1989.
[d] No provision in law for this amount in this year.
[e] Amount specified by Social Security Amendments of 1977.

In addition to the economic factors that affect the determination of OASDI benefits, there are certain legislated changes that affect current and future benefit amounts. Two such changes are the scheduled increases in the normal retirement age and in the delayed retirement credits. Table V.C3 shows the scheduled changes in these parameters and the resulting effects on benefit levels expressed as a percentage of PIA.

Table V.C3.—Legislated Changes in Normal Retirement Age and Delayed Retirement Credits for Persons Reaching Age 62 in Each Year 1986 and Later

Year of birth	Year of attainment of age 62	Normal retirement age (NRA)	Credit for each year of delayed retirement after NRA (percent)	Benefit, as a percentage of PIA, beginning at age —				
				62	65	66	67	70
1924	1986	65	3	80	100	103	106	115
1925	1987	65	$3\frac{1}{2}$	80	100	$103\frac{1}{2}$	107	$117\frac{1}{2}$
1926	1988	65	$3\frac{1}{2}$	80	100	$103\frac{1}{2}$	107	$117\frac{1}{2}$
1927	1989	65	4	80	100	104	108	120
1928	1990	65	4	80	100	104	108	120
1929	1991	65	$4\frac{1}{2}$	80	100	$104\frac{1}{2}$	109	$122\frac{1}{2}$
1930	1992	65	$4\frac{1}{2}$	80	100	$104\frac{1}{2}$	109	$122\frac{1}{2}$
1931	1993	65	5	80	100	105	110	125
1932	1994	65	5	80	100	105	110	125
1933	1995	65	$5\frac{1}{2}$	80	100	$105\frac{1}{2}$	111	$127\frac{1}{2}$
1934	1996	65	$5\frac{1}{2}$	80	100	$105\frac{1}{2}$	111	$127\frac{1}{2}$
1935	1997	65	6	80	100	106	112	130
1936	1998	65	6	80	100	106	112	130
1937	1999	65	$6\frac{1}{2}$	80	100	$106\frac{1}{2}$	113	$132\frac{1}{2}$
1938	2000	65, 2 mo	$6\frac{1}{2}$	$79\frac{1}{6}$	$98\frac{8}{9}$	$105\frac{5}{12}$	$111\frac{11}{12}$	$131\frac{5}{12}$
1939	2001	65, 4 mo	7	$78\frac{1}{3}$	$97\frac{7}{9}$	$104\frac{2}{3}$	$111\frac{2}{3}$	$132\frac{2}{3}$
1940	2002	65, 6 mo	7	$77\frac{1}{2}$	$96\frac{2}{3}$	$103\frac{1}{2}$	$110\frac{1}{2}$	$131\frac{1}{2}$
1941	2003	65, 8 mo	$7\frac{1}{2}$	$76\frac{2}{3}$	$95\frac{5}{9}$	$102\frac{1}{2}$	110	$132\frac{1}{2}$
1942	2004	65, 10 mo	$7\frac{1}{2}$	$75\frac{5}{6}$	$94\frac{4}{9}$	$101\frac{1}{4}$	$108\frac{3}{4}$	$131\frac{1}{4}$
1943-54	2005-16	66	8	75	$93\frac{1}{3}$	100	108	132
1955	2017	66, 2 mo	8	$74\frac{1}{6}$	$92\frac{2}{9}$	$98\frac{8}{9}$	$106\frac{2}{3}$	$130\frac{2}{3}$
1956	2018	66, 4 mo	8	$73\frac{1}{3}$	$91\frac{1}{9}$	$97\frac{7}{9}$	$105\frac{1}{3}$	$129\frac{1}{3}$
1957	2019	66, 6 mo	8	$72\frac{1}{2}$	90	$96\frac{2}{3}$	104	128
1958	2020	66, 8 mo	8	$71\frac{2}{3}$	$88\frac{8}{9}$	$95\frac{5}{9}$	$102\frac{2}{3}$	$126\frac{2}{3}$
1959	2021	66, 10 mo	8	$70\frac{5}{6}$	$87\frac{7}{9}$	$94\frac{4}{9}$	$101\frac{1}{3}$	$125\frac{1}{3}$
1960 & later	2022 & later	67	8	70	$86\frac{2}{3}$	$93\frac{1}{3}$	100	124

2. Covered Employment

Projections of the total U.S. labor force and unemployment rate (see table V.B2) are based on Bureau of Labor Statistics definitions from the Current Population Survey (CPS). These projections represent the average weekly number of employed and unemployed persons, age 16 and over, in the U.S. in a calendar year. Covered employment for a calendar year is defined as the total number of persons who have any OASDI covered earnings (that is, earnings subject to the OASDI payroll tax) at any time during that year. For those age 16 and over, projected covered employment is the sum of age-sex groups, each reflecting the growth projected for the group's total U.S employment and average weeks worked per year.[1] For the short-range period, the age-sex-adjusted average weeks worked declines slightly as the age-sex-adjusted unemployment rate rises to its ultimate assumed value of 5.5 percent. After 2027, the average weeks worked for each age-sex group

[1] For those under age 16, projected covered employment is the sum of age-sex components, each of which is projected as a ratio to the Social Security area population.

is assumed to remain constant. The projection method also accounts for changes in non-OASDI-covered employment and the increase in coverage of Federal civilian employment as a result of the 1983 Social Security Amendments. It also reflects changes in the number and employment status of other-than-LPR immigrants residing within the Social Security coverage area, such as undocumented immigrants and foreign workers and students with temporary visas.

The covered-worker rate is the ratio of OASDI covered workers to the Social Security area population. For men age 16 and over, the projected age-adjusted covered-worker rates[1] for 2092 are 69.3, 68.9, and 68.6 percent for the low-cost, intermediate, and high-cost assumptions, respectively. For women age 16 and over, the projected age-adjusted covered-worker rates for 2092 are 66.4, 65.1, and 63.8 percent for the low-cost, intermediate, and high-cost assumptions, respectively. For men, the intermediate projected rate for 2092 is slightly lower than the 2016 age-adjusted rate of 69.7 percent primarily due to the projected increase in the portion of the Social Security area population that consists of other-than-LPR immigrants. For women, the intermediate projected rate for 2092 is higher than the 2016 age-adjusted rate of 63.6 percent because the projected increase in the age-adjusted labor force participation rate more than offsets the projected increase in the portion of the population that will be other-than-LPR immigrants.

3. Insured Population

Eligibility for worker benefits under the OASDI program requires some threshold level of work in covered employment. A worker satisfies this requirement by his or her accumulation of quarters of coverage (QCs). Prior to 1978, a worker earned one QC for each calendar quarter in which he or she earned at least $50. In 1978, when annual earnings reporting replaced quarterly reporting, the amount required to earn a QC (up to a maximum of four per year) was set at $250. As specified in the law, the Social Security Administration has adjusted this amount each year since then according to changes in the AWI. Its value in 2018 is $1,320.

There are three types of insured status that a worker can acquire under the OASDI program. The number and recency of QCs earned determine each status. A worker is fully insured when his or her total number of QCs is greater than or equal to the number of years elapsed after the year of attainment of age 21 (but not less than six). Once a worker has accumulated

[1] Age-adjusted covered-worker rates are adjusted to the 2011 age distribution of the Social Security area population.

40 QCs, he or she remains permanently fully insured. A worker is disability insured if he or she is: (1) a fully insured worker who has accumulated 20 QCs during the 40-quarter period ending with the current quarter, (2) a fully insured worker aged 24-30 who has accumulated QCs during one-half of the quarters elapsed after the quarter of attainment of age 21 and up to and including the current quarter, or (3) a fully insured worker under age 24 who has accumulated six QCs during the 12-quarter period ending with the current quarter. A worker is currently insured when he or she has accumulated six QCs during the 13-quarter period ending with the current quarter. Periods of disability reduce the number of quarters required for insured status, but not below the minimum of six QCs.

There are many types of benefits payable to workers and their family members under the OASDI program. A worker must be fully insured to be eligible for a primary retirement benefit and for his or her spouse or children to be eligible for auxiliary retirement benefits. A deceased worker must have been either currently insured or fully insured at the time of death for his or her children (and their mother or father) to be eligible for benefits. If there are no eligible surviving children, the deceased worker must have been fully insured at the time of death for his or her surviving spouse to be eligible. A worker must be disability insured to be eligible for a primary disability benefit and for his or her spouse or children to be eligible for auxiliary disability benefits.

The Office of the Chief Actuary estimates the fully insured population, as a percentage of the Social Security area population, by single year of age and sex starting in 1969. The short-range model extrapolates the historical trend in these rates from data in the Continuous Work History Sample (CWHS). The model uses information on quarters of coverage earned due to employment covered by Social Security derived from tabulations of the CWHS. The model also uses historical administrative data on beneficiaries in force and estimated historical mortality rates. The model combines this information to estimate the proportion of individuals who were alive and fully insured as of the end of each historical year. Using projected mortality rates and covered workers, the model extrapolates these rates into the future and applies them to the historical and projected population to arrive at the fully insured population by age and sex through the end of the short-range period.

The long-range fully insured model uses 30,000 simulated work histories for each sex and birth cohort, representing everyone except the other-than-LPR immigrant population. For the other-than-LPR immigrant population, the model generates substantially lower percentages attaining fully insured status. The model constructs simulated work histories using past coverage rates, earnings distributions, and amounts required for crediting QCs, and develops them in a manner that replicates historical individual variations in work patterns. The probability of covered employment in any year is assumed to be higher for those who have worked more consistently in the recent past. Model parameters are selected so that simulated fully insured percentages are consistent with the fully insured percentages estimated by the short-range model for the recent historical period.

The Office of the Chief Actuary estimates the disability insured population, as a percentage of the fully insured population, by age and sex starting in 1970. The office bases historical values on a tabulation of the disability insured population from the CWHS and estimates of the fully insured population. The short-range model projects these percentages by using the relationship between the historical percentages and covered-worker rates. The long-range model projects these percentages by using the same simulated work histories used to project the fully insured percentages. The long-range model makes additional adjustments to the model simulations in order to bring the disability insured percentages in the historical and short-range periods into close agreement with those estimated from the CWHS and the short-range model.

The office does not project the currently insured population because the number of beneficiaries who are entitled to benefits based solely on currently insured status has been very small and is likely to remain small in the future.

Using these insured models, the percentage of the Social Security area population aged 62 and over that is fully insured is projected to increase from its estimated level of 86.4 for December 31, 2015, to 86.8, 87.6, and 88.6 for December 31, 2095, under the low-cost, intermediate, and high-cost alternatives, respectively. Over the projection period, the percentages for both males and females change significantly. The percentage for males declines, reflecting, in part, increases in the percent of the population that is classified as other-than-LPR immigrants and is thus less likely to have earnings reported and credited to them. The percentage for females increases, reflecting the past substantial growth in the employment of younger cohorts of women. Under the intermediate assumptions, for example, the percentage for males decreases from 93.4 to 86.8, and the percentage for females increases from 80.6 to 88.3.

4. Old-Age and Survivors Insurance Beneficiaries

The Office of the Chief Actuary projects the number of OASI beneficiaries for each type of benefit separately by the sex of the worker on whose earnings the benefits are based and by the age of the beneficiary. For the long-range period, the office also projects the number of beneficiaries by marital status for several types of benefits. The office uses two separate models in making these projections. The short-range model makes projections during the first 10 years of the projection period and the long-range model makes projections thereafter.

The short-range model develops the number of retired-worker beneficiaries by applying award rates to the aged fully insured population, excluding those already receiving retired-worker, disabled-worker, aged-widow(er), or aged-spouse benefits, and by applying termination rates to the number of retired-worker beneficiaries.

The long-range model projects the number of retired-worker beneficiaries who were not previously converted from disabled-worker beneficiary status as a percentage of the exposed population.[1] For age 62, the model projects this percentage by using a linear regression based on the historical relationship between this percentage, the labor force participation rate at age 62, and the number of months from age 62 to normal retirement age. The percentage for ages 70 and over is nearly 100 because delayed retirement credits cannot be earned after age 70. The long-range model projects the percentage for each age 63 through 69 based on historical experience with an adjustment for changes in the portion of the primary insurance amount that is payable at each age of entitlement. The model adjusts these percentages for ages 62 through 69 to reflect changes in the normal retirement age.

The long-range model calculates the number of retired-worker beneficiaries previously converted from disabled-worker beneficiary status using an extension of disabled-worker death rates by age, sex, and duration.

The Office of the Chief Actuary estimates the number of aged-spouse beneficiaries, excluding those who are also receiving a retired-worker benefit, from the population projected by age and sex. Benefits of aged-spouse beneficiaries depend on the earnings records of their husbands or wives, who are referred to as "earners." The short-range model projects insured aged-spouse beneficiaries in conjunction with the retired-worker beneficiaries. This model projects uninsured aged-spouse beneficiaries by applying award rates to the aged uninsured male or female population and by applying termination rates to the population already receiving such benefits.

[1] The exposed population is the fully insured population age 62 and over, excluding persons entitled to or converted from disabled-worker benefits and fully insured persons entitled only to widow(er) benefits.

The long-range model estimates aged-spouse beneficiaries separately for those married and divorced. The model projects the number of married aged-spouse beneficiaries, by age and sex, by applying a series of factors to the number of spouses, aged 62 and over, in the population. These factors are the probabilities that the spouse and the earner meet all of the conditions of eligibility—that is, the probabilities that: (1) the earner is 62 or over, (2) the earner is insured, (3) the earner is either receiving benefits or has suspended benefits, (4) the spouse is not receiving a benefit for the care of an entitled child, (5) the spouse is either not insured or is insured but not receiving benefits, and (6) the spouse is not eligible to receive a significant government pension based on earnings in noncovered employment. To calculate the estimated number of aged-spouse beneficiaries, the model applies a projected prevalence rate to the resulting number of spouses. Due to the Bipartisan Budget Act of 2015, aged spouses are no longer eligible to receive an aged-spouse benefit if the earner suspends their benefit after April 29, 2016. Additionally, for those turning age 62 in 2016 and later, deemed filing now applies to all retired workers and spouses even after initial entitlement, regardless of age. Thus, spouses who are insured are no longer eligible to delay their retired-worker benefit while receiving an aged-spouse benefit.

The long-range model estimates the number of divorced aged-spouse beneficiaries, by age and sex, by applying the same factors to the number of divorced persons aged 62 and over in the population, with three differences. First, the model applies a factor to reflect the probability that the earner (former spouse) is still alive. If the former spouse is not alive, the person may be entitled to a divorced widow(er) benefit. Second, the model applies a factor to reflect the probability that the marriage to the former spouse lasted at least 10 years. Third, the model does not apply factor (3) in the previous paragraph because, effective January 1985, a divorced person is generally no longer required to wait for the former spouse to receive benefits.

The Office of the Chief Actuary bases the projected numbers of children under age 18, and students aged 18 and 19, who are eligible for benefits as children of retired-worker beneficiaries, on the projected number of children in the population. The short-range model develops the number of entitled children by applying award rates to the number of children in the population who have two living parents and by applying termination rates to the number of children already receiving benefits.

The long-range model projects separately the number of entitled children by sex of the earner parent. For each age under 18, the model multiplies the projected number of children with a parent aged 62 and over by the ratio of the number of retired workers aged 62 to 71 to the number of members of the population aged 62 to 71. For student beneficiaries, the model multiplies the number of children aged 18 and 19 in the population by the probabilities that: (1) the parent is alive, aged 62 or over, insured, and receiving a retired-worker benefit; and (2) the child is attending high school.

The Office of the Chief Actuary projects the number of disabled children, aged 18 and over, of retired-worker beneficiaries from the adult population. The short-range model applies award rates to the population and applies termination rates to the number of disabled children already receiving benefits. The long-range model projects the number of disabled children in a manner similar to that used for student children except for a factor that reflects the probability of being disabled before age 22.

The short-range model develops the number of spouses of retired workers, who are entitled to spouse benefits because they are caring for a child who is under age 16 or disabled, by applying award rates to the number of awards to children of retired workers and by applying termination rates to the number of young spouses with a child in their care who are already receiving benefits. The long-range model projects the number of young-spouse beneficiaries with a child in their care as a proportion of the number of child beneficiaries of retired workers, including projected changes in average family size.

The Office of the Chief Actuary projects the number of aged-widow(er) beneficiaries, excluding those who are also receiving a retired-worker benefit, from the population by age and sex. The short-range model projects fully insured aged-widow(er) beneficiaries in conjunction with the retired-worker beneficiaries. The model projects the number of uninsured aged-widow(er) beneficiaries by applying award rates to the aged uninsured male or female population and by applying termination rates to the population already receiving such benefits. The long-range model projects uninsured aged-widow(er) beneficiaries by marital status. The model multiplies the number of widow(er)s in the population aged 60 and over by the probabilities that: (1) the deceased earner is fully insured at death, (2) the widow(er) is not receiving a benefit for the care of an entitled child, (3) the widow(er) is not fully insured, and (4) the widow(er) benefits are not withheld because of receipt of a significant government pension based on earnings in noncovered employment. In addition, the model applies the same factors to the number of divorced persons aged 60 and over in the population and includes additional factors representing the probability that the person's former earner spouse has died and that the marriage lasted at least 10 years. The model projects the number of insured aged-widow(er) beneficiaries who are ages 60 through 70 in a manner similar to that for uninsured aged-widow(er) beneficiaries. In addition, the model assumes that some insured widow(er)s who had not applied for their retired-worker benefits will receive widow(er) benefits. The model projects insured aged-widow(er) beneficiaries over age 70 by applying termination rates to the population that started receiving such benefits prior to age 70.

The short-range model develops the number of disabled-widow(er) beneficiaries by applying award rates to the uninsured male or female population and by applying termination rates to the population already receiving a disabled-widow(er) benefit. The long-range model projects the number for each cohort by age from 50 to normal retirement age as percentages of the widowed and divorced populations, adjusted for the insured status of the deceased spouse, the prevalence of disability, and the probability that the disabled spouse is not receiving another type of benefit.

The Office of the Chief Actuary bases the projected number of children under age 18, and students aged 18 and 19, who are entitled to benefits as survivors of deceased workers, on the number of children in the population whose mothers or fathers are deceased. The short-range model develops the number of entitled children by applying award rates to the number of orphaned children and by applying termination rates to the number of children already receiving benefits.

The long-range model projects the number of child-survivor beneficiaries in a manner similar to that for student beneficiaries of retired workers, except that the model replaces the probability that the parent is aged 62 or over with the probability that the parent is deceased.

The Office of the Chief Actuary projects the number of disabled-child-survivor beneficiaries, aged 18 and over, from the adult population. The short-range model applies award rates to the population and applies termination rates to the number of disabled-child-survivor beneficiaries already receiving benefits. The long-range model projects the number of disabled-child-survivor beneficiaries in a manner similar to that for student-child-survivor beneficiaries, except for including an additional factor to reflect the probability of being disabled before age 22.

The short-range model develops the numbers of entitled mother-survivor and father-survivor beneficiaries by applying award rates to the number of awards to child-survivor beneficiaries, in cases where the children are either under age 16 or disabled, and by applying termination rates to the number of mother-survivors and father-survivors already receiving benefits. The long-range model estimates the numbers of mother-survivor and father-survivor beneficiaries, assuming they are not remarried, from the number of child-survivor beneficiaries.

The Office of the Chief Actuary projects the number of parent-survivor beneficiaries based on the historical pattern of the number of such beneficiaries.

Table V.C4 shows the projected number of beneficiaries under the OASI program by type of benefit. The retired-worker beneficiary counts include those persons who receive a residual auxiliary benefit in addition to their retired-worker benefit. The office makes estimates of the number and amount of residual payments separately for spouses and widow(er)s.

Table V.C4.—OASI Beneficiaries With Benefits in Current-Payment Status at the End of Calendar Years 1945-2095
[In thousands]

	Retired workers and auxiliaries			Survivors				
Calendar year	Worker[a]	Spouse	Child	Widow-widower	Mother-father	Child	Parent	Total
Historical data:								
1945	518	159	13	94	121	377	6	1,288
1950	1,771	508	46	314	169	653	15	3,477
1955	4,474	1,192	122	701	292	1,154	25	7,961
1960	8,061	2,269	268	1,544	401	1,577	36	14,157
1965	11,101	2,614	461	2,371	472	2,074	35	19,128
1970	13,349	2,668	546	3,227	523	2,688	29	23,030
1975	16,589	2,867	643	3,888	582	2,919	21	27,509
1980	19,564	3,018	639	4,415	563	2,610	15	30,823
1985	22,435	3,069	456	4,862	372	1,918	10	33,122
1990	24,841	3,104	421	5,098	304	1,777	6	35,551
1995	26,679	3,027	441	5,213	275	1,884	4	37,522
2000	28,505	2,798	459	4,901	203	1,878	3	38,747
2005	30,461	2,524	488	4,569	178	1,903	2	40,126
2006	30,976	2,476	490	4,494	171	1,899	2	40,508
2007	31,528	2,431	494	4,436	165	1,892	2	40,947
2008	32,274	2,370	525	4,380	160	1,915	2	41,625
2009	33,514	2,343	561	4,327	160	1,921	2	42,828
2010	34,593	2,316	580	4,285	159	1,913	2	43,847
2011	35,600	2,291	594	4,239	158	1,907	2	44,791
2012	36,720	2,280	612	4,193	154	1,907	1	45,868
2013	37,893	2,285	625	4,139	150	1,899	1	46,992
2014	39,009	2,303	635	4,092	143	1,892	1	48,075
2015	40,089	2,335	648	4,050	140	1,893	1	49,155
2016	41,233	2,370	661	4,004	133	1,893	1	50,296
2017	42,447	2,375	675	3,961	128	1,904	1	51,491
Intermediate:								
2018	43,859	2,371	692	3,928	125	1,915	1	52,891
2020	47,090	2,263	736	3,866	120	1,940	1	56,015
2025	54,932	1,919	857	3,752	113	1,980	1	63,553
2030	61,907	1,946	983	3,522	119	2,010	1	70,488
2035	66,610	1,923	1,088	3,292	131	2,039	1	75,084
2040	69,007	1,818	1,146	3,105	134	2,066	1	77,277

Table V.C4.—OASI Beneficiaries With Benefits in Current-Payment Status at the End of Calendar Years 1945-2095 (Cont.)
[In thousands]

	Retired workers and auxiliaries			Survivors				
Calendar year	Worker[a]	Spouse	Child	Widow-widower	Mother-father	Child	Parent	Total
Intermediate (Cont.):								
2045	70,204	1,770	1,143	2,977	130	2,038	1	78,263
2050	71,862	1,752	1,164	2,870	126	1,989	1	79,765
2055	74,260	1,764	1,190	2,786	121	1,935	1	82,058
2060	77,441	1,774	1,218	2,710	118	1,884	1	85,146
2065	80,556	1,796	1,229	2,665	116	1,856	1	88,219
2070	83,934	1,844	1,263	2,645	115	1,850	1	91,653
2075	87,209	1,868	1,305	2,621	113	1,845	1	94,961
2080	89,260	1,881	1,316	2,582	110	1,830	1	96,979
2085	90,847	1,930	1,327	2,557	107	1,805	1	98,574
2090	93,417	2,011	1,365	2,552	104	1,785	1	101,236
2095	97,009	2,079	1,412	2,554	103	1,772	1	104,930
Low-cost:								
2018	43,834	2,370	693	3,924	125	1,917	1	52,864
2020	47,000	2,263	737	3,858	120	1,948	1	55,927
2025	54,587	1,923	865	3,734	116	2,019	1	63,245
2030	61,008	1,926	1,009	3,555	117	2,146	1	69,762
2035	65,070	1,904	1,138	3,358	129	2,265	1	73,865
2040	66,806	1,785	1,221	3,194	133	2,383	1	75,524
2045	67,421	1,716	1,235	3,081	131	2,416	1	76,000
2050	68,609	1,676	1,274	2,979	129	2,409	1	77,078
2055	70,687	1,661	1,325	2,892	128	2,400	1	79,094
2060	73,599	1,638	1,382	2,806	129	2,403	1	81,960
2065	76,450	1,619	1,418	2,747	133	2,448	1	84,815
2070	79,510	1,610	1,481	2,712	137	2,524	1	87,974
2075	82,350	1,588	1,553	2,670	140	2,594	1	90,897
2080	83,977	1,570	1,583	2,625	141	2,638	1	92,535
2085	85,519	1,604	1,613	2,617	142	2,667	1	94,162
2090	88,891	1,682	1,694	2,656	144	2,705	1	97,773
2095	93,996	1,743	1,792	2,709	147	2,758	1	103,147
High-cost:								
2018	43,882	2,371	691	3,931	125	1,913	1	52,913
2020	47,175	2,262	732	3,872	119	1,928	1	56,090
2025	55,308	1,909	844	3,768	109	1,930	1	63,869
2030	62,931	1,966	956	3,461	120	1,863	1	71,298
2035	68,369	1,954	1,038	3,192	129	1,801	1	76,483
2040	71,535	1,873	1,064	2,979	128	1,745	1	79,325
2045	73,429	1,853	1,044	2,835	120	1,674	1	80,955
2050	75,645	1,865	1,044	2,726	112	1,599	1	82,993
2055	78,436	1,900	1,045	2,646	104	1,521	1	85,653
2060	81,903	1,951	1,042	2,577	96	1,441	1	89,011
2065	85,249	2,017	1,029	2,539	90	1,375	1	92,300
2070	88,922	2,121	1,038	2,523	85	1,329	1	96,018
2075	92,590	2,198	1,051	2,505	79	1,289	1	99,713
2080	94,993	2,263	1,048	2,466	74	1,251	1	102,096
2085	96,525	2,329	1,043	2,417	70	1,210	1	103,595
2090	97,973	2,395	1,046	2,374	65	1,171	1	105,025
2095	99,625	2,441	1,053	2,337	61	1,136	1	106,654

[a] Retired-worker beneficiaries include persons who also receive a residual benefit consisting of the excess of an auxiliary benefit over their retired-worker benefit.

Notes:
1. The number of beneficiaries does not include uninsured individuals who receive benefits under Section 228 of the Social Security Act. Transfers from the General Fund of the Treasury reimburse the OASI Trust Fund for the cost of most of these individuals.
2. Totals do not necessarily equal the sums of rounded components.

5. Disability Insurance Beneficiaries

The DI Trust Fund pays for benefits to disabled workers who: (1) satisfy the disability insured requirements, (2) are unable to engage in any substantial gainful activity due to a medically determinable physical or mental impairment severe enough to satisfy the requirements of the program, and (3) have not yet attained normal retirement age. Spouses and children of such disabled workers may also receive DI benefits provided they satisfy certain criteria, primarily age and earnings requirements.

The Office of the Chief Actuary projects the number of disabled-worker beneficiaries in current-payment status (disability prevalence) for each future year. The projections start with the number in current-payment status as of December 2017. Projections of the number of new beneficiaries awarded benefits each year (disability incidence) and the number of beneficiaries leaving the disability rolls each year then determine the number in current-payment status in later years. Beneficiaries leave the rolls due to death and recovery (disability terminations) and due to conversion from disabled-worker to retired-worker beneficiary status at normal retirement age, after which the OASI Trust Fund pays for benefits. The remainder of this section describes the concepts of disability incidence, termination, and prevalence.

a. Disability Incidence

The disability incidence rate is the ratio of the number of new beneficiaries awarded benefits each year to the number of individuals who meet insured requirements but are not yet receiving benefits (the disability-exposed population[1]). The Office of the Chief Actuary projects the number of newly awarded beneficiaries for each future year by multiplying assumed age-sex-specific disability incidence rates and the projected disability-exposed population by age and sex.

Figure V.C3 illustrates the historical and estimated incidence rates under the three alternatives. Incidence rates have varied substantially during the historical period since 1970 due to a variety of demographic and economic factors, along with changes in legislation and program administration. The solid lines in figure V.C3 show the incidence rate adjusted to the age-sex distribution of the disability-exposed population for 2000. This adjustment allows a comparison of incidence rates over time by focusing on the likelihood of becom-

[1] The disability-exposed population excludes those receiving benefits, while the disability insured population includes them. Section V.C.3 of this report describes the projection of the disability insured population.

ing disabled, and by excluding the effects of a changing distribution of the population toward ages where disability is more or less likely.

The dashed lines in figure V.C3 represent the gross (unadjusted) incidence rates. The changing age-sex distribution of the exposed population over time influences these unadjusted rates. The gross incidence rate fell substantially below the age-sex-adjusted rate between 1975 and 1995 as the baby-boom generation swelled the size of the younger working-age population, where disability incidence is lower than in older populations. After 1995, the gross rate generally increased relative to the age-sex-adjusted rate as the baby-boom generation moved into an age range where disability incidence peaks. After 2023, the projected gross incidence rate generally declines relative to the age-sex-adjusted rate as the baby-boom generation moves above the normal retirement age and the lower-birth-rate cohorts of the 1970s enter prime disability ages (50 to normal retirement age). As these smaller cohorts age beyond normal retirement age, by about 2050, the gross incidence rate returns to a higher relative level under the intermediate assumptions. Thereafter, the gross rate remains higher than the age-sex-adjusted rate, and reflects the persistently higher average age of the working-age population, which is largely due to lower birth rates since 1965, and to the increase in the normal retirement age.

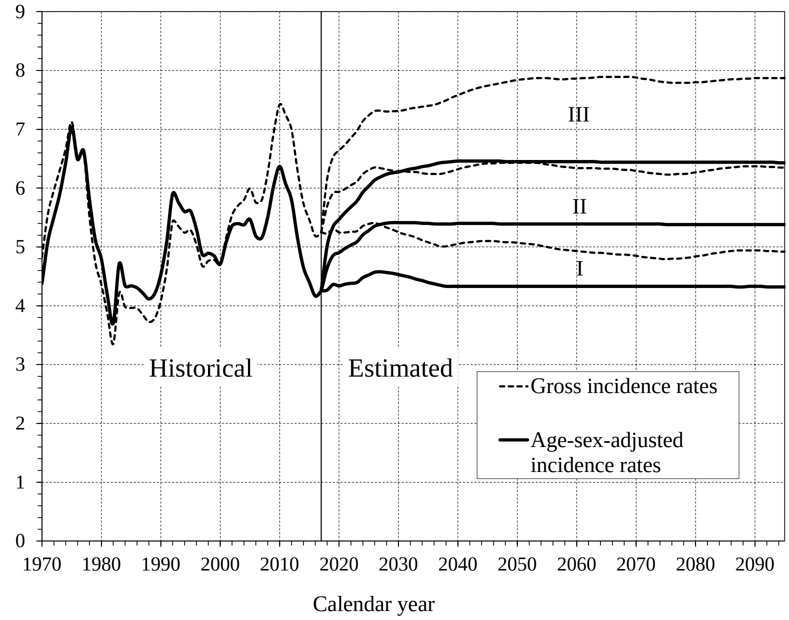
For the first 10 years of the projection period (through 2027), incidence rates reflect several factors including: (1) aspects of program administration, such as efforts to reduce the disability determination backlogs and recent changes in procedures for adjudicating claims; (2) assumed future unemployment rates; and (3) recent trends in incidence. At the beginning of the recent period of high unemployment, disability incidence rates were well above the general trend level, with rates reaching a peak in 2010. Over the last few years, incidence rates have subsided as the economy has recovered, and have persisted at levels well below those expected over the long-term. Some of the elevation of disability incidence rates experienced during the recession and the lowering of incidence rates experienced during the recovery are likely due to many individuals applying for disability benefits earlier than they would have otherwise. For 2017, the actual incidence rate (4.3 per thousand) was below the level projected in last year’s report (4.7 per thousand). In this year’s report, incidence rates are assumed to rise more gradually early in the short-range period than in last year’s report, but are slightly higher late in the period. Incidence rates are assumed to be somewhat elevated during the period 2018 through 2022, when the Social Security Administration is expected to eliminate a backlog of individuals who have appealed for a hearing on a prior disability claim denial. In 2027, at the end of the short-range period, age-sex-specific incidence rates reach the ultimate rates assumed for the long-range projections. These ultimate age-sex-specific disability incidence rates were selected based on careful analysis of historical levels and patterns and expected future conditions, including the impact of scheduled increases in the normal retirement age.[1] The ultimate incidence rates represent the expected average rates of incidence for the future.

For the intermediate alternative, the Trustees assume that the ultimate age-sex-adjusted incidence rate (adjusted to the disability-exposed population for the year 2000) will be 5.4 awards per thousand exposed, which is the same as in last year's report. Figure V.C3 illustrates that the estimated ultimate age-sex-adjusted incidence rate of 5.4 is slightly higher than the average rate for the historical period 1970 through 2017, reflecting the increase in female incidence rates over this period. However, a similar comparison using gross incidence rates gives a very different result. The estimated ultimate gross incidence rate is substantially greater than the average gross rate over the historical period due to the large changes in the age-sex distribution of the disability-exposed population between 1970 and 2010.

The Trustees assume that the ultimate age-sex-adjusted incidence rates for the low-cost and high-cost alternatives will be 4.3 and 6.4 awards per thousand exposed, or about 17 percent lower and 23 percent higher than the average for the historical period, respectively. These ultimate age-sex-adjusted incidence rates are similar to those in last year's report.

[1] Projected incidence rates are adjusted upward to account for additional workers who are expected to file for disability benefits (rather than retirement benefits) in response to reductions in retirement benefits as the normal retirement age rises.

Figure V.C3.—DI Disability Incidence Rates, 1970-2095
[Awards per thousand disability-exposed]



b. Disability Termination

Beneficiaries stop receiving disability benefits when they die, recover from their medically-determinable disabling condition, or return to work. Disabled-worker beneficiaries who return to substantial work for an extended period are deemed to have recovered, and their benefits are then terminated. The termination rate is the ratio of the number of terminations for these reasons to the average number of disabled-worker beneficiaries during the year.

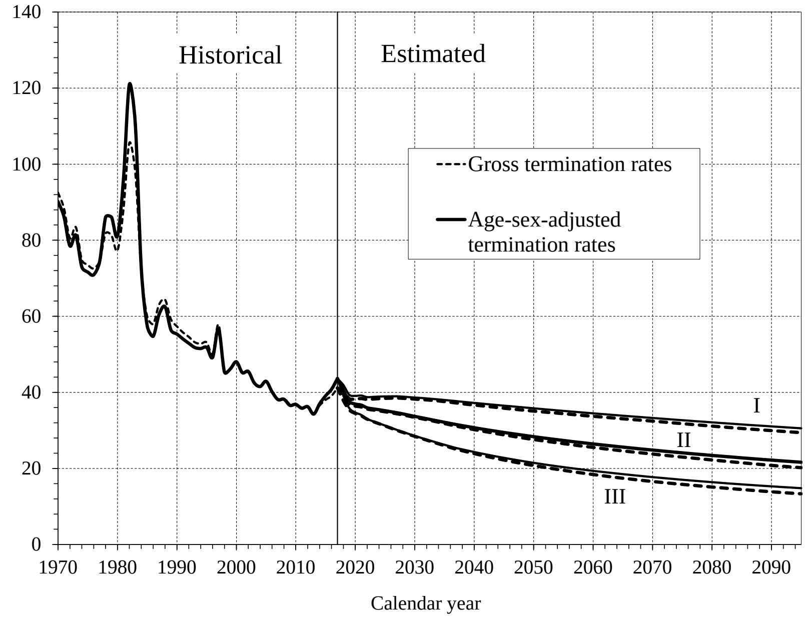
The Office of the Chief Actuary projects termination rates by age, sex, and reason for termination. In addition, the office projects termination rates by duration of entitlement to disabled-worker benefits in the long-range period (post-2027).

In the short-range period (through 2027), the projected age-sex-adjusted death rate (adjusted to the 2000 disabled-worker population) under the intermediate assumptions gradually declines from 25.4 deaths per thousand beneficiaries for 2017 to about 23.7 per thousand for 2027. The projected age-sex-adjusted recovery rate (medical improvement and return to work) under the intermediate assumptions decreases from the relatively high level of 18.2 per thousand beneficiaries for 2017 to 11.0 per thousand beneficiaries for 2027. The recovery rate has been high due to an ongoing administrative effort to work down a backlog of continuing disability reviews. The rate is expected to decrease as the backlog is reduced. Under the low-cost and high-cost assumptions, total age-sex-adjusted termination rates due to death and recovery are roughly 10-15 percent higher or lower, respectively, than under the intermediate assumptions.

For the long-range period (post-2027), the Office of the Chief Actuary projects death and recovery rates by age, sex, and duration of entitlement relative to the average level of rates experienced over the base period 2006 through 2010. The assumed ultimate age-sex-adjusted recovery rate for disabled workers is about 10.3 per thousand beneficiaries. The assumed ultimate age-sex-adjusted recovery rates for the low-cost and high-cost alternatives are about 12.5 and 8.2 recoveries per thousand beneficiaries, respectively. Recovery rates by age, sex, and duration of entitlement reach ultimate levels in the twentieth year of the projection period (2037) for all three sets of assumptions. In contrast, death rates by age and sex change throughout the long-range period at the same rate as death rates in the general population. From the age-sex-adjusted death rate of 25.4 per thousand beneficiaries in 2017, this rate decreases to 18.1, 11.3, and 6.6 per thousand disabled-worker beneficiaries for 2095 under the low-cost, intermediate, and high-cost assumptions, respectively.

Figure V.C4 illustrates gross and age-sex-adjusted total termination rates (including both recoveries and deaths) for disabled-worker beneficiaries for the historical period since 1970, and for the projection period through 2095. In the near term, through 2018, recovery terminations are projected to remain at relatively high levels, consistent with the assumption that the Social Security Administration will receive sufficient budget appropriations to reduce the pending backlog of continuing disability reviews. As with incidence rates, the age-sex-adjusted termination rate illustrates the real change in the tendency to terminate benefits. Changes in the age-sex distribution of the beneficiary population influence the gross termination rate. A shift in the disabled-worker beneficiary population to older ages, as occurred over the past 20 years when the baby-boom generation moved into pre-retirement ages, increases gross death termination rates relative to the age-sex-adjusted rates.

Figure V.C4.—DI Disability Termination Rates, 1970-2095
[Terminations per thousand disabled-worker beneficiaries]



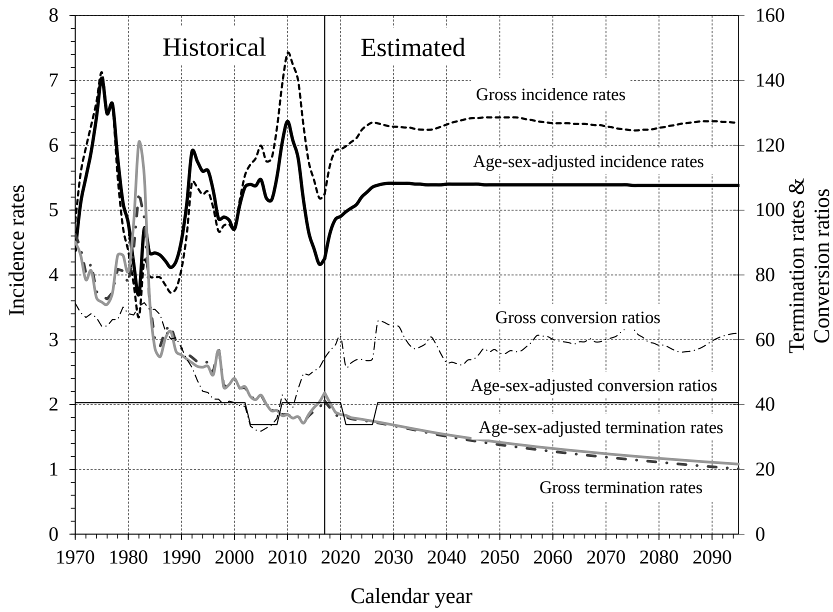
c. Comparison of Incidence, Termination, and Conversion

Incidence and termination rates are the foundation for projecting the number of disabled-worker beneficiaries in current-payment status. At normal retirement age, disabled-worker beneficiaries convert to retired-worker status and leave the DI rolls.

Figure V.C5 compares the historical and projected (intermediate) levels of incidence, termination, and conversion on both a gross basis and an age-sex-adjusted basis. Incidence rates have varied widely, and the Trustees expect the age-sex adjusted rates under the intermediate assumptions to remain near the middle of the high and low extremes experienced since 1970. Termination rates have declined and the Trustees expect them to continue to decline, largely because of declining death rates.

Conversions are simply a transfer of beneficiaries at normal retirement age from the DI program to the OASI program. Therefore, the disability "conversion" rate is 100 percent for disabled-worker beneficiaries reaching normal retirement age in a given year and zero at all other ages. After conversion, recovery from the disabling condition is no longer relevant for benefit eligibility. The conversion ratio is the number of conversions in a given year (that is, beneficiaries who reach normal retirement age) divided by the average number of disabled-worker beneficiaries at all ages in that year. The ratio is constant on an age-sex-adjusted basis, except for the two periods during which normal retirement age increases under current law. On a gross basis, however, the conversion ratio rises and falls with the changing proportion of all disabled-worker beneficiaries who attain normal retirement age in a given year. The gross conversion ratio generally increases from 2002 to 2030 due to aging of the beneficiary population.

Figure V.C5.—Comparison of DI Disability Incidence Rates, Termination Rates and Conversion Ratios Under Intermediate Assumptions, 1970-2095
[Awards per thousand disability-exposed;
terminations and conversions per thousand disabled-worker beneficiaries]



d. DI Beneficiaries and Disability Prevalence Rates

The Office of the Chief Actuary makes detailed projections of disabled-worker awards, terminations, and conversions and combines these to project the number of disabled workers receiving benefits over the next 75 years. Table V.C5 presents the projected numbers of disabled workers in current-payment status. The number of disabled workers in current-payment status grows from 8.7 million at the end of 2017, to 12.7 million, 14.5 million, and 15.4 million at the end of 2095, under the low-cost, intermediate, and high-cost assumptions, respectively. Of course, much of this growth results from the growth and aging of the population described earlier in this chapter. Table V.C5 also presents projected numbers of auxiliary beneficiaries and disability prevalence rates on both a gross basis and an age-sex-adjusted basis.

Table V.C5.—DI Beneficiaries With Benefits in Current-Payment Status at the End of Calendar Years 1960-2095
[Beneficiaries in thousands; prevalence rates per thousand persons insured for disability benefits]

Calendar year	Disabled-worker beneficiaries	Auxiliary beneficiaries		Total beneficiaries	Disability prevalence rates	
		Spouse	Child		Gross	Age-sex-adjusted[a]
Historical data:						
1960	455	77	155	687		
1965	988	193	558	1,739		
1970	1,493	283	889	2,665	20	18
1975	2,488	453	1,411	4,351	29	28
1980	2,856	462	1,359	4,677	28	31
1985	2,653	306	945	3,904	24	26
1990	3,007	266	989	4,261	25	28
1995	4,179	264	1,409	5,852	33	35
2000	5,036	165	1,466	6,667	36	36
2005	6,519	157	1,633	8,309	45	40
2006	6,807	156	1,652	8,615	46	40
2007	7,099	154	1,665	8,918	48	41
2008	7,427	155	1,692	9,273	50	41
2009	7,788	159	1,749	9,695	52	43
2010	8,204	161	1,820	10,185	55	44
2011	8,576	164	1,874	10,614	58	45
2012	8,827	163	1,900	10,890	59	46
2013	8,941	157	1,889	10,987	60	46
2014	8,955	150	1,828	10,932	59	46
2015	8,909	143	1,756	10,808	59	45
2016	8,809	136	1,667	10,612	57	43
2017	8,695	127	1,590	10,412	56	42
Intermediate:						
2018	8,668	125	1,566	10,359	56	42
2020	8,675	125	1,558	10,358	56	41
2025	9,153	142	1,599	10,894	57	42
2030	9,333	146	1,762	11,241	57	43
2035	9,665	153	2,012	11,830	58	45
2040	10,117	157	2,234	12,508	60	46
2045	10,787	171	2,347	13,305	62	47
2050	11,265	174	2,411	13,850	64	47
2055	11,706	178	2,454	14,338	65	48
2060	11,897	175	2,493	14,565	64	48
2065	12,202	181	2,561	14,945	65	49
2070	12,487	190	2,659	15,336	65	49
2075	12,616	187	2,755	15,558	65	49
2080	12,993	192	2,831	16,016	65	49
2085	13,618	202	2,892	16,713	66	50
2090	14,191	212	2,954	17,357	67	50
2095	14,502	214	3,027	17,744	67	50

Table V.C5.—DI Beneficiaries With Benefits in Current-Payment Status at the End of Calendar Years 1960-2095 (Cont.)
[Beneficiaries in thousands; prevalence rates per thousand persons insured for disability benefits]

Calendar year	Disabled-worker beneficiaries	Auxiliary beneficiaries: Spouse	Auxiliary beneficiaries: Child	Total beneficiaries	Disability prevalence rates: Gross	Disability prevalence rates: Age-sex-adjusted[a]
Low-cost:						
2018	8,594	125	1,548	10,267	55	41
2020	8,414	123	1,499	10,036	54	40
2025	8,390	140	1,466	9,996	52	38
2030	8,140	124	1,573	9,837	49	37
2035	8,099	121	1,776	9,997	48	37
2040	8,211	117	1,956	10,284	48	37
2045	8,591	122	2,038	10,752	48	37
2050	8,890	121	2,082	11,093	48	37
2055	9,207	122	2,123	11,452	48	37
2060	9,371	118	2,182	11,672	47	37
2065	9,659	120	2,287	12,065	47	37
2070	9,972	125	2,429	12,526	47	38
2075	10,227	124	2,567	12,918	46	38
2080	10,747	129	2,678	13,554	47	38
2085	11,542	140	2,774	14,456	48	38
2090	12,259	149	2,876	15,284	49	38
2095	12,682	150	2,998	15,830	49	38
High-cost:						
2018	8,741	126	1,583	10,450	57	42
2020	8,935	126	1,612	10,673	58	43
2025	9,915	144	1,711	11,770	63	46
2030	10,553	172	1,932	12,658	66	50
2035	11,273	191	2,191	13,655	69	53
2040	12,085	206	2,410	14,701	73	55
2045	13,063	231	2,541	15,835	78	57
2050	13,721	239	2,619	16,578	81	59
2055	14,269	246	2,652	17,168	83	60
2060	14,456	246	2,654	17,357	84	60
2065	14,726	253	2,660	17,639	86	61
2070	14,900	266	2,683	17,849	87	61
2075	14,773	261	2,712	17,746	86	61
2080	14,815	264	2,737	17,815	86	61
2085	15,020	267	2,752	18,039	87	62
2090	15,270	273	2,762	18,305	88	62
2095	15,401	275	2,773	18,450	88	62

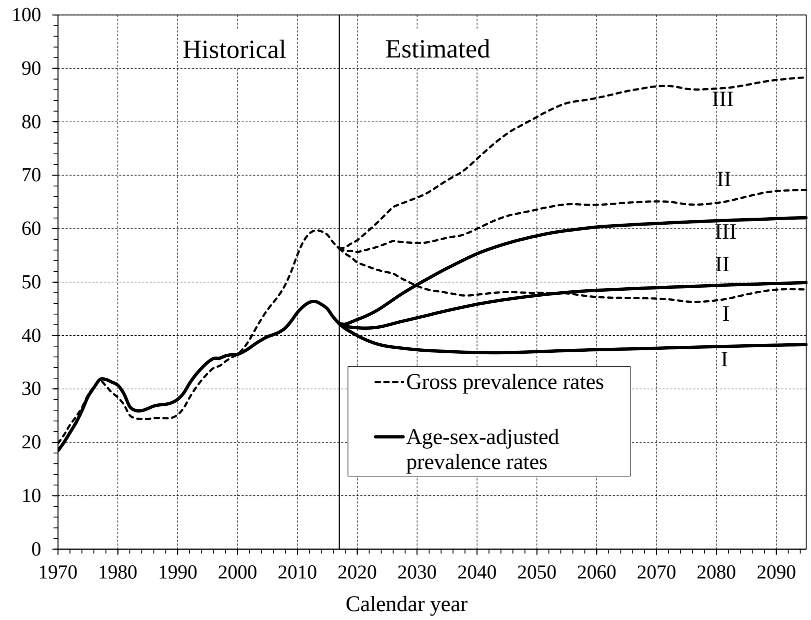
[a] Adjusted to the age-sex distribution of the disability insured population for the year 2000.

Note: Totals do not necessarily equal the sums of rounded components.

The disability prevalence rate is the ratio of the number of disabled-worker beneficiaries in current-payment status to the number of persons insured for disability benefits. Figure V.C6 illustrates the historical and projected disability prevalence rates on both a gross basis and on an age-sex-adjusted basis (adjusted to the age-sex distribution of the disability insured population for the year 2000).

Changes in prevalence rates are a direct result of changes in incidence rates and termination rates. Figure V.C5 depicts patterns for incidence and termination rates, which are helpful for understanding the trend in prevalence rates. Annual incidence and termination rates are not directly comparable or combinable because their denominators differ.

Figure V.C6.—DI Disability Prevalence Rates, 1970-2095
[Rate per thousand persons insured for disability benefits]



Age-sex-adjusted prevalence rates have increased primarily because: (1) termination rates, in particular death termination rates, have declined, (2) incidence rates at younger ages have increased relative to rates at older ages (new beneficiaries at younger ages have more potential years on the disability rolls), and (3) incidence rates have increased substantially for women to parity with men. Gross prevalence rates have increased more than age-sex-adjusted prevalence rates since the baby-boom generation began to reach ages 45 through normal retirement age, a time of life when disability incidence rates are relatively high. The Office of the Chief Actuary projects both gross and age-sex adjusted prevalence rates to grow at a slower pace based on assumed stabilization in three factors: (1) the age distribution of the general population, (2) the age distribution of the disability insured population, and (3) incidence rates by age and gender. As these factors gradually stabilize, the declining death termination rate continues to have a small influence toward higher disability prevalence rates.

As mentioned above in the discussion of incidence and termination rates, the age-sex-adjusted prevalence rate isolates the changing trend in the underlying likelihood of receiving benefits for the insured population, without reflecting changes in the age distribution of the population. As with incidence rates, gross disability prevalence rates declined relative to the age-sex-adjusted rate when the baby-boom generation reached working age between 1970 and 1990; this trend reflects the lower disability prevalence rates associated with younger ages. Conversely, the gross rate of disability prevalence has increased relative to the age-sex-adjusted rate after 1990 due to the aging of the baby-boom generation into ages with higher disability prevalence rates.

Under the intermediate assumptions, the projected age-sex-adjusted disability prevalence rate grows from 42.2 per thousand disability insured at the end of 2017 to 49.9 per thousand at the end of 2095. As mentioned above, the Office of the Chief Actuary projects that the growth in prevalence will slow relative to the historical period.

Under the low-cost and high-cost assumptions, the age-sex-adjusted disability prevalence rate decreases to 38.3 per thousand and increases to 62.0 per thousand insured workers at the end of 2095, respectively.

Table V.C5 presents projections of the numbers of auxiliary beneficiaries paid from the DI Trust Fund. As indicated at the beginning of this subsection, auxiliary beneficiaries are qualifying spouses and children of disabled workers. A spouse must either be at least age 62 or have an eligible child beneficiary in his or her care who is either under age 16 or disabled prior to age 22. A child must be: (1) under age 18, (2) age 18 or 19 and still a student in high school, or (3) age 18 or older and disabled prior to age 22.

The projection of the number of auxiliary beneficiaries relies on the projected number of disabled-worker beneficiaries. In the short-range period (2018 through 2027), the Office of the Chief Actuary projects incidence and termination rates for each category of auxiliary beneficiary. After 2027, the office projects child beneficiaries at ages 18 and under in relation to the projected number of children in the population using the probability that either of their parents is a disabled-worker beneficiary. The office projects the remaining categories of children and spouses in a similar manner.

6. Covered and Taxable Earnings, Taxable Payroll, and Payroll Tax Contributions

Covered earnings are the sum of covered wages and covered self-employment net earnings. The Office of the Chief Actuary projects covered wages for component sectors of the economy (i.e., private, State and local, Federal civilian, and military) based on the projected overall growth of sectoral and total wages in the U.S. economy. The projections of covered wages also reflect changes in covered employment due to a relative increase in non-covered undocumented immigrants and to the mandatory coverage of new hires in the Federal civilian sector. The office projects covered self-employment net earnings based on the growth in net proprietors' income in the U.S. economy.

Taxable earnings are the amount of covered earnings subject to the Social Security payroll tax. Taxable wages for an employee are total covered wages from all wage employment up to the contribution and benefit base. Taxable wages for an employer are the sum of all covered wages paid to each employee up to the base. Employees with multiple jobs whose total wages exceed the base are eligible for a refund of excess employee taxes withheld; employers are not eligible for a refund on this basis. For self-employed workers with no taxable wages, taxable earnings are the amount of covered self-employment net earnings up to the base. For self-employed workers with taxable wages less than the base, covered self-employment net earnings are taxable up to the difference between the base and their taxable wages. For projection purposes, the Office of the Chief Actuary computes taxable earnings based on a proportion of covered earnings that is at or below the base.

The OASDI taxable payroll (see table VI.G6) for a year is the amount of earnings which, when multiplied by the combined OASDI employee-employer payroll tax rate for that year, yields the total amount of payroll taxes due from wages paid and self-employment net earnings for the year. The Trustees use taxable payroll to determine income rates, cost rates, and actuarial balances. Taxable payroll is derived by adjusting total taxable earnings to account for categories of earnings that are taxed at rates other than the combined employee-employer rate and to take into account amounts credited as wages that were not included in normally reported wages. For 1951 and later, taxable earnings are reduced by one-half of the amount of wages paid to employees with multiple jobs that exceed the contribution and benefit base. For 1983 through 2001, deemed wage credits for military service after 1956 are added to taxable earnings. The self-employment tax rates for 1951 through 1983 were less than the combined employee-employer rates; therefore, the self-employment component of taxable payroll for those years is reduced by multiplying the ratio of the self-employment rate to the combined employee-employer rate times the taxable self-employment net earnings. Finally, for 1966 through 1979, employers were exempt from paying their share of payroll tax on their employees' tips and, for 1980 through 1987, employers paid tax on only part of their employees' tips. For those years, the taxable payroll is reduced by half of the amount of tips for which the employer owed no payroll tax.

The ratio of taxable payroll to covered earnings (the taxable ratio) fell from 88.6 percent for 1984 to 82.6 percent for 2000, mostly due to much higher increases in wage levels for very high earners than for all other earners. From 2000 to 2010, the taxable ratio varied with the business cycle, rising during economic downturns and falling during recoveries. Specifically, the taxable ratio rose to 85.7 percent for 2002, declined to 82.4 percent for 2007, rose to 85.2 percent for 2009, and was 82.7 percent for 2016.

For this report, the Trustees assume a level for the taxable ratio at the end of the short-range period (2027) of 82.5 percent for the intermediate assumptions, 81.0 percent for the high-cost assumptions, and 84.0 percent for the low-cost assumptions. These are the same assumptions that the Trustees made for the end of the short-range period (2026) for the 2017 report.

The Office of the Chief Actuary projects payroll tax contributions using the patterns of tax collection required by Federal laws and regulations. The office determines payroll tax liabilities by multiplying the scheduled tax rates for each year by the amount of taxable wages and self-employment net earnings for that year. The office then splits these liabilities into amounts by collection period. For wages, Federal law requires that employers withhold OASDI and HI payroll taxes and Federal individual income taxes from employees' pay. As an employer's accumulation of such taxes (including the employer share of payroll taxes) meets certain thresholds, which the Department of the Treasury determines, the employer must deposit these taxes with the U.S. Treasury by a specific day, depending on the amount of money involved.[1] For projection purposes, the office splits the payroll tax contributions related to wages into amounts paid in the same quarter as incurred and in the following quarter. Self-employed workers must make estimated tax payments on their earnings four times during the year and make up any underestimate on their individual income tax returns. The projection splits the self-employed tax liabilities by collection quarter to reflect this pattern of receipts.

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[1] Generally, the higher the amount of liability, the sooner the taxes must be paid. For smaller employers, payment is due by the middle of the month following when the liability was incurred. Medium-size employers have three banking days in which to make their deposits. Larger employers must make payment on the next business day after paying their employees.

The projected tax contributions also reflect the method used to ensure that money transferred to the trust funds is adjusted, over time, to equal the actual liability owed. Because payers generally make tax payments without identifying the separate OASDI contribution amounts, Treasury makes daily transfers of money from the General Fund to the trust funds on an initial estimated basis. The Social Security Administration periodically certifies the amounts of wages and self-employment net earnings on which tax contributions are owed for each year, at which time Treasury determines adjustments to appropriations to reconcile tax liabilities with deposits in the trust funds. This process also includes periodic transfers from the trust funds to the General Fund for contributions on wages in excess of the contribution and benefit base.

Table V.C6 shows the payroll tax contribution rates applicable under current law in each calendar year and the allocation of these rates between the OASI and DI Trust Funds.[1] It also shows the contribution and benefit base for each year through 2018.

[1] Table VI.G1 shows the payroll tax contribution rates for the Hospital Insurance (HI) program.

Table V.C6.—Contribution and Benefit Base and Payroll Tax Contribution Rates

		Payroll tax contribution rates (percent)					
		Employees and employers, combined[a]			Self-employed[b]		
Calendar years	Contribution and benefit base	OASDI	OASI	DI	OASDI	OASI	DI
1937-49	$3,000	2.00	2.00	—	—	—	—
1950.	3,000	3.00	3.00	—	—	—	—
1951-53	3,600	3.00	3.00	—	2.2500	2.2500	—
1954.	3,600	4.00	4.00	—	3.0000	3.0000	—
1955-56	4,200	4.00	4.00	—	3.0000	3.0000	—
1957-58	4,200	4.50	4.00	0.50	3.3750	3.0000	0.3750
1959.	4,800	5.00	4.50	.50	3.7500	3.3750	.3750
1960-61	4,800	6.00	5.50	.50	4.5000	4.1250	.3750
1962.	4,800	6.25	5.75	.50	4.7000	4.3250	.3750
1963-65	4,800	7.25	6.75	.50	5.4000	5.0250	.3750
1966.	6,600	7.70	7.00	.70	5.8000	5.2750	.5250
1967.	6,600	7.80	7.10	.70	5.9000	5.3750	.5250
1968.	7,800	7.60	6.65	.95	5.8000	5.0875	.7125
1969.	7,800	8.40	7.45	.95	6.3000	5.5875	.7125
1970.	7,800	8.40	7.30	1.10	6.3000	5.4750	.8250
1971.	7,800	9.20	8.10	1.10	6.9000	6.0750	.8250
1972.	9,000	9.20	8.10	1.10	6.9000	6.0750	.8250
1973.	10,800	9.70	8.60	1.10	7.0000	6.2050	.7950
1974.	13,200	9.90	8.75	1.15	7.0000	6.1850	.8150
1975.	14,100	9.90	8.75	1.15	7.0000	6.1850	.8150
1976.	15,300	9.90	8.75	1.15	7.0000	6.1850	.8150
1977.	16,500	9.90	8.75	1.15	7.0000	6.1850	.8150
1978.	17,700	10.10	8.55	1.55	7.1000	6.0100	1.0900
1979.	22,900	10.16	8.66	1.50	7.0500	6.0100	1.0400
1980.	25,900	10.16	9.04	1.12	7.0500	6.2725	.7775
1981.	29,700	10.70	9.40	1.30	8.0000	7.0250	.9750
1982.	32,400	10.80	9.15	1.65	8.0500	6.8125	1.2375
1983.	35,700	10.80	9.55	1.25	8.0500	7.1125	.9375
1984[c].	37,800	11.40	10.40	1.00	11.4000	10.4000	1.0000
1985[c].	39,600	11.40	10.40	1.00	11.4000	10.4000	1.0000
1986[c].	42,000	11.40	10.40	1.00	11.4000	10.4000	1.0000
1987[c].	43,800	11.40	10.40	1.00	11.4000	10.4000	1.0000
1988[c].	45,000	12.12	11.06	1.06	12.1200	11.0600	1.0600
1989[c].	48,000	12.12	11.06	1.06	12.1200	11.0600	1.0600
1990	51,300	12.40	11.20	1.20	12.4000	11.2000	1.2000
1991.	53,400	12.40	11.20	1.20	12.4000	11.2000	1.2000
1992.	55,500	12.40	11.20	1.20	12.4000	11.2000	1.2000
1993.	57,600	12.40	11.20	1.20	12.4000	11.2000	1.2000
1994.	60,600	12.40	10.52	1.88	12.4000	10.5200	1.8800
1995.	61,200	12.40	10.52	1.88	12.4000	10.5200	1.8800
1996.	62,700	12.40	10.52	1.88	12.4000	10.5200	1.8800
1997.	65,400	12.40	10.70	1.70	12.4000	10.7000	1.7000
1998.	68,400	12.40	10.70	1.70	12.4000	10.7000	1.7000
1999.	72,600	12.40	10.70	1.70	12.4000	10.7000	1.7000
2000.	76,200	12.40	10.60	1.80	12.4000	10.6000	1.8000
2001.	80,400	12.40	10.60	1.80	12.4000	10.6000	1.8000
2002.	84,900	12.40	10.60	1.80	12.4000	10.6000	1.8000
2003.	87,000	12.40	10.60	1.80	12.4000	10.6000	1.8000
2004.	87,900	12.40	10.60	1.80	12.4000	10.6000	1.8000
2005.	90,000	12.40	10.60	1.80	12.4000	10.6000	1.8000

Table V.C6.—Contribution and Benefit Base and Payroll Tax Contribution Rates (Cont.)

		Payroll tax contribution rates (percent)					
		Employees and employers, combined[a]			Self-employed[b]		
Calendar years	Contribution and benefit base	OASDI	OASI	DI	OASDI	OASI	DI
2006	$94,200	12.40	10.60	1.80	12.4000	10.6000	1.8000
2007	97,500	12.40	10.60	1.80	12.4000	10.6000	1.8000
2008	102,000	12.40	10.60	1.80	12.4000	10.6000	1.8000
2009	106,800	12.40	10.60	1.80	12.4000	10.6000	1.8000
2010[d]	106,800	12.40	10.60	1.80	12.4000	10.6000	1.8000
2011[d]	106,800	10.40	8.89	1.51	10.4000	8.8900	1.5100
2012[d]	110,100	10.40	8.89	1.51	10.4000	8.8900	1.5100
2013	113,700	12.40	10.60	1.80	12.4000	10.6000	1.8000
2014	117,000	12.40	10.60	1.80	12.4000	10.6000	1.8000
2015	118,500	12.40	10.60	1.80	12.4000	10.6000	1.8000
2016[e]	118,500	12.40	10.03	2.37	12.4000	10.0300	2.3700
2017[e]	127,200	12.40	10.03	2.37	12.4000	10.0300	2.3700
2018[e]	128,400	12.40	10.03	2.37	12.4000	10.0300	2.3700
2019 and later	[f]	12.40	10.60	1.80	12.4000	10.6000	1.8000

[a] Except as noted below, the combined employee/employer rate is divided equally between employees and employers.
[b] Beginning in 1990, self-employed persons receive a deduction, for purposes of computing their net earnings, equal to half of the combined OASDI and HI contributions that would be payable without regard to the contribution and benefit base. The OASDI contribution rate then applies to net earnings after this deduction, but subject to the OASDI base.
[c] In 1984 only, employees received an immediate credit of 0.3 percent of taxable wages against their OASDI payroll tax contributions. The self-employed received similar credits of 2.7 percent, 2.3 percent, and 2.0 percent against their combined OASDI and Hospital Insurance (HI) contributions on net earnings from self-employment in 1984, 1985, and 1986-89, respectively. The General Fund of the Treasury reimbursed the trust funds for these credits.
[d] Public Law 111-147 exempted most employers from paying the employer share of OASDI payroll tax on wages paid during the period March 19, 2010 through December 31, 2010 to certain qualified individuals hired after February 3, 2010. Public Law 111-312 reduced the OASDI payroll tax rate for 2011 by 2 percentage points for employees and for self-employed workers. Public Law 112-96 extended the 2011 rate reduction through 2012. These laws require that the General Fund of the Treasury reimburse the OASI and DI Trust Funds for these temporary reductions in 2010 through 2012 payroll tax revenue, in order to "replicate to the extent possible" revenue that would have been received if the combined employee/employer payroll tax rates had remained at 12.4 percent for OASDI (10.6 percent for OASI and 1.8 percent for DI).
[e] Section 833 of the Bipartisan Budget Act of 2015 reallocated payroll tax rates on a temporary basis. For earnings in calendar years 2016 through 2018, 0.57 percentage point of the 12.40 percent OASDI payroll tax rate is reallocated from OASI to DI.
[f] Subject to automatic adjustment based on increases in average wages.

7. Income From Taxation of Benefits

Under current law, the OASI and DI Trust Funds are credited with income tax revenue from the taxation of up to the first 50 percent of OASI and DI benefit payments. (The HI Trust Fund receives the remainder of the income tax revenue from the taxation of up to 85 percent of OASI and DI benefit payments.) Benefits are taxed for beneficiaries with adjusted income (including half of benefits and all non-taxable interest) exceeding specified threshold amounts. The threshold amounts are $25,000 for single filers, $32,000 for joint filers, and $0 for those married but filing separately.

For the short-range period, the Office of the Chief Actuary estimates the income to the trust funds from taxation of benefits by applying the following two factors (projected by the Office of Tax Analysis, Department of the Treasury) to total OASI and DI scheduled benefits: (1) the percentage of scheduled benefits (limited to 50 percent) that is taxable and (2) the average marginal tax rate applicable to those benefits.

For the long-range period, the office estimates the income to the trust funds from taxation of benefits by applying projected ratios of taxation of OASI and DI benefits to total OASI and DI scheduled benefits. The income thresholds used for benefit taxation are, by law, constant in the future, while income and benefit levels continue to rise. Accordingly, projected ratios of income from taxation of benefits to the amount of benefits increase gradually. Ultimate tax ratios for OASI and DI benefits used in the projection rely on estimates from the Office of Tax Analysis in the Department of the Treasury.

8. Average Benefits

Projections of average benefits for each benefit type reflect recent historical averages, projected average primary insurance amounts (PIAs), and projected ratios of average benefits to average PIAs. Calculations of average PIAs are based on projected distributions of beneficiaries by duration from year of initial entitlement, average PIAs at initial entitlement, and increases in PIAs after initial entitlement. Projected increases in average PIAs after initial entitlement depend on automatic benefit increases, recomputations to reflect additional covered earnings, and differences in mortality by level of lifetime earnings. Calculations of future average PIAs at initial entitlement are based on projected earnings histories, which in turn reflect a combination of the actual earnings histories associated with a sample of 2015 initial entitlements and more recent actual earnings levels by age and sex for covered workers.

For retired-worker, aged-spouse, and aged-widow(er) benefits, the percentage of the PIA that is payable depends on the age at initial entitlement to benefits. Projected ratios of average benefits to average PIAs for these types of benefits are based on projections of age distributions at initial entitlement.

9. Scheduled Benefits

For each type of benefit, scheduled benefits are the product of the number of beneficiaries and the corresponding average monthly benefit. The short-range model calculates scheduled benefits on a quarterly basis. The long-range model calculates all scheduled benefits on an annual basis, using the number of beneficiaries at the beginning and end of the year. Adjustments to these annual scheduled benefits include retroactive payments to newly awarded beneficiaries and other amounts not reflected in the regular monthly scheduled benefits.

Scheduled lump-sum death benefits are estimated as the product of: (1) the number of lump-sum death payments projected on the basis of the assumed death rates, the projected fully insured population, and the estimated percentage of the fully insured population that will qualify for lump-sum death payments; and (2) the amount of the lump-sum death payment, which is $255 (unindexed since 1973).

10. Illustrative Scheduled Benefit Amounts

Table V.C7 shows, under the intermediate assumptions, future benefit amounts payable upon retirement at the normal retirement age and at age 65, for various hypothetical workers attaining age 65 in 2018 and subsequent years. The illustrative benefit amounts in table V.C7 are presented in CPI-indexed 2018 dollars—that is, adjusted to 2018 levels by the CPI indexing series shown in table VI.G6. As a point of comparison, table V.C7 also shows the national average wage index (AWI) for 2018 and subsequent years in CPI-indexed 2018 dollars.

The normal retirement age was 65 for individuals who reached age 62 before 2000. It increased to age 66 during the period 2000 through 2005, at a rate of 2 months per year as workers attained age 62. Under current law, the normal retirement age increases to age 67 during the period 2017 through 2022, also by 2 months per year as workers attain age 62. The illustrative benefit amounts shown in table V.C7 for retirees at age 65 are lower than the amounts shown for retirees at normal retirement age because the statute requires an actuarial reduction for monthly benefits taken before normal retirement age to reflect the expected additional years benefits will be collected. For example, those who collect benefits starting in 2027 at age 65 will receive benefits for two more years than if they instead claim benefits at the normal retirement age (age 67) unless they die between the ages of 65 and 67.

Table V.C7 shows five different pre-retirement earnings patterns. Four of these patterns assume the earnings history of workers with scaled-earnings patterns[1] and reflect very low, low, medium, and high career-average levels of pre-retirement earnings starting at age 21. The fifth pattern assumes the

[1] Actuarial Note 2018.3 has more details on scaled-earnings patterns. See www.ssa.gov/OACT/NOTES/ran3/.

earnings history of a steady maximum earner starting at age 22. The four scaled-earnings patterns derive from earnings experienced by insured workers during 1995-2014. These earnings levels differ by age. The career-average level of earnings for each scaled case targets a percent of the AWI.

For the scaled medium earner, the career-average earnings level is about equal to the AWI (or $51,894 for 2018). For the scaled very low, low, and high earners, the career-average earnings level is about 25 percent, 45 percent, and 160 percent of the AWI, respectively (or $12,974, $23,353, and $83,031, respectively, for 2018). The steady maximum earner has earnings at or above the contribution and benefit base for each year starting at age 22 through the year prior to retirement (or $128,400 for 2018).

Table V.C7.—Annual Scheduled Benefit Amounts for Retired Workers With Various Pre-Retirement Earnings Patterns Based on Intermediate Assumptions, Calendar Years 2018-2095

		Benefits in 2018 dollars[a] with retirement at normal retirement age					
Year attain age 65[b]	Age at retirement	Scaled very low earnings[c]	Scaled low earnings[d]	Scaled medium earnings[e]	Scaled high earnings[f]	Steady maximum earnings[g]	National Average Wage Index in 2018 dollars[h]
2018	66:0	$9,574	$12,531	$20,662	$27,374	$33,428	$51,894
2020	66:2	10,232	13,385	22,078	29,256	35,775	53,755
2025	67:0	10,682	13,987	23,082	30,526	37,605	58,590
2030	67:0	11,630	15,227	25,118	33,244	40,975	62,609
2035	67:0	12,432	16,275	26,838	35,523	43,793	66,642
2040	67:0	13,230	17,319	28,559	37,810	46,580	70,777
2045	67:0	14,049	18,389	30,329	40,152	49,484	75,026
2050	67:0	14,897	19,499	32,152	42,568	52,401	79,622
2055	67:0	15,810	20,694	34,124	45,178	55,507	84,516
2060	67:0	16,781	21,967	36,219	47,950	58,852	89,692
2065	67:0	17,812	23,309	38,438	50,887	62,417	95,051
2070	67:0	18,873	24,703	40,728	53,924	66,147	100,525
2075	67:0	19,962	26,125	43,074	57,031	69,967	106,266
2080	67:0	21,101	27,617	45,533	60,287	73,969	112,249
2085	67:0	22,290	29,171	48,098	63,682	78,145	118,593
2090	67:0	23,552	30,822	50,818	67,283	82,574	125,373
2095	67:0	24,897	32,584	53,724	71,129	87,303	132,573
		Benefits in 2018 dollars[a] with retirement at age 65					
2018	65:0	$8,946	$11,699	$19,298	$25,563	$31,130	$51,894
2020	65:0	9,434	12,349	20,354	26,974	32,886	53,755
2025	65:0	9,253	12,110	19,984	26,441	32,325	58,590
2030	65:0	10,076	13,190	21,761	28,811	35,252	62,609
2035	65:0	10,768	14,098	23,249	30,780	37,689	66,642
2040	65:0	11,463	15,008	24,746	32,766	40,089	70,777
2045	65:0	12,177	15,939	26,280	34,797	42,598	75,026
2050	65:0	12,908	16,894	27,863	36,890	45,112	79,622
2055	65:0	13,700	17,932	29,569	39,148	47,786	84,516
2060	65:0	14,544	19,033	31,385	41,555	50,664	89,692
2065	65:0	15,433	20,202	33,308	44,101	53,737	95,051
2070	65:0	16,356	21,407	35,297	46,733	56,951	100,525

Table V.C7.—Annual Scheduled Benefit Amounts for Retired Workers With Various Pre-Retirement Earnings Patterns Based on Intermediate Assumptions, Calendar Years 2018-2095 (Cont.)

2075	65:0	$17,301	$22,641	$37,330	$49,426	$60,242	$106,266
2080	65:0	18,289	23,934	39,460	52,245	63,690	112,249
2085	65:0	19,318	25,281	41,682	55,189	67,286	118,593
2090	65:0	20,410	26,711	44,040	58,310	71,099	125,373
2095	65:0	21,576	28,238	46,557	61,643	75,171	132,573

[a] Annual amounts are the total for the 12-month period starting with the month of retirement, adjusted to be in 2018 dollars by using the CPI indexing series from table VI.G6.
[b] Attains age 65 on January 1 of the year.
[c] Career-average earnings at about 25 percent of the AWI.
[d] Career-average earnings at about 45 percent of the AWI.
[e] Career-average earnings at about 100 percent of the AWI. Such a worker would have career-average earnings at approximately the 56th percentile of all new retired-worker beneficiaries.
[f] Career-average earnings at about 160 percent of the AWI.
[g] Earnings for each year at or above the contribution and benefit base.
[h] Average Wage Index from table VI.G6, adjusted to be in 2018 dollars by using the CPI indexing series from table VI.G6.

Note: Benefits shown at age 65 reflect adjustments for early retirement. For early retirement as early as age 62, the benefit amount is reduced 5/9 of one percent for each month before normal retirement age, up to 36 months. If the number of months exceeds 36, then the benefit is further reduced 5/12 of one percent per month. For example, if the number of reduction months is 60 (the maximum number for retirement at 62 when normal retirement age is 67), then the benefit is reduced by 30 percent. *Delayed retirement credit* is generally given for retirement after the normal retirement age. The delayed retirement credit is 2/3 of one percent per month for persons born in 1943 and later. No credit is given for delaying benefits after attaining age 70. See table V.C3 for additional details, including adjustments applying to other birth years.

11. Administrative Expenses

The projection of administrative expenses through the short-range period is based on historical experience and the projected growth in average wages. The Office of Budget of the Social Security Administration provides estimates for the first several years of the projection. For years after the short-range period, projected administrative expenses reflect increases in the number of beneficiaries in current-payment status, and increases in the average wage. However, the increases in average wage are partially offset by assumed administrative productivity gains.

12. Railroad Retirement Financial Interchange

Railroad workers are covered under a separate multi-tiered benefit plan, with a first tier of coverage similar to OASDI coverage. An annual financial interchange between the Railroad Retirement fund and the OASI and DI Trust Funds is made to resolve the difference between: (1) the amount of OASDI benefits that would be paid to railroad workers and their families if railroad employment had been covered under the OASDI program, plus administrative expenses associated with these benefits; and (2) the amount of OASDI payroll tax and income tax that would be received with allowances for interest from railroad workers.

Assumptions and Methods

Calculation of the financial interchange with the Railroad Retirement reflects trends similar to those used in estimating the cost of OASDI benefits. The annual short-range net cost for the OASI and DI Trust Funds is about $5-$6 billion and the long-range summarized net cost for the OASI and DI Trust Funds is 0.04 percent of taxable payroll.

VI. APPENDICES

A. HISTORY OF OASI AND DI TRUST FUND OPERATIONS

The Federal Old-Age and Survivors Insurance (OASI) Trust Fund was established on January 1, 1940 as a separate account in the United States Treasury. The Federal Disability Insurance (DI) Trust Fund, another separate account in the United States Treasury, was established on August 1, 1956. These funds conduct the financial operations of the OASI and DI programs. The Board of Trustees is responsible for overseeing the financial operations of these funds. The following paragraphs describe the various components of trust fund income and outgo. Following this description, tables VI.A1 and VI.A2 present the historical operations of the separate trust funds since their inception, and table VI.A3 presents the operations of the hypothetical combined trust funds[1] during the period when they have co-existed.

The primary receipts of these two funds are amounts appropriated under permanent authority on the basis of payroll tax contributions. Federal law requires that all employees who work in OASDI covered employment, and their employers, make payroll tax contributions on their wages. Employees and their employers must also make payroll tax contributions on monthly cash tips if such tips are at least $20. Self-employed persons must make payroll tax contributions on their covered net earnings from self-employment. The Federal Government pays amounts equivalent to the combined employer and employee contributions that would be paid on deemed wage credits attributable to military service performed between 1957 and 2001, if such wage credits were covered wages. Treasury initially deposits payroll tax contributions to the trust funds each day on an estimated basis. Subsequently, Treasury makes adjustments based on the certified amount of wages and self-employment earnings in the records of the Social Security Administration.

Income also includes various reimbursements from the General Fund of the Treasury, such as: (1) the cost of noncontributory wage credits for military service before 1957, and periodic adjustments to previous determinations of this cost; (2) the cost in 1971 through 1982 of deemed wage credits for military service performed after 1956; (3) the cost of benefits to certain uninsured persons who attained age 72 before 1968; (4) the cost of payroll tax credits provided to employees in 1984 and self-employed persons in 1984 through 1989 by Public Law 98-21; (5) the cost in 2009 through 2017 of excluding certain self-employment earnings from SECA taxes under Public Law 110-246; and (6) payroll tax revenue forgone under the provisions of Public Laws 111-147, 111-312, 112-78, and 112-96.

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[1] The OASI and DI Trust Funds are distinct legal entities which operate independently. To illustrate the actuarial status of the program as a whole, the fund operations are often combined on a hypothetical basis.

Beginning in 1984, Federal law subjected up to 50 percent of an individual's or couple's OASDI benefits to Federal income taxation under certain circumstances. Effective for taxable years beginning after 1993, the law increased the maximum percentage from 50 percent to 85 percent. Treasury credits the proceeds from this taxation of up to 50 percent of benefits to the OASI and DI Trust Funds in advance, on an estimated basis, at the beginning of each calendar quarter, with no reimbursement to the General Fund for interest costs attributable to the advance transfers.[1] Treasury makes subsequent adjustments based on the actual amounts shown on annual income tax records. Each of the OASI and DI Trust Funds receives the income taxes paid on the benefits from that trust fund.[2]

Another source of income to the trust funds is interest received on investments held by the trust funds. On a daily basis, Treasury invests trust fund income not required to meet current operating expenses, primarily in interest-bearing obligations of the U.S. Government. These investments include the special public-debt obligations described in the next paragraph. The Social Security Act also authorizes the trust funds to hold obligations guaranteed as to both principal and interest by the United States. The act therefore permits the trust funds to hold certain Federally sponsored agency obligations and marketable obligations.[3] The trust funds may acquire any of these obligations on original issue at the issue price or by purchase of outstanding obligations at their market price.

The Social Security Act authorizes the issuance of special public-debt obligations for purchase exclusively by the trust funds. The act provides that the interest rate for special obligations newly issued in any month is the average market yield, as of the last business day of the prior month, on all of the outstanding marketable U.S. obligations that are due or callable more than 4 years in the future. This rate is rounded to the nearest one-eighth of one percent. Beginning January 1999, in calculating the average market yield rate for this purpose, the Treasury incorporates the yield to the call date when a callable bond's market price is above par.

Although the Social Security Act does not authorize the purchase or sale of special issue securities in the open market, Treasury redeems special issue

[1] The HI Trust Fund receives the additional tax revenue resulting from the increase to 85 percent.

[2] A special provision applies to benefits paid to nonresident aliens. Effective for taxable years beginning after 1994, Public Law 103-465 subjects benefits to a flat-rate tax, usually 25.5 percent, before they are paid. Therefore, this tax remains in the trust funds. From 1984 to 1994, the flat-rate tax was usually 15 percent.

[3] The Social Security Act requires the trust funds to acquire special-issue obligations unless the Managing Trustee determines that the purchase of marketable obligations is in the public interest. The purchase of marketable obligations has been quite limited and has not occurred since 1980.

securities prior to maturity at par value when needed to meet current operating expenses. Given this separation from market-based valuations, changes in market yield rates do not cause fluctuations in principal value. As is true for marketable Treasury securities held by the public, the full faith and credit of the U.S. Government backs all of the investments held by the trust funds.

The primary annual expenditures of the OASI and DI Trust Funds are: (1) OASDI benefit payments[1], net of any reimbursements from the General Fund of the Treasury for unnegotiated benefit checks; and (2) expenses incurred by the Social Security Administration and the Department of the Treasury in administering the OASDI program and the provisions of the Internal Revenue Code relating to the collection of contributions. Such administrative expenses include, among other items, expenditures for (1) payroll, (2) construction, rental, lease, or purchase of office buildings and related facilities for the Social Security Administration, and (3) information technology systems. The Social Security Act prohibits expenditures from the OASI and DI Trust Funds for any purpose not related to the payment of benefits or administrative costs for the OASDI program.

The expenditures from the trust funds also include: (1) the costs of vocational rehabilitation services furnished to disabled persons receiving cash benefits because of their disabilities, where such services contributed to their successful rehabilitation; and (2) net costs of the provisions of the Railroad Retirement Act that provide for a system of coordination and financial interchange between the Railroad Retirement program and the Social Security program. Under the financial interchange provisions, the Railroad Retirement program's Social Security Equivalent Benefit Account and the trust funds interchange amounts on an annual basis so that each trust fund is in the same position it would have been had railroad employment always been covered under Social Security.

The statements of the operations of the trust funds in this report do not include the net worth of facilities and other fixed capital assets because the value of fixed capital assets is not available in the form of a financial asset redeemable for the payment of benefits or administrative expenditures. As a result of this unavailability, the actuarial status of the trust funds does not take these assets into account.

[1] Periodically, benefit payments which were scheduled to be paid on January 3 were actually paid on December 31 of the preceding year as required by the statutory provision included in the 1977 Social Security Amendments for early delivery of benefit payments when the normal payment delivery date is a Saturday, Sunday, or legal public holiday. Such advance payments have occurred about every 7 years, first for benefits scheduled for January 3, 1982. The most recent such accelerated payment affected benefits scheduled to be paid on January 3, 2016. For comparability with the values for historical years and the projections in this report, all trust fund operations and asset reserves reflect the 12 months of benefits scheduled for payment each year without regard to the accelerated payments described above.

Table VI.A1.— Operations of the OASI Trust Fund, Calendar Years 1937-2017
[Dollar amounts in billions]

	Income					Cost				Asset Reserves[a]		
Calendar year	Total	Net payroll tax contributions	GF reimbursements[b]	Taxation of benefits	Net interest[c]	Total[a]	Benefit payments[a d]	Administrative costs	RRB interchange	Net increase during year	Amount at end of year	Trust fund ratio[e]
1937[f] . .	$0.8	$0.8	—	—	[g]	[g]	[g]	—	—	$0.8	$0.8	—
1938[f] . .	.4	.4	—	—	[g]	[g]	[g]	—	—	.4	1.1	7,660
1939[f] . .	.6	.6	—	—	[g]	[g]	[g]	—	—	.6	1.7	8,086
1940 . .	.4	.3	—	—	[g]	$0.1	[g]	[g]	—	.3	2.0	2,781
1941 . .	.8	.8	—	—	$0.1	.1	$0.1	[g]	—	.7	2.8	1,782
1942 . .	1.1	1.0	—	—	.1	.2	.1	[g]	—	.9	3.7	1,737
1943 . .	1.3	1.2	—	—	.1	.2	.2	[g]	—	1.1	4.8	1,891
1944 . .	1.4	1.3	—	—	.1	.2	.2	[g]	—	1.2	6.0	2,025
1945 . .	1.4	1.3	—	—	.1	.3	.3	[g]	—	1.1	7.1	1,975
1946 . .	1.4	1.3	—	—	.2	.4	.4	[g]	—	1.0	8.1	1,704
1947 . .	1.7	1.6	[g]	—	.2	.5	.5	[g]	—	1.2	9.4	1,592
1948 . .	2.0	1.7	[g]	—	.3	.6	.6	$0.1	—	1.4	10.7	1,542
1949 . .	1.8	1.7	[g]	—	.1	.7	.7	.1	—	1.1	11.8	1,487
1950 . .	2.9	2.7	[g]	—	.3	1.0	1.0	.1	—	1.9	13.7	1,156
1951 . .	3.8	3.4	[g]	—	.4	2.0	1.9	.1	—	1.8	15.5	698
1952 . .	4.2	3.8	—	—	.4	2.3	2.2	.1	—	1.9	17.4	681
1953 . .	4.4	3.9	—	—	.4	3.1	3.0	.1	—	1.3	18.7	564
1954 . .	5.6	5.2	—	—	.4	3.7	3.7	.1	[g]	1.9	20.6	500
1955 . .	6.2	5.7	—	—	.5	5.1	5.0	.1	[g]	1.1	21.7	405
1956 . .	6.7	6.2	—	—	.5	5.8	5.7	.1	[g]	.9	22.5	371
1957 . .	7.4	6.8	—	—	.6	7.5	7.3	.2	[g]	-.1	22.4	300
1958 . .	8.1	7.6	—	—	.6	8.6	8.3	.2	$0.1	-.5	21.9	259
1959 . .	8.6	8.1	—	—	.5	10.3	9.8	.2	.3	-1.7	20.1	212
1960 . .	11.4	10.9	—	—	.5	11.2	10.7	.2	.3	.2	20.3	180
1961 . .	11.8	11.3	—	—	.5	12.4	11.9	.2	.3	-.6	19.7	163
1962 . .	12.6	12.1	—	—	.5	14.0	13.4	.3	.4	-1.4	18.3	141
1963 . .	15.1	14.5	—	—	.5	14.9	14.2	.3	.4	.1	18.5	123
1964 . .	16.3	15.7	—	—	.6	15.6	14.9	.3	.4	.6	19.1	118
1965 . .	16.6	16.0	—	—	.6	17.5	16.7	.3	.4	-.9	18.2	109
1966 . .	21.3	20.6	$0.1	—	.6	19.0	18.3	.3	.4	2.3	20.6	96
1967 . .	24.0	23.1	.1	—	.8	20.4	19.5	.4	.5	3.7	24.2	101
1968 . .	25.0	23.7	.4	—	.9	23.6	22.6	.5	.4	1.5	25.7	103
1969 . .	29.6	27.9	.4	—	1.2	25.2	24.2	.5	.5	4.4	30.1	102
1970 . .	32.2	30.3	.4	—	1.5	29.8	28.8	.5	.6	2.4	32.5	101
1971 . .	35.9	33.7	.5	—	1.7	34.5	33.4	.5	.6	1.3	33.8	94
1972 . .	40.1	37.8	.5	—	1.8	38.5	37.1	.7	.7	1.5	35.3	88
1973 . .	48.3	46.0	.4	—	1.9	47.2	45.7	.6	.8	1.2	36.5	75
1974 . .	54.7	52.1	.4	—	2.2	53.4	51.6	.9	.9	1.3	37.8	68
1975 . .	59.6	56.8	.4	—	2.4	60.4	58.5	.9	1.0	-.8	37.0	63
1976 . .	66.3	63.4	.6	—	2.3	67.9	65.7	1.0	1.2	-1.6	35.4	54
1977 . .	72.4	69.6	.6	—	2.2	75.3	73.1	1.0	1.2	-2.9	32.5	47
1978 . .	78.1	75.5	.6	—	2.0	83.1	80.4	1.1	1.6	-5.0	27.5	39
1979 . .	90.3	87.9	.6	—	1.8	93.1	90.6	1.1	1.4	-2.9	24.7	30
1980 . .	105.8	103.5	.5	—	1.8	107.7	105.1	1.2	1.4	-1.8	22.8	23
1981 . .	125.4	122.6	.7	—	2.1	126.7	123.8	1.3	1.6	-1.3	21.5	18
1982 . .	125.2	123.7	.7	—	.8	142.1	138.8	1.5	1.8	[h].6	22.1	15
1983 . .	150.6	138.3	5.5	—	6.7	153.0	149.2	1.5	2.3	-2.4	19.7	14
1984 . .	169.3	159.5	4.7	$2.8	2.3	161.9	157.8	1.6	2.4	7.4	27.1	[i]20
1985 . .	184.2	175.1	4.0	3.2	1.9	171.2	167.2	1.6	2.3	[h]8.7	35.8	[i]24
1986 . .	197.4	189.1	1.8	3.4	3.1	181.0	176.8	1.6	2.6	[h]3.2	39.1	[i]28
1987 . .	210.7	201.1	1.7	3.3	4.7	187.7	183.6	1.5	2.6	23.1	62.1	[i]30
1988 . .	240.8	227.7	2.1	3.4	7.6	200.0	195.5	1.8	2.8	40.7	102.9	[i]41
1989 . .	264.7	248.1	2.1	2.4	12.0	212.5	208.0	1.7	2.8	52.2	155.1	[i]59
1990 . .	286.7	266.1	-.7	4.8	16.4	227.5	223.0	1.6	3.0	59.1	214.2	[i]78
1991 . .	299.3	272.5	.1	5.9	20.8	245.6	240.5	1.8	3.4	53.7	267.8	87
1992 . .	311.2	281.1	-.1	5.9	24.3	259.9	254.9	1.8	3.1	51.3	319.1	103
1993 . .	323.3	290.9	[g]	5.3	27.0	273.1	267.8	2.0	3.4	50.2	369.3	117
1994 . .	328.3	293.3	[g]	5.0	29.9	284.1	279.1	1.6	3.4	44.1	413.5	130

Table VI.A1.— Operations of the OASI Trust Fund, Calendar Years 1937-2017 (Cont.)
[Dollar amounts in billions]

	Income					Cost				Asset Reserves[a]		
Calendar year	Total	Net payroll tax contributions	GF reimbursements[b]	Taxation of benefits	Net interest[c]	Total[a]	Benefit payments[a d]	Administrative costs	RRB interchange	Net increase during year	Amount at end of year	Trust fund ratio[e]
1995 . .	$342.8	$304.7	-$0.2	$5.5	$32.8	$297.8	$291.6	$2.1	$4.1	$45.0	$458.5	139
1996 . .	363.7	321.6	g	6.5	35.7	308.2	302.9	1.8	3.6	55.5	514.0	149
1997 . .	397.2	349.9	g	7.4	39.8	322.1	316.3	2.1	3.7	75.1	589.1	160
1998 . .	424.8	371.2	g	9.1	44.5	332.3	326.8	1.9	3.7	92.5	681.6	177
1999 . .	457.0	396.4	g	10.9	49.8	339.9	334.4	1.8	3.7	117.2	798.8	201
2000 . .	490.5	421.4	g	11.6	57.5	358.3	352.7	2.1	3.5	132.2	931.0	223
2001 . .	518.1	441.5	g	11.9	64.7	377.5	372.3	2.0	3.3	140.6	1,071.5	247
2002 . .	539.7	455.2	.4	12.9	71.2	393.7	388.1	2.1	3.5	146.0	1,217.5	272
2003 . .	543.8	456.1	g	12.5	75.2	406.0	399.8	2.6	3.6	137.8	1,355.3	300
2004 . .	566.3	472.8	g	14.6	79.0	421.0	415.0	2.4	3.6	145.3	1,500.6	322
2005 . .	604.3	506.9	-.3	13.8	84.0	441.9	435.4	3.0	3.6	162.4	1,663.0	340
2006 . .	642.2	534.8	g	15.6	91.8	461.0	454.5	3.0	3.5	181.3	1,844.3	361
2007 . .	675.0	560.9	g	17.2	97.0	495.7	489.1	3.1	3.6	179.3	2,023.6	372
2008 . .	695.5	574.6	g	15.6	105.3	516.2	509.3	3.2	3.6	179.3	2,202.9	392
2009 . .	698.2	570.4	g	19.9	107.9	564.3	557.2	3.4	3.7	133.9	2,336.8	390
2010 . .	677.1	544.8	2.0	22.1	108.2	584.9	577.4	3.5	3.9	92.2	2,429.0	400
2011 . .	698.8	482.4	87.8	22.2	106.5	603.8	596.2	3.5	4.1	95.0	2,524.1	402
2012 . .	731.1	503.9	97.7	26.7	102.8	645.5	637.9	3.4	4.1	85.6	2,609.7	391
2013 . .	743.8	620.8	4.2	20.7	98.1	679.5	672.1	3.4	3.9	64.3	2,674.0	384
2014 . .	769.4	646.2	.4	28.0	94.8	714.2	706.8	3.1	4.3	55.2	2,729.2	374
2015 . .	801.6	679.5	.3	30.6	91.2	750.5	742.9	3.4	4.3	51.0	2,780.3	364
2016 . .	797.5	678.8	.1	31.6	87.0	776.4	768.6	3.5	4.3	21.1	2,801.3	358
2017 . .	825.6	706.5	g	35.9	83.2	806.7	798.7	3.7	4.3	19.0	2,820.3	347

[a] Beginning in 1979, benefit payments scheduled to be paid on January 3 of a given year were paid on December 31 of the preceding year as required by the statutory provision included in the 1977 Social Security Amendments for early delivery of benefit payments when the normal payment delivery date is a Saturday, Sunday, or legal public holiday. Such advance payments have occurred about every 7 years, first for benefits scheduled for January 3, 1982. For comparability with other historical years and the projections in this report, all trust fund operations and asset reserves reflect the 12 months of benefits scheduled for payment in each year without regard to the accelerated payments described above.

[b] Includes net reimbursements from the General Fund of the Treasury to the OASI Trust Fund for: (1) the cost of noncontributory wage credits for military service before 1957; (2) the cost in 1971-82 of deemed wage credits for military service performed after 1956; (3) the cost of benefits to certain uninsured persons who attained age 72 before 1968; (4) the cost of payroll tax credits provided to employees in 1984 and self-employed persons in 1984-89 by Public Law 98-21; (5) the cost in 2009-17 of excluding certain self-employment earnings from SECA taxes under Public Law 110-246; and (6) payroll tax revenue forgone under the provisions of Public Laws 111-147, 111-312, 112-78, and 112-96.

[c] Net interest includes net profits or losses on marketable investments. Beginning in 1967, the trust fund pays administrative expenses on an estimated basis, with a final adjustment including interest made in the following fiscal year. Net interest includes the amounts of these interest adjustments. The 1970 report describes the accounting for administrative expenses for years prior to 1967. Beginning in October 1973, figures include relatively small amounts of gifts to the fund. Net interest for 1983-86 reflects payments for interest on amounts owed under the interfund borrowing provisions. During 1983-90, net interest reflects interest reimbursements paid from the trust fund to the General Fund on advance tax transfers.

[d] Beginning in 1966, includes payments for vocational rehabilitation services furnished to disabled persons receiving benefits because of their disabilities. Beginning in 1983, net benefit amounts include reimbursements paid from the General Fund to the trust fund for unnegotiated benefit checks. Excluding the portion attributable to vocational rehabilitation services and unnegotiated benefit checks, amounts are the same as benefits scheduled under law at that time for all historical years.

[e] The "Trust fund ratio" column represents asset reserves at the beginning of a year as a percentage of expenditures during the year. The table shows no ratio for 1937 because no reserves existed at the beginning of the year.

[f] Operations prior to 1940 are for the Old-Age Reserve Account established by the original Social Security Act. The 1939 Amendments transferred the asset reserves of the Account to the OASI Trust Fund effective January 1, 1940.

[g] Between -$50 million and $50 million.

[h] Reflects interfund borrowing and subsequent repayment of loans. The OASI Trust Fund borrowed $17.5 billion from the DI and HI Trust Funds in 1982 and repaid the loans in 1985 ($4.4 billion) and 1986 ($13.2 billion).

[i] Reserves used for the trust fund ratio calculation include January advance tax transfers.

Note: Totals do not necessarily equal the sums of rounded components.

Table VI.A2.— Operations of the DI Trust Fund, Calendar Years 1957-2017
[Dollar amounts in billions]

	Income					Cost				Asset Reserves[a]		
Calendar year	Total	Net payroll tax contributions	GF reimbursements[b]	Taxation of benefits	Net interest[c]	Total[a]	Benefit payments[a d]	Administrative costs	RRB interchange	Net increase during year	Amount at end of year	Trust fund ratio[e]
1957 . .	$0.7	$0.7	—	—	f	$0.1	$0.1	f	—	$0.6	$0.6	—
1958 . .	1.0	1.0	—	—	f	.3	.2	f	—	.7	1.4	249
1959 . .	.9	.9	—	—	f	.5	.5	f	f	.4	1.8	284
1960 . .	1.1	1.0	—	—	$0.1	.6	.6	f	f	.5	2.3	304
1961 . .	1.1	1.0	—	—	.1	1.0	.9	$0.1	f	.1	2.4	239
1962 . .	1.1	1.0	—	—	.1	1.2	1.1	.1	f	-.1	2.4	206
1963 . .	1.2	1.1	—	—	.1	1.3	1.2	.1	f	-.1	2.2	183
1964 . .	1.2	1.2	—	—	.1	1.4	1.3	.1	f	-.2	2.0	159
1965 . .	1.2	1.2	—	—	.1	1.7	1.6	.1	f	-.4	1.6	121
1966 . .	2.1	2.0	f	—	.1	1.9	1.8	.1	f	.1	1.7	82
1967 . .	2.4	2.3	f	—	.1	2.1	1.9	.1	f	.3	2.0	83
1968 . .	3.5	3.3	f	—	.1	2.5	2.3	.1	f	1.0	3.0	83
1969 . .	3.8	3.6	f	—	.2	2.7	2.6	.1	f	1.1	4.1	111
1970 . .	4.8	4.5	f	—	.3	3.3	3.1	.2	f	1.5	5.6	126
1971 . .	5.0	4.6	$0.1	—	.4	4.0	3.8	.2	f	1.0	6.6	140
1972 . .	5.6	5.1	.1	—	.4	4.8	4.5	.2	f	.8	7.5	140
1973 . .	6.4	5.9	.1	—	.5	6.0	5.8	.2	f	.5	7.9	125
1974 . .	7.4	6.8	.1	—	.5	7.2	7.0	.2	f	.2	8.1	110
1975 . .	8.0	7.4	.1	—	.5	8.8	8.5	.3	f	-.8	7.4	92
1976 . .	8.8	8.2	.1	—	.4	10.4	10.1	.3	f	-1.6	5.7	71
1977 . .	9.6	9.1	.1	—	.3	11.9	11.5	.4	f	-2.4	3.4	48
1978 . .	13.8	13.4	.1	—	.3	13.0	12.6	.3	f	.9	4.2	26
1979 . .	15.6	15.1	.1	—	.4	14.2	13.8	.4	f	1.4	5.6	30
1980 . .	13.9	13.3	.1	—	.5	15.9	15.5	.4	f	-2.0	3.6	35
1981 . .	17.1	16.7	.2	—	.2	17.7	17.2	.4	f	-.6	3.0	21
1982 . .	22.7	22.0	.2	—	.5	18.0	17.4	.6	f	[g] -.4	2.7	17
1983 . .	20.7	18.0	1.1	—	1.6	18.2	17.5	.6	f	2.5	5.2	15
1984 . .	17.3	15.5	.4	$0.2	1.2	18.5	17.9	.6	f	-1.2	4.0	[h]35
1985 . .	19.3	17.0	1.2	.2	.9	19.5	18.8	.6	f	[g]2.4	6.3	[h]27
1986 . .	19.4	18.2	.2	.2	.8	20.5	19.9	.6	$0.1	[g]1.5	7.8	[h]38
1987 . .	20.3	19.5	.2	f	.6	21.4	20.5	.8	.1	-1.1	6.7	[h]44
1988 . .	22.7	21.8	.2	.1	.6	22.5	21.7	.7	.1	.2	6.9	[h]38
1989 . .	24.8	23.8	.2	.1	.7	23.8	22.9	.8	.1	1.0	7.9	[h]38
1990 . .	28.8	28.4	-.6	.1	.9	25.6	24.8	.7	.1	3.2	11.1	[h]40
1991 . .	30.4	29.1	f	.2	1.1	28.6	27.7	.8	.1	1.8	12.9	39
1992 . .	31.4	30.1	f	.2	1.1	32.0	31.1	.8	.1	-.6	12.3	40
1993 . .	32.3	31.2	f	.3	.8	35.7	34.6	1.0	.1	-3.4	9.0	35
1994 . .	52.8	51.4	f	.3	1.2	38.9	37.7	1.0	.1	14.0	22.9	23
1995 . .	56.7	54.4	-.2	.3	2.2	42.1	40.9	1.1	.1	14.6	37.6	55
1996 . .	60.7	57.3	f	.4	3.0	45.4	44.2	1.2	f	15.4	52.9	83
1997 . .	60.5	56.0	f	.5	4.0	47.0	45.7	1.3	.1	13.5	66.4	113
1998 . .	64.4	59.0	f	.6	4.8	49.9	48.2	1.6	.2	14.4	80.8	133
1999 . .	69.5	63.2	f	.7	5.7	53.0	51.4	1.5	.1	16.5	97.3	152
2000 . .	77.9	71.1	-.8	.7	6.9	56.8	55.0	1.6	.2	21.1	118.5	171
2001 . .	83.9	74.9	f	.8	8.2	61.4	59.6	1.7	f	22.5	141.0	193
2002 . .	87.4	77.3	f	.9	9.2	67.9	65.7	2.0	.2	19.5	160.5	208
2003 . .	88.1	77.4	f	.9	9.7	73.1	70.9	2.0	.2	15.0	175.4	219
2004 . .	91.4	80.3	f	1.1	10.0	80.6	78.2	2.2	.2	10.8	186.2	218
2005 . .	97.4	86.1	f	1.1	10.3	88.0	85.4	2.3	.3	9.4	195.6	212
2006 . .	102.6	90.8	f	1.2	10.6	94.5	91.7	2.3	.4	8.2	203.8	207
2007 . .	109.9	95.2	f	1.4	13.2	98.8	95.9	2.5	.4	11.1	214.9	206
2008 . .	109.8	97.6	f	1.3	11.0	109.0	106.0	2.5	.4	.9	215.8	197
2009 . .	109.3	96.9	f	2.0	10.5	121.5	118.3	2.7	.4	-12.2	203.5	178

Table VI.A2.— Operations of the DI Trust Fund, Calendar Years 1957-2017 (Cont.)
[Dollar amounts in billions]

	Income					Cost				Asset Reserves[a]		
Calendar year	Total	Net payroll tax contributions	GF reimbursements[b]	Taxation of benefits	Net interest[c]	Total[a]	Benefit payments[a d]	Administrative costs	RRB interchange	Net increase during year	Amount at end of year	Trust fund ratio[e]
2010. . .	$104.0	$92.5	$0.4	$1.9	$9.3	$127.7	$124.2	$3.0	$0.5	-$23.6	$179.9	159
2011. . .	106.3	81.9	14.9	1.6	7.9	132.3	128.9	2.9	.5	-26.1	153.9	136
2012. . .	109.1	85.6	16.5	.6	6.4	140.3	136.9	2.9	.5	-31.2	122.7	110
2013. . .	111.2	105.4	.7	.4	4.7	143.4	140.1	2.8	.6	-32.2	90.4	86
2014. . .	114.9	109.7	.1	1.7	3.4	145.1	141.7	2.9	.4	-30.2	60.2	62
2015. . .	118.6	115.4	[f]	1.1	2.1	146.6	143.4	2.8	.4	-28.0	32.3	41
2016. . .	160.0	157.4	[f]	1.2	1.4	145.9	142.8	2.8	.4	14.1	46.3	22
2017. . .	171.0	167.1	[f]	2.0	1.9	145.8	142.8	2.8	.2	25.1	71.5	32

[a] Beginning in 1979, benefit payments scheduled to be paid on January 3 of a given year were paid on December 31 of the preceding year as required by the statutory provision included in the 1977 Social Security Amendments for early delivery of benefit payments when the normal payment delivery date is a Saturday, Sunday, or legal public holiday. Such advance payments have occurred about every 7 years, first for benefits scheduled for January 3, 1982. For comparability with other historical years and the projections in this report, all trust fund operations and asset reserves reflect the 12 months of benefits scheduled for payment in each year without regard to the accelerated payments described above.
[b] Includes net reimbursements from the General Fund of the Treasury to the DI Trust Fund for: (1) the cost of noncontributory wage credits for military service before 1957; (2) the cost in 1971-82 of deemed wage credits for military service performed after 1956; (3) the cost of payroll tax credits provided to employees in 1984 and self-employed persons in 1984-89 by Public Law 98-21; (4) the cost in 2009-17 of excluding certain self-employment earnings from SECA taxes under Public Law 110-246; and (5) payroll tax revenue forgone under the provisions of Public Laws 111-147, 111-312, 112-78, and 112-96.
[c] Net interest includes net profits or losses on marketable investments. Beginning in 1967, the trust fund pays administrative expenses on an estimated basis, with a final adjustment including interest made in the following fiscal year. Net interest includes the amounts of these interest adjustments. The 1970 report describes the accounting for administrative expenses for years prior to 1967. Beginning in July 1974, figures include relatively small amounts of gifts to the fund. Net interest for 1983-86 reflects payments for interest on amounts owed under the interfund borrowing provisions. During 1983-90, net interest reflects interest reimbursements paid from the trust fund to the General Fund on advance tax transfers.
[d] Beginning in 1966, includes payments for vocational rehabilitation services furnished to disabled persons receiving benefits because of their disabilities. Beginning in 1983, net benefit amounts include reimbursements paid from the General Fund to the trust fund for unnegotiated benefit checks. Excluding the portion attributable to vocational rehabilitation services and unnegotiated benefit checks, amounts are the same as benefits scheduled under law at that time for all historical years.
[e] The "Trust fund ratio" column represents asset reserves at the beginning of a year as a percentage of expenditures during the year. The table shows no ratio for 1957 because no reserves existed at the beginning of the year.
[f] Between -$50 million and $50 million.
[g] Reflects interfund borrowing and subsequent repayment of loans. The DI Trust Fund loaned $5.1 billion to the OASI Trust Fund in 1982. The OASI Trust Fund repaid the loan in 1985 ($2.5 billion) and 1986 ($2.5 billion).
[h] Reserves used for the trust fund ratio calculation include January advance tax transfers.

Note: Totals do not necessarily equal the sums of rounded components.

Appendices

Table VI.A3.— Operations of the Combined OASI and DI Trust Funds, Calendar Years 1957-2017
[Dollar amounts in billions]

	Income					Cost				Asset Reserves[a]		
Calendar year	Total	Net payroll tax contributions	GF reimbursements[b]	Taxation of benefits	Net interest[c]	Total[a]	Benefit payments[a d]	Administrative costs	RRB interchange	Net increase during year	Amount at end of year	Trust fund ratio[e]
1957 . .	$8.1	$7.5	—	—	$0.6	$7.6	$7.4	$0.2	[f]	$0.5	$23.0	298
1958	9.1	8.5	—	—	.6	8.9	8.6	.2	$0.1	.2	23.2	259
1959 . .	9.5	8.9	—	—	.6	10.8	10.3	.2	.3	-1.3	22.0	215
1960 . .	12.4	11.9	—	—	.6	11.8	11.2	.2	.3	.6	22.6	186
1961 . .	12.9	12.3	—	—	.6	13.4	12.7	.3	.3	-.5	22.2	169
1962 . .	13.7	13.1	—	—	.6	15.2	14.5	.3	.4	-1.5	20.7	146
1963 . .	16.2	15.6	—	—	.6	16.2	15.4	.3	.4	[f]	20.7	128
1964 . .	17.5	16.8	—	—	.6	17.0	16.2	.4	.4	.5	21.2	122
1965 . .	17.9	17.2	—	—	.7	19.2	18.3	.4	.5	-1.3	19.8	110
1966 . .	23.4	22.6	$0.1	—	.7	20.9	20.1	.4	.5	2.5	22.3	95
1967 . .	26.4	25.4	.1	—	.9	22.5	21.4	.5	.5	3.9	26.3	99
1968 . .	28.5	27.0	.4	—	1.0	26.0	25.0	.6	.5	2.5	28.7	101
1969 . .	33.3	31.5	.5	—	1.3	27.9	26.8	.6	.5	5.5	34.2	103
1970 . .	37.0	34.7	.5	—	1.8	33.1	31.9	.6	.6	3.9	38.1	103
1971 . .	40.9	38.3	.5	—	2.0	38.5	37.2	.7	.6	2.4	40.4	99
1972 . .	45.6	42.9	.5	—	2.2	43.3	41.6	.9	.7	2.3	42.8	93
1973 . .	54.8	51.9	.5	—	2.4	53.1	51.5	.8	.8	1.6	44.4	80
1974 . .	62.1	58.9	.5	—	2.7	60.6	58.6	1.1	.9	1.5	45.9	73
1975 . .	67.6	64.3	.5	—	2.9	69.2	67.0	1.2	1.0	-1.5	44.3	66
1976 . .	75.0	71.6	.7	—	2.7	78.2	75.8	1.2	1.2	-3.2	41.1	57
1977 . .	82.0	78.7	.7	—	2.5	87.3	84.7	1.4	1.2	-5.3	35.9	47
1978 . .	91.9	88.9	.8	—	2.3	96.0	93.0	1.4	1.6	-4.1	31.7	37
1979 . .	105.9	103.0	.7	—	2.2	107.3	104.4	1.5	1.5	-1.5	30.3	30
1980 . .	119.7	116.7	.7	—	2.3	123.5	120.6	1.5	1.4	-3.8	26.5	25
1981 . .	142.4	139.4	.8	—	2.2	144.4	141.0	1.7	1.6	-1.9	24.5	18
1982 . .	147.9	145.7	.9	—	1.4	160.1	156.2	2.1	1.8	[g] .2	24.8	15
1983 . .	171.3	156.3	6.7	—	8.3	171.2	166.7	2.2	2.3	.1	24.9	14
1984 . .	186.6	175.0	5.2	$3.0	3.4	180.4	175.7	2.3	2.4	6.2	31.1	[h]21
1985 . .	203.5	192.1	5.2	3.4	2.7	190.6	186.1	2.2	2.4	[g]11.1	42.2	[h]24
1986 . .	216.8	207.4	1.9	3.7	3.9	201.5	196.7	2.2	2.7	[g] 4.7	46.9	[h]29
1987 . .	231.0	220.6	1.9	3.2	5.3	209.1	204.1	2.4	2.6	21.9	68.8	[h]31
1988 . .	263.5	249.5	2.3	3.4	8.2	222.5	217.1	2.5	2.9	41.0	109.8	[h]41
1989 . .	289.4	271.9	2.3	2.5	12.7	236.2	230.9	2.4	2.9	53.2	163.0	[h]57
1990 . .	315.4	294.5	-1.3	5.0	17.2	253.1	247.8	2.3	3.0	62.3	225.3	[h]75
1991 . .	329.7	301.6	.1	6.1	21.9	274.2	268.2	2.6	3.5	55.5	280.7	82
1992 . .	342.6	311.3	-.1	6.1	25.4	291.9	286.0	2.7	3.2	50.7	331.5	96
1993 . .	355.6	322.0	.1	5.6	27.9	308.8	302.4	3.0	3.4	46.8	378.3	107
1994 . .	381.1	344.7	[f]	5.3	31.1	323.0	316.8	2.7	3.5	58.1	436.4	117
1995 . .	399.5	359.1	-.4	5.8	35.0	339.8	332.6	3.1	4.1	59.7	496.1	128
1996 . .	424.5	378.9	[f]	6.8	38.7	353.6	347.0	3.0	3.6	70.9	567.0	140
1997 . .	457.7	406.0	[f]	7.9	43.8	369.1	362.0	3.4	3.7	88.6	655.5	154
1998 . .	489.2	430.2	[f]	9.7	49.3	382.3	375.0	3.5	3.8	106.9	762.5	171
1999 . .	526.6	459.6	[f]	11.6	55.5	392.9	385.8	3.3	3.8	133.7	896.1	194
2000 . .	568.4	492.5	-.8	12.3	64.5	415.1	407.6	3.8	3.7	153.3	1,049.4	216
2001 . .	602.0	516.4	[f]	12.7	72.9	438.9	431.9	3.7	3.3	163.1	1,212.5	239
2002 . .	627.1	532.5	.4	13.8	80.4	461.7	453.8	4.2	3.6	165.4	1,378.0	263
2003 . .	631.9	533.5	[f]	13.4	84.9	479.1	470.8	4.6	3.7	152.8	1,530.8	288
2004 . .	657.7	553.0	[f]	15.7	89.0	501.6	493.3	4.5	3.8	156.1	1,686.8	305
2005 . .	701.8	592.9	-.3	14.9	94.3	529.9	520.7	5.3	3.9	171.8	1,858.7	318
2006 . .	744.9	625.6	[f]	16.9	102.4	555.4	546.2	5.3	3.8	189.5	2,048.1	335
2007 . .	784.9	656.1	[f]	18.6	110.2	594.5	584.9	5.5	4.0	190.4	2,238.5	345
2008 . .	805.3	672.1	[f]	16.9	116.3	625.1	615.3	5.7	4.0	180.2	2,418.7	358
2009 . .	807.5	667.3	[f]	21.9	118.3	685.8	675.5	6.2	4.1	121.7	2,540.3	353

Table VI.A3.— Operations of the Combined OASI and DI Trust Funds, Calendar Years 1957-2017 (Cont.)
[Dollar amounts in billions]

	Income					Cost				Asset Reserves[a]		
Calendar year	Total	Net payroll tax contributions	GF reimbursements[b]	Taxation of benefits	Net interest[c]	Total[a]	Benefit payments[a d]	Administrative costs	RRB interchange	Net increase during year	Amount at end of year	Trust fund ratio[e]
2010 . . .	$781.1	$637.3	$2.4	$23.9	$117.5	$712.5	$701.6	$6.5	$4.4	$68.6	$2,609.0	357
2011 . . .	805.1	564.2	102.7	23.8	114.4	736.1	725.1	6.4	4.6	69.0	2,677.9	354
2012 . . .	840.2	589.5	114.3	27.3	109.1	785.8	774.8	6.3	4.7	54.4	2,732.3	341
2013 . . .	855.0	726.2	4.9	21.1	102.8	822.9	812.3	6.2	4.5	32.1	2,764.4	332
2014 . . .	884.3	756.0	.5	29.6	98.2	859.2	848.5	6.1	4.7	25.0	2,789.5	322
2015 . . .	920.2	794.9	.3	31.6	93.3	897.1	886.3	6.2	4.7	23.0	2,812.5	311
2016 . . .	957.5	836.2	.1	32.8	88.4	922.3	911.4	6.2	4.7	35.2	2,847.7	305
2017 . . .	996.6	873.6	[f]	37.9	85.1	952.5	941.5	6.5	4.5	44.1	2,891.8	299

[a] Beginning in 1979, benefit payments scheduled to be paid on January 3 of a given year were paid on December 31 of the preceding year as required by the statutory provision included in the 1977 Social Security Amendments for early delivery of benefit payments when the normal payment delivery date is a Saturday, Sunday, or legal public holiday. Such advance payments have occurred about every 7 years, first for benefits scheduled for January 3, 1982. For comparability with other historical years and the projections in this report, all trust fund operations and asset reserves reflect the 12 months of benefits scheduled for payment in each year without regard to the accelerated payments described above.
[b] Includes net reimbursements from the General Fund of the Treasury to the OASI and DI Trust Funds for: (1) the cost of noncontributory wage credits for military service before 1957; (2) the cost in 1971-82 of deemed wage credits for military service performed after 1956; (3) the cost of benefits to certain uninsured persons who attained age 72 before 1968; (4) the cost of payroll tax credits provided to employees in 1984 and self-employed persons in 1984-89 by Public Law 98-21; (5) the cost in 2009-17 of excluding certain self-employment earnings from SECA taxes under Public Law 110-246; and (6) payroll tax revenue forgone under the provisions of Public Laws 111-147, 111-312, 112-78, and 112-96.
[c] Net interest includes net profits or losses on marketable investments. Beginning in 1967, the trust funds pay administrative expenses on an estimated basis, with a final adjustment including interest made in the following fiscal year. Net interest includes the amounts of these interest adjustments. The 1970 report describes the accounting for administrative expenses for years prior to 1967. Beginning in October 1973, figures include relatively small amounts of gifts to the funds. Net interest for 1983-86 reflects payments for interest on amounts owed under the interfund borrowing provisions. During 1983-90, net interest reflects interest reimbursements paid from the trust funds to the General Fund on advance tax transfers.
[d] Beginning in 1966, includes payments for vocational rehabilitation services furnished to disabled persons receiving benefits because of their disabilities. Beginning in 1983, net benefit amounts include reimbursements paid from the General Fund to the trust funds for unnegotiated benefit checks. Excluding the portion attributable to vocational rehabilitation services and unnegotiated benefit checks, amounts are the same as benefits scheduled under law at that time for all historical years.
[e] The "Trust fund ratio" column represents asset reserves at the beginning of a year as a percentage of expenditures during the year.
[f] Between -$50 million and $50 million.
[g] Reflects interfund borrowing and subsequent repayment of loans. The OASI Trust Fund borrowed $12.4 billion from the HI Trust Fund in 1982 and repaid the loan in 1985 ($1.8 billion) and 1986 ($10.6 billion).
[h] Reserves used for the trust fund ratio calculation include January advance tax transfers.

Note: Totals do not necessarily equal the sums of rounded components.

Tables VI.A4 and VI.A5 show the total asset reserves of the OASI Trust Fund and the DI Trust Fund, respectively, at the end of calendar years 2016 and 2017. The tables show the invested asset reserves by interest rate and year of maturity. Bonds issued to the trust funds in 2017 had an interest rate of 2.250 percent, compared with an interest rate of 1.875 percent for bonds issued in 2016.

Table VI.A4.—OASI Trust Fund Asset Reserves, End of Calendar Years 2016 and 2017
[In thousands]

	December 31, 2016	December 31, 2017
Obligations sold only to the trust funds (special issue securities):		
Certificates of indebtedness:		
2.375 percent, 2017	50,383,106	—
2.375 percent, 2018	—	$48,361,532
Bonds:		
1.375 percent, 2018	6,693,020	
1.375 percent, 2019-25	46,851,140	46,851,140
1.375 percent, 2026	6,693,019	6,693,019
1.375 percent, 2027	173,240,401	173,240,401
1.750 percent, 2018	4,908,186	—
1.750 percent, 2019-25	34,357,295	34,357,295
1.750 percent, 2026-27	9,816,372	9,816,372
1.750 percent, 2028	178,148,587	178,148,587
1.875 percent, 2018	2,320,955	—
1.875 percent, 2019	2,320,955	2,320,955
1.875 percent, 2020-27	18,567,648	18,567,648
1.875 percent, 2028-30	6,962,865	6,962,865
1.875 percent, 2031	188,111,583	188,111,583
2.000 percent, 2018	3,655,629	—
2.000 percent, 2019	3,655,629	3,655,629
2.000 percent, 2020-25	21,933,768	21,933,768
2.000 percent, 2026-29	14,622,516	14,622,516
2.000 percent, 2030	185,790,628	185,790,628
2.250 percent, 2018	3,986,412	—
2.250 percent, 2019	3,986,413	5,582,927
2.250 percent, 2020	3,986,413	5,582,927
2.250 percent, 2021	3,986,413	5,582,927
2.250 percent, 2022	3,986,413	5,582,927
2.250 percent, 2023	3,986,413	5,582,927
2.250 percent, 2024	3,986,413	5,582,927
2.250 percent, 2025	3,986,413	5,582,927
2.250 percent, 2026	3,986,412	5,582,926
2.250 percent, 2027	3,986,412	5,582,926
2.250 percent, 2028	3,986,412	5,582,927
2.250 percent, 2029	182,134,999	183,731,514
2.250 percent, 2030-31	—	3,193,030
2.250 percent, 2032	—	189,708,097
2.500 percent, 2018	5,971,787	—
2.500 percent, 2019-25	41,802,509	41,802,509
2.500 percent, 2026	166,547,382	166,547,382
2.875 percent, 2018	7,264,432	—
2.875 percent, 2019-24	43,586,592	43,586,592
2.875 percent, 2025	160,575,595	160,575,595
3.250 percent, 2018	10,628,270	—
3.250 percent, 2019-23	53,141,350	53,141,350
3.250 percent, 2024	153,311,163	153,311,163
3.500 percent, 2018	86,900,994	60,311,343
4.000 percent, 2018-22	60,375,960	60,375,960
4.000 percent, 2023	142,682,893	142,682,893
4.125 percent, 2017	6,883,312	—
4.125 percent, 2018-19	21,033,892	21,033,892
4.125 percent, 2020	106,585,700	106,585,700
4.625 percent, 2017	9,167,663	—
4.625 percent, 2018	9,167,663	9,167,663

Table VI.A4.—OASI Trust Fund Asset Reserves, End of Calendar Years 2016 and 2017 (Cont.)
[In thousands]

	December 31, 2016	December 31, 2017
4.625 percent, 2019	96,068,657	96,068,657
5.000 percent, 2017	12,454,232	—
5.000 percent, 2018-21	49,816,928	49,816,928
5.000 percent, 2022	130,607,701	130,607,701
5.125 percent, 2017	11,567,866	—
5.125 percent, 2018-19	23,135,732	23,135,732
5.125 percent, 2020	11,567,769	11,567,769
5.125 percent, 2021	118,153,469	118,153,469
5.250 percent, 2017	77,387,242	—
Total investments	2,801,405,593	2,820,368,145
Undisbursed balances[a]	-56,915	-58,948
Total asset reserves	2,801,348,678	2,820,309,197

[a] A negative amount for a given year represents a situation where actual program cash expenditures exceeded the amount of invested securities of the OASI Trust Fund that were redeemed to pay for such expenditures. In this situation, future redemption of additional invested securities will be required to pay for this shortfall.

Note: Amounts of special issue securities are at par value. The trust fund purchases and redeems special issue securities at par value. The table groups equal amounts that mature in two or more years at a given interest rate.

Table VI.A5.—DI Trust Fund Asset Reserves, End of Calendar Years 2016 and 2017
[In thousands]

	December 31, 2016	December 31, 2017
Obligations sold only to the trust funds (special issue securities):		
Certificates of indebtedness:		
2.375 percent, 2017	$8,437,206	—
2.375 percent, 2018	—	$14,830,708
Bonds:		
1.875 percent, 2018	180,001	—
1.875 percent, 2019-22	12,045,560	12,045,560
2.250 percent, 2019-20	—	12,619,604
2.250 percent, 2021	—	6,309,801
4.000 percent, 2023	14,675,554	14,675,554
5.000 percent, 2022	11,142,596	11,142,596
Total investments	46,480,917	71,623,823
Undisbursed balances[a]	-143,066	-143,810
Total asset reserves	46,337,851	71,480,013

[a] A negative amount for a given year represents a situation where actual program cash expenditures exceeded the amount of invested securities of the DI Trust Fund that were redeemed to pay for such expenditures. In this situation, future redemption of additional invested securities will be required to pay for this shortfall.

Note: Amounts of special issue securities are at par value. The trust fund purchases and redeems special issue securities at par value. The table groups equal amounts that mature in two or more years at a given interest rate.

B. HISTORY OF ACTUARIAL STATUS ESTIMATES

This appendix chronicles the history of the OASDI actuarial balance and the year of combined OASI and DI Trust Fund reserve depletion since 1982 under the intermediate assumptions. The actuarial balance is the principal summary measure of actuarial status for the long-range period as a whole. The year of trust fund reserve depletion is also critical, as it indicates the year by which legislative action would be needed in order to maintain timely payment of scheduled benefits.

The 1983 report was the last report for which the actuarial balance was positive. The two basic components of actuarial balance are the summarized income rate and the summarized cost rate, both of which are expressed as percentages of taxable payroll over the period. Section IV.B.4 defines the summarized income rate, summarized cost rate, and actuarial balance in detail. For any given period, the actuarial balance includes the difference between the present value of non-interest income for the period and the present value of the cost for the period, each divided by the present value of taxable payroll for all years in the period. The computation of the actuarial balance also includes:

- In the reports for 1988 and later, the amount of the trust fund asset reserves on hand at the beginning of the valuation period; and
- In the reports for 1991 and later, the present value of a target trust fund asset reserve equal to 100 percent of the annual cost to be reached and maintained at the end of the valuation period.

Reports of 1973-87 used the average-cost method, a simpler method which approximates the results of the present-value approach for computing the actuarial balance. Under the average-cost method, the sum of the annual cost rates over the 75-year projection period was divided by the total number of years, 75, to obtain the average cost rate per year. A similar computation produced the average income rate. The actuarial balance was the difference between the average income rate and the average cost rate.

When the 1973 report introduced the average-cost method, the financing of the program was more nearly on a pay-as-you-go basis over the long-range. Also, the long-range demographic and economic assumptions in that report produced an annual rate of growth in total taxable payroll which was about the same as the annual rate at which the trust funds earned interest. In either circumstance (i.e., pay-as-you-go financing, where the annual income rate is the same as the annual cost rate, or an annual rate of growth in total taxable payroll equal to the annual interest rate), the average-cost method produces the same result as the present-value method. However, by 1988, neither of these circumstances still existed.

After the 1977 and 1983 Social Security Amendments, projections indicated substantial increases in the trust fund reserves continuing well into the 21st century. These laws changed the program's financing from essentially pay-as-you-go to partial advance funding through the 75-year period. Also, for the reports from 1973 through 1987, long-range fertility rates and average real-wage growth assumptions were gradually reduced, resulting in an annual rate of growth in taxable payroll that was significantly lower than the assumed interest rate by 1987. As a result of the difference between this rate of growth and the assumed interest rate, the results of the average-cost method and the present-value method began to diverge in the reports for 1973 through 1987, and by 1988 they were quite different. While the average-cost method reflected most of the effects of assumed interest rates, it no longer reflected all interest effects. The present-value method, by contrast, accurately reflects the implications of assumed interest rates. As a result, the 1988 report reintroduced the present-value method of calculating the actuarial balance.

A positive actuarial balance indicates that estimated income (plus starting reserves, beginning with the 1988 report) is more than sufficient to meet estimated trust fund obligations (plus the ending target fund, beginning with the 1991 report) for the period as a whole. Even with a positive actuarial balance, it is possible for reserves to become temporarily depleted within the long-range period. An actuarial balance of zero indicates that the estimated income (plus starting reserves, beginning with the 1988 report) exactly matches estimated trust fund obligations (plus the ending target fund, beginning with the 1991 report) for the period as a whole. A negative actuarial balance indicates that estimated income (plus starting reserves, beginning with the 1988 report) is insufficient to meet estimated trust fund obligations (plus the ending target fund, beginning with the 1991 report) for the entire period.

Table VI.B1 contains the estimated OASDI actuarial balances, summarized income rates, and summarized cost rates for the 1982 report through the current report. The reports presented these values on the basis of the intermediate assumptions, which recent reports refer to as alternative II and reports from 1982 to 1990 referred to as alternative II-B.

Table VI.B1.—Long-Range OASDI Actuarial Balances and Trust Fund Reserve Depletion Dates as Shown in the Trustees Reports for 1982-2018 under Intermediate Assumptions[a]
[As a percentage of taxable payroll]

Year of report	Summarized income rate	Summarized cost rate	Actuarial balance[b]	Change from previous year[c]	Year of combined trust fund reserve depletion
1982	12.27	14.09	-1.82	[d]	1983
1983	12.87	12.84	+.02	+1.84	solvent
1984	12.90	12.95	-.06	-.08	solvent
1985	12.94	13.35	-.41	-.35	2049
1986	12.96	13.40	-.44	-.03	2051
1987	12.89	13.51	-.62	-.18	2051
1988	12.94	13.52	-.58	+.04	2048
1989	13.02	13.72	-.70	-.13	2046
1990	13.04	13.95	-.91	-.21	2043
1991	13.11	14.19	-1.08	-.17	2041
1992	13.16	14.63	-1.46	-.38	2036
1993	13.21	14.67	-1.46	[d]	2036
1994	13.24	15.37	-2.13	-.66	2029
1995	13.27	15.44	-2.17	-.04	2030
1996	13.33	15.52	-2.19	-.02	2029
1997	13.37	15.60	-2.23	-.03	2029
1998	13.45	15.64	-2.19	+.04	2032
1999	13.49	15.56	-2.07	+.12	2034
2000	13.51	15.40	-1.89	+.17	2037
2001	13.58	15.44	-1.86	+.03	2038
2002	13.72	15.59	-1.87	-.01	2041
2003	13.78	15.70	-1.92	-.04	2042
2004	13.84	15.73	-1.89	+.03	2042
2005	13.87	15.79	-1.92	-.04	2041
2006	13.88	15.90	-2.02	-.09	2040
2007	13.92	15.87	-1.95	+.06	2041
2008	13.94	15.63	-1.70	+.26	2041
2009	14.02	16.02	-2.00	-.30	2037
2010	14.01	15.93	-1.92	+.08	2037
2011	14.02	16.25	-2.22	-.30	2036
2012	14.02	16.69	-2.67	-.44	2033
2013	13.88	16.60	-2.72	-.05	2033
2014	13.89	16.77	-2.88	-.16	2033
2015	13.86	16.55	-2.68	+.20	2034
2016	13.84	16.50	-2.66	+.02	2034
2017	13.84	16.67	-2.83	-.17	2034
2018	13.84	16.69	-2.84	-.02	2034

[a] This table shows the actuarial balance and year of trust fund reserve depletion based on the intermediate assumptions, which the 1982-90 reports referred to as alternative II-B and the 1991 and later reports refer to as alternative II.
[b] The definition and method of calculating the actuarial balance were changed in 1988 and 1991. See text for details.
[c] A detailed year-by-year breakdown of the reasons for the changes in the actuarial balance since the 1983 Trustees Report may be found in Actuarial Note 2018.8 at www.ssa.gov/OACT/NOTES/ran8/.
[d] Between -0.005 and 0.005 percent of taxable payroll.

Note: Totals do not necessarily equal the sums of rounded components.

For several of the years included in the table, significant legislative changes or definitional changes affected the estimated actuarial balance. The Social Security Amendments of 1983 account for the largest single change shown in the table: the actuarial balance of -1.82 for the 1982 report improved to +0.02 for the 1983 report. In 1985, the estimated actuarial balance changed largely because of an adjustment made to the method for estimating the age distribution of immigrants.

Rebenchmarking of the National Income and Product Accounts and changes in demographic assumptions contributed to the change in the actuarial balance for 1987. Various changes in assumptions and methods for the 1988 report had roughly offsetting effects on the actuarial balance. In 1989 and 1990, changes in economic assumptions accounted for most of the changes in the estimated actuarial balance.

In 1991, the effect of legislation, changes in economic assumptions, and the introduction of the cost of reaching and maintaining an ending target trust fund level combined to produce the change in the actuarial balance. In 1992, changes in disability assumptions and the method for projecting average benefit levels accounted for most of the change in the actuarial balance. In 1993, numerous small changes in assumptions and methods had offsetting effects on the actuarial balance. In 1994, changes in the real-wage assumptions, disability rates, and the earnings sample used for projecting average benefit levels accounted for most of the change in the actuarial balance. In 1995, numerous small changes had largely offsetting effects on the actuarial balance, including a substantial reallocation of the payroll tax rate, which reduced the OASI actuarial balance, but increased the DI actuarial balance.

In 1996, a change in the method of projecting dually-entitled beneficiaries produced a large increase in the actuarial balance, which almost totally offset decreases produced by changes in the valuation period and in the demographic and economic assumptions. Various changes in assumptions and methods for the 1997 report had roughly offsetting effects on the actuarial balance. In 1998, increases caused by changes in the economic assumptions, although partially offset by decreases produced by changes in the valuation period and in the demographic assumptions, accounted for most of the changes in the estimated actuarial balance. In 1999, increases caused by changes in the economic assumptions (related to improvements in the CPI by the Bureau of Labor Statistics) accounted for most of the changes in the estimated actuarial balance. For the 2000 report, changes in economic assumptions and methodology caused increases in the actuarial balance, although reductions in the balance caused by the change in valuation period and changes in demographic assumptions partially offset these increases.

For the 2001 report, increases caused by changes in the demographic starting values, although partially offset by a decrease produced by the change in the valuation period, accounted for most of the changes in the estimated actuarial balance. For the 2002 report, changes in the valuation period and the demographic assumptions—both decreases in the actuarial balance—were offset by changes in the economic assumptions, while an increase due to disability assumptions was slightly more than offset by a decrease due to changes in the projection methods and data. For the 2003 report, an increase due to the change in program assumptions was more than offset by decreases due to the change in valuation period and changes in demographic assumptions. In the 2004 report, increases due to changing the method of projecting benefit levels for higher earners more than offset decreases in the actuarial balance arising from the change in the valuation period and the net effect of other changes in programmatic data and methods. For the 2005 report, an increase due to changing the method of projecting future average benefit levels was more than offset by decreases due to changes in the valuation period, updated starting values for the economic assumptions, and other methodological changes.

In 2006, decreases in the actuarial balance due to the change in the valuation period, a reduction in the ultimate annual real interest rate, and improvements in calculating mortality for disabled workers, were greater in aggregate than increases in the actuarial balance due to changes in demographic starting values and the ultimate total fertility rate, as well as other programmatic data and method changes. For the 2007 report, increases in the actuarial balance arising from revised disability incidence rate assumptions, improvements in average benefit level projections, and changes in near-term economic projections, more than offset decreases in the balance due to the valuation period change and updated historical mortality data. For the 2008 report, the large increase in the actuarial balance was primarily due to changes in immigration projection methods and assumptions. These changes more than offset the decreases in the actuarial balance due to the change in the valuation period and the lower starting and ultimate mortality rates. In 2009, changes in starting values and near-term economic assumptions due to the economic recession, faster ultimate rates of decline in death rates for ages 65-84, and the change in the valuation period accounted for most of the large decrease in the actuarial balance. Legislative changes, in particular the estimated effects of the Patient Protection and Affordable Care Act and the Health Care and Education Reconciliation Act of 2010, were the main reason for the increase in the actuarial balance for the 2010 report. The change in the valuation period partially offset this increase; there were also changes in several assumptions, methods, and recent data which had largely offsetting effects.

For the 2011 report, changes in mortality projections, due to new starting values and revised methods, were the most significant of several factors contributing to the increase in the deficit. In 2012, changes in economic assumptions and starting values accounted for about half of the decrease in actuarial balance. Other factors worsening the actuarial balance were the change in valuation period, changes to starting demographic values, changes to ultimate disability incidence assumptions, and methodology changes and data updates. For the 2013 report, the change in valuation period accounted for the entire net change in the actuarial balance. The effects of substantially lower death rates for 2009 than previously projected and the American Taxpayer Relief Act of 2012 (which lowered the Federal marginal income tax rates) were offset by updates of program-specific data and methodology improvements. In 2014, changes in economic data and assumptions accounted for the majority of the net change in the actuarial balance. Other factors worsening the actuarial balance were the change in the valuation period and various methodology improvements and data updates. For the 2015 report, methodological improvements and updates of programmatic data accounted for the majority of the net increase in the actuarial balance. Also increasing the actuarial balance were a lower assumed ultimate average wage differential and changes in near-term economic assumptions. These increases were offset somewhat by the change in the valuation period and updates to historical and near-term projected birth rates.

For the 2016 report, the actuarial balance increased primarily due to the effects of the Bipartisan Budget Act of 2015 and improvements made to immigration methods. The most notable immigration change was a revision to the method for projecting emigration of the never-authorized population to reflect lower rates of emigration for those who have resided here longer. These increases in the actuarial balance were largely offset by the effects of changes in ultimate economic assumptions, including a lower real interest rate and a lower annual increase in the rate of price inflation. In 2017, the change in the valuation period and various methodology improvements accounted for most of the net reduction in the actuarial balance. Other economic factors also contributed to worsening the actuarial balance, including a lower real-wage differential assumption and an assumed weaker recovery from the recent recession. These reductions were offset somewhat by lower estimated disability incidence rates over the short-range period.

Section IV.B.6 describes changes affecting the actuarial balance shown for the 2018 report.

C. FISCAL YEAR HISTORICAL AND PROJECTED TRUST FUND OPERATIONS THROUGH 2027

Tables VI.C1, VI.C2, and VI.C3 contain details of the fiscal year 2017 operations of the OASI, DI, and the combined OASI and DI Trust Funds, respectively. The fiscal year for the U.S. Government is the 12-month period ending September 30. Fiscal year 2017 is the most recent fiscal year for which complete information is available. The descriptions of the values in these tables are similar to the corresponding descriptions and values in the calendar year operations tables in section III.A. Please see that section for a description of the various items of income and outgo.

Table VI.C1.—Operations of the OASI Trust Fund, Fiscal Year 2017
[In millions]

Total asset reserves, September 30, 2016		$2,796,620
Receipts:		
Net payroll tax contributions:		
Payroll tax contributions[a]	$704,865	
Payments from the General Fund of the Treasury for payroll tax contributions subject to refund[a]	-2,741	
Net payroll tax contributions[a]		702,123
Reimbursements from the General Fund:		
Reduction in payroll tax contributions due to P.L.s 111-312, 112-78, and 112-96[a]	9	
Reimbursements directed by P.L. 110-246	6	
Payroll tax credits due to P.L. 98-21[a]	[b]	
Net General Fund reimbursements[a]		15
Income based on taxation of benefit payments:		
Withheld from benefit payments to nonresident aliens	206	
All other, not subject to withholding[a]	35,210	
Total income from taxation of benefits[a]		35,416
Investment income and interest adjustments:		
Interest on investments	84,887	
Interest adjustments[c]	1	
Total investment income and interest adjustments		84,888
Gifts		[b]
Total receipts		822,442
Disbursements:		
Benefit payments:		
Monthly benefits and lump-sum death payments[d]	791,126	
Reimbursement from the General Fund for unnegotiated checks	-35	
Payment for costs of vocational rehabilitation services for disabled beneficiaries	4	
Net benefit payments[d]		791,094
Financial interchange with the Railroad Retirement "Social Security Equivalent Benefit Account"		4,316
Administrative expenses:		
Costs incurred by:		
Social Security Administration	3,046	
Department of the Treasury	520	
Offsetting miscellaneous receipts	-10	
Miscellaneous reimbursements from the General Fund[e]	-5	
Net administrative expenses		3,551
Total disbursements		798,961
Net increase in asset reserves		23,481
Total invested assets	2,820,200	
Undisbursed balances[f]	-99	
Total asset reserves, September 30, 2017		2,820,101

[a] Includes adjustments for prior years
[b] Between -$0.5 and $0.5 million.
[c] Includes: (1) interest on adjustments in the allocation of administrative expenses between the trust fund and the General Fund account for the Supplemental Security Income program, (2) interest arising from the revised allocation of administrative expenses among the trust funds, and (3) interest on certain reimbursements to the trust fund.
[d] Includes net reductions for the recovery of overpayments.
[e] Reimbursements for costs incurred in performing certain legislatively mandated activities not directly related to administering the OASI program.
[f] A negative balance represents a situation where the actual program cash expenditures exceeded the amount of invested securities of the OASI Trust Fund that were redeemed to pay for such expenditures. In this situation, future redemption of additional invested securities will be required to pay for this shortfall.

Note: Totals do not necessarily equal the sums of rounded components.

Table VI.C2.—Operations of the DI Trust Fund, Fiscal Year 2017
[In millions]

Total asset reserves, September 30, 2016		$45,740
Receipts:		
Net payroll tax contributions:		
Payroll tax contributions[a]	$166,543	
Payments from the General Fund of the Treasury for payroll tax contributions subject to refund[a]	-642	
Net payroll tax contributions[a]		165,901
Reimbursements from the General Fund:		
Reduction in payroll tax contributions due to P.L.s 111-312, 112-78, and 112-96[a]	2	
Reimbursements directed by P.L. 110-246	1	
Payroll tax credits due to P.L. 98-21[a]	[b]	
Net General Fund reimbursements[a]		3
Income based on taxation of benefit payments:		
Withheld from benefit payments to nonresident aliens	4	
All other, not subject to withholding[a]	1,947	
Total income from taxation of benefits[a]		1,951
Investment income and interest adjustments:		
Interest on investments	1,624	
Interest adjustments[c]	2	
Total investment income and interest adjustments		1,625
Gifts		—
Total receipts		169,480
Disbursements:		
Benefit payments:		
Monthly benefits[d]	142,823	
Reimbursement from the General Fund for unnegotiated checks	-19	
Payment for costs of vocational rehabilitation services for disabled beneficiaries	79	
Net benefit payments[d]		142,883
Financial interchange with the Railroad Retirement "Social Security Equivalent Benefit Account"		207
Administrative expenses:		
Costs incurred by:		
Social Security Administration	2,580	
Department of the Treasury	100	
Offsetting miscellaneous receipts	[b]	
Demonstration projects	10	
Miscellaneous reimbursements from the General Fund[e]	-3	
Net administrative expenses		2,686
Total disbursements		145,776
Net increase in asset reserves		23,704
Total invested assets	69,669	
Undisbursed balances[f]	-225	
Total asset reserves, September 30, 2017		69,444

[a] Includes adjustments for prior years.
[b] Between -$0.5 and $0.5 million.
[c] Includes: (1) interest on adjustments in the allocation of administrative expenses between the trust fund and the General Fund account for the Supplemental Security Income program, (2) interest arising from the revised allocation of administrative expenses among the trust funds, and (3) interest on certain reimbursements to the trust fund.
[d] Includes net reductions for the recovery of overpayments.
[e] Reimbursements for costs incurred in performing certain legislatively mandated activities not directly related to administering the DI program.
[f] A negative balance represents a situation where the actual program cash expenditures exceeded the amount of invested securities of the DI Trust Fund that were redeemed to pay for such expenditures. In this situation, future redemption of additional invested securities will be required to pay for this shortfall.

Note: Totals do not necessarily equal the sums of rounded components.

Table VI.C3.—Operations of the Combined OASI and DI Trust Funds, Fiscal Year 2017
[In millions]

Total asset reserves, September 30, 2016		$2,842,360
Receipts:		
Net payroll tax contributions:		
Payroll tax contributions[a]	$871,408	
Payments from the General Fund of the Treasury for payroll tax contributions subject to refund[a]	-3,384	
Net payroll tax contributions[a]		868,024
Reimbursements from the General Fund:		
Reduction in payroll tax contributions due to P.L.s 111-312, 112-78, and 112-96[a]	11	
Reimbursements directed by P.L. 110-246	7	
Payroll tax credits due to P.L. 98-21[a]	[b]	
Net General Fund reimbursements[a]		18
Income based on taxation of benefit payments:		
Withheld from benefit payments to nonresident aliens	210	
All other, not subject to withholding[a]	37,157	
Total income from taxation of benefits[a]		37,367
Investment income and interest adjustments:		
Interest on investments	86,510	
Interest adjustments[c]	3	
Total investment income and interest adjustments		86,513
Gifts		[b]
Total receipts		991,922
Disbursements:		
Benefit payments:		
Monthly benefits and lump-sum death payments[d]	933,948	
Reimbursement from the General Fund for unnegotiated checks	-54	
Payment for costs of vocational rehabilitation services for disabled beneficiaries	83	
Net benefit payments[d]		933,977
Financial interchange with the Railroad Retirement "Social Security Equivalent Benefit Account"		4,522
Administrative expenses:		
Costs incurred by:		
Social Security Administration	5,626	
Department of the Treasury	620	
Offsetting miscellaneous receipts	-10	
Demonstration projects	10	
Miscellaneous reimbursements from the General Fund[e]	-8	
Net administrative expenses		6,237
Total disbursements		944,737
Net increase in asset reserves		47,185
Total invested assets	2,889,869	
Undisbursed balances[f]	-325	
Total asset reserves, September 30, 2017		2,889,545

[a] Includes adjustments for prior years.
[b] Between -$0.5 and $0.5 million.
[c] Includes: (1) interest on adjustments in the allocation of administrative expenses between the trust funds and the General Fund account for the Supplemental Security Income program, (2) interest arising from the revised allocation of administrative expenses among the trust funds, and (3) interest on certain reimbursements to the trust funds.
[d] Includes net reductions for the recovery of overpayments.
[e] Reimbursements for costs incurred in performing certain legislatively mandated activities not directly related to administering the OASI and DI programs.
[f] A negative net balance represents a situation where the actual combined program cash expenditures exceeded the amount of invested securities of the OASI and DI Trust Funds that were redeemed to pay for such expenditures. In this situation, future net redemption of additional invested securities will be required to pay for this shortfall.

Note: Totals do not necessarily equal the sums of rounded components.

Tables VI.C4, VI.C5, and VI.C6 show estimates of the operations and status of the OASI, DI, and the hypothetical combined OASI and DI Trust Funds, respectively, during fiscal years 2013 through 2027.

Table VI.C4.—Operations of the OASI Trust Fund, Fiscal Years 2013-2027
[Dollar amounts in billions]

	Income					Cost				Asset Reserves		
Fiscal year	Total	Net payroll tax contributions	GF reimbursements[a]	Taxation of benefits[b]	Net interest	Total	Scheduled benefits	Administrative costs	RRB interchange	Net increase during year	Amount at end of year	Trust fund ratio[c]
Historical data:												
2013 .	$739.7	$590.0	$26.4	$23.1	$100.1	$670.6	$663.2	$3.4	$3.9	$69.1	$2,655.0	386
2014 .	763.3	642.3	.1	24.6	96.3	705.6	698.2	3.2	4.3	57.6	2,712.7	376
2015 .	795.3	672.2	.2	29.6	93.2	741.5	733.7	3.5	4.3	53.9	2,766.6	366
2016 .	799.9	679.6	.1	31.1	89.1	769.8	762.1	3.4	4.3	30.1	2,796.6	359
2017 .	822.4	702.1	[d]	35.4	84.9	799.0	791.1	3.6	4.3	23.5	2,820.1	350
Intermediate:												
2018 .	819.6	704.1	[d]	34.0	81.5	841.6	833.4	3.5	4.7	-22.0	2,798.1	335
2019 .	899.6	784.7	[d]	35.1	79.7	894.5	886.3	3.3	4.8	5.1	2,803.2	313
2020 .	950.6	832.1	[d]	39.4	79.1	955.5	947.4	3.2	4.9	-4.9	2,798.2	293
2021 .	1,002.6	880.4	[d]	43.4	78.9	1,020.5	1,012.2	3.4	4.9	-17.9	2,780.4	274
2022 .	1,053.4	927.3	[d]	47.5	78.6	1,089.0	1,080.3	3.6	5.2	-35.6	2,744.7	255
2023 .	1,099.8	970.8	[d]	51.7	77.4	1,161.7	1,152.7	3.7	5.2	-61.8	2,682.9	236
2024 .	1,153.5	1,019.4	[d]	56.2	77.9	1,238.3	1,229.1	3.9	5.3	-84.8	2,598.1	217
2025 .	1,206.2	1,067.3	[d]	61.1	77.8	1,317.0	1,307.6	4.0	5.3	-110.7	2,487.4	197
2026 .	1,271.7	1,120.6	[d]	74.0	77.1	1,398.8	1,389.2	4.2	5.5	-127.2	2,360.2	178
2027 .	1,328.4	1,168.4	[d]	82.8	77.2	1,484.1	1,474.3	4.3	5.5	-155.7	2,204.6	159
Low-cost:												
2018 .	822.7	706.9	[d]	34.0	81.8	841.2	833.0	3.5	4.7	-18.5	2,801.6	335
2019 .	927.6	809.8	[d]	35.2	82.6	897.0	888.8	3.3	4.8	30.7	2,832.3	312
2020 .	1,003.3	876.9	[d]	39.7	86.6	963.8	955.7	3.2	4.9	39.5	2,871.7	294
2021 .	1,079.1	944.5	[d]	44.0	90.5	1,034.2	1,025.9	3.5	4.9	44.8	2,916.6	278
2022 .	1,154.1	1,010.6	[d]	48.3	95.1	1,108.4	1,099.6	3.7	5.1	45.6	2,962.2	263
2023 .	1,228.5	1,073.8	[d]	52.8	101.9	1,187.6	1,178.4	3.9	5.2	40.9	3,003.1	249
2024 .	1,311.9	1,144.0	[d]	57.7	110.1	1,271.7	1,262.3	4.1	5.3	40.1	3,043.2	236
2025 .	1,397.0	1,214.9	[d]	63.0	119.1	1,359.1	1,349.4	4.3	5.4	37.9	3,081.1	224
2026 .	1,499.4	1,293.5	[d]	76.8	129.2	1,450.9	1,440.8	4.5	5.5	48.6	3,129.7	212
2027 .	1,596.3	1,368.2	[d]	86.3	141.8	1,547.6	1,537.3	4.7	5.5	48.7	3,178.4	202
High-cost:												
2018 .	817.8	702.3	[d]	34.0	81.5	842.0	833.8	3.5	4.7	-24.1	2,796.0	335
2019 .	868.1	755.0	[d]	35.0	78.1	890.6	882.4	3.3	4.9	-22.5	2,773.5	314
2020 .	888.1	776.3	[d]	38.9	72.9	944.1	935.9	3.2	5.0	-56.0	2,717.5	294
2021 .	921.8	810.0	[d]	42.7	69.1	1,003.1	994.9	3.3	4.9	-81.4	2,636.1	271
2022 .	950.2	839.9	[d]	46.5	63.8	1,066.0	1,057.4	3.4	5.2	-115.8	2,520.3	247
2023 .	976.8	867.1	[d]	50.4	59.4	1,132.2	1,123.4	3.5	5.2	-155.3	2,364.9	223
2024 .	1,006.2	898.1	[d]	54.6	53.6	1,201.6	1,192.6	3.6	5.3	-195.3	2,169.6	197
2025 .	1,035.4	928.4	[d]	59.0	48.0	1,272.1	1,263.1	3.7	5.3	-236.8	1,932.9	171
2026 .	1,077.1	963.0	[d]	71.1	43.0	1,344.7	1,335.5	3.8	5.4	-267.6	1,665.3	144
2027 .	1,108.9	991.2	[d]	79.2	38.5	1,419.1	1,409.8	3.9	5.4	-310.2	1,355.1	117

[a] Includes reimbursements from the General Fund of the Treasury to the OASI Trust Fund for: (1) the cost of benefits to certain uninsured persons who attained age 72 before 1968; (2) the cost of payroll tax credits provided to employees in 1984 and self-employed persons in 1984-89 by Public Law 98-21; (3) the cost in 2009-17 of excluding certain self-employment earnings from SECA taxes under Public Law 110-246; and (4) payroll tax revenue forgone under the provisions of Public Laws 111-147, 111-312, 112-78, and 112-96.
[b] Revenue from taxation of benefits is the amount that would be assessed on benefit amounts scheduled in the law.
[c] The "Trust fund ratio" column represents asset reserves at the beginning of a year (which are identical to reserves at the end of the prior year shown in the "Amount at end of year" column) as a percentage of cost for the year.
[d] Between -$50 million and $50 million.

Note: Totals do not necessarily equal the sums of rounded components.

Table VI.C5.—Operations of the DI Trust Fund, Fiscal Years 2013-2027[a]
[Dollar amounts in billions]

	Income					Cost				Asset Reserves		
Fiscal year	Total	Net payroll tax contributions	GF reimbursements[b]	Taxation of benefits[c]	Net interest	Total	Scheduled benefits	Administrative costs	RRB interchange	Net increase during year	Amount at end of year	Trust fund ratio[d]
Historical data:												
2013	$111.3	$100.2	$4.5	$1.1	$5.5	$142.8	$139.4	$2.8	$0.6	-$31.5	$100.5	92
2014	114.1	109.1	e	1.0	4.0	144.7	141.3	2.9	.4	-30.6	69.9	69
2015	118.0	114.2	e	1.0	2.7	146.2	142.9	2.9	.4	-28.3	41.7	48
2016	150.3	147.6	e	1.2	1.5	146.2	143.1	2.8	.4	4.1	45.7	28
2017	169.5	165.9	e	2.0	1.6	145.8	142.9	2.7	.2	23.7	69.4	31
Intermediate:												
2018	170.4	166.5	e	1.7	2.2	148.0	145.0	2.9	.2	22.4	91.8	47
2019	151.0	146.5	e	1.6	2.9	152.0	149.1	2.8	.1	-1.0	90.8	60
2020	146.0	141.3	e	1.8	2.9	156.1	153.2	2.8	.2	-10.1	80.7	58
2021	154.1	149.5	e	1.9	2.7	161.5	158.3	3.0	.2	-7.4	73.3	50
2022	161.9	157.5	e	2.1	2.4	167.5	164.1	3.3	.1	-5.6	67.7	44
2023	169.3	164.9	e	2.2	2.2	174.6	170.8	3.6	.1	-5.3	62.4	39
2024	177.6	173.1	e	2.4	2.1	182.2	178.2	3.9	.1	-4.6	57.8	34
2025	185.7	181.2	e	2.6	1.9	191.0	186.8	4.1	.1	-5.3	52.5	30
2026	195.2	190.3	e	3.2	1.7	200.3	195.8	4.4	.1	-5.1	47.4	26
2027	203.5	198.4	e	3.5	1.6	209.8	205.1	4.7	.1	-6.3	41.1	23
Low-cost:												
2018	171.1	167.2	e	1.7	2.3	146.5	143.5	2.9	.2	24.6	94.1	47
2019	156.0	151.0	e	1.6	3.4	149.1	146.2	2.8	.1	6.9	100.9	63
2020	154.7	148.9	e	1.8	4.0	152.4	149.5	2.8	.2	2.3	103.2	66
2021	166.8	160.4	e	1.9	4.5	156.8	153.5	3.1	.1	10.0	113.3	66
2022	178.9	171.6	e	2.0	5.3	161.8	158.3	3.4	.1	17.1	130.4	70
2023	191.1	182.3	e	2.1	6.6	167.8	164.0	3.7	.1	23.3	153.6	78
2024	204.8	194.3	e	2.3	8.2	174.5	170.4	4.0	.1	30.3	183.9	88
2025	219.0	206.3	e	2.5	10.3	182.6	178.2	4.3	.1	36.5	220.4	101
2026	235.5	219.7	e	3.0	12.8	191.1	186.4	4.7	.1	44.4	264.7	115
2027	251.6	232.3	e	3.4	15.9	200.2	195.1	5.0	.1	51.4	316.2	132
High-cost:												
2018	169.9	166.1	e	1.7	2.1	149.6	146.5	2.9	.2	20.4	89.8	46
2019	145.4	141.3	e	1.7	2.5	154.8	151.8	2.8	.1	-9.3	80.5	58
2020	135.8	131.8	e	1.8	2.1	159.4	156.5	2.8	.2	-23.7	56.8	50
2021	141.1	137.5	e	2.0	1.6	165.6	162.4	3.0	.2	-24.5	32.4	34
2022	145.6	142.6	e	2.1	.8	172.4	169.0	3.3	.2	-26.8	5.6	19
2023	f	147.2	e	2.3	f	179.9	176.3	3.5	.1	f	f	3
2024	f	152.5	e	2.5	f	188.0	184.1	3.7	.1	f	f	f
2025	f	157.6	e	2.7	f	197.1	193.0	3.9	.1	f	f	f
2026	f	163.5	e	3.3	f	206.5	202.2	4.1	.1	f	f	f
2027	f	168.3	e	3.7	f	216.0	211.5	4.3	.1	f	f	f

[a] The DI Trust Fund becomes depleted in fiscal year 2023 under the high-cost assumptions. For any period during which reserves would be depleted, scheduled benefits could not be paid in full on a timely basis, income from taxing benefits would be less than would apply to scheduled benefits, and interest on trust fund reserves would be negligible.
[b] Includes reimbursements from the General Fund of the Treasury to the DI Trust Fund for: (1) the cost of payroll tax credits provided to employees in 1984 and self-employed persons in 1984-89 by Public Law 98-21; (2) the cost in 2009-17 of excluding certain self-employment earnings from SECA taxes under Public Law 110-246; and (3) payroll tax revenue forgone under the provisions of Public Laws 111-147, 111-312, 112-78, and 112-96.
[c] Revenue from taxation of benefits is the amount that would be assessed on benefit amounts scheduled in the law.
[d] The "Trust fund ratio" column represents asset reserves at the beginning of a year (which are identical to reserves at the end of the prior year shown in the "Amount at end of year" column) as a percentage of cost for the year.
[e] Between -$50 million and $50 million.
[f] While the fund is depleted, values under current law would reflect permissible expenditures only, which are inconsistent with the cost of scheduled benefits shown in this table.

Note: Totals do not necessarily equal the sums of rounded components.

Table VI.C6.—Operations of the Combined OASI and DI Trust Funds, Fiscal Years 2013-2027
[Dollar amounts in billions]

	Income					Cost				Asset Reserves		
Fiscal year	Total	Net payroll tax contributions	GF reimbursements[a]	Taxation of benefits[b]	Net interest	Total	Scheduled benefits	Administrative costs	RRB interchange	Net increase during year	Amount at end of year	Trust fund ratio[c]
Historical data:												
2013. .	$850.9	$690.1	$30.9	$24.2	$105.7	$813.3	$802.6	$6.2	$4.5	$37.6	$2,755.5	334
2014. .	877.4	751.3	.2	25.7	100.3	850.3	839.6	6.0	4.7	27.1	2,782.6	324
2015. .	913.3	786.4	.3	30.7	96.0	887.7	876.6	6.4	4.7	25.6	2,808.2	313
2016. .	950.2	827.1	.2	32.3	90.6	916.0	905.2	6.2	4.7	34.1	2,842.4	307
2017. .	991.9	868.0	[d]	37.4	86.5	944.7	934.0	6.2	4.5	47.2	2,889.5	301
Intermediate:												
2018. .	990.0	870.6	[d]	35.7	83.7	989.6	978.4	6.4	4.9	.4	2,889.9	292
2019. .	1,050.6	931.2	[d]	36.8	82.6	1,046.5	1,035.4	6.1	5.0	4.1	2,894.0	276
2020. .	1,096.6	973.4	[d]	41.2	82.0	1,111.7	1,100.6	6.0	5.1	-15.1	2,878.9	260
2021. .	1,156.8	1,029.8	[d]	45.4	81.5	1,182.0	1,170.5	6.4	5.1	-25.3	2,853.7	244
2022. .	1,215.3	1,084.8	[d]	49.5	81.0	1,256.6	1,244.4	6.9	5.3	-41.3	2,812.4	227
2023. .	1,269.1	1,135.6	[d]	53.9	79.6	1,336.2	1,323.5	7.3	5.4	-67.1	2,745.3	210
2024. .	1,331.0	1,192.5	[d]	58.6	79.9	1,420.5	1,407.3	7.7	5.4	-89.4	2,655.9	193
2025. .	1,392.0	1,248.6	[d]	63.7	79.7	1,508.0	1,494.4	8.2	5.4	-116.0	2,539.9	176
2026. .	1,466.9	1,310.9	[d]	77.2	78.9	1,599.1	1,585.0	8.6	5.6	-132.2	2,407.7	159
2027. .	1,531.9	1,366.8	[d]	86.4	78.8	1,693.9	1,679.3	9.0	5.6	-162.0	2,245.7	142
Low-cost:												
2018. .	993.9	874.1	[d]	35.7	84.1	987.8	976.5	6.4	4.9	6.1	2,895.7	293
2019. .	1,083.7	960.8	[d]	36.8	86.1	1,046.1	1,035.0	6.1	4.9	37.6	2,933.2	277
2020. .	1,157.9	1,025.8	[d]	41.5	90.6	1,116.2	1,105.2	6.0	5.0	41.7	2,975.0	263
2021. .	1,245.9	1,104.9	[d]	45.9	95.0	1,191.0	1,179.4	6.5	5.0	54.9	3,029.8	250
2022. .	1,333.0	1,182.2	[d]	50.3	100.4	1,270.2	1,257.9	7.1	5.3	62.7	3,092.6	239
2023. .	1,419.5	1,256.1	[d]	55.0	108.4	1,355.4	1,342.5	7.6	5.3	64.1	3,156.7	228
2024. .	1,516.6	1,338.3	[d]	60.0	118.3	1,446.3	1,432.7	8.1	5.4	70.4	3,227.1	218
2025. .	1,616.0	1,421.2	[d]	65.5	129.4	1,541.6	1,527.5	8.6	5.5	74.4	3,301.5	209
2026. .	1,734.9	1,513.2	[d]	79.8	142.0	1,642.0	1,627.2	9.2	5.6	93.0	3,394.5	201
2027. .	1,847.9	1,600.5	[d]	89.7	157.7	1,747.8	1,732.4	9.7	5.6	100.1	3,494.6	194
High-cost:												
2018. .	987.8	868.4	[d]	35.7	83.6	991.5	980.3	6.4	4.9	-3.8	2,885.8	291
2019. .	1,013.5	896.2	[d]	36.6	80.6	1,045.4	1,034.3	6.1	5.0	-31.8	2,853.9	276
2020. .	1,023.9	908.1	[d]	40.7	75.1	1,103.6	1,092.4	6.0	5.1	-79.7	2,774.3	259
2021. .	1,062.9	947.6	[d]	44.7	70.7	1,168.7	1,157.2	6.3	5.1	-105.8	2,668.5	237
2022. .	1,095.8	982.6	[d]	48.6	64.6	1,238.4	1,226.3	6.7	5.3	-142.6	2,525.9	215
2023. .	1,126.1	1,014.4	[d]	52.7	59.1	1,312.1	1,299.7	7.0	5.4	-186.0	2,339.8	193
2024. .	1,159.8	1,050.6	[d]	57.0	52.1	1,389.6	1,376.8	7.4	5.4	-229.8	2,110.0	168
2025. .	1,192.8	1,086.0	[d]	61.7	45.1	1,469.2	1,456.1	7.7	5.4	-276.4	1,833.6	144
2026. .	1,239.3	1,126.5	[d]	74.4	38.3	1,551.1	1,537.6	8.0	5.5	-311.9	1,521.8	118
2027. .	1,274.3	1,159.5	[d]	82.8	32.0	1,635.1	1,621.3	8.3	5.5	-360.8	1,161.0	93

[a] Includes reimbursements from the General Fund of the Treasury to the OASI and DI Trust Funds for: (1) the cost of benefits to certain uninsured persons who attained age 72 before 1968; (2) the cost of payroll tax credits provided to employees in 1984 and self-employed persons in 1984-89 by Public Law 98-21; (3) the cost in 2009-17 of excluding certain self-employment earnings from SECA taxes under Public Law 110-246; and (4) payroll tax revenue forgone under the provisions of Public Laws 111-147, 111-312, 112-78, and 112-96.
[b] Revenue from taxation of benefits is the amount that would be assessed on benefit amounts scheduled in the law.
[c] The "Trust fund ratio" column represents asset reserves at the beginning of a year (which are identical to reserves at the end of the prior year shown in the "Amount at end of year" column) as a percentage of cost for the year.
[d] Between -$50 million and $50 million.

D. LONG-RANGE SENSITIVITY ANALYSIS

This appendix presents estimates that illustrate the sensitivity of the long-range actuarial status of the OASDI program to changes in selected individual assumptions. The estimates based on the three alternative sets of assumptions, which were presented earlier in this report, illustrate the effects of varying all of the principal assumptions simultaneously, in order to portray a significantly more optimistic or pessimistic future. For each sensitivity analysis presented in this appendix, the intermediate alternative II projection is the reference point, and one assumption is varied within that alternative. The variation used for each individual assumption is the same as the level used for that assumption in the low-cost alternative I and high-cost alternative III projections.

Each table in this section shows the effects of changing a particular assumption on the OASDI summarized income rates, summarized cost rates, and actuarial balances for 25-year, 50-year, and 75-year valuation periods. Following each table is a discussion of the estimated changes in cost rates. The change in each of the actuarial balances is approximately equal to the change in the corresponding cost rate, but in the opposite direction. This appendix does not discuss income rates following each table because income rates vary only slightly with changes in assumptions that affect revenue from taxation of benefits.

1. Total Fertility Rate

Table VI.D1 shows OASDI income rates, cost rates, and actuarial balances on the basis of alternative II with three different assumptions about the ultimate total fertility rate. The Trustees assume that total fertility will ultimately be 1.8, 2.0, and 2.2 children per woman under alternatives III, II, and I, respectively. The total fertility rate reaches ultimate values in 2023, 2027, and 2027 under alternatives III, II, and I, respectively.

Table VI.D1.—Sensitivity of OASDI Measures to Fertility Assumptions
[As a percentage of taxable payroll]

Valuation period	Ultimate total fertility rate[a b] 1.8	2.0	2.2
Summarized income rate:			
25-year: 2018-42	14.59	14.59	14.59
50-year: 2018-67	14.03	14.01	13.99
75-year: 2018-92	13.89	13.84	13.80
Summarized cost rate:			
25-year: 2018-42	16.34	16.36	16.38
50-year: 2018-67	16.63	16.45	16.28
75-year: 2018-92	17.14	16.69	16.26
Actuarial balance:			
25-year: 2018-42	-1.75	-1.77	-1.78
50-year: 2018-67	-2.61	-2.45	-2.29
75-year: 2018-92	-3.25	-2.84	-2.46
Annual balance for 2092	-5.84	-4.32	-3.02
Year of combined trust fund reserve depletion	2034	2034	2034

[a] The total fertility rate for any year is the average number of children that would be born to a woman in her lifetime if she were to experience, at each age of her life, the birth rate observed in, or assumed for, the selected year, and if she were to survive the entire childbearing period. The ultimate total fertility rate is reached in 2023, 2027, and 2027 under alternatives III, II, and I, respectively.
[b] Ultimate total fertility rates used for this analysis are: 1.8 from the alternative III assumptions, 2.0 from the alternative II assumptions, and 2.2 from the alternative I assumptions. All other assumptions used for this analysis are from alternative II.

For the 25-year period, the cost rate for the three fertility assumptions varies by only about 0.03 percent of taxable payroll. In contrast, the 75-year cost rate varies over a wide range, decreasing from 17.14 to 16.26 percent, as the assumed ultimate total fertility rate increases from 1.8 to 2.2. Similarly, while the 25-year actuarial balance varies by only 0.03 percent of taxable payroll, the 75-year actuarial balance varies over a much wider range, from -3.25 to -2.46 percent.

During the 25-year period, the very slight increases in the working population resulting from higher fertility (than that experienced in an alternative scenario) are more than offset by decreases in the female labor force and increases in the number of child beneficiaries. Therefore, program cost increases slightly with higher fertility. For the 75-year long-range period, however, changes in fertility have a relatively greater effect on the labor force than on the beneficiary population. As a result, an increase in fertility significantly reduces the cost rate. Each increase of 0.1 in the ultimate total fertility rate increases the long-range actuarial balance by about 0.20 percent of taxable payroll.

2. Death Rates

Table VI.D2 shows OASDI income rates, cost rates, and actuarial balances on the basis of alternative II with three different assumptions about future reductions in death rates for the period from 2017 to 2092. These assumptions are described in section V.A.2. The Trustees assume that the age-sex-adjusted death rates will decline at average annual rates of 0.41 percent, 0.77 percent, and 1.15 percent for alternatives I, II, and III, respectively.

Table VI.D2.—Sensitivity of OASDI Measures to Death-Rate Assumptions
[As a percentage of taxable payroll]

Valuation period	Average annual death-rate reduction[a b]		
	0.41 percent	0.77 percent	1.15 percent
Summarized income rate:			
25-year: 2018-42	14.59	14.59	14.59
50-year: 2018-67	14.00	14.01	14.02
75-year: 2018-92	13.82	13.84	13.86
Summarized cost rate:			
25-year: 2018-42	16.20	16.36	16.54
50-year: 2018-67	16.10	16.45	16.84
75-year: 2018-92	16.18	16.69	17.22
Actuarial balance:			
25-year: 2018-42	-1.61	-1.77	-1.95
50-year: 2018-67	-2.10	-2.45	-2.82
75-year: 2018-92	-2.36	-2.84	-3.36
Annual balance for 2092	-3.31	-4.32	-5.32
Year of combined trust fund reserve depletion	2035	2034	2034

[a] The average annual death-rate reduction is the average annual geometric rate of decline in the age-sex-adjusted death rate between 2017 and 2092. The overall age-sex-adjusted death rate decreases from 2017 to 2092 by 27 percent, 44 percent, and 58 percent for alternatives I, II, and III, respectively.
[b] The average annual death-rate reductions used for this analysis are: 0.41 percent from the alternative I assumptions, 0.77 percent from the alternative II assumptions, and 1.15 percent from the alternative III assumptions. All other assumptions used for this analysis are from alternative II.

The variation in cost for the 25-year period is less pronounced than the variation for the 75-year period because decreases in death rates have cumulative effects. The 25-year cost rate increases from 16.20 percent (for an average annual death-rate reduction of 0.41 percent) to 16.54 percent (for an average annual death-rate reduction of 1.15 percent). The 75-year cost rate increases from 16.18 to 17.22 percent. The actuarial balance decreases from -1.61 to -1.95 percent for the 25-year period, and from -2.36 to -3.36 percent for the 75-year period.

Lower death rates raise both the income (through increased taxable payroll) and the cost of the OASDI program. The relative increase in cost, however, exceeds the relative increase in taxable payroll. For any given year, reductions in the death rates for people who are age 62 and over (ages at which death rates are the highest) increase the number of retired-worker beneficiaries (and, therefore, the amount of retirement benefits paid) without adding significantly to the number of covered workers (and, therefore, to the taxable payroll). Reductions for people at age 50 to retirement eligibility age result in significant increases to the taxable payroll. However, those increases are not large enough to offset the sum of the additional retirement benefits mentioned above and the disability benefits paid to additional beneficiaries at these pre-retirement ages, which are ages of high disability incidence. At ages under 50, death rates are so low that even substantial reductions in death rates do not result in significant increases in the numbers of covered workers or beneficiaries. Consequently, if death rates decline by about the same relative amount for all ages, the cost increases faster than the rate of growth in payroll, which results in higher cost rates and lower actuarial balances. Each additional 0.1-percentage-point increase in the average annual rate of decline in the death rate decreases the long-range actuarial balance by about 0.14 percent of taxable payroll.

3. Immigration

Table VI.D3 shows OASDI income rates, cost rates, and actuarial balances under alternative II with three different assumptions about the magnitude of total net immigration (sum of net lawful permanent resident (LPR) immigration and net other-than-LPR immigration). See section V.A.3 for more information on immigration assumptions and methods. The Trustees assume annual levels of immigration and emigration, with total net annual immigration averaging 952,000 persons, 1,272,000 persons, and 1,607,000 persons over the long-range period under alternatives III, II, and I, respectively.

Table VI.D3.—Sensitivity of OASDI Measures to Total Net Immigration Assumptions
[As a percentage of taxable payroll]

	Average annual total net immigration[a b]		
Valuation period	952,000	1,272,000	1,607,000
Summarized income rate:			
25-year: 2018-42	14.62	14.59	14.56
50-year: 2018-67	14.04	14.01	13.98
75-year: 2018-92	13.88	13.84	13.81
Summarized cost rate:			
25-year: 2018-42	16.56	16.36	16.19
50-year: 2018-67	16.72	16.45	16.21
75-year: 2018-92	17.00	16.69	16.41
Actuarial balance:			
25-year: 2018-42	-1.93	-1.77	-1.62
50-year: 2018-67	-2.68	-2.45	-2.24
75-year: 2018-92	-3.12	-2.84	-2.60
Annual balance for 2092	-4.81	-4.32	-3.91
Year of combined trust fund reserve depletion	2034	2034	2035

[a] Average annual total net immigration is the annual total net immigration to the Social Security area, including both LPR and other-than-LPR immigration, averaged over the 75-year projection period.
[b] The average annual total net immigration assumptions used for this analysis are: 952,000 from the alternative III assumptions, 1,272,000 from the alternative II assumptions, and 1,607,000 from the alternative I assumptions. All other assumptions used for this analysis are from alternative II.

For all three periods, when total net immigration increases, the cost rate decreases. For the 25-year period, the cost rate decreases from 16.56 percent of taxable payroll (for average annual total net immigration of 952,000 persons) to 16.19 percent (for average annual total net immigration of 1,607,000 persons). For the 50-year period, it decreases from 16.72 percent to 16.21 percent, and for the 75-year period, it decreases from 17.00 percent to 16.41 percent. The actuarial balance increases from -1.93 to -1.62 percent for the 25-year period, from -2.68 to -2.24 percent for the 50-year period, and from -3.12 to -2.60 percent for the 75-year period.

The cost rate decreases with an increase in total net immigration because immigration occurs at relatively young ages, thereby increasing the numbers of covered workers earlier than the numbers of beneficiaries. Increasing average annual total net immigration by 100,000 persons improves the long-range actuarial balance by about 0.08 percent of taxable payroll.

4. Real-Wage Differential

Table VI.D4 shows OASDI income rates, cost rates, and actuarial balances on the basis of alternative II with three different assumptions about the real-wage differential. The Trustees assume the ultimate real-wage differential will be 0.58 percentage point, 1.20 percentage points, and 1.82 percentage points under alternatives III, II, and I, respectively. In each case, the ultimate annual increase in the CPI is 2.60 percent (consistent with alternative II). Therefore, the ultimate percentage increases in average annual wages in covered employment are 3.18, 3.80, and 4.42 percent.

For the 25-year period, the cost rate decreases from 17.16 percent (for a real-wage differential of 0.58 percentage point) to 15.58 percent (for a differential of 1.82 percentage points). For the 50-year period, it decreases from 17.61 to 15.34 percent, and for the 75-year period it decreases from 17.96 to 15.45 percent. The actuarial balance increases from -2.43 to -1.12 percent for the 25-year period, from -3.43 to -1.49 percent for the 50-year period, and from -3.93 to -1.78 percent for the 75-year period.

Table VI.D4.—Sensitivity of OASDI Measures to Real-Wage Assumptions
[As a percentage of taxable payroll]

Valuation period	Ultimate percentage increase in wages-CPI[a b] 3.18-2.60	3.80-2.60	4.42-2.60
Summarized income rate:			
25-year: 2018-42	14.72	14.59	14.46
50-year: 2018-67	14.17	14.01	13.85
75-year: 2018-92	14.03	13.84	13.67
Summarized cost rate:			
25-year: 2018-42	17.16	16.36	15.58
50-year: 2018-67	17.61	16.45	15.34
75-year: 2018-92	17.96	16.69	15.45
Actuarial balance:			
25-year: 2018-42	-2.43	-1.77	-1.12
50-year: 2018-67	-3.43	-2.45	-1.49
75-year: 2018-92	-3.93	-2.84	-1.78
Annual balance for 2092	-6.26	-4.32	-2.62
Year of combined trust fund reserve depletion	2033	2034	2037

[a] The first value in each pair is the ultimate annual percentage increase in average wages in covered employment. The second value is the ultimate annual percentage increase in the Consumer Price Index. The difference between the two values is the ultimate real-wage differential.
[b] The ultimate real-wage differentials of 0.58, 1.20, and 1.82 percentage points are the same as in alternatives III, II, and I, respectively. All other assumptions used for this analysis are from alternative II.

The cost rate decreases with increasing real-wage differentials. Higher wages increase taxable payroll immediately, but they increase benefit levels only gradually as new beneficiaries become entitled. In addition, cost-of-living adjustments (COLAs) to benefits depend not on changes in wages, but on changes in prices. Each 0.1-percentage-point increase in the real-wage differential increases the long-range actuarial balance by about 0.17 percent of taxable payroll.

5. Consumer Price Index

Table VI.D5 shows OASDI income rates, cost rates, and actuarial balances on the basis of alternative II with three different assumptions about the rate of increase for the Consumer Price Index (CPI). The Trustees assume the annual increase in the CPI will be 3.20 percent, 2.60 percent, and 2.00 percent under alternatives I, II, and III, respectively.[1] In each case, the ultimate real-wage differential is 1.20 percentage points (consistent with alternative II), yielding ultimate percentage increases in average annual wages in covered employment of 4.40, 3.80, and 3.20 percent.

[1] Prior to the 2014 report, alternative I included a lower ultimate annual change in the CPI and alternative III included a higher ultimate annual change in the CPI than was included for alternative II.

Table VI.D5.—Sensitivity of OASDI Measures to CPI-Increase Assumptions
[As a percentage of taxable payroll]

Valuation period	Ultimate percentage increase in wages-CPI[a b]		
	4.40-3.20	3.80-2.60	3.20-2.00
Summarized income rate:			
25-year: 2018-42	14.57	14.59	14.61
50-year: 2018-67	13.99	14.01	14.02
75-year: 2018-92	13.83	13.84	13.86
Summarized cost rate:			
25-year: 2018-42	16.26	16.36	16.46
50-year: 2018-67	16.32	16.45	16.58
75-year: 2018-92	16.54	16.69	16.83
Actuarial balance:			
25-year: 2018-42	-1.69	-1.77	-1.84
50-year: 2018-67	-2.33	-2.45	-2.56
75-year: 2018-92	-2.71	-2.84	-2.97
Annual balance for 2092	-4.14	-4.32	-4.48
Year of combined trust fund reserve depletion	2035	2034	2034

[a] The first value in each pair is the ultimate annual percentage increase in average wages in covered employment. The second value is the ultimate annual percentage increase in the Consumer Price Index. The difference between the two values is the ultimate real-wage differential.
[b] The ultimate CPI increases of 3.20, 2.60, and 2.00 percent are the same as in alternatives I, II, and III, respectively. The ultimate real-wage differential of 1.20 percentage points is the same as in alternative II. All other assumptions used for this analysis are also from alternative II.

For all three periods, the cost rate increases when the assumed rates of increase in the CPI are smaller. For the 25-year period, the cost rate increases from 16.26 (for CPI increases of 3.20 percent) to 16.46 percent (for CPI increases of 2.00 percent). For the 50-year period, it increases from 16.32 to 16.58 percent, and for the 75-year period, it increases from 16.54 to 16.83 percent. The actuarial balance decreases from -1.69 to -1.84 percent for the 25-year period, from -2.33 to -2.56 percent for the 50-year period, and from -2.71 to -2.97 percent for the 75-year period.

The time lag between the effects of the CPI changes on taxable payroll and on scheduled benefits explains these patterns. When the rate of increase in the CPI is greater and the real-wage differential is constant, then: (1) the effect on taxable payroll due to a greater rate of increase in average wages occurs immediately and (2) the effect on benefits due to a larger COLA occurs with a lag of about 1 year. As a result of these effects, the higher taxable payrolls have a stronger effect than the higher benefits, which results in lower cost rates. Each 0.1-percentage-point decrease in the rate of the change in the CPI decreases the long-range actuarial balance by about 0.02 percent of taxable payroll.

6. Real Interest Rate

Table VI.D6 shows OASDI income rates, cost rates, and actuarial balances under alternative II with three different assumptions about the annual real interest rate (compounded semiannually) for special public-debt obligations issuable to the trust funds. The Trustees assume that the ultimate annual real interest rate will be 2.2 percent, 2.7 percent, and 3.2 percent under alternatives III, II, and I, respectively. In each case, the ultimate annual increase in the CPI is 2.60 percent, which is consistent with alternative II. Therefore, the ultimate annual yields are 4.9, 5.4, and 5.9 percent, respectively.

Table VI.D6.—Sensitivity of OASDI Measures to Real-Interest Assumptions
[As a percentage of taxable payroll]

	Ultimate annual real interest rate[a b]		
Valuation period	2.2 percent	2.7 percent	3.2 percent
Summarized income rate:			
25-year: 2018-42	14.54	14.59	14.65
50-year: 2018-67	13.94	14.01	14.08
75-year: 2018-92	13.77	13.84	13.92
Summarized cost rate:			
25-year: 2018-42	16.43	16.36	16.29
50-year: 2018-67	16.54	16.45	16.37
75-year: 2018-92	16.80	16.69	16.57
Actuarial balance:			
25-year: 2018-42	-1.89	-1.77	-1.65
50-year: 2018-67	-2.60	-2.45	-2.30
75-year: 2018-92	-3.03	-2.84	-2.65
Annual balance for 2092	-4.32	-4.32	-4.32
Year of combined trust fund reserve depletion	2034	2034	2035

[a] The ultimate real interest rate is the effective annual yield on asset reserves held by the trust funds divided by the annual rate of growth in the CPI.
[b] The ultimate annual real interest rates used for this analysis are: 2.2 percent from the alternative III assumptions, 2.7 percent from the alternative II assumptions, and 3.2 percent from the alternative I assumptions. All other assumptions used for this analysis are from alternative II.

For the 25-year period, the cost rate decreases with increasing real interest rates from 16.43 percent (for an ultimate real interest rate of 2.2 percent) to 16.29 percent (for an ultimate real interest rate of 3.2 percent). For the 50-year period, it decreases from 16.54 to 16.37 percent and, for the 75-year period, it decreases from 16.80 to 16.57 percent. The actuarial balance increases from -1.89 to -1.65 percent for the 25-year period, from -2.60 to -2.30 percent for the 50-year period, and from -3.03 to -2.65 percent for the 75-year period. Each 0.1-percentage-point increase in the real interest rate increases the long-range actuarial balance by about 0.04 percent of taxable payroll.

7. Taxable Ratio

Table VI.D7 shows OASDI income rates, cost rates, and actuarial balances under alternative II with three different assumptions about the ratio of taxable payroll to covered earnings (the taxable ratio). Note that covered earnings are the sum of wages and net self-employment earnings covered by Social Security, and taxable payroll is essentially the amount of covered earnings subject to the Social Security payroll tax up to the contribution and benefit base ($128,400 for 2018). The Trustees assume that the ultimate taxable ratio will be 81.0 percent, 82.5 percent, and 84.0 percent under alternatives III, II, and I, respectively.

Table VI.D7.—Sensitivity of OASDI Measures to Taxable Ratio Assumptions
[As a percentage of taxable payroll]

	Ultimate taxable ratio[a b]		
Valuation period	81.0 percent	82.5 percent	84.0 percent
Summarized income rate:			
25-year: 2018-42	14.63	14.59	14.56
50-year: 2018-67	14.03	14.01	13.98
75-year: 2018-92	13.86	13.84	13.82
Summarized cost rate:			
25-year: 2018-42	16.59	16.36	16.14
50-year: 2018-67	16.67	16.45	16.25
75-year: 2018-92	16.87	16.69	16.50
Actuarial balance:			
25-year: 2018-42	-1.97	-1.77	-1.58
50-year: 2018-67	-2.63	-2.45	-2.26
75-year: 2018-92	-3.01	-2.84	-2.68
Annual balance for 2092	-4.43	-4.32	-4.21
Year of combined trust fund reserve depletion	2033	2034	2035

[a] The taxable ratio is the ratio of taxable payroll to covered earnings. These concepts are described in further detail in section V.C.6 of this report.
[b] The ultimate taxable ratios used for this analysis are: 81.0 percent from the alternative III assumptions, 82.5 percent from the alternative II assumptions, and 84.0 percent from the alternative I assumptions. All other assumptions used for this analysis are from alternative II.

Because the combined employee-employer tax rate of 12.4 percent is unchanged across all alternatives, the income rate changes a relatively small amount as the taxable ratio increases, due to changes in taxation of benefits and the initial fund as a percentage of taxable payroll.

For the 25-year period, the cost rate decreases with increasing taxable ratios, from 16.59 percent (for an ultimate taxable ratio of 81.0 percent) to 16.14 percent (for an ultimate taxable ratio of 84.0 percent). For the 50-year period, it decreases from 16.67 to 16.25 percent and, for the 75-year period, it decreases from 16.87 to 16.50 percent. The actuarial balance increases from -1.97 to -1.58 percent for the 25-year period, from -2.63 to

-2.26 percent for the 50-year period, and from -3.01 to -2.68 for the 75-year period.

The cost rate decreases with an increase in taxable payroll because the increase in taxable payroll occurs immediately. The increase in benefit amounts occurs much more gradually as new beneficiaries become entitled. In addition, the change in the taxable ratio does not affect COLAs or AWIs. Each 1.0 percentage-point increase in the ultimate taxable ratio increases (improves) the long-range actuarial balance by about 0.11 percent of taxable payroll.

8. Disability Incidence Rates

Table VI.D8 shows OASDI income rates, cost rates, and actuarial balances on the basis of alternative II with three different assumptions concerning future disability incidence rates. The Trustees assume that the ultimate age-sex-adjusted incidence rates will be 4.3, 5.4, and 6.4 awards per thousand exposed for alternatives I, II, and III, respectively. These levels are about 17 percent lower, 4 percent higher, and 23 percent higher, respectively, than the average incidence rate for the historical period 1970 through 2017. For all three alternatives, the Trustees assume that incidence rates by age and sex will vary during the early years of the projection period before attaining ultimate levels.

Table VI.D8.—Sensitivity of OASDI Measures to Disability Incidence Assumptions
[As a percentage of taxable payroll]

	Disability incidence rates[a] based on alternative—		
Valuation period	I	II	III
Summarized income rate:			
25-year: 2018-42	14.59	14.59	14.59
50-year: 2018-67	14.00	14.01	14.01
75-year: 2018-92	13.84	13.84	13.85
Summarized cost rate:			
25-year: 2018-42	16.16	16.36	16.56
50-year: 2018-67	16.20	16.45	16.70
75-year: 2018-92	16.42	16.69	16.95
Actuarial balance:			
25-year: 2018-42	-1.57	-1.77	-1.96
50-year: 2018-67	-2.19	-2.45	-2.69
75-year: 2018-92	-2.58	-2.84	-3.10
Annual balance for 2092	-4.02	-4.32	-4.61
Year of combined trust fund reserve depletion	2035	2034	2034

[a] The ultimate age-sex-adjusted incidence rates used for this analysis are: 4.3 awards per thousand exposed for the alternative I assumptions, 5.4 awards per thousand exposed for the alternative II assumptions, and 6.4 awards per thousand exposed for the alternative III assumptions. All other assumptions used for this analysis are from alternative II.

For the 25-year period, the cost rate increases with increasing disability incidence rates, from 16.16 percent (for the relatively low rates assumed for alternative I) to 16.56 percent (for the relatively high rates assumed for alternative III). For the 50-year period, it increases from 16.20 to 16.70 percent, and for the 75-year period, it increases from 16.42 to 16.95 percent. The actuarial balance decreases from -1.57 to -1.96 percent for the 25-year period, from -2.19 to -2.69 percent for the 50-year period, and from -2.58 to -3.10 percent for the 75-year period.

9. Disability Termination Rates

Table VI.D9 shows OASDI income rates, cost rates, and actuarial balances on the basis of alternative II with three different assumptions about future disability termination rates, including deaths and recoveries up to the age at which disabled-worker beneficiaries convert to retired-worker status.

For all three alternatives, the Trustees assume that death rates for disabled-worker beneficiaries will decline throughout the long-range period. The Trustees assume that the age-sex-adjusted[1] death rate of 25.4 deaths per thousand disabled-worker beneficiaries in 2017 will decline to 18.4, 11.6, and 6.9 deaths per thousand in 2092 for alternatives I, II, and III, respectively. These levels are about 28 percent, 54 percent, and 73 percent lower, respectively, than the level in 2017.

For all three alternatives, ultimate recovery rates by age, sex, and duration are attained in the twentieth year of the projection period. For alternative I, the age-sex-adjusted[1] recovery rate for 2037 is about 13 recoveries per thousand disabled-worker beneficiaries. For alternative II, the age-sex-adjusted recovery rate for 2037 is about 10 recoveries per thousand disabled-worker beneficiaries. For alternative III, the age-sex-adjusted recovery rate for 2037 is about 8 recoveries per thousand disabled-worker beneficiaries.

[1] Age adjusted to the total disabled workers in current-payment status as of the year 2000.

Table VI.D9.—Sensitivity of OASDI Measures to Disability Termination Assumptions
[As a percentage of taxable payroll]

Valuation period	Disability termination rates[a] based on alternative— I	II	III
Summarized income rate:			
25-year: 2018-42	14.59	14.59	14.59
50-year: 2018-67	14.01	14.01	14.01
75-year: 2018-92	13.84	13.84	13.84
Summarized cost rate:			
25-year: 2018-42	16.33	16.36	16.39
50-year: 2018-67	16.42	16.45	16.48
75-year: 2018-92	16.66	16.69	16.70
Actuarial balance:			
25-year: 2018-42	-1.74	-1.77	-1.80
50-year: 2018-67	-2.41	-2.45	-2.48
75-year: 2018-92	-2.81	-2.84	-2.86
Annual balance for 2092	-4.31	-4.32	-4.30
Year of combined trust fund reserve depletion	2034	2034	2034

[a] The age-sex-adjusted death rates in 2092 used for this analysis are: 18.4 deaths per thousand disabled-worker beneficiaries for the alternative I assumptions, 11.6 deaths per thousand disabled-worker beneficiaries for the alternative II assumptions, and 6.9 deaths per thousand disabled-worker beneficiaries for the alternative III assumptions. The ultimate age-sex-adjusted recovery rates used for this analysis are: 13 recoveries per thousand disabled-worker beneficiaries for the alternative I assumptions, 10 recoveries per thousand disabled-worker beneficiaries for the alternative II assumptions, and 8 recoveries per thousand disabled-worker beneficiaries for the alternative III assumptions. All other assumptions used for this analysis are from alternative II.

For the 25-year period, the cost rate increases with decreasing disability termination rates, from 16.33 percent (for the relatively high termination rates assumed for alternative I) to 16.39 percent (for the relatively low termination rates assumed for alternative III). For the 50-year period, it increases from 16.42 to 16.48 percent, and for the 75-year period, it increases from 16.66 to 16.70 percent. The actuarial balance decreases from -1.74 to -1.80 percent for the 25-year period, from -2.41 to -2.48 percent for the 50-year period, and from -2.81 to -2.86 percent for the 75-year period.

E. STOCHASTIC PROJECTIONS AND UNCERTAINTY

Significant uncertainty surrounds the estimates under the intermediate assumptions, especially for a period as long as 75 years. This appendix presents stochastic projections, a way to illustrate the uncertainty of these estimates. The stochastic projections supplement the traditional methods of examining such uncertainty.

1. Background

The Trustees have traditionally shown estimates using the low-cost and high-cost sets of specified assumptions to illustrate the potential implications of uncertainty. These alternative estimates provide a range of possible outcomes for the projections. However, they do not provide an indication of the probability that actual future experience will be inside or outside this range. This appendix presents the results of a model, based on stochastic modeling techniques, that estimates a probability distribution of future outcomes of the financial status of the combined OASI and DI Trust Funds. This model, which was first included in the 2003 report, is subject to further development in the future, most notably by incorporating parameter uncertainty. This will allow the stochastic model to better reflect the uncertainty in the estimates of the underlying factors for these projections.

2. Stochastic Methodology

Other sections of this report provide estimates of the financial status of the combined OASI and DI Trust Funds using a scenario-based model. For the scenario-based model, the Trustees use three alternative scenarios (low-cost, intermediate, and high-cost) that use specific assumptions about levels of fertility, rates of change in mortality, lawful permanent resident (LPR) and other-than-LPR immigration levels, legal and other-than-LPR emigration levels, changes in the Consumer Price Index, changes in average real wages, unemployment rates, trust fund real yield rates, and disability incidence and recovery rates. In general, the Trustees assume that each of these variables will reach an ultimate value at a specific point during the long-range period, and will maintain that value throughout the remainder of the period. The three alternative scenarios assume separate, specified values for each of these variables. Chapter V contains more details about each of these assumptions.

This appendix presents estimates of the probability that key measures of OASDI solvency will fall in certain ranges, based on 5,000 independent stochastic simulations. Each simulation allows the above variables to vary throughout the long-range period. The fluctuation of each variable over time is simulated using historical data and standard time-series techniques. Generally, each variable is modeled using an equation that: (1) captures a relationship between current and prior years' values of the variable, and (2) introduces year-by-year random variation based on variation observed in the historical period. For some variables, the equations also reflect relationships with other variables. The equations contain parameters that are estimated using historical data for periods from 11 years to over 110 years, depending on the nature and quality of the available data. Each time-series equation is designed so that, in the absence of random variation over time, the value of the variable for each year equals its value under the intermediate assumptions.[1]

For each simulation, the stochastic method develops year-by-year random variation for each variable using Monte Carlo techniques. Each simulation produces an estimate of the financial status of the combined OASI and DI Trust Funds. This appendix shows the distribution of results from 5,000 simulations of the model.

Readers should interpret the results from this model with caution and with an understanding of the model's limitations. Results are sensitive to equation specifications, degrees of interdependence among variables, and the historical periods used for estimating model coefficients. For some variables, recent historical variation may not provide a realistic representation of the potential variation for the future. Also, results would differ if additional variables (such as labor force participation rates, retirement rates, marriage rates, and divorce rates) were also allowed to vary randomly. Furthermore, more variability would result if statistical approaches were used to model uncertainty in the central tendencies of the variables. Time-series modeling reflects only what occurred in the historical period. Future uncertainty exists not only for the underlying central tendency but also for the frequency and size of occasional longer-term shifts in the central tendency. Many experts predict, and history suggests, that the future will likely bring substantial shifts that are not fully reflected in the historical period used for the current model. As a result, readers should understand that the true range of uncertainty is larger than indicated in this appendix.

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[1] More detail on this model, and stochastic modeling in general, is available at www.ssa.gov/OACT/stochastic/index.html.

3. Stochastic Results

This section illustrates the results for the stochastic simulations of two fundamental measures of actuarial status: the annual cost rates and the trust fund ratio. The latter measure is highlighted in the Overview of this report. Section 4 follows with a comparison of stochastic results to results from the alternative scenarios for these and other measures, and an analysis of the differences.

Figure VI.E1 displays the probability distribution of the year-by-year OASDI cost rates (that is, cost as a percentage of taxable payroll). The range of the annual cost rates widens as the projections move further into the future, which reflects increasing uncertainty. Because there is relatively little variation in income rates across the 5,000 stochastic simulations, the figure includes the income rate only under the intermediate assumptions. The two outermost lines in this figure indicate the range within which future annual cost rates are projected to occur 95 percent of the time (i.e., a 95-percent confidence interval). In other words, the current model estimates that there is a 2.5 percent probability that the cost rate for a given year will exceed the upper end of this range and a 2.5 percent probability that it will fall below the lower end of this range. Other lines in the figure delineate additional confidence intervals (80-percent, 60-percent, 40-percent, and 20-percent) around future annual cost rates. The median (50th percentile) cost rate for each year is the rate for which half of the simulated outcomes are higher and half are lower for that year. These lines do not represent the results of individual stochastic simulations. Instead, for each given year, they represent the percentile distribution of annual cost rates based on all stochastic simulations for that year.

Figure VI.E1.—Long-Range OASDI Cost Rates From Stochastic Modeling

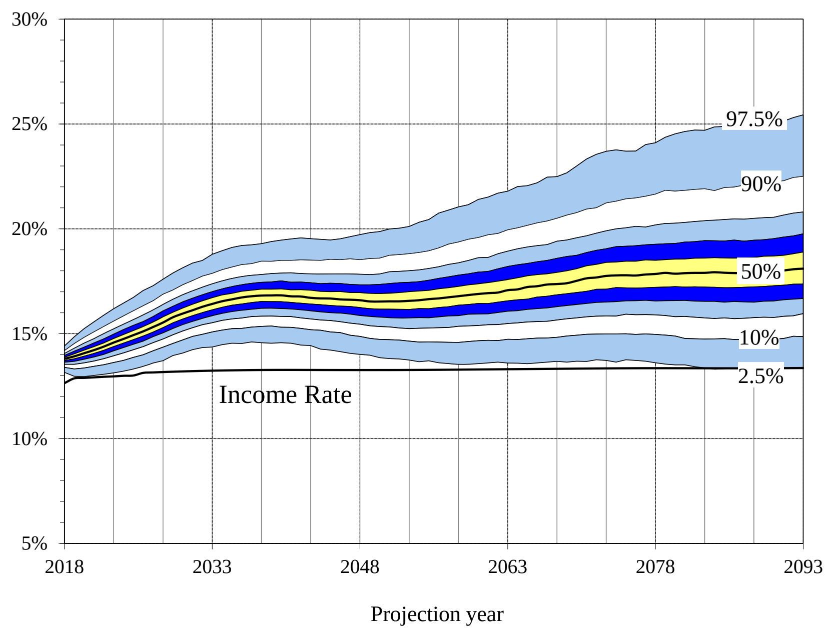
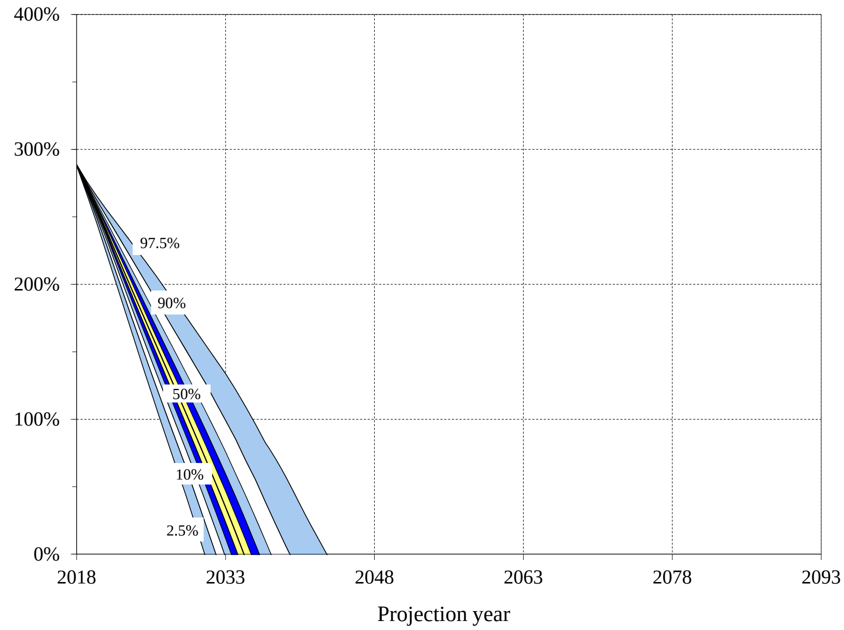


Figure VI.E2 presents the simulated probability distribution of the annual trust fund ratios for the combined OASI and DI Trust Funds. The lines in this figure display the median set (50th percentile) of estimated annual trust fund ratios and delineate the 95-percent, 80-percent, 60-percent, 40-percent, and 20-percent confidence intervals estimated for future annual trust fund ratios. Again, none of these lines represent the path of a single simulation. For each given year, they represent the percentile distribution of trust fund ratios based on all stochastic simulations for that year.

Figure VI.E2 shows that the 95-percent confidence interval for the trust fund depletion year ranges from 2030 to 2043, and that there is a 50-percent probability of trust fund depletion by the end of 2034 (the median depletion year). The median depletion year is the same as the Trustees project under the intermediate assumptions. The figure also shows confidence intervals for the trust fund ratio in each year. For example, the 95-percent confidence interval for the trust fund ratio at the beginning of 2025 ranges from 216 to 132 percent of annual cost.

Figure VI.E2.—Long-Range OASDI Trust Fund Ratios From Stochastic Modeling



4. Comparison of Results: Stochastic to Low-Cost, Intermediate, and High-Cost Alternatives

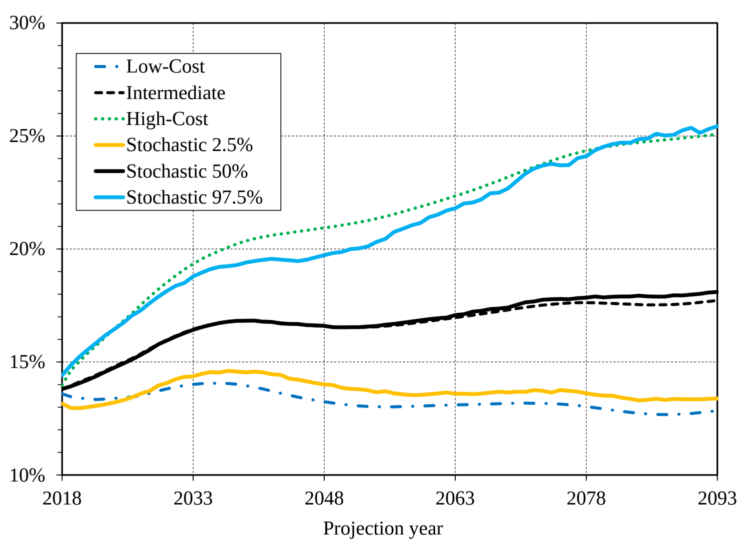
This section compares results from two different approaches for illustrating ranges of uncertainty for trust fund actuarial status. One approach uses results from the low-cost, intermediate, and high-cost alternative scenarios. The other approach uses distributions of results from the stochastic simulations. Each of these approaches provides insights into uncertainty. Comparing the results requires an understanding of fundamental differences in the approaches.

One fundamental difference relates to the presentation of distributional results. Figure VI.E3 shows projected OASDI annual cost rates for the low-cost, intermediate, and high-cost alternatives along with the annual cost rates at the 97.5th percentile, 50th percentile, and 2.5th percentile for the stochastic simulations. While all values on each line for the alternatives are results from a single specified scenario, the values on each stochastic line may be results from different simulations for different years. The one stochastic simulation (from the 5,000 simulations) that yields results closest to a particular percentile for one projected year may yield results that are distant from that percentile in another projected year.

Because each stochastic simulation shows substantial variability from year to year, the range shown between the 97.5th and 2.5th percentiles is broader than would be seen if simulations followed a smooth trend like in the alternatives. In spite of this effect, the range from high-cost to low-cost annual rates for the stochastic distribution is generally contained slightly within the range for the high-cost and low-cost alternatives. With introduction of parameter uncertainty for the stochastic simulations expected in future reports, the range for the 95-percent confidence interval is expected to expand.

Both the alternatives and the stochastic results suggest that the range of potential cost rates above the central levels (those for the intermediate alternative and for the median, respectively) is larger than the range below these central results. The difference between the central results and the higher cost levels (the high-cost alternative and the upper end of the 95-percent confidence range, respectively) is about 1.5 times as large as the difference between the central and lower cost levels for both models by the end of the projection period.

Figure VI.E3.—OASDI Cost Rates: Comparison of Stochastic to Low-Cost, Intermediate, and High-Cost Alternatives
[As a percentage of taxable payroll]

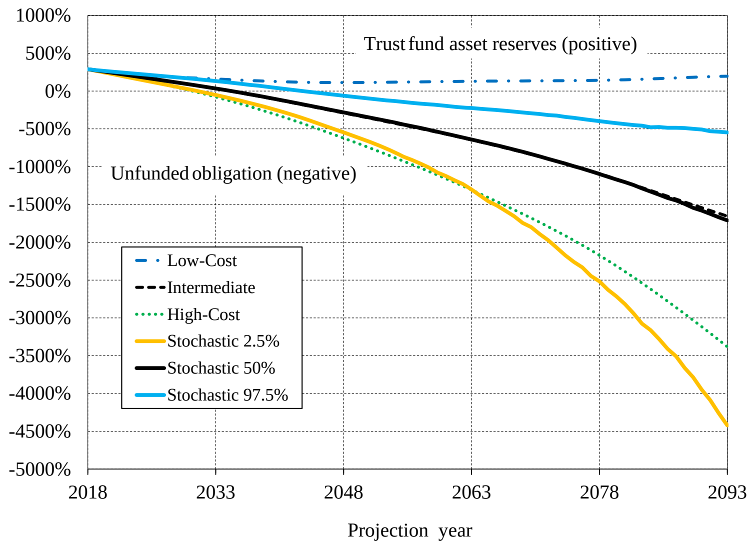


Another fundamental difference between the alternatives and the stochastic simulations is the method of assigning values for assumptions. For the alternatives, specific values are assigned for each of the key demographic, economic, and program-specific variables. The high-cost alternative uses parameter values that increase estimated annual cost as a percent of payroll, while the low-cost alternative uses parameter values that decrease annual cost as a percent of payroll. (One parameter, the interest rate, has no effect on annual cost as a percent of payroll for either the alternatives or the stochastic simulations.) In contrast, the stochastic method essentially randomly assigns values for each of the key demographic and economic variables for each year in each of the 5,000 independent stochastic simulations. For each of the stochastic simulations, randomly assigned values for different variables result in varying and often offsetting effects on projected cost as a percent of payroll, with some tending toward higher cost and some tending toward lower cost. This difference tends to reduce the range of cost as a percent of payroll across the 95-percent confidence interval. Again, the future introduction of parameter uncertainty is expected to broaden this range.

It is important to understand that the stochastic model's 95-percent confidence intervals for any summary measure of trust fund finances would tend to be narrower than the range produced for the low-cost and high-cost alternatives, even if the stochastic model's 95-percent confidence interval for annual cost rates were identical to the range defined by the low-cost and high-cost projections. This is true because summary measures of trust fund finances depend on cost rates for many years, and the probability that annual cost rates, on average for individual stochastic simulations, will be at least as low (high) as the 2.5 (97.5) percentile line is significantly lower than 2.5 percent. As a result, the relationship between the ranges presented for annual cost rates and summary measures of trust fund finances is fundamentally different for the stochastic model than it is for the low-cost and high-cost alternatives.

Figure VI.E4 compares the ranges of trust fund (unfunded obligation) ratios for the alternative scenarios to the 95-percent confidence interval of the stochastic simulations. This figure extends figure VI.E2 to show unfunded obligation ratios, expressed as negative values below the zero percent line. An unfunded obligation ratio is the ratio of the unfunded obligation accumulated through the beginning of the year to the cost for that year.

Figure VI.E4.—OASDI Trust Fund (Unfunded Obligation) Ratios: Comparison of Stochastic to Low-Cost, Intermediate, and High-Cost Alternatives[a]
[Asset reserves (unfunded obligation) as a percentage of annual cost]



[a] An unfunded obligation, shown as a negative value in this figure, is equivalent to the amount the trust funds would need to have borrowed to date in order to pay all scheduled benefits (on a timely basis) after trust fund asset reserves are depleted. Note that current law does not permit the trust funds to borrow.

As mentioned above, a summary measure that accumulates annual values tends to smooth the kind of annual fluctuations that occur in stochastic simulations. Therefore, one might expect the range across the stochastic confidence interval for trust fund (unfunded obligation) ratios to be narrower and fall within the range seen across the high-cost and low-cost alternatives, as it does for the actuarial balance measure. But this is not the case, largely due to the way interest rates are assigned.

For the stochastic model, real interest rates for each simulation are assigned essentially randomly, so the rate for compounding of trust fund reserves (unfunded obligations) is essentially uncorrelated with the level of cost as a percent of payroll. On the other hand, real interest rates are assigned to be higher for the low-cost alternative and lower for the high-cost alternative. High interest rates raise the level of the positive trust fund ratio in the low-cost alternative somewhat, but this effect is limited because the magnitude of reserves is small. However, low interest rates substantially reduce the magnitude of the unfunded obligation ratio for the high-cost alternative because the magnitude of unfunded obligations is relatively large. As a result, the trust fund (unfunded obligation) ratios are shifted, albeit unevenly, higher (or less negative) for both the high-cost and low-cost alternatives.

This interest rate effect on the alternatives is not as evident for some other summary measures of actuarial status, such as the actuarial balance. Because the actuarial balance reflects the cumulative effects of interest in both its numerator and denominator, the interest rate effect is much less pronounced. In contrast, cumulative interest affects only the numerator of the trust fund (unfunded obligation) ratio. There is also no significant interest rate effect on the trust fund depletion date.

Other factors also contribute, to varying degrees, to the difference in ranges between the results of the alternative scenarios and the stochastic simulations. The contrasts in results and methods do not mean that either approach to illustrating ranges of uncertainty is superior to the other. The ranges are different and explainable.

Table VI.E1 displays long-range actuarial estimates for the combined OASDI program using the two methods of illustrating uncertainty: alternative scenarios and stochastic simulations. The table shows scenario-based estimates for the intermediate, low-cost, and high-cost assumptions. It also shows stochastic estimates for the median (50th percentile) and for the 80-percent and 95-percent confidence intervals. Each individual stochastic estimate in the table is the level at that percentile from the distribution of the 5,000 simulations. For each given percentile, the values in the table for each long-range actuarial measure are generally from different stochastic simulations.

The median stochastic estimates displayed in table VI.E1 are similar to the intermediate scenario-based estimates. The median estimate of the long-range actuarial balance is -2.86 percent of taxable payroll, about 0.02 percentage point lower than projected under the intermediate assumptions. The median estimate for the open group unfunded obligation is $13.3 trillion, slightly higher than the $13.2 trillion estimate under the intermediate assumptions. The median first projected year that cost exceeds non-interest income (as it did in 2010 through 2017), and remains in excess of non-interest income throughout the remainder of the long-range period, is 2018. This is the same year as projected under the intermediate assumptions. The median year that asset reserves first become depleted is 2034, also the same as projected under the intermediate assumptions. The median estimates of the annual cost rate for the 75th year of the projection period are 18.07 percent of taxable payroll and 6.25 percent of gross domestic product

(GDP). The comparable estimates under the intermediate assumptions are 17.68 percent of payroll and 6.12 percent of GDP.

For three measures in table VI.E1 (the actuarial balance, the first projected year cost exceeds non-interest income and remains in excess through 2092, and the first year asset reserves become depleted), the 95-percent stochastic confidence interval falls within the range defined by the low-cost and high-cost alternatives. For the remaining three measures (the open group unfunded obligation, the annual cost in the 75th year as a percent of taxable payroll, and the annual cost in the 75th year as a percent of GDP), one or both of the bounds of the 95-percent stochastic confidence interval fall outside the range defined by the low-cost and high-cost alternatives.

Table VI.E1.—Long-Range Estimates Relating to the Actuarial Status of the Combined OASDI Program
[Comparison of scenario-based and stochastic results]

	Traditional scenario-based model			Stochastic model				
				Median	80-percent confidence interval		95-percent confidence interval	
	Interme-diate	Low-cost	High-cost	50th percentile	10th percentile	90th percentile	2.5th percentile	97.5th percentile
Actuarial balance	-2.84	0.13	-6.62	-2.86	-4.28	-1.70	-5.10	-1.10
Open group unfunded obligation (in trillions)	$13.2	-$1.6	$25.8	$13.3	$6.9	$23.8	$4.3	$31.7
First projected year cost exceeds non-interest income and remains in excess through 2092[a]	2018	[b]	2018	2018	2018	2026	2018	2091
First year asset reserves become depleted[c]	2034	[d]	2030	2034	2032	2039	2030	2043
Annual cost in 75th year (percent of taxable payroll)	17.68	12.80	25.03	18.07	14.88	22.44	13.37	25.31
Annual cost in 75th year (percent of GDP)	6.12	4.83	7.95	6.25	5.18	7.71	4.67	8.64

[a] Cost also exceeded non-interest income in 2010 through 2017.
[b] The annual balance is projected to be negative for a temporary period, returning to positive levels before the end of the projection period.
[c] For some stochastic simulations, the first year in which trust fund reserves become depleted does not indicate a permanent depletion of reserves.
[d] Trust fund reserves are not estimated to be depleted within the projection period.

F. INFINITE HORIZON PROJECTIONS

Another measure of trust fund financial status is the infinite horizon unfunded obligation, which takes account of all past and future annual balances, even those after the next 75 years. The extension of the time period past 75 years assumes that the current law for the OASDI program and the demographic and economic trends used for the 75-year projection continue indefinitely.

Table VI.F1 shows that the OASDI open group unfunded obligation over the infinite horizon is $34.3 trillion in present value, which is $21.2 trillion larger than for the 75-year period. The $21.2 trillion increment reflects a significant financing gap projected for OASDI for years after 2092 into perpetuity. Of course, the degree of uncertainty associated with estimates increases substantially for years further in the future.

The $34.3 trillion infinite horizon open group unfunded obligation is equivalent to 4.0 percent of taxable payroll or 1.3 percent of GDP. These relative measures of the unfunded obligation over the infinite horizon express its magnitude in relation to the resources potentially available to finance the shortfall.

The summarized shortfalls for the 75-year period and through the infinite horizon both reflect annual cash-flow shortfalls for all years after trust fund reserve depletion. The annual shortfalls after trust fund reserve depletion rise slowly and reflect increases in life expectancy after 2034. The summarized shortfalls over the infinite horizon, as percentages of taxable payroll and GDP, are larger than the shortfalls for the 75-year period.

To illustrate the magnitude of the projected infinite horizon shortfall, consider that it could be eliminated with additional revenue equivalent to an immediate increase in the combined payroll tax rate from 12.4 percent to about 16.6 percent,[1] or with cost reductions equivalent to an immediate and permanent reduction in benefits for all current and future beneficiaries by about 24 percent.

[1] The indicated increase in the payroll tax rate of 4.2 percent is somewhat larger than the 4.0 percent infinite horizon actuarial deficit because the indicated increase reflects a behavioral response to tax rate changes. In particular, the calculation assumes that an increase in payroll taxes results in a small shift of wages and salaries to forms of employee compensation that are not subject to the payroll tax.

Table VI.F1.—Unfunded OASDI Obligations Through the Infinite Horizon, Based on Intermediate Assumptions
[Present values as of January 1, 2018; dollar amounts in trillions]

		Expressed as a percentage of future payroll and GDP	
	Present value	Taxable payroll	GDP
Unfunded obligation through the infinite horizon[a]	$34.3	4.0	1.3
Unfunded obligation through 2092[b]	13.2	2.7	1.0

[a] Present value of future cost less future non-interest income, reduced by the amount of trust fund asset reserves at the beginning of 2018. Expressed as a percentage of payroll and GDP for the period 2018 through the infinite horizon.
[b] Present value of future cost less future non-interest income through 2092, reduced by the amount of trust fund reserves at the beginning of 2018. Expressed as a percentage of payroll and GDP for the period 2018 through 2092.

Notes:
1. The present values of future taxable payroll for 2018-92 and for 2018 through the infinite horizon are $491.1 trillion and $858.7 trillion, respectively.
2. The present values of GDP for 2018-92 and for 2018 through the infinite horizon are $1,373.2 trillion and $2,544.9 trillion, respectively. Present values of GDP shown in the Medicare Trustees Report differ slightly due to the use of discount rates that are specific to each program's trust fund holdings.

Last year, the Trustees projected that the infinite horizon unfunded obligation was $34.2 trillion in present value. If the assumptions, methods, and starting values had not changed, moving the valuation date forward by 1 year would have increased the unfunded obligation by about $1.0 trillion, to $35.2 trillion. The net effects of changes in assumptions, methods, law, and starting values decreased the infinite horizon unfunded obligation by $0.9 trillion.

The infinite horizon unfunded obligation is 0.2 percentage point lower than in last year's report when expressed as a share of taxable payroll, and is 0.1 percentage point lower than last year when expressed as a share of GDP. See section IV.B.6 for details regarding changes in law, data, methods, and assumptions.

a. Unfunded Obligations for Past, Current, and Future Participants

Table VI.F2 separates the components of the infinite horizon unfunded obligation (with the exception of General Fund reimbursements) among past, current, and future participants. The table does not separate past General Fund reimbursements among participants because there is no clear basis for attributing the reimbursements across generations.

Past participants are defined as those no longer alive as of the valuation date. Current participants are those age 15 and older as of 2018. Future participants are those under age 15 or not yet born.

The excess of the present value of cost for past and current participants over the present value of dedicated tax income for past and current participants produces an unfunded obligation for past and current participants of $33.0 trillion. Table VI.F2 also shows an unfunded obligation of $32.4 trillion for past and current participants, including past and future General Fund reimbursements. Future participants are scheduled to pay dedicated taxes of $1.9 trillion less into the system than the cost of their scheduled benefits ($81.3 trillion of dedicated tax income as compared to $83.2 trillion of cost). The unfunded obligation for all participants through the infinite horizon thus equals $34.3 trillion.

Making Social Security solvent over the infinite horizon requires some combination of increased revenue or reduced benefits for current and future participants amounting to $34.3 trillion in present value, 4.0 percent of future taxable payroll, or 1.3 percent of future GDP.

Table VI.F2.—Present Values of OASDI Cost Less Non-interest Income and Unfunded Obligations for Program Participants, Based on Intermediate Assumptions
[Present values as of January 1, 2018; dollar amounts in trillions]

		Expressed as a percentage of future payroll and GDP	
	Present value	Taxable payroll	GDP
Present value of past cost	$61.9	7.2	2.4
Less present value of past dedicated tax income	64.1	7.5	2.5
Plus present value of future cost for current participants	68.6	8.0	2.7
Less present value of future dedicated tax income for current participants	33.3	3.9	1.3
Equals unfunded obligation for past and current participants excluding General Fund reimbursements	33.0	3.8	1.3
Less present value of past General Fund reimbursements[a]	.6	.1	[b]
Less present value of future General Fund reimbursements over the infinite horizon[a]	[c]	[d]	[b]
Equals unfunded obligation for past and current participants including General Fund reimbursements	32.4	3.8	1.3
Plus present value of cost for future participants over the infinite horizon	83.2	9.7	3.3
Less present value of dedicated tax income for future participants over the infinite horizon	81.3	9.5	3.2
Equals unfunded obligation for all participants through the infinite horizon	34.3	4.0	1.3

[a] Distribution of General Fund reimbursements among past, current, and future participants cannot be determined.
[b] Less than 0.05 percent of GDP.
[c] Less than $50 billion.
[d] Less than 0.05 percent of taxable payroll.

Notes:
1. The present value of future taxable payroll for 2018 through the infinite horizon is $858.7 trillion.
2. The present value of GDP for 2018 through the infinite horizon is $2,544.9 trillion.
3. Totals do not necessarily equal the sums of rounded components.

G. ESTIMATES FOR OASDI AND HI, SEPARATE AND COMBINED

In this appendix, the Trustees present long-range actuarial estimates for the OASDI and Hospital Insurance (HI) programs both separately and on a combined basis. These estimates facilitate analysis of the adequacy of the income and asset reserves of these programs relative to their cost under current law. This appendix does not include estimates for the Supplementary Medical Insurance (SMI) program because adequate financing is guaranteed in the law and because the SMI program is not financed through a payroll tax. For more information on Medicare estimates, please see the 2018 Medicare Trustees Report.

The information in this appendix on combined operations, while significant, should not obscure the analysis of the financial status of the individual trust funds, which are legally separate and cannot be commingled. In addition, the factors which determine the costs of the OASI, DI, and HI programs differ substantially.

1. Estimates as a Percentage of Taxable Payroll

Comparing cost and income rates for the OASDI and HI programs as percentages of taxable payroll requires a note of caution. The taxable payrolls for the HI program are larger than those estimated for the OASDI program because: (1) a larger maximum taxable amount was established for the HI program in 1991, with the maximum eliminated altogether for the HI program in 1994; (2) larger proportions of Federal, State, and local government employees are covered under the HI program; and (3) the earnings of railroad workers are included directly in the HI taxable payroll but are not included in the OASDI taxable payroll. (Railroad worker contributions for the equivalent of OASDI benefits are accounted for in a net interchange that occurs annually between the OASDI and Railroad Retirement programs.) As a result, the HI taxable payroll is about 25 percent larger than the OASDI taxable payroll throughout the long-range period.

As with the OASI and DI Trust Funds, income to the HI Trust Fund comes primarily from contributions paid by employees, employers, and self-employed persons. Table VI.G1 shows the OASDI and HI contribution rates that are authorized in the Federal Insurance Contributions Act.

Table VI.G1.—Payroll Tax Contribution Rates for the OASDI and HI Programs
[In percent]

	Employees and employers, combined[a]		Employees only	Self employed[b]		
Calendar years	OASDI up to base[c]	HI all earnings[d]	HI over limit[e]	OASDI up to base[c]	HI all earnings[d]	HI over limit[e]
1966	7.70	0.70	—	5.80	0.35	—
1967	7.80	1.00	—	5.90	.50	—
1968	7.60	1.20	—	5.80	.60	—
1969-70	8.40	1.20	—	6.30	.60	—
1971-72	9.20	1.20	—	6.90	.60	—
1973	9.70	2.00	—	7.00	1.00	—
1974-77	9.90	1.80	—	7.00	.90	—
1978	10.10	2.00	—	7.10	1.00	—
1979-80	10.16	2.10	—	7.05	1.05	—
1981	10.70	2.60	—	8.00	1.30	—
1982-83	10.80	2.60	—	8.05	1.30	—
1984[f]	11.40	2.60	—	11.40	2.60	—
1985[f]	11.40	2.70	—	11.40	2.70	—
1986-87[f]	11.40	2.90	—	11.40	2.90	—
1988-89[f]	12.12	2.90	—	12.12	2.90	—
1990-2010[g]	12.40	2.90	—	12.40	2.90	—
2011-2012[h]	10.40	2.90	—	10.40	2.90	—
2013 and later	12.40	2.90	0.90	12.40	2.90	0.90

[a] Except as noted below, the combined employee/employer rate is divided equally between employees and employers.

[b] Beginning in 1990, self-employed persons receive a deduction, for purposes of computing their net earnings, equal to half of the combined OASDI and HI contributions that would be payable without regard to the contribution and benefit base. The OASDI contribution rate then applies to net earnings after this deduction, but subject to the OASDI base.

[c] The payroll tax on earnings for the OASDI program applies to annual earnings up to a contribution and benefit base indexed to the average wage level. The base is $128,400 for 2018.

[d] Prior to 1994, the payroll tax on earnings for the HI program applied to annual earnings up to a contribution base. The HI contribution base was eliminated beginning in 1994.

[e] Starting with Federal personal income tax returns for tax year 2013, earned income exceeding $200,000 for individual filers and $250,000 for married couples filing jointly is subject to an additional HI tax of 0.9 percent. These income limits are not indexed after 2013.

[f] In 1984 only, employees received an immediate credit of 0.3 percent of taxable wages against their OASDI payroll tax contributions. The self-employed received similar credits of 2.7 percent, 2.3 percent, and 2.0 percent against their combined OASDI and Hospital Insurance (HI) contributions on net earnings from self-employment in 1984, 1985, and 1986-89, respectively. The General Fund of the Treasury reimbursed the trust funds for these credits.

[g] Public Law 111-147 exempted most employers from paying the employer share of OASDI payroll tax on wages paid during the period March 19, 2010 through December 31, 2010 to certain qualified individuals hired after February 3, 2010.

[h] Public Law 111-312, Public Law 112-78, and Public Law 112-96 reduced the OASDI payroll tax rate for 2011 and 2012 by 2 percentage points for employees and for self-employed workers. These laws require that the General Fund of the Treasury reimburse the OASI and DI Trust Funds for these temporary reductions in 2010, 2011, and 2012 payroll tax revenue, in order to “replicate to the extent possible” revenue that would have been received if the combined employee/employer payroll tax rates had remained at 12.4 percent for OASDI (10.6 percent for OASI and 1.8 percent for DI).

Table VI.G2 shows the Trustees’ estimates of annual income rates and cost rates for the OASDI program and the HI program under the low-cost, intermediate, and high-cost sets of assumptions described earlier in this report.

The income rates reflect the payroll tax rates shown in table VI.G1, revenue from taxation of scheduled OASDI benefits for both the OASDI and HI Trust Funds, and any reimbursements from the General Fund of the Treasury. For the HI program, the income rates also reflect: (1) the additional 0.9-percent tax on employees for relatively high earnings and the portion of total payroll to which the 0.9-percent rate applies; (2) premium revenues; and (3) monies from fraud and abuse control activities. Annual income and cost rates indicate the cash-flow operation of the programs. Therefore, income rates exclude interest earned on trust fund asset reserves. Table VI.G2 also shows annual balances, which are the differences between annual income rates and cost rates.

The Trustees project that the OASDI and HI cost rates will rise generally above current levels under the intermediate and high-cost sets of assumptions. The greatest increase occurs from 2018 to 2037 under both sets of assumptions for OASDI and under the intermediate assumptions for HI. Under the intermediate assumptions, the OASDI cost rate increases by 28 percent from its current level by 2092, while under the high-cost assumptions, the cost rate increases by 79 percent by 2092. For HI, cost rates increase by 51 percent and 213 percent from 2018 to 2092 under the intermediate and high-cost assumptions, respectively. Under the low-cost assumptions, the OASDI and HI cost rates decrease from 2018 to 2092 by 6 percent and 28 percent, respectively.

The Trustees project annual deficits for every year of the projection period under the intermediate and high-cost assumptions for both the OASDI and HI programs. Under the low-cost assumptions, OASDI annual balances are negative through 2051, positive for 2052 through 2062, negative for 2063 through 2076, and then positive through the remainder of the 75-year projection period. HI annual balances are positive throughout the projection period under the low-cost assumptions.

Table VI.G2.—OASDI and HI Annual Income Rates, Cost Rates, and Balances, Calendar Years 2018-2095
[As a percentage of taxable payroll[a]]

	OASDI			HI		
Calendar year	Income rate	Cost rate[b]	Balance[b]	Income rate	Cost rate	Balance
Intermediate:						
2018	12.64	13.81	-1.17	3.34	3.42	-0.08
2019	12.87	13.95	-1.08	3.36	3.45	-.09
2020	12.89	14.12	-1.23	3.38	3.48	-.10
2021	12.92	14.27	-1.35	3.40	3.54	-.14
2022	12.95	14.44	-1.49	3.41	3.62	-.21
2023	12.97	14.62	-1.66	3.43	3.70	-.27
2024	12.99	14.80	-1.81	3.45	3.77	-.32
2025	13.01	14.98	-1.98	3.47	3.84	-.37
2026	13.13	15.16	-2.02	3.55	3.91	-.35
2027	13.15	15.36	-2.21	3.58	3.98	-.40
2030	13.20	15.98	-2.78	3.65	4.32	-.68
2035	13.25	16.65	-3.40	3.74	4.66	-.92
2040	13.27	16.83	-3.56	3.81	4.88	-1.07
2045	13.27	16.66	-3.39	3.87	4.98	-1.12
2050	13.27	16.54	-3.27	3.93	5.00	-1.07
2055	13.28	16.59	-3.31	3.99	4.97	-.98
2060	13.29	16.81	-3.51	4.07	4.97	-.91
2065	13.31	17.07	-3.75	4.14	5.02	-.88
2070	13.34	17.36	-4.03	4.21	5.10	-.90
2075	13.35	17.59	-4.23	4.27	5.18	-.91
2080	13.36	17.61	-4.25	4.32	5.21	-.90
2085	13.35	17.53	-4.18	4.35	5.19	-.84
2090	13.35	17.60	-4.24	4.39	5.17	-.77
2095	13.37	17.82	-4.45	4.44	5.15	-.71
Low-cost:						
2018	12.58	13.59	-1.01	3.33	3.33	.01
2019	12.85	13.46	-.62	3.35	3.25	.10
2020	12.86	13.41	-.55	3.36	3.21	.15
2021	12.88	13.35	-.48	3.38	3.21	.17
2022	12.90	13.35	-.45	3.39	3.22	.17
2023	12.91	13.36	-.45	3.41	3.23	.18
2024	12.93	13.39	-.46	3.42	3.23	.20
2025	12.94	13.42	-.48	3.44	3.22	.22
2026	13.04	13.45	-.41	3.51	3.22	.30
2027	13.06	13.50	-.45	3.53	3.21	.32
2030	13.09	13.81	-.72	3.60	3.29	.31
2035	13.12	14.06	-.94	3.70	3.22	.48
2040	13.12	13.89	-.76	3.78	3.05	.73
2045	13.10	13.45	-.35	3.84	2.80	1.05
2050	13.09	13.13	-.05	3.91	2.59	1.32
2055	13.09	13.02	.07	3.98	2.43	1.56
2060	13.09	13.07	.03	4.06	2.34	1.72
2065	13.10	13.12	-.02	4.12	2.32	1.80
2070	13.11	13.17	-.07	4.17	2.35	1.82
2075	13.10	13.14	-.03	4.22	2.39	1.83
2080	13.09	12.92	.17	4.25	2.41	1.85
2085	13.08	12.70	.38	4.28	2.40	1.88
2090	13.08	12.72	.36	4.31	2.38	1.93
2095	13.09	12.95	.14	4.36	2.38	1.98

Table VI.G2.—OASDI and HI Annual Income Rates, Cost Rates, and Balances, Calendar Years 2018-2095 (Cont.)
[As a percentage of taxable payroll[a]]

	OASDI			HI		
Calendar year	Income rate	Cost rate[b]	Balance[b]	Income rate	Cost rate	Balance
High-cost:						
2018	12.69	13.98	-1.29	3.34	3.49	-0.15
2019	12.91	14.63	-1.72	3.37	3.66	-.30
2020	12.93	15.04	-2.11	3.39	3.76	-.37
2021	12.97	15.41	-2.44	3.42	3.89	-.47
2022	13.01	15.76	-2.76	3.44	4.06	-.62
2023	13.03	16.12	-3.09	3.46	4.23	-.76
2024	13.07	16.48	-3.41	3.49	4.39	-.90
2025	13.09	16.82	-3.73	3.51	4.56	-1.05
2026	13.24	17.15	-3.91	3.60	4.72	-1.12
2027	13.27	17.53	-4.26	3.63	4.90	-1.27
2030	13.33	18.53	-5.20	3.71	5.64	-1.94
2035	13.41	19.75	-6.34	3.80	6.70	-2.90
2040	13.46	20.45	-6.99	3.88	7.73	-3.84
2045	13.48	20.77	-7.29	3.95	8.68	-4.73
2050	13.50	21.05	-7.55	4.00	9.43	-5.42
2055	13.53	21.44	-7.91	4.07	9.95	-5.88
2060	13.57	21.99	-8.42	4.13	10.33	-6.20
2065	13.61	22.60	-8.99	4.20	10.61	-6.40
2070	13.66	23.33	-9.67	4.28	10.79	-6.51
2075	13.70	24.03	-10.33	4.35	10.95	-6.60
2080	13.74	24.50	-10.77	4.42	11.03	-6.61
2085	13.76	24.75	-11.00	4.47	10.99	-6.52
2090	13.77	24.95	-11.18	4.52	10.92	-6.41
2095	13.78	25.17	-11.38	4.56	10.89	-6.32

[a] The taxable payroll for HI is significantly larger than the taxable payroll for OASDI because the HI taxable maximum amount was eliminated beginning in 1994, and because HI covers all Federal civilian employees, all State and local government employees hired after April 1, 1986, and railroad employees.

[b] OASDI benefit payments which were scheduled to be paid on January 3 for some past and future years were actually paid on December 31 as required by the statutory provision for early delivery of benefit payments when the normal payment delivery date is a Saturday, Sunday, or legal public holiday. For comparability with the values for historical years and the projections in this report, all trust fund operations and asset reserves reflect the 12 months of benefits scheduled for payment each year.

Notes:
1. The income rate excludes interest income.
2. The Trustees show income and cost estimates generally on a cash basis for the OASDI program and on an incurred basis for the HI program.
3. Totals do not necessarily equal the sums of rounded components.

Table VI.G3 shows summarized values over the 25-year, 50-year, and 75-year valuation periods. For each of those periods, the summarized income rates include beginning trust fund asset reserves, and the summarized cost rates include the cost of accumulating an ending fund reserve equal to 100 percent of annual cost at the end of the period.

Table VI.G3.—Summarized OASDI and HI Income Rates and Cost Rates for Valuation Periods,[a] Calendar Years 2018-2092
[As a percentage of taxable payroll[b]]

Valuation period	OASDI Income rate	OASDI Cost rate[c]	OASDI Actuarial balance	HI Income rate	HI Cost rate	HI Actuarial balance
Intermediate:						
25-year:						
2018-42	14.59	16.36	-1.77	3.70	4.41	-0.71
50-year:						
2018-67	14.01	16.45	-2.45	3.83	4.65	-.82
75-year:						
2018-92	13.84	16.69	-2.84	3.95	4.77	-.82
Low-cost:						
25-year:						
2018-42	14.36	14.26	.09	3.66	3.31	.35
50-year:						
2018-67	13.77	13.69	.08	3.81	2.92	.89
75-year:						
2018-92	13.59	13.45	.13	3.93	2.76	1.17
High-cost:						
25-year:						
2018-42	14.89	18.80	-3.90	3.75	5.88	-2.13
50-year:						
2018-67	14.31	19.87	-5.56	3.88	7.50	-3.62
75-year:						
2018-92	14.18	20.80	-6.62	4.00	8.25	-4.25

[a] Income rates include beginning trust fund asset reserves and cost rates include the cost of reaching an ending target trust fund equal to 100 percent of annual cost at the end of the period.
[b] The taxable payroll for HI is significantly larger than the taxable payroll for OASDI because the HI taxable maximum amount was eliminated beginning 1994, and because HI covers all Federal civilian employees, all State and local government employees hired after April 1, 1986, and railroad employees.
[c] OASDI benefit payments which were scheduled to be paid on January 3 for some past and future years were actually paid on December 31 as required by the statutory provision for early delivery of benefit payments when the normal payment delivery date is a Saturday, Sunday, or legal public holiday. For comparability with the values for historical years and the projections in this report, all trust fund operations and asset reserves reflect the 12 months of benefits scheduled for payment each year.

Note: Totals do not necessarily equal the sums of rounded components.

The Trustees project that the OASDI and HI programs will each experience large actuarial deficits for the 25-year, 50-year, and 75-year valuation periods under the high-cost assumptions. Actuarial deficits under the intermediate assumptions are smaller than those for the high-cost assumptions for all three valuation periods. Under the low-cost assumptions, the OASDI and HI programs have positive actuarial balances for all three valuation periods.

2. Estimates as a Percentage of Gross Domestic Product

This section presents long-range projections of the operations of the combined Old-Age and Survivors Insurance and Disability Insurance (OASI and DI) Trust Funds and of the Hospital Insurance (HI) Trust Fund, expressed as a percentage of gross domestic product (GDP). While expressing fund operations as a percentage of taxable payroll is a very useful approach for assessing the financial status of the programs (see section IV.B.1), expressing them as a percentage of the total value of goods and services produced in the United States provides an additional perspective.

Table VI.G4 shows non-interest income, total cost, and the resulting balance of the combined OASI and DI Trust Funds, of the HI Trust Fund, and of the combined OASI, DI, and HI Trust Funds, expressed as percentages of GDP on the basis of each of the three alternative sets of assumptions. Table VI.G4 also contains estimates of GDP. For OASDI, non-interest income consists of payroll tax contributions, proceeds from taxation of scheduled OASDI benefits, and any reimbursements from the General Fund of the Treasury. Cost consists of scheduled benefits, administrative expenses, financial interchange with the Railroad Retirement program, and payments for vocational rehabilitation services for disabled beneficiaries. For HI, non-interest income consists of payroll tax contributions (including contributions from railroad employment), up to an additional 0.9 percent tax on earned income for relatively high earners, proceeds from taxation of scheduled OASDI benefits, premium revenues, monies from fraud and abuse control activities, and any reimbursements from the General Fund of the Treasury. Cost consists of outlays (benefits and administrative expenses) for beneficiaries. The Trustees show income and cost estimates generally on a cash basis for the OASDI program[1] and on an incurred basis for the HI program.

The Trustees project the OASDI annual balance (non-interest income less cost) as a percentage of GDP to be negative throughout the projection period under the intermediate and high-cost assumptions. Under the low-cost assumptions, the OASDI annual deficit as a percentage of GDP decreases through 2022. After 2022, deficits generally increase to a peak in 2035 and then decrease through 2051. The deficit decreases in 2026 in part because of a one-time upward shift in taxation of benefits income due to the expiration of the personal income tax provisions in Public Law 115-97, the Tax Cuts

[1] OASDI benefits paid for entitlement for a particular month are generally paid in the succeeding month. There are two primary exceptions to this general rule. First, payments can occur with a greater delay when a benefit award is made after the month of initial benefit entitlement. At the time of benefit award, benefits owed for months of prior entitlement are then also paid to the beneficiary. For the projections in this report, such retroactive payments are included in the period where they are paid (at time of award). Second, when benefit payments scheduled for January 3 are paid on the prior December 31, because January 3 falls on a Sunday, such payments are shown in this report for the period they were scheduled to be paid.

and Jobs Act. The annual balances are positive for 2052 through 2062, negative for 2063 through 2076, and positive for 2077 through the remainder of the 75-year projection period. Under the intermediate assumptions, the annual deficit decreases from 2018 to 2019. Thereafter, annual deficits increase through 2039, then decrease through 2052, and generally increase thereafter. Under the high-cost assumptions, annual deficits increase throughout the projection period.

The Trustees project that the HI annual balance as a percentage of GDP will be positive throughout the projection period under the low-cost assumptions. Under the intermediate and the high-cost assumptions, the HI annual balance is negative for all years of the projection period. Under the intermediate assumptions, annual deficits generally increase through 2045, and then generally decline thereafter. Under the high-cost assumptions, annual deficits reach a peak in 2075 and decline slowly thereafter.

The combined OASDI and HI annual balance as a percentage of GDP is negative throughout the projection period under both the intermediate and high-cost assumptions. Under the low-cost assumptions, the combined OASDI and HI annual balance is negative through 2039, and then positive and mostly rising thereafter. Under the intermediate assumptions, the combined OASDI and HI annual deficit decreases from 2018 to 2019. Thereafter, annual deficits increase through 2040, decrease through 2054, then increase through 2077, and generally decline thereafter, reaching 1.82 percent of GDP by 2092. Under the high-cost assumptions, combined annual deficits rise to a peak of 6.26 percent in 2081 and decrease thereafter.

By 2092, the combined OASDI and HI annual balances as percentages of GDP range from a positive annual balance of 1.01 percent for the low-cost assumptions to an annual deficit of 6.17 percent for the high-cost assumptions. Annual balances differ by a much smaller amount for the tenth projection year, 2027, ranging from an annual deficit of 0.02 percent for the low-cost assumptions to an annual deficit of 2.11 percent for the high-cost assumptions.

The summarized long-range (75-year) actuarial balance as a percentage of GDP for the combined OASDI and HI programs varies among the three alternatives by a relatively large amount, from a positive actuarial balance of 0.59 percent under the low-cost assumptions to an actuarial deficit of 4.14 percent under the high-cost assumptions. The 25-year summarized actuarial balance varies by a smaller amount, from a positive actuarial balance of 0.19 percent to an actuarial deficit of 2.35 percent. Summarized rates are calculated on a present-value basis. They include the trust fund reserve balances on January 1, 2018 and the cost of reaching a target trust fund level equal to

100 percent of the following year's annual cost at the end of the period. (See section IV.B.4 for further explanation.)

Table VI.G4.—OASDI and HI Annual and Summarized Income, Cost, and Balance as a Percentage of GDP, Calendar Years 2018-2095

	Percentage of GDP									GDP in dollars (billions)
	OASDI			HI			Combined			
Calendar year	Income[a]	Cost[b]	Balance[b]	Income[a]	Cost	Balance	Income[a]	Cost[b]	Balance[b]	
Intermediate:										
2018	4.52	4.94	-0.42	1.49	1.53	-0.04	6.01	6.47	-0.46	$20,307
2019	4.61	4.99	-.39	1.51	1.55	-.04	6.11	6.54	-.43	21,262
2020	4.62	5.07	-.44	1.52	1.57	-.05	6.15	6.64	-.49	22,288
2021	4.65	5.14	-.49	1.54	1.60	-.06	6.19	6.74	-.55	23,346
2022	4.68	5.22	-.54	1.55	1.65	-.09	6.23	6.87	-.63	24,440
2023	4.70	5.30	-.60	1.57	1.69	-.12	6.27	6.99	-.72	25,577
2024	4.73	5.39	-.66	1.58	1.72	-.14	6.31	7.11	-.80	26,765
2025	4.75	5.47	-.72	1.59	1.76	-.17	6.34	7.23	-.89	27,978
2026	4.81	5.55	-.74	1.63	1.80	-.16	6.44	7.35	-.90	29,229
2027	4.82	5.63	-.81	1.64	1.83	-.18	6.46	7.45	-.99	30,535
2030	4.82	5.83	-1.01	1.67	1.98	-.31	6.49	7.81	-1.32	34,731
2035	4.80	6.03	-1.23	1.70	2.12	-.42	6.50	8.15	-1.65	42,930
2040	4.78	6.07	-1.28	1.72	2.21	-.48	6.51	8.27	-1.76	53,040
2045	4.76	5.98	-1.22	1.74	2.24	-.50	6.51	8.23	-1.72	65,746
2050	4.75	5.93	-1.17	1.76	2.25	-.48	6.52	8.17	-1.65	81,536
2055	4.74	5.93	-1.18	1.79	2.23	-.44	6.53	8.16	-1.62	100,989
2060	4.74	5.99	-1.25	1.82	2.22	-.41	6.56	8.21	-1.66	124,750
2065	4.73	6.06	-1.33	1.84	2.24	-.39	6.57	8.30	-1.73	153,867
2070	4.71	6.14	-1.42	1.87	2.26	-.40	6.58	8.40	-1.82	189,838
2075	4.70	6.19	-1.49	1.88	2.29	-.40	6.58	8.47	-1.89	234,618
2080	4.67	6.16	-1.49	1.90	2.29	-.39	6.57	8.45	-1.88	290,420
2085	4.65	6.10	-1.46	1.90	2.27	-.37	6.55	8.38	-1.82	359,507
2090	4.63	6.10	-1.47	1.91	2.25	-.34	6.54	8.35	-1.81	444,282
2095	4.62	6.16	-1.54	1.92	2.23	-.31	6.54	8.39	-1.85	548,108
Summarized rates: [c]										
25-year:										
2018-42 . .	5.29	5.93	-.64	1.68	2.01	-.32	6.97	7.94	-.96	
50-year:										
2018-67 . .	5.05	5.93	-.88	1.73	2.10	-.37	6.78	8.03	-1.25	
75-year:										
2018-92 . .	4.95	5.97	-1.02	1.77	2.14	-.37	6.72	8.11	-1.39	
Low-cost:										
2018	4.50	4.86	-.36	1.49	1.49	[d]	5.99	6.35	-.36	20,587
2019	4.59	4.81	-.22	1.50	1.46	.04	6.10	6.28	-.18	22,055
2020	4.62	4.82	-.20	1.52	1.45	.07	6.14	6.27	-.13	23,558
2021	4.66	4.84	-.17	1.54	1.46	.08	6.20	6.29	-.09	25,023
2022	4.70	4.87	-.16	1.55	1.47	.08	6.25	6.34	-.08	26,511
2023	4.74	4.91	-.17	1.56	1.48	.08	6.30	6.38	-.08	28,064
2024	4.77	4.94	-.17	1.57	1.48	.09	6.34	6.42	-.08	29,716
2025	4.80	4.98	-.18	1.58	1.48	.10	6.38	6.46	-.08	31,444
2026	4.87	5.02	-.15	1.62	1.48	.14	6.48	6.50	-.01	33,238
2027	4.89	5.05	-.17	1.63	1.48	.15	6.51	6.53	-.02	35,129
2030	4.89	5.16	-.27	1.66	1.51	.14	6.55	6.67	-.13	41,396
2035	4.89	5.23	-.35	1.70	1.48	.22	6.58	6.71	-.13	54,308
2040	4.88	5.16	-.28	1.73	1.40	.33	6.61	6.56	.05	71,362
2045	4.88	5.01	-.13	1.76	1.28	.48	6.64	6.29	.35	94,360
2050	4.88	4.90	-.02	1.80	1.19	.61	6.68	6.09	.59	125,033
2055	4.89	4.87	.03	1.83	1.12	.72	6.73	5.99	.74	165,423
2060	4.91	4.90	.01	1.87	1.08	.79	6.78	5.98	.80	218,200
2065	4.92	4.93	-.01	1.90	1.07	.83	6.82	6.00	.82	287,519
2070	4.93	4.95	-.03	1.93	1.09	.84	6.85	6.04	.81	379,457
2075	4.93	4.94	-.01	1.95	1.11	.85	6.88	6.05	.83	502,419
2080	4.93	4.86	.06	1.97	1.11	.85	6.89	5.98	.92	666,725
2085	4.93	4.78	.14	1.98	1.11	.87	6.91	5.89	1.01	884,116
2090	4.93	4.80	.13	2.00	1.11	.89	6.93	5.90	1.03	1,168,855
2095	4.95	4.89	.05	2.02	1.10	.92	6.97	6.00	.97	1,541,437

Table VI.G4.—OASDI and HI Annual and Summarized Income, Cost, and Balance as a Percentage of GDP, Calendar Years 2018-2095 (Cont.)

	Percentage of GDP									GDP in dollars (billions)
	OASDI			HI			Combined			
Calendar year	Income[a]	Cost[b]	Balance[b]	Income[a]	Cost	Balance	Income[a]	Cost[b]	Balance[b]	
Low-cost (Cont.):										
Summarized rates: [c]										
25-year:										
2018-42 . .	5.32	5.28	0.04	1.68	1.52	0.16	6.99	6.80	0.19	
50-year:										
2018-67 . .	5.12	5.09	.03	1.75	1.34	.41	6.87	6.43	.44	
75-year:										
2018-92 . .	5.07	5.02	.05	1.81	1.27	.54	6.88	6.29	.59	
High-cost:										
2018	4.53	5.00	-.46	1.50	1.56	-.07	6.03	6.56	-.53	$20,129
2019	4.63	5.25	-.62	1.51	1.64	-.13	6.14	6.89	-.75	20,179
2020	4.63	5.39	-.76	1.52	1.69	-.17	6.15	7.08	-.92	20,767
2021	4.64	5.51	-.87	1.54	1.75	-.21	6.18	7.27	-1.09	21,505
2022	4.66	5.64	-.99	1.56	1.84	-.28	6.21	7.48	-1.27	22,261
2023	4.67	5.78	-1.11	1.57	1.92	-.35	6.25	7.70	-1.45	23,032
2024	4.69	5.91	-1.22	1.59	2.00	-.41	6.28	7.92	-1.64	23,823
2025	4.70	6.04	-1.34	1.61	2.09	-.48	6.31	8.13	-1.82	24,641
2026	4.76	6.17	-1.41	1.65	2.17	-.51	6.41	8.33	-1.92	25,487
2027	4.76	6.29	-1.53	1.67	2.25	-.58	6.43	8.54	-2.11	26,335
2030	4.76	6.61	-1.85	1.69	2.57	-.88	6.45	9.18	-2.74	28,903
2035	4.73	6.97	-2.24	1.72	3.02	-1.31	6.45	10.00	-3.55	33,674
2040	4.71	7.15	-2.45	1.74	3.46	-1.72	6.44	10.61	-4.17	39,118
2045	4.68	7.21	-2.53	1.75	3.85	-2.10	6.43	11.06	-4.63	45,405
2050	4.65	7.25	-2.60	1.76	4.15	-2.39	6.41	11.40	-4.99	52,639
2055	4.62	7.33	-2.71	1.78	4.35	-2.57	6.40	11.68	-5.28	60,941
2060	4.60	7.46	-2.86	1.79	4.48	-2.69	6.40	11.94	-5.54	70,383
2065	4.57	7.60	-3.02	1.81	4.56	-2.75	6.38	12.16	-5.78	81,117
2070	4.54	7.76	-3.22	1.82	4.60	-2.77	6.37	12.36	-5.99	93,358
2075	4.51	7.91	-3.40	1.84	4.62	-2.78	6.35	12.53	-6.18	107,431
2080	4.47	7.98	-3.50	1.84	4.60	-2.76	6.31	12.58	-6.26	123,695
2085	4.43	7.97	-3.54	1.84	4.54	-2.69	6.27	12.51	-6.23	142,510
2090	4.39	7.96	-3.57	1.85	4.47	-2.62	6.24	12.42	-6.19	164,144
2095	4.35	7.95	-3.60	1.85	4.41	-2.56	6.20	12.36	-6.16	188,939
Summarized rates: [c]										
25-year:										
2018-42 . .	5.30	6.68	-1.39	1.70	2.66	-.96	6.99	9.34	-2.35	
50-year:										
2018-67 . .	5.00	6.95	-1.94	1.73	3.35	-1.61	6.74	10.29	-3.56	
75-year:										
2018-92 . .	4.88	7.16	-2.28	1.76	3.63	-1.87	6.64	10.78	-4.14	

[a] Income for individual years excludes interest on the trust funds. Interest is implicit in all summarized values.
[b] OASDI benefit payments which were scheduled to be paid on January 3 for some past and future years were actually paid on December 31 as required by the statutory provision for early delivery of benefit payments when the normal payment delivery date is a Saturday, Sunday, or legal public holiday. For comparability with the values for historical years and the projections in this report, all trust fund operations and asset reserves reflect the 12 months of benefits scheduled for payment each year.
[c] Summarized rates are calculated on a present-value basis. They include the value of the trust funds on January 1, 2018 and the cost of reaching a target trust fund level equal to 100 percent of annual cost at the end of the period.
[d] Between 0 and 0.005 percent of GDP.

Notes:
1. The Trustees show income and cost estimates generally on a cash basis for the OASDI program and on an incurred basis for the HI program.

2. Totals do not necessarily equal the sums of rounded components.

Table VI.G5 displays annual ratios of OASDI taxable payroll to GDP. These ratios facilitate comparisons of trust fund operations expressed as percentages of taxable payroll and those expressed as percentages of GDP. HI taxable payroll is about 25 percent larger than the OASDI taxable payroll throughout the long-range period; see section 1 of this appendix for a detailed description of the difference. For each year, the cost as a percentage of GDP is equal to the cost as a percentage of taxable payroll multiplied by the ratio of taxable payroll to GDP.

Table VI.G5.—Ratio of OASDI Taxable Payroll to GDP, Calendar Years 2018-2095

Calendar year	Intermediate	Low-cost	High-cost
2018	0.358	0.357	0.357
2019	.358	.358	.359
2020	.359	.359	.358
2021	.360	.362	.358
2022	.362	.365	.358
2023	.363	.367	.358
2024	.364	.369	.359
2025	.365	.371	.359
2026	.366	.373	.360
2027	.366	.374	.359
2030	.365	.374	.357
2035	.362	.372	.353
2040	.360	.372	.350
2045	.359	.372	.347
2050	.358	.373	.344
2055	.357	.374	.342
2060	.356	.375	.339
2065	.355	.376	.336
2070	.353	.376	.333
2075	.352	.376	.329
2080	.350	.376	.326
2085	.348	.377	.322
2090	.347	.377	.319
2095	.345	.378	.316

Projections of GDP reflect projected increases in U.S. employment, labor productivity, average hours worked, and the GDP price index (GDP deflator). Projections of taxable payroll reflect the components of growth in GDP along with assumed changes in the ratio of total compensation to GDP, the ratio of earnings to total compensation, the ratio of OASDI covered earnings to total earnings, and the ratio of taxable to total covered earnings.

Over the long-range period, the ratio of OASDI taxable payroll to GDP is projected to decline mostly due to a projected decline in the ratio of wages and salaries to employee compensation. Over the last five complete economic cycles, the ratio of wages and salaries to employee compensation declined at an average annual rate of 0.23 percent. Over the 65-year period ending in 2092, the ratio of wages and salaries to employee compensation is projected to decline at an average annual rate of 0.08 and 0.18 percent for the intermediate and high-cost assumptions, respectively, and to increase at an average annual rate of 0.02 percent for the low-cost assumptions.

3. Estimates in Dollars

This section presents long-range projections, in dollars, of the operations of the combined OASI and DI Trust Funds and in some cases the HI Trust Fund. Comparing current dollar values over long periods of time is difficult because of the effect of inflation. In order to compare dollar values in a meaningful way, table VI.G6 provides several economic series or indices which can be used to adjust current dollars for changes in prices, wages, or other aspects of economic growth during the projection period. Any series of values can be adjusted by dividing the value for each year by the corresponding index value for the year.

One of the most common forms of standardization is price indexing, which uses some measure of change in the prices of consumer goods. The Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W, hereafter referred to as CPI), published by the Bureau of Labor Statistics, Department of Labor, is one such price index. Consistent with the law, the Social Security Administration (SSA) uses this index to determine the annual cost-of-living increases for OASDI monthly benefits. The ultimate annual rate of increase in the CPI is assumed to be 3.2, 2.6, and 2.0 percent for the low-cost, intermediate, and high-cost sets of assumptions, respectively. Table VI.G7 provides CPI-indexed dollar values (those adjusted using the CPI in table VI.G6), which indicate the relative purchasing power of the values over time.

Wage indexing is another type of standardization. It combines the effects of price inflation and real-wage growth. The wage index presented here is the national average wage index, as defined in section 209(k)(1) of the Social Security Act. SSA uses this index to annually adjust the contribution and benefit base and other earnings-related program amounts. The average wage is assumed to grow by an average rate of 5.0, 3.8, and 2.6 percent under the low-cost, intermediate, and high-cost assumptions, respectively, between 2027 and 2092. Wage-indexed values indicate the level of a series of values relative to the changing standard of living of workers over time.

The taxable payroll series is used as an index to adjust for the effects of changes in the number of workers and changes in the proportion of earnings that are taxable, as well as for the effects of price inflation and real-wage growth. The OASDI taxable payroll consists of all earnings subject to OASDI taxation, with an adjustment for the lower effective tax rate on multiple-employer excess wages. A series of values, divided by the taxable payroll, indicates the percentage of payroll that each value represents, and thus the extent to which the series of values increases or decreases as a percent of payroll over time.

The GDP series is used as an index to adjust for the growth in the aggregate amount of goods and services produced in the United States. Values adjusted by GDP (see section 2 of this appendix) indicate their relative share of the total output of the economy. No direct assumption is made about growth in taxable payroll or GDP. These series reflect the basic demographic and economic assumptions, as discussed in sections V.A and V.B, respectively.

Discounting at the rate of interest is another way of standardizing current dollars. The compound new-issue interest factor shown in table VI.G6 increases each year by the assumed effective annual nominal yield for special public-debt obligations issuable to the trust funds in the 12 months of the prior year. The compound effective trust-fund interest factor shown in table VI.G6 uses the effective annual yield on all currently-held securities in the combined OASI and DI Trust Funds. The reciprocal of the compound effective trust-fund interest factor approximates the cumulative discount factor used to convert nominal dollar values to present values as of the start of the valuation period in order to create summarized values for this report.

Table VI.G6.—Selected Economic Variables, Calendar Years 2017-2095
[GDP and taxable payroll in billions]

Calendar year	Adjusted CPI[a]	Average wage index	Taxable payroll[b]	Gross domestic product	Compound new-issue interest factor[c]	Compound effective trust-fund interest factor[d]
Intermediate:						
2017	97.82	$50,020.69	$6,956	$19,385	0.9773	0.9853
2018	100.00	51,894.47	7,261	20,307	1.0000	1.0145
2019	102.50	54,076.92	7,608	21,262	1.0271	1.0438
2020	105.17	56,534.16	7,994	22,288	1.0622	1.0736
2021	107.91	59,089.48	8,407	23,346	1.1045	1.1043
2022	110.71	61,705.86	8,836	24,440	1.1523	1.1358
2023	113.59	64,405.95	9,278	25,577	1.2059	1.1685
2024	116.54	67,191.23	9,739	26,765	1.2652	1.2032
2025	119.57	70,057.16	10,213	27,978	1.3302	1.2401
2026	122.68	73,003.92	10,702	29,229	1.3996	1.2797
2027	125.87	75,908.24	11,185	30,535	1.4741	1.3227
2030	135.95	85,114.16	12,671	34,731	1.7246	1.4891
2035	154.56	103,003.87	15,556	42,930	2.2401	1.9203
2040	175.73	124,375.91	19,117	53,040	2.9098	2.4944
2045	199.79	149,896.71	23,609	65,746	3.7796	3.2400
2050	227.15	180,862.31	29,205	81,536	4.9095	4.2086
2055	258.26	218,269.08	36,090	100,989	6.3772	5.4667
2060	293.62	263,354.75	44,465	124,750	8.2836	7.1009
2065	333.83	317,308.93	54,643	153,867	10.7598	9.2237
2070	379.55	381,537.58	67,102	189,838	13.9764	11.9810
2075	431.52	458,555.69	82,548	234,618	18.1545	15.5626
2080	490.61	550,706.66	101,628	290,420	23.5816	20.2149
2085	557.79	661,504.94	125,189	359,507	30.6311	26.2580
2090	634.18	795,083.51	154,082	444,282	39.7879	34.1075
2095	721.02	955,877.40	189,340	548,108	51.6821	44.3036
Low-cost:						
2017	97.35	50,031.80	6,957	19,393	0.9773	0.9853
2018	100.00	52,409.41	7,359	20,587	1.0000	1.0147
2019	103.26	55,687.90	7,887	22,055	1.0355	1.0449
2020	106.59	59,194.02	8,464	23,558	1.0862	1.0772
2021	110.01	62,741.89	9,061	25,023	1.1427	1.1118
2022	113.53	66,191.66	9,671	26,511	1.2052	1.1490
2023	117.16	69,734.56	10,308	28,064	1.2734	1.1896
2024	120.91	73,442.74	10,970	29,716	1.3487	1.2345
2025	124.78	77,392.43	11,668	31,444	1.4318	1.2844
2026	128.77	81,576.71	12,397	33,238	1.5223	1.3401
2027	132.89	85,836.60	13,148	35,129	1.6206	1.4026
2030	146.06	99,756.77	15,464	41,396	1.9584	1.6402
2035	170.97	128,098.89	20,224	54,308	2.6835	2.2342
2040	200.14	163,884.74	26,539	71,362	3.6771	3.0613
2045	234.28	209,144.66	35,118	94,360	5.0385	4.1948
2050	274.24	267,472.51	46,635	125,033	6.9040	5.7478
2055	321.02	342,393.10	61,867	165,423	9.4601	7.8759
2060	375.77	438,260.96	81,810	218,200	12.9626	10.7919
2065	439.87	560,079.76	107,975	287,519	17.7619	14.7875
2070	514.90	714,119.46	142,614	379,457	24.3381	20.2625
2075	602.73	909,999.24	189,018	502,419	33.3491	27.7645
2080	705.53	1,158,789.71	250,905	666,725	45.6963	38.0440
2085	825.88	1,476,031.64	332,968	884,116	62.6150	52.1295
2090	966.75	1,881,273.21	440,861	1,168,855	85.7976	71.4299
2095	1,131.65	2,398,277.32	582,276	1,541,437	117.5634	97.8762

Table VI.G6.—Selected Economic Variables, Calendar Years 2017-2095 (Cont.)
[GDP and taxable payroll in billions]

Calendar year	Adjusted CPI[a]	Average wage index	Taxable payroll[b]	Gross domestic product	Compound new-issue interest factor[c]	Compound effective trust-fund interest factor[d]
High-cost:						
2017	98.39	$50,015.84	$6,955	$19,383	0.9773	0.9853
2018	100.00	51,505.66	7,194	20,129	1.0000	1.0144
2019	101.49	51,740.36	7,240	20,179	1.0215	1.0429
2020	103.43	53,243.84	7,441	20,767	1.0379	1.0709
2021	105.50	54,994.26	7,692	21,505	1.0664	1.0986
2022	107.61	56,917.34	7,969	22,261	1.1026	1.1258
2023	109.77	58,885.61	8,255	23,032	1.1435	1.1526
2024	111.96	60,812.41	8,550	23,823	1.1886	1.1792
2025	114.20	62,796.24	8,856	24,641	1.2368	1.2056
2026	116.48	64,830.08	9,165	25,487	1.2886	1.2323
2027	118.81	66,699.05	9,451	26,335	1.3439	1.2596
2030	126.09	72,141.40	10,311	28,903	1.5224	1.3767
2035	139.21	82,251.25	11,889	33,674	1.8741	1.7074
2040	153.70	93,730.26	13,683	39,118	2.3069	2.1019
2045	169.70	106,678.22	15,752	45,405	2.8398	2.5874
2050	187.36	121,401.97	18,127	52,639	3.4958	3.1850
2055	206.86	138,079.28	20,832	60,941	4.3033	3.9207
2060	228.39	156,983.21	23,872	70,383	5.2974	4.8264
2065	252.16	178,249.01	27,264	81,117	6.5210	5.9413
2070	278.40	202,032.73	31,057	93,358	8.0273	7.3137
2075	307.38	228,917.56	35,368	107,431	9.8816	9.0031
2080	339.37	259,191.35	40,266	123,695	12.1641	11.0827
2085	374.69	293,535.68	45,896	142,510	14.9739	13.6427
2090	413.69	332,662.09	52,349	164,144	18.4328	16.7941
2095	456.75	377,069.65	59,683	188,939	22.6906	20.6734

[a] CPI-W indexed to calendar year 2018.
[b] Total earnings subject to OASDI contribution rates, adjusted to reflect the lower effective contribution rates (compared to the combined employee-employer rate) that apply to multiple-employer "excess wages."
[c] For each alternative, incorporates the average of the assumed annual yield for special public-debt obligations issuable to the trust funds in the 12 months of the prior year.
[d] For each alternative, incorporates the annual effective yield for all outstanding special public-debt obligations held by the trust fund, with a half-year's interest effect in each row. The effective yield for a period equals total interest earned during the period divided by the total exposure to interest on asset reserves and all income and outgo items during the period. The reciprocals of the factors approximate the discounting/accumulation factors that are used to calculate summarized rates and balances in this report.

Table VI.G7 shows the operations of the combined OASI and DI Trust Funds in CPI-indexed 2018 dollars—that is, adjusted by the CPI indexing series as discussed above. The following items are presented in the table: (1) non-interest income, (2) interest income, (3) total income, (4) cost, and (5) asset reserves at the end of the year. Non-interest income consists of payroll tax contributions, income from taxation of scheduled OASDI benefits, and any reimbursements from the General Fund of the Treasury. Cost consists of scheduled benefits, administrative expenses, financial interchange with the Railroad Retirement program, and payments for vocational rehabilitation services for disabled beneficiaries. Table VI.G7 shows trust fund operations under the low-cost, intermediate, and high-cost sets of assumptions.

Table VI.G7.—Operations of the Combined OASI and DI Trust Funds, in CPI-indexed 2018 Dollars,[a] Calendar Years 2018-2095
[In billions]

Calendar year	Non-interest income	Interest income	Total income	Cost[b]	Asset reserves at end of year[b]
Intermediate:					
2018	$918.0	$83.1	$1,001.1	$1,002.8	$2,890.1
2019	955.3	80.1	1,035.4	1,035.6	2,819.3
2020	980.0	77.8	1,057.8	1,073.6	2,732.0
2021	1,006.6	74.9	1,081.5	1,112.0	2,632.3
2022	1,033.2	72.1	1,105.3	1,152.3	2,518.6
2023	1,059.1	70.2	1,129.3	1,194.3	2,389.9
2024	1,085.9	68.6	1,154.5	1,237.1	2,246.7
2025	1,111.0	66.4	1,177.4	1,279.8	2,087.4
2026	1,145.6	64.5	1,210.1	1,322.2	1,922.4
2027	1,168.9	62.2	1,231.1	1,365.3	1,739.5
2030[c]	1,230.5	54.7	1,285.2	1,489.7	1,083.1
Low-cost:					
2018	925.7	84.3	1,010.0	1,000.1	2,901.7
2019	981.1	85.0	1,066.1	1,028.3	2,847.7
2020	1,021.0	86.8	1,107.8	1,064.8	2,801.7
2021	1,060.6	88.7	1,149.3	1,099.9	2,764.3
2022	1,098.6	91.8	1,190.4	1,136.8	2,732.2
2023	1,135.6	96.6	1,232.2	1,175.5	2,704.2
2024	1,173.2	102.3	1,275.5	1,215.2	2,680.6
2025	1,209.8	108.5	1,318.3	1,255.0	2,660.8
2026	1,255.9	116.4	1,372.3	1,294.9	2,655.6
2027	1,291.6	124.7	1,416.4	1,335.9	2,653.7
2030	1,386.0	149.7	1,535.7	1,462.5	2,634.1
2035	1,552.0	160.7	1,712.7	1,662.8	2,537.9
2040	1,740.0	151.0	1,891.0	1,841.4	2,379.9
2045	1,964.0	150.9	2,114.9	2,016.1	2,397.0
2050	2,225.8	167.6	2,393.4	2,233.5	2,686.5
2055	2,522.1	199.1	2,721.2	2,508.6	3,206.9
2060	2,850.8	238.2	3,089.0	2,844.6	3,834.2
2065	3,215.8	280.4	3,496.2	3,221.1	4,511.1
2070	3,629.9	325.7	3,955.6	3,649.1	5,236.4
2075	4,109.8	376.9	4,486.7	4,120.1	6,067.1
2080	4,656.0	449.5	5,105.5	4,596.3	7,277.9
2085	5,272.8	564.9	5,837.7	5,121.0	9,201.2
2090	5,964.5	720.8	6,685.3	5,802.1	11,742.0
2095	6,737.6	888.9	7,626.5	6,665.2	14,431.2
High-cost:					
2018	912.7	82.4	995.1	1,005.6	2,881.3
2019	921.1	76.7	997.8	1,043.6	2,793.3
2020	930.3	70.5	1,000.8	1,081.9	2,659.4
2021	945.9	64.3	1,010.2	1,123.7	2,493.8
2022	963.1	57.3	1,020.3	1,167.2	2,298.0
2023	980.1	50.5	1,030.5	1,212.5	2,071.0
2024	998.0	43.7	1,041.7	1,258.5	1,813.5
2025	1,015.0	36.6	1,051.5	1,304.2	1,525.3
2026	1,041.4	30.3	1,071.7	1,349.3	1,217.8
2027[c]	1,055.3	23.2	1,078.6	1,394.5	878.0

[a] CPI-indexed 2018 dollars equal current dollars adjusted by the CPI indexing series in table VI.G6.
[b] Benefit payments which were scheduled to be paid on January 3 for some past and future years were actually paid on December 31 as required by the statutory provision for early delivery of benefit payments when the normal payment delivery date is a Saturday, Sunday, or legal public holiday. For comparability with the values for historical years and the projections in this report, all trust fund operations and asset reserves reflect the 12 months of benefits scheduled for payment each year.
[c] The combined OASI and DI Trust Funds become depleted in 2034 under the intermediate assumptions and in 2030 under the high-cost assumptions, so estimates for later years are not shown.

Note: Totals do not necessarily equal the sums of rounded components.

Figure VI.G1 compares annual cost with annual total income and annual non-interest income. The figure shows only the OASDI program under intermediate assumptions, and presents values in CPI-indexed 2018 dollars, consistent with table VI.G7. The difference between the income values for each year is equal to the trust fund interest earnings. The figure illustrates that, under intermediate assumptions, annual cost exceeds both total income and non-interest income in each year of the projection period. For 2018 through 2033 (the year preceding the year of trust fund reserve depletion), annual cost is covered by drawing down combined trust fund reserves.

Figure VI.G1.—Estimated OASDI Income and Cost in CPI-indexed 2018 Dollars, Based on Intermediate Assumptions
[In billions]

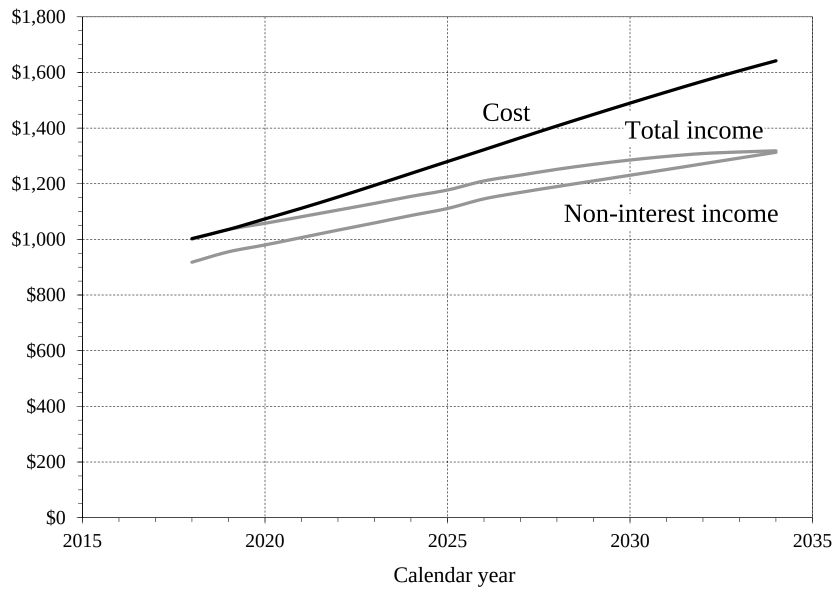


Table VI.G8 presents the operations of the combined OASI and DI Trust Funds in current, or nominal, dollars—that is, in dollars unadjusted for inflation. The following items are presented in the table: (1) non-interest income, (2) interest income, (3) total income, (4) cost, and (5) asset reserves at the end of the year. These estimates are presented using the low-cost, intermediate, and high-cost sets of demographic and economic assumptions to facilitate independent analysis.

Table VI.G8.—Operations of the Combined OASI and DI Trust Funds, in Current Dollars, Calendar Years 2018-2095
[In billions]

Calendar year	Non-interest income	Interest income	Total income	Cost[a]	Asset reserves at end of year[a]
Intermediate:					
2018	$918.0	$83.1	$1,001.1	$1,002.8	$2,890.1
2019	979.2	82.2	1,061.4	1,061.5	2,889.9
2020	1,030.7	81.8	1,112.5	1,129.2	2,873.2
2021	1,086.1	80.9	1,167.0	1,199.9	2,840.3
2022	1,143.9	79.8	1,223.7	1,275.7	2,788.4
2023	1,203.0	79.8	1,282.8	1,356.5	2,714.6
2024	1,265.5	80.0	1,345.5	1,441.8	2,618.4
2025	1,328.5	79.4	1,407.9	1,530.2	2,496.0
2026	1,405.5	79.1	1,484.6	1,622.1	2,358.5
2027	1,471.2	78.3	1,549.6	1,718.5	2,189.5
2030[b]	1,672.8	74.3	1,747.2	2,025.2	1,472.5
Low-cost:					
2018	925.7	84.3	1,010.0	1,000.1	2,901.7
2019	1,013.1	87.7	1,100.9	1,061.9	2,940.7
2020	1,088.3	92.6	1,180.9	1,135.0	2,986.5
2021	1,166.7	97.6	1,264.3	1,209.9	3,040.9
2022	1,247.2	104.3	1,351.4	1,290.5	3,101.8
2023	1,330.5	113.1	1,443.6	1,377.2	3,168.2
2024	1,418.5	123.7	1,542.2	1,469.3	3,241.1
2025	1,509.5	135.4	1,644.9	1,566.0	3,320.1
2026	1,617.2	149.9	1,767.1	1,667.5	3,419.6
2027	1,716.4	165.8	1,882.2	1,775.3	3,526.5
2030	2,024.4	218.7	2,243.1	2,136.1	3,847.4
2035	2,653.6	274.7	2,928.3	2,842.9	4,339.2
2040	3,482.4	302.3	3,784.7	3,685.3	4,763.1
2045	4,601.2	353.5	4,954.6	4,723.2	5,615.7
2050	6,104.1	459.5	6,563.6	6,125.2	7,367.3
2055	8,096.4	639.2	8,735.6	8,052.9	10,294.6
2060	10,712.5	894.9	11,607.4	10,689.1	14,407.9
2065	14,145.3	1,233.3	15,378.7	14,168.5	19,842.7
2070	18,690.2	1,677.2	20,367.4	18,789.4	26,961.9
2075	24,770.6	2,271.7	27,042.3	24,832.7	36,567.7
2080	32,850.0	3,171.2	36,021.1	32,428.2	51,347.9
2085	43,546.8	4,665.8	48,212.6	42,293.4	75,990.7
2090	57,662.1	6,968.0	64,630.1	56,091.5	113,516.3
2095	76,246.0	10,059.4	86,305.4	75,427.4	163,310.9
High-cost:					
2018	912.7	82.4	995.1	1,005.6	2,881.3
2019	934.8	77.8	1,012.6	1,059.1	2,834.8
2020	962.2	72.9	1,035.1	1,119.1	2,750.8
2021	997.9	67.9	1,065.8	1,185.5	2,631.1
2022	1,036.4	61.6	1,098.0	1,256.1	2,473.0
2023	1,075.8	55.4	1,131.2	1,330.9	2,273.3
2024	1,117.3	48.9	1,166.2	1,409.1	2,030.4
2025	1,159.1	41.7	1,200.8	1,489.4	1,741.9
2026	1,213.0	35.3	1,248.4	1,571.7	1,418.5
2027[b]	1,253.9	27.6	1,281.5	1,656.8	1,043.2

[a] Benefit payments which were scheduled to be paid on January 3 for some past and future years were actually paid on December 31 as required by the statutory provision for early delivery of benefit payments when the normal payment delivery date is a Saturday, Sunday, or legal public holiday. For comparability with the values for historical years and the projections in this report, all trust fund operations and asset reserves reflect the 12 months of benefits scheduled for payment each year.

[b] The combined OASI and DI Trust Funds become depleted in 2034 under the intermediate assumptions and in 2030 under the high-cost assumptions, so estimates for later years are not shown.

Note: Totals do not necessarily equal the sums of rounded components.

Table VI.G9 presents values in CPI-indexed 2018 dollars—that is, adjusted by the CPI indexing series discussed at the beginning of this section. This table contains the annual non-interest income and cost of the combined OASI and DI Trust Funds, of the HI Trust Fund, and of the combined OASI, DI, and HI Trust Funds, based on the low-cost, intermediate, and high-cost sets of assumptions. For OASDI, non-interest income consists of payroll tax contributions, proceeds from taxation of scheduled OASDI benefits, and any reimbursements from the General Fund of the Treasury. Cost consists of scheduled benefits, administrative expenses, financial interchange with the Railroad Retirement program, and payments for vocational rehabilitation services for disabled beneficiaries. For HI, non-interest income consists of payroll tax contributions (including contributions from railroad employment), up to an additional 0.9 percent tax on earned income for relatively high earners, proceeds from the taxation of scheduled OASDI benefits, premium revenues, monies from fraud and abuse control activities, and any reimbursements from the General Fund of the Treasury. Total cost consists of scheduled benefits and administrative expenses. The Trustees show income and cost estimates generally on a cash basis for the OASDI program[1] and on an incurred basis for the HI program. Table VI.G9 also shows the annual balance, which equals the difference between non-interest income and cost.

[1] OASDI benefits paid for entitlement for a particular month are generally paid in the succeeding month. There are two primary exceptions to this general rule. First, payments can occur with a greater delay when a benefit award is made after the month of initial benefit entitlement. At the time of benefit award, benefits owed for months of prior entitlement are then also paid to the beneficiary. For the projections in this report, such retroactive payments are included in the period where they are paid (at time of award). Second, when benefit payments scheduled for January 3 are paid on the prior December 31, because January 3 falls on a Sunday, such payments are shown in this report for the period they were scheduled to be paid.

Table VI.G9.—OASDI and HI Annual Non-interest Income, Cost, and Balance in CPI-Indexed 2018 Dollars,[a] Calendar Years 2018-2095
[In billions]

Calendar year	OASDI Non-interest income	OASDI Cost[b]	OASDI Balance[b]	HI Non-interest income	HI Cost	HI Balance	Combined Non-interest income	Combined Cost[b]	Combined Balance[b]
Intermediate:									
2018	$918	$1,003	-$85	$303	$311	-$8	$1,221	$1,314	-$93
2019	955	1,036	-80	313	321	-9	1,268	1,357	-89
2020	980	1,074	-94	323	333	-10	1,303	1,406	-104
2021	1,007	1,112	-105	333	347	-14	1,340	1,459	-119
2022	1,033	1,152	-119	343	364	-21	1,376	1,516	-140
2023	1,059	1,194	-135	353	380	-27	1,412	1,574	-163
2024	1,086	1,237	-151	363	396	-33	1,449	1,633	-185
2025	1,111	1,280	-169	373	412	-40	1,484	1,692	-208
2026	1,146	1,322	-177	389	428	-39	1,535	1,750	-215
2027	1,169	1,365	-196	399	443	-44	1,568	1,808	-241
2030	1,231	1,490	-259	426	505	-79	1,657	1,995	-338
2035	1,334	1,676	-342	472	588	-116	1,806	2,264	-458
2040	1,444	1,831	-387	520	666	-146	1,964	2,496	-532
2045	1,568	1,969	-401	573	739	-165	2,141	2,707	-566
2050	1,706	2,127	-421	633	806	-173	2,339	2,933	-594
2055	1,855	2,318	-463	700	872	-172	2,555	3,190	-635
2060	2,013	2,545	-532	773	945	-172	2,786	3,490	-704
2065	2,179	2,794	-614	850	1,031	-181	3,029	3,825	-796
2070	2,358	3,070	-712	933	1,132	-199	3,291	4,202	-911
2075	2,554	3,364	-810	1,025	1,243	-219	3,579	4,608	-1,029
2080	2,766	3,647	-880	1,122	1,355	-233	3,889	5,002	-1,114
2085	2,996	3,934	-938	1,226	1,464	-237	4,223	5,398	-1,175
2090	3,245	4,276	-1,031	1,340	1,576	-236	4,584	5,851	-1,267
2095	3,511	4,680	-1,169	1,462	1,698	-235	4,973	6,377	-1,404
Low-cost:									
2018	926	1,000	-74	307	307	[c]	1,233	1,307	-74
2019	981	1,028	-47	321	312	9	1,303	1,341	-38
2020	1,021	1,065	-44	336	321	15	1,357	1,386	-29
2021	1,061	1,100	-39	350	332	18	1,410	1,432	-22
2022	1,099	1,137	-38	362	343	18	1,460	1,480	-20
2023	1,136	1,176	-40	374	354	20	1,509	1,529	-20
2024	1,173	1,215	-42	386	363	22	1,559	1,579	-20
2025	1,210	1,255	-45	398	373	25	1,608	1,628	-20
2026	1,256	1,295	-39	418	382	35	1,674	1,677	-4
2027	1,292	1,336	-44	431	391	39	1,722	1,727	-5
2030	1,386	1,462	-76	470	429	40	1,856	1,892	-36
2035	1,552	1,663	-111	539	469	70	2,091	2,132	-41
2040	1,740	1,841	-101	617	498	119	2,357	2,340	17
2045	1,964	2,016	-52	709	516	193	2,673	2,532	141
2050	2,226	2,234	-8	819	542	277	3,045	2,775	269
2055	2,522	2,509	14	945	576	369	3,467	3,084	382
2060	2,851	2,845	6	1,086	626	460	3,937	3,470	466
2065	3,216	3,221	-5	1,244	700	543	4,459	3,921	538
2070	3,630	3,649	-19	1,422	802	620	5,052	4,451	600
2075	4,110	4,120	-10	1,627	922	705	5,737	5,042	695
2080	4,656	4,596	60	1,859	1,052	807	6,515	5,648	867
2085	5,273	5,121	152	2,121	1,188	932	7,393	6,309	1,084
2090	5,965	5,802	162	2,418	1,336	1,082	8,383	7,138	1,244
2095	6,738	6,665	72	2,757	1,503	1,255	9,495	8,168	1,327

Table VI.G9.—OASDI and HI Annual Non-interest Income, Cost, and Balance in CPI-Indexed 2018 Dollars,[a] Calendar Years 2018-2095 (Cont.)
[In billions]

	OASDI			HI			Combined		
Calendar year	Non-interest income	Cost[b]	Balance[b]	Non-interest income	Cost	Balance	Non-interest income	Cost[b]	Balance[b]
High-cost:									
2018	$913	$1,006	-$93	$301	$315	-$14	$1,214	$1,321	-$107
2019	921	1,044	-123	300	326	-26	1,221	1,370	-149
2020	930	1,082	-152	305	339	-33	1,236	1,421	-185
2021	946	1,124	-178	314	358	-44	1,260	1,481	-221
2022	963	1,167	-204	322	380	-58	1,285	1,547	-262
2023	980	1,212	-232	330	403	-73	1,310	1,616	-305
2024	998	1,259	-261	338	426	-88	1,336	1,685	-348
2025	1,015	1,304	-289	347	450	-104	1,362	1,754	-393
2026	1,041	1,349	-308	362	474	-113	1,403	1,824	-420
2027	1,055	1,394	-339	369	498	-129	1,425	1,893	-468
2030	1,090	1,515	-425	387	590	-202	1,478	2,105	-627
2035	1,145	1,687	-542	415	732	-316	1,560	2,418	-858
2040	1,198	1,821	-623	442	879	-437	1,640	2,700	-1,060
2045	1,251	1,928	-677	469	1,031	-562	1,720	2,959	-1,239
2050	1,306	2,037	-731	496	1,167	-671	1,802	3,204	-1,402
2055	1,362	2,159	-797	524	1,282	-758	1,886	3,441	-1,555
2060	1,418	2,298	-880	553	1,382	-829	1,971	3,680	-1,709
2065	1,471	2,444	-972	582	1,468	-886	2,053	3,912	-1,858
2070	1,523	2,603	-1,079	611	1,542	-930	2,135	4,144	-2,010
2075	1,577	2,765	-1,188	642	1,615	-973	2,219	4,380	-2,161
2080	1,630	2,907	-1,278	672	1,676	-1,005	2,302	4,584	-2,282
2085	1,685	3,032	-1,347	702	1,725	-1,023	2,387	4,757	-2,371
2090	1,742	3,157	-1,415	733	1,773	-1,040	2,475	4,930	-2,455
2095	1,801	3,289	-1,487	765	1,825	-1,060	2,566	5,113	-2,547

[a] CPI-indexed 2018 dollars equal current dollars adjusted by the CPI indexing series in table VI.G6.
[b] OASDI benefit payments which were scheduled to be paid on January 3 for some past and future years were actually paid on December 31 as required by the statutory provision for early delivery of benefit payments when the normal payment delivery date is a Saturday, Sunday, or legal public holiday. For comparability with the values for historical years and the projections in this report, all trust fund operations and asset reserves reflect the 12 months of benefits scheduled for payment each year.
[c] Between $0 and $500 million.

Note: Totals do not necessarily equal the sums of rounded components.

Table VI.G10 shows values in current, or nominal, dollars—that is, in dollars unadjusted for inflation. This table presents the annual non-interest income, cost, and balance of the combined OASI and DI Trust Funds, of the HI Trust Fund, and of the combined OASI, DI, and HI Trust Funds, based on the low-cost, intermediate, and high-cost sets of assumptions.

Table VI.G10.—OASDI and HI Annual Non-interest Income, Cost, and Balance in Current Dollars, Calendar Years 2018-2095
[In billions]

	OASDI			HI			Combined		
Calendar year	Non-interest income	Cost[a]	Balance[a]	Non-interest income	Cost	Balance	Non-interest income	Cost[a]	Balance[a]
Intermediate:									
2018	$918	$1,003	-$85	$303	$311	-$8	$1,221	$1,314	-$93
2019	979	1,062	-82	321	329	-9	1,300	1,391	-91
2020	1,031	1,129	-98	340	350	-10	1,370	1,479	-109
2021	1,086	1,200	-114	359	374	-15	1,446	1,574	-129
2022	1,144	1,276	-132	380	403	-23	1,524	1,678	-155
2023	1,203	1,357	-154	401	432	-31	1,604	1,788	-185
2024	1,265	1,442	-176	423	462	-39	1,688	1,903	-215
2025	1,329	1,530	-202	446	493	-47	1,774	2,023	-249
2026	1,405	1,622	-217	477	525	-47	1,883	2,147	-264
2027	1,471	1,719	-247	502	558	-56	1,973	2,276	-303
2030	1,673	2,025	-352	580	687	-107	2,252	2,712	-460
2035	2,062	2,590	-528	730	909	-180	2,791	3,500	-708
2040	2,538	3,217	-680	914	1,170	-256	3,452	4,387	-935
2045	3,133	3,933	-801	1,146	1,476	-330	4,278	5,409	-1,131
2050	3,875	4,831	-956	1,439	1,831	-392	5,314	6,662	-1,349
2055	4,791	5,987	-1,196	1,808	2,252	-444	6,599	8,239	-1,640
2060	5,912	7,474	-1,562	2,268	2,774	-506	8,180	10,248	-2,068
2065	7,275	9,327	-2,051	2,837	3,442	-605	10,112	12,769	-2,656
2070	8,948	11,652	-2,703	3,542	4,297	-755	12,490	15,949	-3,458
2075	11,022	14,518	-3,496	4,422	5,366	-944	15,444	19,883	-4,440
2080	13,573	17,892	-4,319	5,505	6,650	-1,145	19,078	24,542	-5,464
2085	16,714	21,946	-5,233	6,840	8,163	-1,323	23,554	30,110	-6,556
2090	20,578	27,116	-6,538	8,496	9,992	-1,496	29,074	37,108	-8,034
2095	25,315	33,743	-8,428	10,544	12,240	-1,695	35,859	45,982	-10,123
Low-cost:									
2018	926	1,000	-74	307	307	[b]	1,233	1,307	-74
2019	1,013	1,062	-49	332	322	9	1,345	1,384	-39
2020	1,088	1,135	-47	358	343	16	1,447	1,478	-31
2021	1,167	1,210	-43	384	365	19	1,551	1,575	-24
2022	1,247	1,291	-43	411	390	21	1,658	1,680	-22
2023	1,330	1,377	-47	438	414	23	1,768	1,792	-23
2024	1,419	1,469	-51	467	439	27	1,885	1,909	-24
2025	1,510	1,566	-56	497	466	32	2,007	2,032	-25
2026	1,617	1,667	-50	538	492	46	2,155	2,160	-5
2027	1,716	1,775	-59	572	520	52	2,289	2,295	-6
2030	2,024	2,136	-112	686	627	59	2,710	2,763	-53
2035	2,654	2,843	-189	921	802	119	3,575	3,645	-70
2040	3,482	3,685	-203	1,235	998	237	4,717	4,683	34
2045	4,601	4,723	-122	1,662	1,209	452	6,263	5,932	330
2050	6,104	6,125	-21	2,245	1,486	760	8,350	7,611	739
2055	8,096	8,053	43	3,032	1,848	1,184	11,129	9,901	1,228
2060	10,712	10,689	23	4,081	2,352	1,730	14,794	13,041	1,753
2065	14,145	14,168	-23	5,470	3,080	2,390	19,615	17,248	2,367
2070	18,690	18,789	-99	7,321	4,131	3,191	26,011	22,920	3,091
2075	24,771	24,833	-62	9,808	5,556	4,252	34,578	30,389	4,190
2080	32,850	32,428	422	13,116	7,422	5,694	45,966	39,850	6,115
2085	43,547	42,293	1,253	17,514	9,814	7,699	61,060	52,108	8,953
2090	57,662	56,091	1,571	23,379	12,920	10,460	81,041	69,011	12,030
2095	76,246	75,427	819	31,205	17,004	14,202	107,451	92,430	15,020

Table VI.G10.—OASDI and HI Annual Non-interest Income, Cost, and Balance in Current Dollars, Calendar Years 2018-2095 (Cont.)
[In billions]

Calendar year	OASDI Non-interest income	OASDI Cost[a]	OASDI Balance[a]	HI Non-interest income	HI Cost	HI Balance	Combined Non-interest income	Combined Cost[a]	Combined Balance[a]
High-cost:									
2018	$913	$1,006	-$93	$301	$315	-$14	$1,214	$1,321	-$107
2019	935	1,059	-124	305	331	-27	1,239	1,390	-151
2020	962	1,119	-157	316	350	-34	1,278	1,469	-191
2021	998	1,186	-188	331	377	-46	1,329	1,563	-234
2022	1,036	1,256	-220	347	409	-62	1,383	1,665	-282
2023	1,076	1,331	-255	363	443	-80	1,438	1,773	-335
2024	1,117	1,409	-292	379	477	-98	1,496	1,886	-390
2025	1,159	1,489	-330	396	514	-118	1,555	2,004	-449
2026	1,213	1,572	-359	421	552	-131	1,634	2,124	-490
2027	1,254	1,657	-403	439	592	-153	1,693	2,249	-556
2030	1,375	1,910	-536	488	743	-255	1,863	2,654	-791
2035	1,594	2,348	-754	578	1,018	-440	2,172	3,366	-1,194
2040	1,841	2,798	-957	679	1,352	-672	2,521	4,150	-1,629
2045	2,123	3,272	-1,149	795	1,749	-954	2,918	5,021	-2,103
2050	2,447	3,816	-1,369	929	2,186	-1,258	3,376	6,002	-2,627
2055	2,818	4,467	-1,649	1,084	2,652	-1,568	3,902	7,118	-3,217
2060	3,239	5,248	-2,010	1,263	3,156	-1,893	4,501	8,404	-3,903
2065	3,710	6,162	-2,452	1,467	3,702	-2,234	5,178	9,864	-4,686
2070	4,241	7,246	-3,005	1,702	4,292	-2,590	5,943	11,538	-5,595
2075	4,847	8,499	-3,652	1,972	4,963	-2,991	6,819	13,462	-6,643
2080	5,531	9,867	-4,335	2,279	5,689	-3,410	7,811	15,556	-7,745
2085	6,313	11,361	-5,048	2,629	6,464	-3,835	8,942	17,825	-8,883
2090	7,208	13,060	-5,852	3,031	7,334	-4,302	10,239	20,393	-10,154
2095	8,227	15,021	-6,794	3,493	8,335	-4,841	11,720	23,356	-11,635

[a] OASDI benefit payments which were scheduled to be paid on January 3 for some past and future years were actually paid on December 31 as required by the statutory provision for early delivery of benefit payments when the normal payment delivery date is a Saturday, Sunday, or legal public holiday. For comparability with the values for historical years and the projections in this report, all trust fund operations and asset reserves reflect the 12 months of benefits scheduled for payment each year.
[b] Between $0 and $500 million.

Note: Totals do not necessarily equal the sums of rounded components.

H. ANALYSIS OF BENEFIT DISBURSEMENTS FROM THE OASI TRUST FUND WITH RESPECT TO DISABLED BENEFICIARIES

(Required by section 201(c) of the Social Security Act)

Effective January 1957, the OASI Trust Fund pays monthly benefits to disabled children aged 18 and over of retired and deceased workers if the disability began before age 18. The age by which disability must have begun was later changed to age 22. Effective February 1968, the OASI Trust Fund pays reduced monthly benefits to disabled widows and widowers at ages 50 and over. Effective January 1991, the requirements for the disability of the widow or widower were made less restrictive.

At the end of 2017, the OASI Trust Fund was providing monthly benefit payments to about 1,124,000 people because of their disabilities or the disabilities of children. This total includes approximately 24,000 mothers and fathers (wives or husbands under normal retirement age of retired-worker beneficiaries and widows or widowers of deceased insured workers) who met all other qualifying requirements and were receiving unreduced benefits solely because they had disabled-child beneficiaries (or disabled children aged 16 or 17) in their care. In calendar year 2017, the OASI Trust Fund paid a total of $11,355 million to the people described above. Table VI.H1 shows OASI scheduled benefits for disability for selected calendar years during 1960 through 2017 and estimates for 2018 through 2027 based on the intermediate set of assumptions.

Table VI.H1.—Scheduled Benefit Disbursements From the OASI Trust Fund With Respect to Disabled Beneficiaries
[Beneficiaries in thousands; scheduled benefits in millions]

Calendar year	Disabled beneficiaries, end of year			Amount of scheduled benefits[a b]		
	Total	Children[c]	Widows-widowers[d]	Total	Children[c]	Widows-widowers[e]
Historical data:						
1960	117	117	—	$59	$59	—
1965	214	214	—	134	134	—
1970	316	281	36	301	260	$41
1975	435	376	58	664	560	104
1980	519	460	59	1,223	1,097	126
1985	594	547	47	2,072	1,885	187
1990	662	613	49	2,882	2,649	233
1995	772	681	91	4,202	3,672	531
2000	811	707	104	5,203	4,523	680
2005	836	728	108	6,449	5,556	834
2006	840	732	108	6,720	5,852	864
2007	851	744	107	7,053	6,181	869
2008	922	813	109	7,688	6,776	908
2009	969	857	112	8,595	7,618	974
2010	996	879	117	8,858	7,848	1,008
2011	1,020	899	121	9,136	8,085	1,050
2012	1,045	920	125	9,698	8,595	1,102
2013	1,065	939	126	9,953	8,840	1,109
2014	1,079	954	125	10,326	9,217	1,108
2015	1,096	972	124	10,736	9,624	1,109
2016	1,109	988	121	11,025	9,933	1,087
2017	1,124	1,006	117	11,355	10,288	1,061
Estimates under the intermediate assumptions:						
2018	1,139	1,025	114	11,737	10,689	1,042
2019	1,153	1,044	110	12,250	11,213	1,029
2020	1,168	1,062	106	12,828	11,796	1,024
2021	1,183	1,079	103	13,388	12,357	1,023
2022	1,197	1,097	100	13,972	12,942	1,022
2023	1,211	1,113	98	14,567	13,541	1,018
2024	1,226	1,130	96	15,211	14,175	1,028
2025	1,240	1,146	94	15,888	14,847	1,033
2026	1,254	1,162	92	16,610	15,550	1,051
2027	1,268	1,176	91	17,363	16,286	1,069

[a] Beginning in 1966, includes payments for vocational rehabilitation services.

[b] Amounts for 2015 and 2016 are adjusted to include in 2016 operations those benefit payments regularly scheduled in the law to be paid on January 3, 2016, which were actually paid on December 31, 2015 as required by the statutory provision for early benefit payments when the normal delivery date is on a Saturday, Sunday, or public holiday. Such shifts in payments across calendar years occur periodically whenever January 3rd falls on a Sunday. In order to provide a consistent perspective on scheduled benefits over time, scheduled benefits in each year reflect the 12 months of benefits that are regularly scheduled for payment in that year.

[c] Also includes certain mothers and fathers (see text).

[d] In 1984 and later years, includes only disabled widows and widowers aged 50-59, because disabled widows and widowers age 60 and older are eligible for the same benefit as a nondisabled aged widow or widower. Therefore, they are not receiving benefits solely because of a disability.

[e] In 1983 and prior years, includes the offsetting effect of lower benefits payable to disabled widows and widowers who continued to receive benefits after attaining age 60 (62, for disabled widowers prior to 1973), compared to the higher nondisabled widow's and widower's benefits that would otherwise be payable. In 1984 and later years, includes only scheduled benefits to disabled widows and widowers aged 50-59 (see footnote d).

Note: Totals do not necessarily equal the sums of rounded components.

Under the intermediate assumptions, estimated total scheduled benefits from the OASI Trust Fund with respect to disabled beneficiaries will increase from $11,737 million in calendar year 2018 to $17,363 million in calendar year 2027.

In calendar year 2017, benefit payments (including expenditures for vocational rehabilitation services) with respect to disabled persons from the OASI Trust Fund and from the DI Trust Fund (including payments from the DI fund to all children and spouses of disabled-worker beneficiaries) totaled $154,181 million. Of this amount, $11,355 million, or 7.4 percent, represented payments from the OASI Trust Fund. Table VI.H2 contains these and similar figures for selected calendar years during 1960 through 2017 and estimates for calendar years 2018 through 2027.

Table VI.H2.—Scheduled Benefit Disbursements[a] Under the OASDI Program With Respect to Disabled Beneficiaries
[Amounts in millions]

			OASI Trust Fund	
Calendar year	Total[b]	DI Trust Fund[c]	Amount[d]	Percentage of total
Historical data:				
1960	$627	$568	$59	9.4
1965	1,707	1,573	134	7.9
1970	3,386	3,085	301	8.9
1975	9,169	8,505	664	7.2
1980	16,738	15,515	1,223	7.3
1985	20,908	18,836	2,072	9.9
1990	27,717	24,835	2,882	10.4
1995	45,140	40,937	4,202	9.3
2000	60,204	55,001	5,203	8.6
2005	91,835	85,386	6,449	7.0
2006	99,165	92,446	6,720	6.8
2007	106,200	99,147	7,053	6.6
2008	114,064	106,376	7,688	6.7
2009	127,002	118,407	8,595	6.8
2010	133,103	124,245	8,858	6.7
2011	138,115	128,979	9,136	6.6
2012	146,623	136,925	9,698	6.6
2013	150,108	140,155	9,953	6.6
2014	152,031	141,705	10,326	6.8
2015	154,124	143,388	10,736	7.0
2016	153,824	142,800	11,025	7.2
2017	154,181	142,826	11,355	7.4
Estimates under the intermediate assumptions:				
2018	158,036	146,298	11,737	7.4
2019	162,382	150,132	12,250	7.5
2020	167,069	154,240	12,828	7.7
2021	173,139	159,751	13,388	7.7
2022	179,634	165,662	13,972	7.8
2023	187,277	172,710	14,567	7.8
2024	195,532	180,321	15,211	7.8
2025	204,781	188,894	15,888	7.8
2026	214,571	197,961	16,610	7.7
2027	224,647	207,284	17,363	7.7

[a] Amounts for 2015 and 2016 are adjusted to include in 2016 operations those benefit payments regularly scheduled in the law to be paid on January 3, 2016, which were actually paid on December 31, 2015 as required by the statutory provision for early benefit payments when the normal delivery date is on a Saturday, Sunday, or public holiday. Such shifts in payments across calendar years occur periodically whenever January 3rd falls on a Sunday. In order to provide a consistent perspective on scheduled benefits over time, scheduled benefits in each year reflect the 12 months of benefits that are regularly scheduled for payment in that year.

[b] Beginning in 1966, includes payments for vocational rehabilitation services.

[c] Scheduled benefits for disabled workers and their children and spouses.

[d] Scheduled benefits for disabled children aged 18 and over, for certain mothers and fathers (see text), and for disabled widows and widowers (see footnote e, table VI.H1).

Note: Totals do not necessarily equal the sums of rounded components.

I. GLOSSARY

Actuarial balance. The difference between the summarized income rate and the summarized cost rate as a percentage of taxable payroll over a given valuation period.

Actuarial deficit. A negative actuarial balance.

Administrative expenses. Expenses incurred by the Social Security Administration and the Department of the Treasury in administering the OASDI program and the provisions of the Internal Revenue Code relating to the collection of contributions. Such administrative expenses are paid from the OASI and DI Trust Funds.

Advance tax transfers. Amounts representing the estimated total OASDI tax contributions for a given month. From May 1983 through November 1990, such amounts were credited to the OASI and DI Trust Funds at the beginning of each month. The trust funds reimbursed the General Fund of the Treasury for the associated loss of interest. Advance tax transfers are no longer made unless needed in order to pay benefits.

Alternatives I, II, or III. See "Assumptions."

Annual balance. The difference between the income rate and the cost rate for a given year.

Asset reserves. The cumulative excess of trust fund income over trust fund expenditures over all years to date. These reserves are held by the trust funds in the form of Treasury notes and bonds, other securities guaranteed by the Federal Government, certain Federally sponsored agency obligations, and cash.

Assumptions. Values related to future trends in key factors that affect the trust funds. Demographic assumptions include fertility, mortality, net immigration, marriage, and divorce. Economic assumptions include unemployment rates, average earnings, inflation, interest rates, and productivity. Program-specific assumptions include retirement patterns, and disability incidence and termination rates. This report presents three sets of demographic, economic, and program-specific assumptions:

- Alternative II is the intermediate set of assumptions, and represents the Trustees' best estimates of likely future demographic, economic, and program-specific conditions.
- Alternative I is a low-cost set of assumptions—it assumes relatively rapid economic growth, high inflation, and favorable (from the standpoint of program financing) demographic and program-specific conditions.

- Alternative III is a high-cost set of assumptions—it assumes relatively slow economic growth, low inflation, and unfavorable (from the standpoint of program financing) demographic and program-specific conditions.

See tables V.A2, V.B1, and V.B2.

Automatic cost-of-living benefit increase. The annual increase in benefits, effective for December, reflecting the increase, if any, in the cost of living. A benefit increase is applicable only after a beneficiary becomes eligible for benefits. In general, the benefit increase equals the percentage increase in the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W) measured from the third quarter of the previous year to the third quarter of the current year. If there is no increase in the CPI-W, there is no cost-of-living benefit increase. See table V.C1.

Auxiliary benefits. Monthly benefits payable to a spouse or child of a retired or disabled worker, or to a survivor of a deceased worker.

Average indexed monthly earnings—AIME. The measure of lifetime earnings used in determining the primary insurance amount (PIA) for most workers who attain age 62, become disabled, or die after 1978. A worker's actual past earnings are adjusted by changes in the average wage index, in order to bring them up to their approximately equivalent value at the time of retirement or other eligibility for benefits.

Average wage index—AWI. A series that generally increases with the average amount of total wages for each year after 1950, including wages in noncovered employment and wages in covered employment in excess of the OASDI contribution and benefit base. (See Title 20, Chapter III, section 404.211(c) of the Code of Federal Regulations for a more precise definition.) These average wage amounts are used to index the taxable earnings of most workers first becoming eligible for benefits in 1979 or later, and for automatic adjustments in the contribution and benefit base, bend points, earnings test exempt amounts, and other wage-indexed amounts. See table V.C1.

Award. An administrative determination that an individual is entitled to receive a specified type of OASDI benefit. Awards can represent not only new entrants to the benefit rolls but also persons already on the rolls who become entitled to a different type of benefit. Awards usually result in the immediate payment of benefits, although payments may be deferred or withheld depending on the individual's particular circumstances.

Baby boom. The period from the end of World War II (1946) through 1965 marked by unusually high birth rates.

Bend points. The dollar amounts defining the AIME or PIA brackets in the benefit formulas. For the bend points for years 1979 and later, see table V.C2.

Beneficiary. A person who has been awarded benefits on the basis of his or her own or another's earnings record. The benefits may be either in current-payment status or withheld.

Benefit award. See "Award."

Benefit conversion. See "Disability conversion."

Benefit payments. The amounts disbursed for OASI and DI benefits by the Department of the Treasury.

Benefit termination. See "Termination."

Best estimate assumptions. See "Assumptions."

Board. See "Board of Trustees."

Board of Trustees. A Board established by the Social Security Act to oversee the financial operations of the Federal Old-Age and Survivors Insurance Trust Fund and the Federal Disability Insurance Trust Fund. The Board is composed of six members. Four members serve by virtue of their positions in the Federal Government: the Secretary of the Treasury, who is the Managing Trustee; the Secretary of Labor; the Secretary of Health and Human Services; and the Commissioner of Social Security. The President appoints and the Senate confirms the other two members to serve as public representatives. Also referred to as the "Board" or the "Trustees."

Cash flow. Actual or projected revenue and costs reflecting the levels of payroll tax contribution rates and benefits scheduled in the law. Net cash flow is the difference between non-interest income and cost.

Consumer Price Index—CPI. An official measure of inflation in consumer prices. In this report, CPI refers to the Consumer Price Index for Urban Wage Earners and Clerical Workers (CPI-W). The Bureau of Labor Statistics, Department of Labor, publishes historical values for the CPI-W.

Contribution and benefit base. Annual dollar amount above which earnings in employment covered under the OASDI program are neither taxable nor creditable for benefit-computation purposes. (Also referred to as maximum contribution and benefit base, annual creditable maximum, taxable maximum, and maximum taxable.) See tables V.C1 and V.C6. See "Hospital Insurance (HI) contribution base."

Contributions. See "Payroll tax contributions."

Conversion. See "Disability conversion."

Cost. The cost shown for a year includes benefits scheduled for payment in the year, administrative expenses, financial interchange with the Railroad

Retirement program, and payments for vocational rehabilitation services for disabled beneficiaries.

Cost-of-living adjustment. See "Automatic cost-of-living benefit increase."

Cost rate. The cost rate for a year is the ratio of the cost of the program to the taxable payroll for the year.

Covered earnings. Wages or earnings from self-employment covered by the OASDI program.

Covered employment. All employment for which earnings are creditable for Social Security purposes. The program covers almost all employment. Some exceptions are:

- State and local government employees whose employer has not elected to be covered under Social Security and who are participating in an employer-provided pension plan.
- Current Federal civilian workers hired before 1984 who have not elected to be covered.
- Self-employed workers earning less than $400 in a calendar year.

Covered worker. A person who has earnings creditable for Social Security purposes based on services for wages in covered employment or income from covered self-employment.

CPI-indexed dollars. Amounts adjusted by the CPI to the value of the dollar in a particular year.

Creditable earnings. Wages or self-employment earnings posted to a worker's earnings record. Such earnings determine eligibility for benefits and the amount of benefits on that worker's record. The contribution and benefit base is the maximum amount of creditable earnings for each worker in a calendar year.

Current-cost financing. See "Pay-as-you-go financing."

Current dollars. Amounts expressed in nominal dollars with no adjustment for inflation.

Currently insured status. A worker acquires currently insured status when he or she has accumulated six quarters of coverage during the 13-quarter period ending with the current quarter.

Current-payment status. Status of a beneficiary to whom a benefit is being paid for a given month (with or without deductions, provided the deductions add to less than a full month's benefit).

Deemed filing. Under certain circumstances, a person applying for or receiving either an aged-spouse benefit or a retired-worker benefit is required to also file for the other of these two types of benefits. For those first eligible for benefits before 2016, this requirement applies to any person under normal retirement age who is eligible for the other benefit as of the starting month for the first benefit. For those first eligible for benefits in 2016 and later, this requirement applies whenever the person is eligible for the other benefit. This can occur at any age, and in months after the starting month of the first benefit.

Deemed wage credit. See “Military service wage credits.”

Delayed retirement credits. Increases in the benefit amount for certain individuals who did not receive benefits for months after attaining normal retirement age but before age 70. Delayed retirement credits apply to benefits for January of the year following the year they are earned or for the month of attainment of age 70, whichever comes first. See table V.C3.

Demographic assumptions. See “Assumptions.”

Disability. For Social Security purposes, the inability to engage in substantial gainful activity (see “Substantial gainful activity—SGA”) by reason of any medically determinable physical or mental impairment that can be expected to result in death or to last for a continuous period of not less than 12 months. Special rules apply for workers at ages 55 and over whose disability is based on blindness.

The law generally requires that a person be disabled continuously for 5 months before he or she can qualify for a disabled-worker benefit.

Disability conversion ratio. For a given year, the ratio of the number of disability conversions to the average number of disabled-worker beneficiaries at all ages during the year.

Disability conversion. Upon attainment of normal retirement age, a disabled-worker beneficiary is automatically converted to retired-worker status.

Disability incidence rate. The proportion of workers in a given year, insured for but not receiving disability benefits, who apply for and are awarded disability benefits.

Disability Insurance (DI) Trust Fund. See “Trust fund.”

Disability insured status. A worker acquires disability insured status if he or she is: (1) a fully insured worker who has accumulated 20 quarters of coverage during the 40-quarter period ending with the current quarter, (2) a fully insured worker aged 24-30 who has accumulated quarters of coverage during one-half of the quarters elapsed after the quarter of attainment of age 21 and up to and including the current quarter, or (3) a fully insured worker under age 24 who has accumulated six quarters of coverage during the 12-quarter period ending with the current quarter.

Disability prevalence rate. The proportion of persons insured for disability benefits who are disabled-worker beneficiaries in current-payment status.

Disability termination rate. The proportion of disabled-worker beneficiaries in a given year whose disability benefits terminate as a result of their recovery or death.

Disabled-worker benefit. A monthly benefit payable to a disabled worker under normal retirement age and insured for disability. Before November 1960, disability benefits were limited to disabled workers aged 50-64.

Disbursements. Actual expenditures (outgo) made or expected to be made under current law, including benefits paid or payable, administrative expenses, financial interchange with the Railroad Retirement program, and payments for vocational rehabilitation services for disabled beneficiaries.

Dual entitlement. A person may be entitled to more than one benefit at the same time. For example, a person may be entitled as a retired worker on his or her own record and as a spouse on another record. However, a person's benefit amount can never exceed the highest single benefit to which that person is entitled. Some benefits are calculated independently with the larger benefit being paid or the smaller benefit being paid plus the excess amount of the larger one.

Earnings. Unless otherwise qualified, all wages from employment and net earnings from self-employment, whether or not they are taxable or covered.

Earnings test. The provision requiring the withholding of benefits if beneficiaries under normal retirement age have earnings in excess of certain exempt amounts. See table V.C1.

Economic assumptions. See “Assumptions.”

Effective interest rate. See “Interest rate.”

Excess wages. Wages in excess of the contribution and benefit base on which a worker initially makes payroll tax contributions, usually as a result of working for more than one employer during a year. Employee payroll taxes on excess wages are refundable to affected employees, while the employer taxes are not refundable.

Expenditures. See “Disbursements.”

Federal Insurance Contributions Act—FICA. Provision authorizing payroll taxes on the wages of employed persons to provide for Old-Age, Survivors, and Disability Insurance, and for Hospital Insurance. Workers and their employers generally pay the tax in equal amounts.

File and suspend. The ability to apply for a retired-worker benefit at or after normal retirement age, then voluntarily suspend it, allowing the worker to earn delayed retirement credits and a spouse or child to receive benefits on the worker’s record. Voluntary suspensions requested after April 29, 2016 no longer allow spouses (other than divorced spouses) and children to receive benefits while the worker’s benefit is suspended.

Financial interchange. Provisions of the Railroad Retirement Act providing for transfers between the trust funds and the Social Security Equivalent Benefit Account of the Railroad Retirement program in order to place each trust fund in the same financial position it would have been had railroad employment always been covered under Social Security.

Fiscal year. The accounting year of the United States Government. A fiscal year is the 12-month period ending September 30. For example, fiscal year 2018 began October 1, 2017, and will end September 30, 2018.

Full advance funding. A financing method in which contributions are established to match the full cost of future benefits as these costs are incurred through current service. Such financing methods also provide for amortization over a fixed period of any financial obligation that is incurred at the beginning of the program (or subsequent modification) as a result of granting credit for past service.

Fully insured status. A worker acquires fully insured status when his or her total number of quarters of coverage is greater than or equal to the number of years elapsed after the year of attainment of age 21 (but not less than six). Once a worker has accumulated 40 quarters of coverage, he or she remains permanently fully insured.

General Fund of the Treasury. Funds held by the Treasury of the United States, other than receipts collected for a specific purpose (such as Social Security), and maintained in a separate account for that purpose.

General Fund reimbursements. Payments from the General Fund of the Treasury to the trust funds for specific purposes defined in the law, including:

- The cost of noncontributory wage credits for military service before 1957, and periodic adjustments of previous determinations.
- The cost in 1971-82 of deemed wage credits for military service performed after 1956.
- The cost of benefits to certain uninsured persons who attained age 72 before 1968.
- The cost of payroll tax credits provided to employees in 1984 and self-employed persons in 1984-89 by Public Law 98-21.
- The cost in 2009-17 of excluding certain self-employment earnings from SECA taxes under Public Law 110-246.
- Payroll tax revenue forgone under the provisions of Public Laws 111-147, 111-312, 112-78, and 112-96.

The General Fund also reimburses the trust funds for various other items, including interest on checks which are not negotiated 6 months after the month of issue and costs incurred in performing certain legislatively mandated activities not directly related to administering the OASI and DI programs.

Gross domestic product—GDP. The total dollar value of all goods and services produced by labor and property located in the United States, regardless of who supplies the labor or property.

Hospital Insurance (HI) contribution base. Annual dollar amount above which earnings in employment covered under the HI program are not taxable. (Also referred to as maximum contribution base, taxable maximum, and maximum taxable.) Beginning in 1994, the HI contribution base was eliminated.

High-cost assumptions. See "Assumptions."

Hospital Insurance (HI) Trust Fund. See "Trust fund."

Immigration. See "Lawful permanent resident (LPR) immigration" and "Other-than-LPR immigration."

Income. Income for a given year is the sum of tax revenue on a cash basis (payroll tax contributions and income from the taxation of scheduled benefits), reimbursements from the General Fund of the Treasury, if any, and interest credited to the trust funds.

Income rate. Ratio of non-interest income to the OASDI taxable payroll for the year.

Infinite horizon. The period extending indefinitely into the future.

Inflation. An increase in the general price level of goods and services.

Insured status. The state or condition of having sufficient quarters of coverage to meet the eligibility requirements for retired-worker or disabled-worker benefits, or to permit the worker's spouse and children or survivors to establish eligibility for benefits in the event of his or her disability, retirement, or death. See "Quarters of coverage."

Interest. A payment in exchange for the use of money during a specified period.

Interest rate. Interest rates on new public-debt obligations issuable to Federal trust funds (see "Special public-debt obligation") are determined monthly. Such rates are equal to the average market yield on all outstanding marketable U.S. securities not due or callable until after 4 years from the date the rate is determined. See table V.B2 for historical and assumed future interest rates on new special-issue securities. The effective interest rate for a trust fund is the ratio of the interest earned by the fund over a given period of time to the average level of asset reserves held by the fund during the period. The effective rate of interest thus represents a measure of the overall average interest earnings on the fund's portfolio of investments.

Interfund borrowing. The borrowing of asset reserves by a trust fund (OASI, DI, or HI) from another trust fund when the first fund is in danger of depletion. The Social Security Act permitted interfund borrowing only during 1982 through 1987, and required all amounts borrowed to be repaid prior to the end of 1989. The only exercise of this authority occurred in 1982, when the OASI Trust Fund borrowed from the DI and HI Trust Funds. The final repayment of borrowed amounts occurred in 1986.

Intermediate assumptions. See “Assumptions.”

Lawful permanent resident (LPR) immigration. Persons who enter the Social Security area population and are granted LPR status, or who are already in the Social Security area population and adjust their status to become LPRs. Persons who enter the country with legal visas but without LPR status, such as temporary foreign workers and students, are not included in the “LPR immigration” category.

Legal emigration. Lawful permanent residents and citizens who leave the Social Security area population.

Life expectancy. Average remaining number of years expected prior to death. Period life expectancy is calculated for a given year using the actual or expected death rates at each age for that year. Cohort life expectancy, sometimes referred to as generational life expectancy, is calculated for individuals at a specific age in a given year using actual or expected death rates from the years in which the individuals would actually reach each succeeding age if they survive.

Long-range. The next 75 years. The Trustees make long-range actuarial estimates for this period because it covers approximately the maximum remaining lifetime for virtually all current Social Security participants.

Low-cost assumptions. See “Assumptions.”

Lump-sum death payment. A lump sum, generally $255, payable on the death of a fully or currently insured worker. The lump sum is payable to the surviving spouse of the worker, under most circumstances, or to the worker’s children.

Maximum family benefit. The maximum monthly amount that can be paid on a worker’s earnings record. Whenever the total of the individual monthly benefits payable to all the beneficiaries entitled on one earnings record exceeds the maximum, each dependent’s or survivor’s benefit is proportionately reduced. Benefits payable to divorced spouses or surviving divorced spouses are not reduced under the family maximum provision.

Medicare. A nationwide, Federally administered health insurance program authorized in 1965 under Title XVIII of the Social Security Act to cover the cost of hospitalization, medical care, and some related services for most persons age 65 and over. In 1972, lawmakers extended coverage to persons receiving Social Security Disability Insurance payments for 2 years and persons with End-Stage Renal Disease. (For beneficiaries whose primary or secondary diagnosis is Amyotrophic Lateral Sclerosis, the 2-year waiting period is waived.) In 2010, persons exposed to environmental health hazards within areas under a corresponding emergency declaration became Medicare-eligible. In 2006, prescription drug coverage was added as well. Medicare consists of two separate but coordinated trust funds—Hospital Insurance (HI, Part A) and Supplementary Medical Insurance (SMI). The SMI Trust Fund is composed of two separate accounts—the Part B account and the Part D account. Almost all persons who are aged 65 and over or disabled and who are entitled to HI are eligible to enroll in Part B and Part D on a voluntary basis by paying monthly premiums.

Military service wage credits. Credits toward OASDI earnings records for benefit computation purposes, recognizing that military personnel receive non-wage compensation (such as food and shelter) in addition to their basic pay and other cash payments. Military personnel do not pay payroll taxes on these credits. Noncontributory wage credits of $160 were provided for each month of active military service from September 16, 1940, through December 31, 1956. For years after 1956, the basic pay of military personnel is covered under the Social Security program on a contributory basis. In addition to the contributory credits for basic pay, noncontributory wage credits of $300 were granted for each calendar quarter, from January 1957 through December 1977, in which a person received pay for military service. Noncontributory wage credits of $100 were granted for each $300 of military wages, up to a maximum credit of $1,200 per calendar year, from January 1978 through December 2001.

National average wage index—AWI. See “Average wage index—AWI.”

Non-interest income. Non-interest income for a given year is the sum of tax revenue on a cash basis (payroll tax contributions and income from the taxation of scheduled benefits) and reimbursements from the General Fund of the Treasury, if any.

Nonresident alien beneficiary. An OASDI beneficiary who is not a U.S. citizen and who is living abroad while receiving benefits.

Normal retirement age—NRA. The age at which a person may first become entitled to retirement benefits without reduction based on age. For persons reaching age 62 before 2000, the normal retirement age is 65. It will increase gradually to 67 for persons reaching that age in 2027 or later, beginning with an increase to 65 years and 2 months for persons reaching age 65 in 2003. See table V.C3.

Old-Age and Survivors Insurance (OASI) Trust Fund. See “Trust fund.”

Old-law base. Amount the contribution and benefit base would have been if the 1977 amendments had not provided for ad hoc increases. The Social Security Amendments of 1972 provided for automatic annual indexing of the contribution and benefit base. The Social Security Amendments of 1977 specified ad hoc bases for 1978-81, with subsequent bases updated in accordance with the normal indexing procedure. See table V.C2.

Open group unfunded obligation. See “Unfunded obligation.”

Other-than-LPR emigration. Other-than-LPR immigrants who leave the Social Security area population or who adjust their status to become LPRs.

Other-than-LPR immigration. Persons who enter the Social Security area population and stay to the end of the year without being granted LPR status, such as undocumented immigrants, and foreign workers and students entering with temporary visas.

Outgo. See “Disbursements.”

Par value. The value printed on the face of a bond. For both public and special issues held by the trust funds, par value is also the redemption value at maturity.

Partial advance funding. A financing method in which contributions are established to provide a substantial accumulation of trust fund asset reserves, thereby generating additional interest income to the trust funds and reducing the need for payroll tax increases in periods when costs are relatively high. Higher general contributions or additional borrowing may be required, however, to support the payment of such interest. While substantial, the trust fund buildup under partial advance funding is much smaller than it would be with full advance funding.

Pay-as-you-go financing. A financing method in which contributions are established to produce just as much income as required to pay current benefits, with trust fund asset reserves built up only to the extent needed to prevent depletion of the fund by random economic fluctuations.

Payroll tax contributions. The amount based on a percent of earnings, up to an annual maximum, that must be paid by:

- employers and employees on wages from employment under the Federal Insurance Contributions Act,
- the self-employed on net earnings from self-employment under the Self-Employment Contributions Act, and
- States on the wages of State and local government employees covered under the Social Security Act through voluntary agreements under section 218 of the act.

Also referred to as payroll taxes.

Population in the Social Security area. See “Social Security area population.”

Present value. The equivalent value, at the present time, of a stream of values (either income or cost, past or future). Present values are used widely in calculations involving financial transactions over long periods of time to account for the time value of money, by discounting or accumulating these transactions at the rate of interest. Present-value calculations for this report use the effective yield on trust fund asset reserves.

Primary insurance amount—PIA. The monthly amount payable to a retired worker who begins to receive benefits at normal retirement age or, generally, to a disabled worker. This amount, which is typically related to the worker's average monthly wage or average indexed monthly earnings, is also used as a base for computing all types of benefits payable on an individual's earnings record.

Primary-insurance-amount formula. The mathematical formula relating the PIA to the AIME for workers who attain age 62, become disabled, or die after 1978. The PIA is equal to the sum of 90 percent of AIME up to the first bend point, plus 32 percent of AIME above the first bend point up to the second bend point, plus 15 percent of AIME in excess of the second bend point. Automatic benefit increases are applied beginning with the year of eligibility. See table V.C2 for historical and assumed future bend points and table V.C1 for historical and assumed future benefit increases.

Quarters of coverage. Basic unit of measurement for determining insured status. In 2018, a worker receives one quarter of coverage (up to a total of four) for each $1,320 of annual covered earnings. For years after 1978, the amount of earnings required for a quarter of coverage is subject to annual automatic increases in proportion to increases in average wages. See table V.C2.

Railroad Retirement. A Federal insurance program, similar to Social Security, designed for workers in the railroad industry. The provisions of the Railroad Retirement Act provide for a system of coordination and financial interchange between the Railroad Retirement program and the Social Security program.

Reallocation of payroll tax rates. An increase in the payroll tax rate for either the OASI or DI Trust Fund, with a corresponding reduction in the rate for the other fund, so that the total OASDI payroll tax rate is not changed.

Real-wage differential. The difference between the percentage increases in: (1) the average annual wage in covered employment and (2) the average annual Consumer Price Index. See table V.B1.

Recession. A period of adverse economic conditions; in particular, two or more successive calendar quarters of negative growth in gross domestic product.

Reserves. See "Asset reserves."

Retired-worker benefit. A monthly benefit payable to a fully insured retired worker aged 62 or older or to a person entitled under the transitionally insured status provision in the law.

Retirement earnings test. See "Earnings test."

Retirement eligibility age. The age, currently age 62, at which a fully insured individual first becomes eligible to receive retired-worker benefits.

Retirement test. See “Earnings test.”

Scheduled benefits. The level of benefits specified under current law.

Scenario-based model. A model with specified assumptions for and relationships among variables. Under such a model, any specified set of assumptions determines a single outcome directly reflecting the specifications.

Self-employment. Operation of a trade or business by an individual or by a partnership in which an individual is a member.

Self-Employment Contributions Act−SECA. Provision authorizing Social Security payroll taxes on the net earnings of most self-employed persons.

Short-range. The next 10 years. The Trustees prepare short-range actuarial estimates for this period because of the test of short-range financial adequacy. The Social Security Act requires estimates for 5 years; the Trustees prepare estimates for an additional 5 years to help clarify trends which are only starting to develop in the mandated first 5-year period.

Social Security Act. Provisions of the law governing most operations of the Social Security program. The original Social Security Act is Public Law 74-271, enacted August 14, 1935. With subsequent amendments, the Social Security Act consists of 21 titles, of which three have been repealed. Title II of the Social Security Act authorized the Old-Age, Survivors, and Disability Insurance program.

Social Security area population. The population comprised of: (1) residents of the 50 States and the District of Columbia (adjusted for net census undercount); (2) civilian residents of Puerto Rico, the Virgin Islands, Guam, American Samoa, and the Northern Mariana Islands; (3) Federal civilian employees and persons in the U.S. Armed Forces abroad and their dependents; (4) non-citizens living abroad who are insured for Social Security benefits; and (5) all other U.S. citizens abroad.

Solvency. A program is solvent at a point in time if it is able to pay scheduled benefits when due with scheduled financing. For example, the OASDI program is solvent over any period for which the trust funds maintain a positive level of asset reserves.

Special public-debt obligation. Securities of the United States Government issued exclusively to the OASI, DI, HI, and SMI Trust Funds and other Federal trust funds. Section 201(d) of the Social Security Act provides that the public-debt obligations issued for purchase by the OASI and DI Trust Funds shall have maturities fixed with due regard for the needs of the funds. The usual practice has been to spread the holdings of special issues, as of each June 30, so that the amounts maturing in each of the next 15 years are approximately equal. Special public-debt obligations are redeemable at par value at any time and carry interest rates determined by law (see “Interest rate”). See tables VI.A4 and VI.A5 for a listing of the obligations held by the OASI and DI Trust Funds, respectively.

Stochastic model. A model used for projecting a probability distribution of potential outcomes. Such models allow for random variation in one or more variables through time. The random variation is generally based on fluctuations observed in historical data for a selected period. A large number of simulations, each of which reflects random variation in the variable(s), produce a distribution of potential outcomes.

Substantial gainful activity—SGA. The level of work activity used to establish disability. A finding of disability requires that a person be unable to engage in substantial gainful activity. A person who earns more than a certain monthly amount (net of impairment-related work expenses) is ordinarily considered to be engaging in SGA. The amount of monthly earnings considered as SGA depends on the nature of a person's disability. The Social Security Act specifies a higher SGA amount for statutorily blind individuals; Federal regulations specify a lower SGA amount for non-blind individuals. Both SGA amounts increase with increases in the national average wage index.

Summarized balance. The difference between the summarized income rate and the summarized cost rate, expressed as a percentage of GDP. The difference between the summarized income rate and cost rate as a percentage of taxable payroll is referred to as the actuarial balance.

Summarized cost rate. The ratio of the present value of cost to the present value of the taxable payroll (or GDP) for the years in a given period, expressed as a percentage. To evaluate the financial adequacy of the program, the summarized cost rate is adjusted to include the cost of reaching and maintaining a target trust fund level. A trust fund level of about 1 year's cost is considered to be an adequate reserve for unforeseen contingencies; therefore, the targeted trust fund ratio is 100 percent of annual cost. Accordingly, the adjusted summarized cost rate is equal to the ratio of: (1) the sum of the present value of the cost during the period plus the present value of the targeted ending trust fund level to (2) the present value of the taxable payroll (or GDP) during the projection period.

Summarized income rate. The ratio of the present value of scheduled non-interest income to the present value of taxable payroll (or GDP) for the years in a given period, expressed as a percentage. To evaluate the financial adequacy of the program, the summarized income rate is adjusted to include asset reserves on hand at the beginning of the period. Accordingly, the adjusted summarized income rate equals the ratio of: (1) the sum of the trust fund reserve at the beginning of the period plus the present value of non-interest income during the period to (2) the present value of the taxable payroll (or GDP) for the years in the period.

Supplemental Security Income—SSI. A Federally administered program (often with State supplementation) of cash assistance for needy aged, blind, or disabled persons. The General Fund of the Treasury funds SSI and the Social Security Administration administers it.

Supplementary Medical Insurance (SMI) Trust Fund. See “Trust fund.”

Survivor benefit. Benefit payable to a survivor of a deceased worker.

Sustainable solvency. Sustainable solvency for the financing of the program under a specified set of assumptions is achieved when the projected trust fund ratio is positive throughout the 75-year projection period and is either stable or rising at the end of the period.

Taxable earnings. Wages or self-employment income, in employment covered by the OASDI or HI programs, that is under the applicable annual maximum taxable limit. For 1994 and later, no maximum taxable limit applies to the HI program.

Taxable payroll. A weighted sum of taxable wages and taxable self-employment income. When multiplied by the combined employee-employer payroll tax rate, taxable payroll yields the total amount of payroll taxes incurred by employees, employers, and the self-employed for work during the period.

Taxable self-employment income. The maximum amount of net earnings from self-employment by an earner which, when added to any taxable wages, does not exceed the contribution and benefit base. For HI beginning in 1994, all net earnings from self-employment.

Taxable wages. See “Taxable earnings.”

Taxation of benefits. Beginning in 1984, Federal law subjected up to 50 percent of an individual’s or a couple’s OASDI benefits to Federal income taxation under certain circumstances. Treasury allocates the revenue derived from this provision to the OASI and DI Trust Funds on the basis of the income taxes paid on the benefits from each fund. Beginning in 1994, the law increased the maximum percentage from 50 percent to 85 percent. The HI Trust Fund receives the additional tax revenue resulting from the increase to 85 percent.

Taxes. See “Payroll tax contributions” and “Taxation of benefits.”

Termination. Cessation of payment because the beneficiary is no longer entitled to receive a specific type of benefit. For example, benefits might terminate as a result of the death of the beneficiary, the recovery of a disabled beneficiary, or the attainment of age 18 by a child beneficiary. In some cases, an individual may cease one benefit and this is not a termination because they become immediately entitled to another type of benefit, such as the conversion of a disabled-worker beneficiary at normal retirement age to a retired-worker beneficiary.

Test of long-range close actuarial balance. The conditions required to meet this test are:

- The trust fund satisfies the test of short-range financial adequacy; and

- The trust fund ratios stay above zero throughout the 75-year projection period, such that benefits would be payable in a timely manner throughout the period.

The Trustees apply the test to OASI, DI, and the combined OASDI program based on the intermediate set of assumptions.

Test of short-range financial adequacy. The conditions required to meet this test are:

- If the trust fund ratio for a fund is at least 100 percent at the beginning of the projection period, the test requires that it remain at or above 100 percent throughout the 10-year projection period;
- If the ratio is initially less than 100 percent, then it must reach at least 100 percent within 5 years (without asset reserve depletion at any time during this period) and then remain at or above 100 percent throughout the remainder of the 10-year period.

The Trustees apply the test to OASI, DI, and the combined OASDI program based on the intermediate set of assumptions.

Total-economy productivity. The ratio of real GDP to hours worked by all workers. Also referred to as "labor productivity."

Total fertility rate. The sum of the single year of age birth rates for women aged 14 through 49, where the rate for age 14 includes births to women aged 14 and under, and the rate for age 49 includes births to women aged 49 and over. The total fertility rate may be interpreted as the average number of children that would be born to a woman in her lifetime if she were to experience, at each age of her life, the birth rate observed in, or assumed for, a specified year, and if she were to survive the entire childbearing period.

Trust fund. Separate accounts in the United States Treasury which hold the payroll taxes received under the Federal Insurance Contributions Act and the Self-Employment Contributions Act; payroll taxes resulting from coverage of State and local government employees; any sums received under the financial interchange with the railroad retirement account; voluntary hospital and medical insurance premiums; and reimbursements or payments from the General Fund of the Treasury. As required by law, the Department of the Treasury invests funds not required to meet current expenditures in interest-bearing securities backed by the full faith and credit of the U.S. Government. The interest earned is also deposited in the trust funds.

- **Old-Age and Survivors Insurance (OASI).** The trust fund used for paying monthly benefits to retired-worker (old-age) beneficiaries, their spouses and children, and to survivors of deceased insured workers.
- **Disability Insurance (DI).** The trust fund used for paying monthly benefits to disabled-worker beneficiaries, their spouses and children, and for providing rehabilitation services to the disabled.

- **Hospital Insurance (HI).** The trust fund used for paying part of the costs of inpatient hospital services and related care for aged and disabled individuals who meet the eligibility requirements. Also known as Medicare Part A.
- **Supplementary Medical Insurance (SMI).** The Medicare trust fund composed of the Part B Account, the Part D Account, and the Transitional Assistance Account. The Part B Account pays for a portion of the costs of physicians' services, outpatient hospital services, and other related medical and health services for voluntarily enrolled aged and disabled individuals. The Part D Account pays private plans to provide prescription drug coverage, beginning in 2006. The Transitional Assistance Account paid for transitional assistance under the prescription drug card program in 2004 and 2005.

The trust funds are distinct legal entities which operate independently. Fund operations are sometimes combined on a hypothetical basis.

Trust fund ratio. A measure of trust fund adequacy. The asset reserves at the beginning of a year, which do not include advance tax transfers, expressed as a percentage of the cost for the year. The trust fund ratio represents the proportion of a year's cost which could be paid solely with the reserves at the beginning of the year.

Trustees. See "Board of Trustees."

Undisbursed balances. In general, refers to the cumulative differences between the actual cash expenditures that the Social Security Administration (SSA) made each month compared to security redemptions from the trust fund reserves made on a preliminary basis to cover such cash expenditures during the same month. On a monthly basis, SSA pays benefits and makes payments for other programmatic expenses associated with the trust funds. During each month, SSA draws cash from the trust funds on a preliminary basis, which results in Treasury redeeming invested securities to cover these expenditures. This monthly difference can be either positive or negative depending on net monthly activity, and is added to the balance at the end of the prior month.

A net positive undisbursed balance represents a situation where cumulative redemptions from the trust fund's securities are more than was needed to cover actual program cash expenditures through the end of the month. A net negative balance represents a situation where cumulative program cash expenditures exceeded the amount redeemed from the invested securities. A negative value requires future redemption of additional invested securities.

In addition, about every seven years, when January 3 falls on a Sunday, benefit payments scheduled to be paid on January 3rd are actually paid on December 31 of the preceding year, as required by the statutory provision included in the 1977 Social Security Amendments for early delivery of benefit payments when the normal payment delivery date is a Saturday, Sunday, or legal public holiday. Consistent with practice in prior reports and for comparability with other historical years and the projections in this report, all trust fund operations and asset reserves reflect the 12 months of benefits scheduled for payment in each year. Therefore, such advance payments are included as positive values in the undisbursed balance at the end of the calendar years in which the advance payments are made.

Unfunded obligation. A measure of the shortfall of trust fund income to fully cover program cost through a specified date after depletion of trust fund asset reserves. This measure can be expressed in present value dollars, discounted to the beginning of the valuation period, by computing the excess of the present value of the projected cost of the program through a specified date over the sum of: (1) the value of trust fund reserves at the beginning of the valuation period; and (2) the present value of the projected non-interest income of the program through a specified date, assuming scheduled tax rates and benefit levels. This measure can apply for all participants through a specified date, i.e., the open group, or be limited to a specified subgroup of participants.

Unfunded obligation ratio. The unfunded obligation accumulated through the beginning of a year expressed as a percentage of the cost for the year.

Unnegotiated check. A check which has not been cashed 6 months after the end of the month in which the check was issued. When a check has been outstanding for a year, the Department of the Treasury administratively cancels the check and reimburses the issuing trust fund separately for the amount of the check and interest for the period the check was outstanding. The appropriate trust fund also receives an interest adjustment for the time the check was outstanding if it is cashed 6-12 months after the month of issue. If a check is presented for payment after it has been administratively canceled, a replacement check is issued.

Valuation period. A period of years which is considered as a unit for purposes of calculating the financial status of a trust fund.

Vocational rehabilitation. Services provided to disabled persons to help them to return to gainful employment. The trust funds reimburse the providers of such services only in those cases where the services contributed to the successful rehabilitation of the beneficiaries.

Year of depletion. The year in which a trust fund becomes unable to pay benefits when due because the fund's asset reserves have been used up.

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STATEMENT OF ACTUARIAL OPINION

It is my opinion that, with the important caveat noted below: (1) the techniques and methodology used herein to evaluate the actuarial status of the Federal Old-Age and Survivors Insurance and Disability Insurance Trust Funds are based upon sound principles of actuarial practice and are generally accepted within the actuarial profession; and (2) the assumptions used and the resulting actuarial estimates are, individually and in the aggregate, reasonable for the purpose of evaluating the actuarial status of the trust funds, taking into consideration the past experience and future expectations for the population, the economy, and the program. I am an Associate of the Society of Actuaries, a member of the American Academy of Actuaries, and I meet the Qualification Standards of the American Academy of Actuaries to render the actuarial opinion contained herein.

Federal Budget Accounting

This report focuses on the actuarial status of the OASI and DI Trust Funds, as required by law. It includes important information on (1) the years in which trust fund asset reserves are projected to be depleted and (2) the degree to which benefits scheduled in the law would no longer be fully payable on a timely basis after reserve depletion. However, the footnote on page 44 of this report directs the reader to an appendix in the Medicare Trustees Report, which states, “The trust fund perspective does not encompass the interrelationship between the Medicare and Social Security trust funds and the overall Federal budget.” The reader of this report should consider this “overall” Federal unified budget perspective with care because the assumptions underlying unified budget accounting are inconsistent with the assumptions of trust fund accounting.

In particular, trust fund accounting accurately reflects the law, under which benefits cannot be paid in full on a timely basis after reserve depletion. In contrast, unified budget accounting assumes that full scheduled benefits will continue to be paid through transfers from the General Fund of the Treasury, thus representing “a draw on other Federal resources for which there is no earmarked source of revenue from the public.” Not only are such “draws” not permissible under the law, no precedent exists for a change in the Social Security Act to finance unfunded trust fund obligations with such draws on other Federal resources. Under this unified budget accounting assumption, $13.2 trillion of OASDI unfunded obligations, which are not payable under the law over the next 75 years, are referred to as “expenditures” requiring a “draw” from the General Fund of the Treasury.

In addition, unified budget accounting treats redemptions of trust fund reserves as an addition to annual Federal deficits, referring to these redemptions also as “a draw on other Federal resources.” In fact, redemptions of trust fund reserves represent a deferred use of revenues earmarked for the trust fund program alone, which have been collected in prior years and saved for later use. These redemptions utilize the entire $2.9 trillion accumulation of net past earmarked revenue for OASDI, but are referred to as draws on the General Fund of the Treasury under the unified budget perspective.

Therefore, the actual operations of the trust funds under current law do not draw on other Federal resources. Expenditures can only be paid from current or deferred earmarked resources for the specific program financed from the trust fund. Assertions that trust fund reserve redemption and shortfalls after reserve depletion represent draws on other Federal resources are based on assumptions that are inconsistent with the law and with actual trust fund annual cash-flow operations.

In addition to Federal budget annual cash flows, the budget perspective is equally concerned with the build-up of Federal debt. The total Federal debt subject to limit includes trust fund reserves. Thus, as trust fund reserves are accumulated or redeemed, they are offset in the total Federal debt by securities issued to the public, with no net effect on the total Federal debt. Moreover, even in considering the Federal debt owed to (held by) the public, there is no net direct effect on that debt from accumulating and then redeeming trust fund asset reserves. However, budget analysis frequently refers to both trust fund reserve redemptions and trust fund obligations not payable under the law after reserve depletion as factors that increase the Federal debt held by the public in the future. This assertion is not consistent with a full assessment of the investment and redemption flows of the trust funds or with the limitations in the law on paying benefits after trust fund reserves are depleted.

Stephen C. Goss

Stephen C. Goss

Associate of the Society of Actuaries
Member of the American Academy of Actuaries
Chief Actuary, Social Security Administration

CASE: UG 366
WITNESSES: MATT MULDOON &
MOYA ENRIGHT

PUBLIC UTILITY COMMISSION
OF
OREGON

STAFF EXHIBIT 1107

Long Run U.S. BEA
GDP Growth Rates

Exhibits in Furtherance
of Testimony in Support of Partial Stipulation

July 11, 2019

STAFF EXHIBIT 1107

PROVIDED IN ELECTRONIC FORMAT ONLY

CASE: UG 366
WITNESSES: MATT MULDOON &
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PUBLIC UTILITY COMMISSION
OF
OREGON

STAFF EXHIBIT 1108

TIPS Synthetic Forward Curve
Capture of Inflation Expectations

Exhibits in Furtherance
of Testimony in Support of Partial Stipulation

July 11, 2019

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PUBLIC UTILITY COMMISSION
OF
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STAFF EXHIBIT 1109

Risk Premium Model (RPM)
Supplemental Analysis

Exhibits in Furtherance
of Testimony in Support of Partial Stipulation

July 11, 2019

Year	Return on Moodys A-Rated Utility Bond	Approved ROEs			Risk Premium (Arithmetic calculation)			Return on (Geometric calculation)			
		Electric	Gas	Electric & Gas	Electric	Gas	Electric & Gas	Moodys A-Rated Utility Bond Index	Electric	Gas	Electric & Gas
1980	13.3%	14.2%	14.0%	14.2%	0.9%	0.7%	0.8%	1.13	1.14	1.14	1.14
1981	16.0%	15.2%	15.1%	15.2%	-0.7%	-0.8%	-0.8%	1.16	1.15	1.15	1.15
1982	15.9%	15.8%	15.6%	15.7%	-0.1%	-0.2%	-0.1%	1.16	1.16	1.16	1.16
1983	13.7%	15.4%	15.2%	15.3%	1.7%	1.6%	1.7%	1.14	1.15	1.15	1.15
1984	14.0%	15.3%	15.3%	15.3%	1.3%	1.3%	1.3%	1.14	1.15	1.15	1.15
1985	12.5%	15.2%	14.7%	15.0%	2.7%	2.3%	2.6%	1.12	1.15	1.15	1.15
1986	9.6%	14.0%	13.5%	13.8%	4.4%	3.9%	4.2%	1.10	1.14	1.13	1.14
1987	10.0%	13.0%	12.7%	12.9%	3.0%	2.7%	2.9%	1.10	1.13	1.13	1.13
1988	10.3%	12.8%	12.8%	12.8%	2.5%	2.6%	2.6%	1.10	1.13	1.13	1.13
1989	9.8%	13.0%	12.9%	12.9%	3.2%	3.1%	3.1%	1.10	1.13	1.13	1.13
1990	9.9%	12.7%	12.7%	12.7%	2.8%	2.8%	2.8%	1.10	1.13	1.13	1.13
1991	9.4%	12.5%	12.4%	12.5%	3.2%	3.1%	3.1%	1.09	1.13	1.12	1.13
1992	8.7%	12.1%	12.0%	12.1%	3.4%	3.3%	3.4%	1.09	1.12	1.12	1.12
1993	7.6%	11.5%	11.4%	11.4%	3.9%	3.8%	3.8%	1.08	1.11	1.11	1.11
1994	8.3%	11.2%	11.2%	11.2%	2.9%	2.9%	2.9%	1.08	1.11	1.11	1.11
1995	7.9%	11.6%	11.4%	11.5%	3.7%	3.5%	3.6%	1.08	1.12	1.11	1.12
1996	7.7%	11.4%	11.1%	11.3%	3.7%	3.4%	3.5%	1.08	1.11	1.11	1.11
1997	7.6%	11.3%	11.3%	11.3%	3.7%	3.7%	3.7%	1.08	1.11	1.11	1.11
1998	7.0%	11.8%	11.5%	11.6%	4.7%	4.5%	4.6%	1.07	1.12	1.12	1.12
1999	7.6%	10.7%	10.7%	10.7%	3.1%	3.1%	3.1%	1.08	1.11	1.11	1.11
2000	8.2%	11.6%	11.3%	11.4%	3.3%	3.1%	3.2%	1.08	1.12	1.11	1.11
2001	7.8%	11.1%	11.0%	11.0%	3.3%	3.2%	3.3%	1.08	1.11	1.11	1.11
2002	7.4%	11.2%	11.2%	11.2%	3.8%	3.8%	3.8%	1.07	1.11	1.11	1.11
2003	6.6%	11.0%	11.0%	11.0%	4.4%	4.4%	4.4%	1.07	1.11	1.11	1.11
2004	6.2%	10.8%	10.6%	10.7%	4.6%	4.5%	4.6%	1.06	1.11	1.11	1.11
2005	5.6%	10.5%	10.4%	10.5%	4.9%	4.8%	4.8%	1.06	1.11	1.10	1.10
2006	6.1%	10.3%	10.4%	10.4%	4.3%	4.3%	4.3%	1.06	1.10	1.10	1.10
2007	6.1%	10.3%	10.2%	10.3%	4.2%	4.2%	4.2%	1.06	1.10	1.10	1.10
2008	6.5%	10.4%	10.4%	10.4%	3.9%	3.9%	3.9%	1.07	1.10	1.10	1.10
2009	6.0%	10.5%	10.2%	10.4%	4.5%	4.2%	4.4%	1.06	1.11	1.10	1.10
2010	5.5%	10.4%	10.1%	10.3%	4.9%	4.7%	4.8%	1.05	1.10	1.10	1.10
2011	5.0%	10.3%	9.9%	10.2%	5.2%	4.9%	5.1%	1.05	1.10	1.10	1.10
2012	4.1%	10.2%	9.9%	10.1%	6.0%	5.8%	6.0%	1.04	1.10	1.10	1.10
2013	4.5%	10.0%	9.7%	9.9%	5.5%	5.2%	5.4%	1.04	1.10	1.10	1.10
2014	4.3%	9.9%	9.8%	9.9%	5.6%	5.5%	5.6%	1.04	1.10	1.10	1.10
2015	4.1%	9.9%	9.6%	9.8%	5.7%	5.5%	5.6%	1.04	1.10	1.10	1.10
2016	3.9%	9.8%	9.5%	9.7%	5.8%	5.6%	5.7%	1.04	1.10	1.10	1.10
2017	4.0%	9.7%	9.7%	9.7%	5.7%	5.7%	5.7%	1.04	1.10	1.10	1.10
2018	4.3%	9.6%	9.6%	9.6%	5.3%	5.3%	5.3%	1.04	1.10	1.10	1.10
2019	4.2%	9.7%	9.6%	9.6%	5.5%	5.4%	5.5%	1.04	1.10	1.10	1.10
								7.87%	11.68%	11.54%	11.62%

Arithmetic Average Risk Premium		
Electric	Gas	Both
3.77%	3.63%	3.72%

Geometric Average Risk Premium		
Electric	Gas	Both
3.80%	3.66%	3.75%

Results of Regression - Estimates relationship between bond returns and the Risk Premium

Regression Statistics	
Multiple R	0.9523004
R Square	0.90687606
Adjusted R^2	0.90442543
Standard Err(	0.00550198
Observations	40

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	0.01120232	0.01120232	370.058327	3.4792E-21
Residual	38	0.00115033	3.0272E-05		
Total	39	0.01235265			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	0.08130709	0.00214677	37.8740821	8.6641E-32	0.07696118	0.08565301	0.07696118	0.08565301
X Variable 1	-0.4337423	0.02254741	-19.2369	3.4792E-21	-0.47938717	-0.3880975	-0.4793872	-0.3880975

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Anomalies: The Equity Premium Puzzle

Jeremy J. Siegel; Richard H. Thaler

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Anomalies
The Equity Premium Puzzle

Jeremy J. Siegel and Richard H. Thaler

Economics can be distinguished from other social sciences by the belief that most (all?) behavior can be explained by assuming that rational agents with stable, well-defined preferences interact in markets that (eventually) clear. An empirical result qualifies as an anomaly if it is difficult to "rationalize" or if implausible assumptions are necessary to explain it within the paradigm. Suggestions for future topics should be sent to Richard Thaler, c/o *Journal of Economic Perspectives,* Graduate School of Business, University of Chicago, Chicago, IL 60637, or thaler@gsb.uchicago.edu.

Introduction

Suppose your great grandmother had some money lying around at the end of 1925 and, with rational expectations, anticipated your birth and decided to bequeath you $1000. Naturally, since you weren't born yet, she invested the money, and being worried about the speculative boom in stocks going on at the time, she put the money in Treasury bills, where it remained until December 31, 1995. On that date it was worth $12,720. Imagine, instead that she had invested the money in a (value-weighted) portfolio of stocks. You would now have $842,000, or 66 times

[1] The returns we quote are arithmetic returns. Geometric returns are slightly lower.

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as much money. This difference in returns (3.7 percent vs. 10.1 percent[1]) is strikingly large. The difference between the return on stocks and the return on a risk-free asset such as treasury bills is called the equity premium (or the equity risk premium, since it is thought to be attributable to the higher risk associated with stocks). The fact that it is too large to be explained by standard economic models is called the equity premium puzzle.[2]

The Puzzle

Of course, stocks are riskier than Treasury bills, so we should expect them to earn higher returns. How can we tell whether the equity premium is too big? Mehra and Prescott (1985) were the first to declare the equity premium an official "puzzle." They used a standard general equilibrium model in which individuals have additively separable utility functions (meaning that my utility of consumption this year does not depend on my consumption in other years) and constant relative risk aversion. In this model, the only parameter is the coefficient of relative risk aversion, A. The interpretation of A is that if consumption falls by 1 percent, then the marginal value of a dollar of income increases by A percent. The question Mehra and Prescott (1985) posed was this: what value of A is necessary to explain the historic equity premium? The value they obtained was between 30-40, which they concluded was much too high to be reasonable.

Why did they conclude that this value of A is too high? Suppose you have a gamble where you face a 50 percent chance to double your wealth (including your human capital) and a 50 percent chance to have your wealth fall by half. How much would you be willing to pay to avoid such a gamble? If your coefficient of relative risk aversion is 30, then you would be willing to pay 49 percent of your wealth to avoid the 50 percent chance of losing half your wealth. This seems absurd.[3]

There is another aspect of the data that is puzzling. A high value of A implies that individuals should want desperately to smooth consumption over time, because consumption shortfalls deliver far more pain than surpluses give pleasure.[4] Since the economy becomes richer over time, individuals should all try to borrow from their richer future in order to improve their (relatively) impoverished present. But this common desire to borrow should lead to high real interest rates. Instead, the real rate of interest has been scarcely positive over long periods of time. Thus, as

[2] Our review of this puzzle will, of necessity, be brief. For more detail see Abel (1995), Kocherlakota (1996) and Siegel (1994).

[3] Mehra and Prescott point out (p. 154) that most empirical estimates of A are in the neighborhood of 1.0–2.0. Arrow (1971, p. 98) argues on theoretical grounds that A "must hover around 1, being, if anything, somewhat less for low wealths and somewhat higher for high wealths."

[4] This follows because in the Mehra-Prescott model the coefficient of relative risk aversion, A, is also the inverse of the elasticity of intertemporal substitution.

pointed out by Weil (1989), the equity premium puzzle could as easily be called the (low) risk-free rate puzzle.[5]

Empirical Questions

There are two broad approaches to explaining the equity premium puzzle. One is to find factors that require adjustment to the empirical side of the puzzle: for example, to uncover data that would make the equity premium smaller or equity returns riskier. The other option is to explore different theoretical frameworks. We consider the empirical questions first and then discuss the theoretical variations below.

Longer Time Period

The question about whether the time period studied by Mehra and Prescott (1985) was special has been investigated by Siegel (1992a,b), who extended the U.S. data on real stock and bond returns back to 1802. He finds that early stock returns did not exceed fixed income returns by nearly the same magnitude they did in more recent data. Siegel divides the whole period into three subperiods: 1802–1871, the early period of U.S. development; 1872–1925, the middle period where data on stock and fixed income returns are of far higher quality; and 1926 to the present.

Siegel finds that real returns in the short-term fixed income market have fallen dramatically over time: from 5.4 percent in the first period, to 3.3 percent in the second, and 0.7 percent since 1926. The real return on equity, in contrast, has remained remarkably constant. As a result, the excess returns on the stock market over the risk-free rate have risen from 2.9 percent to 4.7 percent and finally 8.1 percent over the most recent period. Over the 193-year period, the excess return on equity has been 5.3 percent per year, 1.3 percentage points less than that reported by Mehra and Prescott (1985).

The reason for the fall in the real return on short-term government bonds over the last two centuries is not well understood. In the earliest period, there may have been a greater default risk perceived for a young country. As for the low return to bonds in the last 70 years, it is likely that bondholders in the early post–World War II period did not expect the high inflation of the 1970s, which diminished their real returns. However, short-term investors should presumably have captured the inflation premium in their yield, and yet real returns on short-dated government bills were persistently negative over the high-inflation 1970s.

Since 1982 (after the end of the inflationary 1970s) the real return on short-term government securities has averaged about 3 percent. This higher return on

[5] Kandel and Stambaugh (1991) note that in a world with uncertainty, the real rate of interest is also negatively related to the degree of risk aversion, which can partially explain the low observed interest rates.

bonds would have reduced the equity premium had not the return on stocks been exceptionally high.

Survivorship Bias

An alternate explanation for the equity premium puzzle is that investors are rationally worried about a small chance of an economic catastrophe of some kind, which, though it had not happened, might have (Reitz, 1988). Of the 36 stock exchanges that operated at the turn of the twentieth century, more than one-half of them had significant interruptions or were abolished outright (Brown, Goetzmann and Ross, 1995). Hence, the equity risk premium, estimated from U.S. data alone, is necessarily distorted by the fact that it is calculated for a survivor. On this argument, the riskiness of equities is understated by estimates relying on U.S. existing data, because the data do not show the catastrophe that might have occurred here also, but didn't.

This kind of explanation is not easily testable. However, several objections can be raised. First, the time period studied by Mehra and Prescott (1985) does contain an economic catastrophe, namely the 1929 stock market crash and the subsequent Great Depression. Between 1929 and 1933, stocks lost about 80 percent of their value and did not recover their lost value again until late in World War II. Moreover, careful evaluation of the stock markets that closed for extended periods shows that most did reopen and eventually rewarded equity holders. Gregor Gielen (1994) and Hirose and Tso (1995) have calculated stock returns for both Germany and Japan through World War II. Despite the defeat of the Axis powers, and the precipitous decline in their stock prices at the close of the war, the average real compound annual return on German stocks from 1926 through 1995 was 5.9 percent in Germany and 4.0 percent in Japan. In contrast, in Germany, the hyperinflation of the 1920s wiped out bondholders altogether, and in Japan, the post–World War II hyperinflation did the same. In both these hyperinflations, equities managed to regain most of their real value. Hence if the equity premium is measured as the difference between real returns on stocks and fixed income securities, it was actually *greater* for Japan and Germany during this century than for the United States. More generally, most financial holocausts that destroy stock values have been associated with hyperinflation or financial wealth confiscation where investors are often worse off in bonds than in stocks.[6]

Mean Reversion and Aversion

The equity premium is a puzzle because the measured risk associated with equity returns is not high enough to justify the observed high returns. However,

[6] The equity premium puzzle is also observed in other smaller markets. In one recent analysis, John Campbell (1996) estimates the values of the coefficient of relative risk aversion, A, implied by the post-1970 times series of asset prices and consumption in several other countries, including Australia, Canada, France, Italy, the Netherlands, Spain and Sweden (as well as the larger countries we have already discussed). Except for three countries where the implied value of A is negative (because stock prices and consumption are negatively correlated), the obtained values for A are all very high—from 31 to over 5000. He also reports an estimate of 62 for Sweden for the period 1919-1992.

the usual measurements of risk, such as standard deviation of annual rates of returns, may mischaracterize long-term risk if year-to-year returns do not follow a random walk. To investigate the implications of this assumption, Siegel (1992b) has examined the variability of real returns of equity and fixed income assets over the period 1802–1992 and extended here through 1995. He finds that the observed deviations from a random walk in stock and bill real returns actually deepen the puzzle.

If returns are independent from one year to the next, then the standard deviation of annual average decreases with the square root of the horizon. Although the standard deviation of one-year returns is 18.15 percent, the theoretical (assuming a random walk) standard deviation of annual rates of return over 20-year periods would be just 4.06.[7] However, Poterba and Summers (1988) show that the standard deviation of stock returns actually decreases more quickly than it would if returns were a random walk because stock returns display mean reversion. Several bad years are more likely to be followed by good ones, and vice versa. Thus, Siegel finds that the actual standard deviation of 20-year rates of return is only 2.76 percent. This means that for long-horizon investors, the risk of holding stocks is less than one would expect by just looking at the annual standard deviation of returns.

Mean reversion is not, however, a characteristic of the real returns on fixed income assets. In contrast to stocks, the standard deviation of average annual real returns to bonds and treasury bills decreases *less* than the square root of the horizon. This behavior is called *mean aversion.* While the annual standard deviation of real T-bill rates of return is about a third of that of stocks (6.14 percent), the standard deviation of annual rates of returns for 20-year horizons is actually greater than that of stocks: 2.86 percent.

This analysis suggests that the equity premium is even a bigger puzzle than has previously been thought. It is not that the risk of equities is not great enough to explain their high rate of return; rather, for long-term investors, fixed income securities have been riskier in real terms. By this reasoning, the equity premium should be negative!

Theoretical Explanations

The combination of the equity premium puzzle and the real rate puzzle has captured the attention of many economic theorists who have taken on the challenge of modifying the theory of the representative agent to accommodate the historical facts. None has been completely successful in resolving the puzzle.

One approach, pioneered by Epstein and Zin (1989), uses a utility function that breaks the rigid link between the coefficient of relative risk aversion and

[7] Of course, the standard deviation of *wealth* is increasing as the horizon increases. It is the standard deviation of the annual rate of return that declines as the horizon lengthens.

elasticity of intertemporal substitution. These utility functions (which are not consistent with the axioms of expected utility theory) allow for the possibility of explaining both a high equity premium and a low real interest rate. Still, they find that this approach can only explain about a third of the equity premium.

Mankiw and Zeldes (1991) suggest that the equity premium puzzle may result from the aggregation of the consumption of stockholders and nonstockholders. Not including pension accounts, they found that almost three-quarters of individuals do not hold stocks. Of those that do, their consumption is three times more sensitive to stock market fluctuations than that found in aggregate data. But even after making this adjustment, the level of risk aversion needed to explain the equity premium puzzle is still in the neighborhood of 10.

Other economists have modified the utility function by making the utility of consumption depend on a comparison between current consumption and some benchmark. If the benchmark is taken to be prior levels of consumption, then the behavior can be described as "habit formation," as first suggested by Duesenberry (1952). In the context of the equity premium, habit formation has the effect of making an investor more sensitive to short-run reductions in consumption. This implies a high short-run risk aversion but a lower long-run risk aversion (Constantinides, 1990). However, habit formation cannot explain the difference in returns between stocks and bills (Ferson and Constantinides, 1991).

Another possible benchmark with which current consumption can be compared is the consumption levels of others. I may get utility not just from my own consumption but from knowing that I am consuming more than you are. Conversely, if you become better off and I do not, I am miserable. Abel (1990) examines asset pricing when agents have this type of utility functions, which he terms "catching up with the Joneses." A similar approach has been taken by Campbell and Cochrane (1995). Compared to the standard constant-elasticity-of-substitution utility function, this has the effect of increasing an individual's marginal utility of consumption in the future, since others at that time will also become better off. Catching up with the Joneses reduces an individual's desire to borrow against higher future consumption and hence lowers the real rate, but leaves an investor just as risk averse to contemporaneous shocks. This model can explain the equity premium with a value of A of only six: still high, but more plausible than 30.

One final "solution" to the puzzle is to deny that it is a puzzle. This is the tack taken by Kandel and Stambaugh (1991), who argue that perhaps investors really do have very high values of A. They point out that while high levels of risk aversion may lead to unreasonable behavior with respect to large changes in consumption, it does not imply implausible behavior for small changes in wealth. For example, to avoid a 50-50 chance of your consumption rising or falling by 1 percent if the coefficient of risk aversion is 10, one would pay 5 percent of the gamble. Even if the coefficient is as high as 29 (which is their estimate of A) an investor would pay only 14.3 percent of the gamble to avoid the risk of a 1 percent rise or fall in wealth. Neither of these actions seem completely unreasonable.

In evaluating this argument, however, it is important to remember that in the domain of retirement savings the stakes are, in fact, large relative to wealth. Similarly, university endowments are a substantial portion of the wealth of private universities. This seems to put us back into the high-stakes category where values of A greater than 10 lead to absurd results.

Myopic Loss Aversion

The models discussed above use reasonable assumptions that the utility of consumption depends on the past levels of consumption or on the consumption of peers. Another approach, in a similar vein, is offered by Benartzi and Thaler (1995) using Tversky and Kahneman's (1992) prospect theory. In Benartzi and Thaler's model, all investors (individuals, pension plan sponsors, endowment fund managers, and so on) are assumed to get utility from the *changes* in the value of their portfolios; that is, utility comes from returns, not from the overall level of assets. Furthermore, investors display "loss aversion": losses are assumed to hurt significantly more than gains yield pleasure.[8]

When investors have loss averse preferences, their attitude toward risk depends crucially on the time horizon over which returns are evaluated. For example, an investor with these preferences who computed the value of her portfolio every day would find investing in stocks very unattractive, since stock prices fall almost as often as they rise on a daily basis, and losses are psychologically doubled. Consider, on the other hand, a modern version of Rip Van Winkle, who, knowing he is about to go to sleep for 20 years, makes one final phone call to his broker. Rip should sleep soundly in the knowledge that over a 20-year period, stocks have never declined in real value.

Using this interplay between the time period used to evaluate investments and loss aversion, Benartzi and Thaler (1995) estimate what evaluation period would make investors indifferent between stocks and bonds (or bills). They do this by simulating distributions of returns for stocks, bonds and bills over various horizons (from one month and up) by selecting months at random from history. They find that the evaluation period that makes stocks and bonds equally attractive is about 13 months, or just over one year.

How can this result be evaluated? One method is to use the same "plausibility" test that Mehra and Prescott (1985) apply. They declared the equity premium a puzzle because they judged a value of A much greater than 10 to be implausible. In contrast, a one-year evaluation period seems consistent with the observation that tax returns and many other activities take place once a year, making annual evaluations particularly salient.

[8] Specifically, the value function used is

$$v(x) = \begin{cases} x^{\alpha} & \text{if } x \geq 0 \\ -\lambda(-x)^{\alpha} & \text{if } x < 0 \end{cases}$$

where x is returns. The parameters α and λ (the coefficient of loss aversion) have been estimated by Tversky and Kahneman to be .88 and 2.25, respectively.

An implication of myopia as an explanation is that if people did concentrate on long-term results, they would invest more in stocks. In a follow-up paper, Benartzi and Thaler (1996) report an experiment in which groups of university employees were shown distributions of returns for two hypothetical retirement funds, *A* and *B*, where the distributions were derived from the actual distributions of stocks and bonds since 1926. One group was shown a distribution of annual returns; this group invested 40 percent of their money in stocks. Another group was shown a simulated distribution of 30-year returns derived from the annual return data by drawing years at random. Although this group is given essentially the same information, they chose to invest 90 percent of their money in stocks, presumably because they found the long-run return distribution for stocks more attractive than for bonds.

Commentary

The equity premium puzzle is a rare bird among economics anomalies. Because economic theory rarely makes quantitative predictions, many tests of the theory come down to whether the sign of some magnitude is the same as the theory predicts. Such tests are hard to fail. Indeed, since stocks are riskier than bonds or bills (at least on an annual basis) according to a crude sign test, asset pricing conforms to economic theory. The ingenious contribution of Mehra and Prescott (1985) was to come up with a quantitative test of the theory. They established a value of 10 as a reasonable upper bound for *A* (we feel an even lower upper bound could be justified), and their results were a resounding rejection of the theory.

What should we make of these results? One view is that history has just been kind to stock markets, especially those in the larger markets. According to this view, we have just experienced 200 years of good luck. Yet we have shown that the equity returns in such countries as Germany and Japan, which have experienced much bad luck, still greatly outperform short-term fixed income securities. And the equity premium has been high over extremely long periods of time. This raises the question of how long it should take for investors in an economy to learn about the true risk and return on financial assets.

Another view is that investors really are extremely risk averse, as argued by Kandel and Stambaugh (1991). Eugene Fama (1991, p. 1596) offers a different interpretation:

> . . . a large equity premium is not necessarily a puzzle; high risk aversion (or low intertemporal elasticity of substitution for consumption) may be a fact. Roughly speaking, a large equity premium says that consumers are extremely averse to small negative consumption shocks. This is in line with the perception that consumers live in morbid fear of recessions (and economists devote enormous energy to studying them) even though, at

least in the post war period, recessions are associated with small changes in consumption.

Note that Fama seems to suggest that while the risk aversion displayed is real, that it is some kind of mistake by consumers. A similar view is offered by Thomas MaCurdy and John Shoven (1992). They find it so difficult to understand why investors put any of their retirement funds in bonds that they conclude (p. 12) that people must be "confused about the relative safety of different investments over long horizons." In the myopic loss aversion explanation investors are also making a mistake: they fail to aggregate over time periods.[9]

What are the practical implications of this? If you believe that the equity premium is simply a fair return for bearing the risks associated with buying stocks, then you can base your asset allocation decision in part on whether you think you are more or less risk averse than the marginal investor. However, if you think that the equity premium is partially derived from other peoples' mistakes and fears, then you might find equities very attractive. Indeed, most economists we know have a very high proportion of their retirement wealth invested in equities (as we do). Are economists just risk lovers, or do they think that the equity premium is big enough to be attractive?

We must stress that our analysis has all been on historical data, which suggest that the equity premium has been too large *in the past.* Of course, as mutual fund companies typically say in their advertisements, past returns are no guarantee of future returns. What is the equity premium now? There is reason to believe that it is lower than it has been in the past. As we noted above, current estimates of expected inflation imply real rates of return of 3-4 percent on long-term bonds, just 3 percent below the historic real return on equities. In a recent detailed investigation of this question, Blanchard (1993) concluded that the equity premium was about 3 percent (or half what it has been over the last 70 years), which he attributes in part to the fading memories of the Great Depression and to the disappearance of significant inflation. Still, even a 3 percent equity premium is substantial when compounded over long periods, and for long-horizon investors such as the young saving for retirement, pension plans and endowments, we find the case for equities compelling. However, if after reading this piece you decide to put more of your retirement savings in stocks, remember we are stressing long-term results and will not accept complaints for 20 years. Feel free to call us in 2017.

■ *Thanks for helpful comments go to Andrew Abel, Olivier Blanchard, George Constantinides, Robert Stambaugh and the editors.*

[9] That is, even if loss aversion is real, investors should realize that they should care about retirement consumption, not returns along the way. To paraphrase the well-known country song, loss averse long-term investors must learn not to "count their money while they're sittin' at the table. . . ."

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The Equity Premium: It's Still a Puzzle

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Views of Financial Economists on the Equity Premium and on Professional Controversies

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Views of Financial Economists on the Equity Premium and on Professional Controversies*

The consensus of 226 academic financial economists forecasts an arithmetic equity premium of 7% per year over 10- and 30-year horizons and of 6%–7% over 1- and 5-year horizons. Pessimistic and optimistic 30-year scenario forecasts average 2% and 13%, respectively. Respondents claim to revise their forecast downward when the stock market rises. They perceive the profession's consensus to be higher than it really is and are influenced by this perception. There is agreement that markets are efficient and lack arbitrage opportunities and that government intervention in financial markets is detrimental.

The equity premium is perhaps the single most important number in financial economics: the rate by which risky stocks are expected to outperform safe fixed-income investments, such as bonds or bills. It is the main input both in asset allocation decisions—how much of one's portfolio an investor should put into stocks versus bonds—and in the capital asset pricing model (CAPM)—the model used by most practitioners in computing an appropriate hurdle rate for accepting investment projects.

The academic finance profession has been teaching asset allocation and CAPM budgeting for many years. But oddly, it has been relatively quiet in recommending an appropriate ‘‘standard'' for the equity premium, the key input to these models. This is unfortunate, in that without a good estimate of the equity premium, the mainstream theories are really quite useless from a practical perspective. The main reason for the scarcity of good justifications and recommendations for a ‘‘good practical estimate'' is, of course, that neither do financial economists know what the correct equity premium is nor is there

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a consensus on how it should be estimated. Existing estimates are discussed in more detail in Section I.

This article intends to supplement existing equity premium estimates with a ‘‘common practice estimate,’’ the consensus in the academic profession. Although this consensus is itself likely to be a weighted estimate obtained by other methods, the distribution of estimated values among academics is itself interesting. The consensus estimate can be a number of some relevance in classroom, courtroom, and boardroom discussions, even if it may not be the best estimate of the equity premium itself. Then again, if there was agreement on how to calculate the best estimate, there would be no need for a survey of financial economists to begin with. Still, surveys in general and this survey in particular have shortcomings, and these are discussed in Section II, which describes the design of the survey.

Section III discusses the principal survey results, that is, the consensus view about the equity premium among the 226 responding financial economists. The most important findings, in brief, follow. The arithmetic 30-year equity premium consensus forecast is about 7%. It is between 0.5% and 1.5% lower on the 1-year horizon, depending on the central statistic. The consensus perception of a pessimistic outcome (at one in 20 probability assessments) over 30 years is 2%–3%; the optimistic equivalent is 12%–13%. There is evidence for a ‘‘false-consensus effect,’’ in that economists seem to anchor their forecast to what they perceive the consensus to be—and this perceived consensus is about 0.5%–1% above the actual consensus. Finally, economists claim that increases in the stock market would, on the margin, cause them to reduce their forecast of the equity premium. Section IV briefly discusses the answers to a set of issues of interest to both financial academics and financial practitioners. The strongest consensus obtains that markets are efficient and lack arbitrage opportunities and that government intervention in financial markets is detrimental. Section V concludes with a summary of the findings.

I. Existing Estimates of the Equity Premium

Cochrane (1997) and Siegel and Thaler (1997) provide comprehensive surveys of the macroeconomics and finance literature about the equity premium puzzle—the question as to why stocks have historically performed so well relative to bonds. This section briefly discusses existing methods to estimate the equity premium.

A. Equity Premium Measurement Issues

Unfortunately, there is neither a uniformly accepted precise definition nor agreement on how the equity premium should be computed and applied.

First, the geometric average is earned by a buy-and-hold investment strategy that is long on stocks and short on interest-bearing securities, while the arithmetic average is earned by a strategy that rebalances investment to a fixed amount each year. Mathematically, the geometric mean is always lower than the arithmetic mean. For example, a 50% decrease followed by a 100% increase leaves an investor with a 0% geometric return, although the arithmetic average would suggest a positive 25% return. Historically, the 30-year geometric mean equity premium has been about 2% lower than the arithmetic mean (see app. A for more detail). It is not clear whether the arithmetic or the geometric average should be used in capital budgeting applications using the CAPM (Indro and Lee 1997).

Second, stocks are long-term investments, and the most common method to compute the equity premium—subtracting a short-term bond return from a long-term equity return—is neither parsimonious nor necessarily a fair investment holding-period comparison.[1] Subtracting off the return to long-term bonds instead of the return to short-term bonds for a 30-year equity premium computation decreases the long-term equity premium by between 1% and 2%. Shiller (1989) subtracts a bond index that splices corporate bonds with treasuries. This, too, results in a lower equity premium.

Lacking formal agreement on how the equity premium should be computed and used, even identical views on the implied equity premium can easily lead different individuals to respond with and themselves use different estimates for the same task. This article describes arithmetic equity premia relative to short-term bills, unless otherwise indicated.

B. *Historical Average Equity Premia*

Perhaps the most popular method to obtain an estimate of the equity risk premium is an extrapolation of historically realized equity premia into the future. Table 1 shows that practitioners can advocate a whole range of estimates as ‘‘their’’ equity premium choice. The use of Ibbotson equity premia estimates seems to be particularly widespread. For example, the most popular finance textbook, Brealey and Myers (1996, p. 146), recommended 8.2%–8.5% in 1996, as sourced from the *Ibbotson 1995 Yearbook.* Table 1 shows that as of December 1998, the equivalent 1926–98 Ibbotson historical arithmetic equity premium average has risen to 9.4%. Shiller (1989, ch. 26) has assembled a longer data set, which can justify as low an equity premium average as 4.3%, using geometric averages over the entire 129-year history.

1. Abel (1999) decomposes the equity premium into a risk and a term premium. Not surprisingly, the term premium accounts for about 25% of the observed equity premium.

TABLE 1 Historical Stock Market and Equity Premium Performance

Source and Time Frame	Number of Years	Geometric Mean (%)	Arithmetic Mean (%)	Arithmetic SD (%)	Arithmetic Minimum (%)	Arithmetic Maximum (%)	Arithmetic SE (%)
Stock market return historical averages:							
Shiller 1870–1998	129	9.3	10.8	17.8	−42.9	54.9	1.6
Shiller 1899–1998	100	10.2	11.9	18.6	−42.9	54.9	1.9
Ibbotson 1926–98	73	11.2	13.2	20.3	NA	NA	2.4
Shiller 1926–98	73	11.0	12.8	19.3	−42.9	55	2.3
Shiller 1949–98	50	13.3	14.3	15.1	−21	46	2.1
Shiller 1974–98	25	14.8	15.9	15.5	−20.8	38.6	3.1
Shiller 1994–98	5	23.8	24.5	13.4	.0	35.1	7.4
Equity premiums historical averages:							
Shiller 1870–1998	129	4.3	6.0	18.5	−45.4	53.4	1.6
Shiller 1899–1998	100	5.3	7.1	19.1	−45.4	53.4	1.9
Ibbotson 1926–98	73	7.1	9.4	NA	NA	NA	NA
Shiller 1926–98	73	6.1	8.0	19.8	−45.4	53.4	2.3
Shiller 1949–98	50	6.9	8.2	16.1	−31.8	44.1	2.3
Shiller 1974–98	25	6.5	7.9	16.3	−31.8	31.3	3.3
Shiller 1994–98	5	18.4	19.0	12.7	−.0	28.6	5.7

NOTE.—Ibbotson estimates are published in the Year-End Summary Report (1998). They are based on the Standard and Poor's 500 Stock Index (S&P500) return wi th dividends (''large company stocks'') and 30-day-to-maturity Treasury bills. Shiller indices are published in Shiller (1989, ch. 26) and updated on http://www.econ.yale.edu/~shiller/chap26.html. They are based on the dividend-adjusted S&P500 (formerly called the Standard and Poor's Composite Index) and a short interest rate spliced from corporates and treasuries, and are computed from January-to-January index averages (of the following year), not December-to-December closing prices. Thus, the last price used in the computations is an average January 1999 index price. The indices differ primarily because of the use of different interest rates. Geometric means are computed as $g_T = \sqrt[T]{[\Pi_{y=1}^{T}(1 + rm_y)]/[\Pi_{y=1}^{T}(1 + rf_y)]}$, where rm_y is the market return and rf_y is the risk-free rate in year y. Arithmetic statistics are computed from a T-year series of $(rm_y - rf_y)$ in a standard fashion. Unreported: averages computed using the value-weighted stock market index obtained from Center for Research in Security Prices have means of about 0.3% more and standard deviations of about 2% more than equivalent S&P returns. Unreported: inflation from 1926 to 1997 was about 3.1%. NA = not available.

Yet, historical averages have limits. Even from a theoretical perspective, an observer could interpret recently high historical stock returns to be indicative of lower (not higher) future stock returns. If the true expected rate of return on stocks were to have fallen over the last couple of years because investors were unexpectedly streaming into the stock market and competing away previously higher expected rates of return, because investors became less risk averse, or because volatility declined, recent increases in stock prices (high stock returns) would soon be followed by lower stock returns in the future. There is also the more mundane nonstationarity problem that 50-year old equity premia may have little relevance to the world today. But stock returns are so volatile that shorter time series have too high a standard deviation to be useful estimators. For example, a 95% confidence interval (plus or minus two standard errors) for the true equity premium average over the 1994–98 period ranges from +7.6% to +30.4%—not a useful range for practical capital budgeting purposes.

C. *Predictive Regressions*

An alternative popular method to estimate future expected returns relies on the observation that, in the very long run, expected corporate payouts and expected investment returns must be equal. The stock price today must be the present value of all future dividend payouts (or earnings). Many researchers (e.g., Campbell and Shiller 1988; Fama and French 1988; Blanchard 1993) have used this observation to predict future equity returns and equity premia with dividend yields (and, to a lesser extent, other variables).[2] As of 1999, a regression of annual data from 1927–97 yields

$$\mathrm{EQP}_y = -11.5\% + 3.95\left(\frac{D_{y-1}}{P_{y-2}}\right) + \mathrm{noise}_y, \tag{1}$$

where EQP_y is the equity premium (here the difference between the return on a value-weighted stock index and short-term treasury investments) in year y, and D_{y-1}/P_{y-2} is the lagged dividend yield. As of 1999, with a dividend yield of below 1.5%, this regression predicts a 1-year-ahead forecast of less than −10%. (Longer period forecasts converge to the historical average.) Variations of such ''conditional models'' predict equity premia ranging from about −10% to about 0%. These are not comfortable estimates. After all, why would anyone hold equity if stocks did not offer higher expected returns than bills? And, what

2. ''Fortunately,'' aside from a number of statistical problems, such models have predicted consistently poorly out of sample at least since 1946. Goyal and Welch (1999) show that this is because simple linear models are unstable—the coefficients have declined over time.

does this imply for firms' capital budgeting decisions—should firms place a lower hurdle rate on riskier projects?

D. Theoretical Arguments

Yet another popular approach to estimating the expected equity premium relies on calculations of what reasonable expected rates of returns are necessary to entice the average investor to be roughly indifferent between investing in stocks and bonds, given historical aggregate volatility and covariances. Assuming reasonable risk aversion for such an investor (and introspection), such estimates typically arrive at estimates of about 1%–3% (Mehra and Prescott 1985).

Unfortunately, these calculations have predicted about 1%–3% for decades, while the historical 1926–98 average has increased to an all-time high of 9.4%. This puzzle deepens even further if the average investor is not tax-exempt, because equity capital gains face lower effective tax rates than bond interest receipts. Cochrane (1997) and Siegel and Thaler (1997) both conclude that economic theory has great difficulty in explaining such high figures (even with high degrees of risk aversion and all sorts of modifications to standard consumer choice models).[3] Still, they remain skeptical about the continued presence of an equity premium in the (often quoted) 6%–8% range.

E. Popular Views

Small investor surveys tend to find equity premium expectations between 10% and 15% per year. On October 10, 1997, The *New York Times* reports that a Montgomery Asset Management telephone survey found an expected 1-year stock market return of 22%. On November 22, 1999, *Fortune* Magazine mentions that a similar Paine-Webber survey in July 1999 found expected stock market returns in excess of 20% for both the 1-year and 10-year horizons. On November 15, 1999, the *Financial Times* reports a Gallup/Paine-Webber poll that found ''only'' a 16% expected stock market return over both 1- and 10-year horizons.[4]

3. In addition to models based on standard representative agent utility maximization, these summary papers also discuss other, more ''radical'' explanations, such as behavioral explanations (e.g., Benartzi and Thaler 1995) and ex post survival bias (e.g., Jorion and Goetzmann 1999).

4. Not surprisingly, investors have poured into the stock market in unprecedented numbers. In the 1996 *Mutual Fund Fact Book,* the Investment Company Institute reports a strong positive correlation between stock market rallies and mutual fund net inflows (p. 130). In 1995, investors poured in $164 billion, which was up from $2.8 billion, just after the crash (in 1988), up from a $40 billion/year average throughout the 1980s, and up from net outflows during the 1970s. (In general, the more aggressive the equity fund investment style, the larger the net fund inflows in the 1990s.) Aggregate net inflows into the three major public equity markets (equity issues minus dividends and repurchases and bankruptcies) have seen multiyear levels unprecedented since the Great Depression.

In contrast, professionals tend to be more conservative. A survey of pension fund executives and other institutional investors by *Pensions and Investments* (January 12, 1998, p. 1) found an expected equity premium of 3%, and the 1997 Greenwich Associates survey of fund professionals found an expected 5-year equity premium of 4%–6%.[5]

Individual organizations tend to be in line with professional investors. Financial Engines appears to use a short-term equity premium of about 6%. McKinsey seems to have standardized recently on an equity premium arithmetic figure of 5%–5.5% for valuation purposes. The Social Security Administration Office assumes a 7%–3% = 4% geometric equity premium, based on a dated historical average. Naturally, those arguing that rescuing Social Security requires an asset reallocation into equities contend that the 4% equity premium is too low, based on observed historical averages; others consider this figure too high (Diamond 1999).

A sampling of finance textbooks shows that, for instance, Copeland, Koller, and Murrin (1995, p. 260) recommends a 5%–6% geometric average. Grinblatt and Titman (1998, p. 174) uses 10% in an example but, after giving a discussion, is notably silent on giving any estimate (see p. 176). Ross, Westerfield, and Jaffe (1993, p. 257) recommends 8.5%, Van Horne (1992, p. 214) 3%–7%, and Weston, Chung, and Siu (1997, p. 190) 7.5%.

F. Summary

In sum, there are wide discrepancies in estimates of the expected equity premium, ranging all the way from −10% to +20%, depending on the source of the forecast. Such disagreement about the expected equity premium can lead to absurd consequences in the classroom, courtroom, and boardroom: the same project may require passing a hurdle rate of 10% in one company and 20% in another; the same investor may receive retirement advice that suggests vastly different retirement ages, saving needs, and investment policies; and politicians may or may not advocate different reforms of the social security system, each based on a different estimate of the equity premium and each backed up by a generally accepted estimation method.

The goal of this survey is to provide a ‘‘metaestimate,’’ that is, a

5. Fund managers predicted the Standard and Poor’s 500 Stock Index (i.e., without dividends that account for about 1%–2% per year) to offer a 10.4% mean and a 9.8% median. A range of 8%–14% represents about two-thirds of the distribution. The survey was taken in September and October 1997 and encompassed 2,309 funds, of which about 75% responded. It is published in ‘‘What Now?’’ by Greenwich Associates. Prior academic research on investment expectation can be found in Shiller (1987, 1999), Pound and Shiller (1989), and Kon-Ya, Shiller, and Tsutsui (1991, 1996). An update of Kon-Ya et al. (1996) of their 1991 article on Shiller’s website (http//aida.econ.yale.edu/Schiller/data.htm) shows a 1-year stock market expectation of 6.6% by U.S. respondents but high year-to-year variability.

weighted average of estimates used by financial economists, which could become a focal point different from the aforementioned estimates. Although this consensus has no claim that it offers the correct best ex ante estimate, it is at least an appropriate common-practice estimate among one group of well-informed individuals, who are usually asked to provide such estimates in their ordinary course of instruction and who are without financial incentives to radiate biased estimates.

II. The Survey Design

This article summarizes the results of two surveys, henceforth referred to as the first and second survey.

A. The First Survey

The first survey is reprinted in appendix B. This article reports statistics for (*a*) forecasts of the mean and 5% and 95% confidence intervals for the equity risk premium (stocks minus equivalent horizon bonds) for 1-year, 5-year, 10-year, and 30-year horizons; (*b*) an estimate of the mean that other academics would provide on this survey; and (*c*) views regarding nine issues of relevance to the academic finance literature.

This survey was posted on my World Wide Web site (http://linux.agsm.ucla.edu/) in October 1997. In addition, a hard copy was mailed to finance professors at 11 universities with large finance faculties, associate editors at three major journals, and my colleagues at the University of California, Los Angeles. Almost all of the responses came from the mailings, not from visitors to the Web site. There were 114 valid completed forms, the first arriving in October 1997, the last in February 1998.

To correct the major ambiguity in the first survey, whether participants had responded with a geometric or arithmetic average, respondents were contacted by e-mail in October 1998 and asked whether their 30-year answers were arithmetic or geometric averages and whether their views on the 30-year equity premium forecast had changed. Eighty-five participants responded to the request for clarification; only 29 did not. Overall figures provided in the tables reflect appropriate adjustments to the first-survey estimates, as described in appendix A, to make them equivalent to answers to the second survey.

B. The Second Survey

The second survey is reprinted in appendix C. It was shorter than and corrected several shortcomings of the first survey. It elicited explicitly both geometric and arithmetic 30-year averages, requested an equity premium defined as the difference between stocks and short-term bills, posed a question about how an increase in equity prices would influence a researcher's views, and added questions on the 100-year equity premium and 30-year inflation, on whether the respondent considered himself an expert or had published on the subject, and on survey completion time and clarity of the survey. This second version was posted both on my Web site and on the *Journal of Finance* World Wide Web site and elicited 112 responses by Ph.D.-level financial economists.[6] The first response was received in January 1999, the last in May 1999. Reported figures in the tables break out responses to this second (more accurate) survey.

C. Problems

The surveys admittedly suffer from a number of problems. First, economists had no powerful incentive to reveal their best estimates. However, the cost of jotting down a number that all finance professors have to tell students on a daily basis is low. The majority of professors contacted were willing to participate. Even though it is possible that participants represent a biased sample, a visual inspection reveals a fairly large subset of professors at many leading universities. Second, the surveys were not a controlled experiment but an attempt to take the pulse of the profession. The surveys did not permit anonymous responses, and none was received. I was clearly identified as the person asking the question. Most finance professors would be unlikely to answer a survey sent by someone they do not know. Indeed, most responses were received only after private e-mail reminders. Third, second-survey participants answered 1 year later—after a significant market rise and after the first write-up of this article was available. Yet, even if the circulated first draft of the article had changed some participants' views, I would be interested more in their revised than in their original views for this article. Fourth, the presence of the Brealey and Myers's (1996) historical figures on the right of each question may have induced respondents to anchor on them. In defense, the Ibbotson numbers are familiar to most finance professors, and their presence may have increased the survey response rate by allowing participants to answer without delaying until they could find the time to verify the Ibbotson numbers. (Moreover, these figures were originally intended to clarify whether I was asking for a geometric or arithmetic average.) Fifth, the questions in the first survey were ambiguously phrased and required e-mail clarification and adjustments. Unfortunately, it is not possible to find a fresh set of participants to replenish the pool. Fortu-

6. Fourteen responses were from individuals who were not financial economists with a Ph.D. (mostly finance Ph.D. students; their 30-year arithmetic average forecast was 5.3% on average, with a median of 5.9%).

nately, clarified adjusted answers to the first survey are very close to the answers of the second survey.

III. The Academic Equity Premium Consensus

A. Long-Horizon Equity Premia

Figure 1*D* plots the distribution of 226 answers to the 30-year arithmetic forecast for the equity premium using the largest set of answers. Impulse lines within the bars on the 30-year graph plot the distribution of answers to the second survey only.

Table 2 shows that various central statistics (the mean, the 5% and 95% truncated mean, and median) suggest an academic expected arithmetic 30-year equity premium consensus of about 7%.[7] Figure 1 shows that the mode response is about 8%. Still, only about 20% of participants on either the first or the second survey picked an (unadjusted)[8] number between 8% and 8.9% (8.5% being the largest), equal to the historical Ibbotson estimate quoted by the questionnaire itself. The historical average does seem to have strong influence, but about 80% of the participants provided their own estimate instead. The standard deviation of the expected 30-year premium is about 2.0%,[9] the first quartile is 6%, and the third quartile is 8.4%. There is a pronounced clustering between 5% and 9%, but there are more individuals below 5% than there are above 9%. Remarkably, figure 1 does not indicate multimodality—the profession does not divide neatly into two or three camps, each of which forecasts its own number. Most individuals choose a convex combination of the above-mentioned forecast methods, with most of the weight on the long-term historical average.

As to differences between the first and second survey, 112 second-survey respondents offered an equity premium estimate of 6.7%–7.0%, depending on the central statistic. Adding in the e-mail-clarified responses (for a total of 197 clear responses), the mean 30-year equity premium forecast rises back to the 7.1%, equal to the average of all 226 respondents. The (relatively small) difference of 0.4% can thus be mostly attributed to a sampling variation across individuals (perhaps because of the increased stock market level by the time the second

7. There is one outlier of 15%, which is responsible for a 0.04% higher estimate. In correlation and regression computations, this observation was eliminated.

8. This is the only exception where the frequency of unadjusted estimates to the first survey is quoted. This is because there is a question as to how many individuals just copied the provided 8% Ibbotson estimate provided by the survey. The median and mean unadjusted response to the first survey was about 6%, not 8%.

9. Nordhaus (1994) surveys a set of economic and natural researchers about the potential impact of global warming and finds remarkably high dispersion in expert opinion. This equity premium survey mirrors this dispersion in expert opinion in finding high across-expert dispersion.

survey was run; see Sec. III*E*) and only secondarily to remaining mis-correction in the adjustment calculation.

In sum, 6.8%–7.0% is a robust estimate for the consensus about the 30-year arithmetic equity premium among financial economists. However, there is considerable disagreement across economists. The following are not reported in table 2.

Geometric average. About half the respondents explicitly offered a geometric 30-year equity premium forecast. The academic consensus for the geometric 30-year equity premium is around 5.2% per year.

One-hundred-year equity premium forecast. Among 45 responses to the (optional) request for 100-year forecasts on the second survey, the 100-year arithmetic equity premium forecast mean was 6.5%, which was about 1% less than the same respondents' 30-year forecast mean.

Stock market forecast. Respondents to the second survey offered a 30-year arithmetic stock market forecast of 11% (SD of 2.1%).

Recent updating. Among 85 first-survey respondents contacted by e-mail about a year later, only nine individuals chose to reduce their estimates; four individuals chose to increase their estimates.

B. Shorter-Horizon Equity Premia

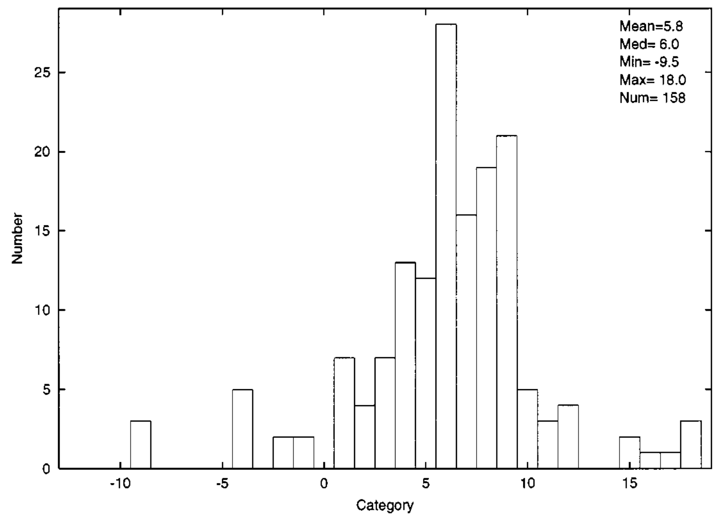
Table 2 shows that the largest set of adjusted responses, 170 in total,[10] indicates an arithmetic 10-year equity premium forecast of 7% (SD: 2%). For the 58 individuals answering this question on the second survey, the average was slightly lower and practically identical to the average of these respondents' 30-year arithmetic equity premium forecasts; both were 6.8%. (The average difference between 10-year and 30-year arithmetic equity premia forecasts when both are available is 0.2%.) It is fair to characterize any difference between 10- and 30-year equity premia forecasts as insignificant.

However, the two shorter-term (1-year and 5-year) arithmetic equity premium forecasts are lower, both in economic and statistical terms.[11] Relative to the 10-year and 30-year forecasts of about 7.1%, the 5-year untruncated forecast mean is about 0.5% lower, and the 1-year untruncated mean forecast is about 1% lower. (Truncated mean differences are smaller, and the average drops for respondents for which I

10. In the second survey, shorter-term equity premia estimates were optimal. There is no real difference between statistics computed over all reported answers or only for those individuals' answers where both shorter- and longer-equity premia forecasts were available. See app. A for more details.

11. About 20% of survey participants offered an expected premium term structure that was monotonically increasing in horizon; 50% had the expected premium term structure monotonically decreasing. This decline in forecast by horizon is comforting in another sense: many financial economists did not just copy the provided Ibbotson estimate but instead provided their own estimate. The number of unadjusted 8% answers drops from the 20% for the 30-year estimate to about 15% for the 1-year estimate.

A



B

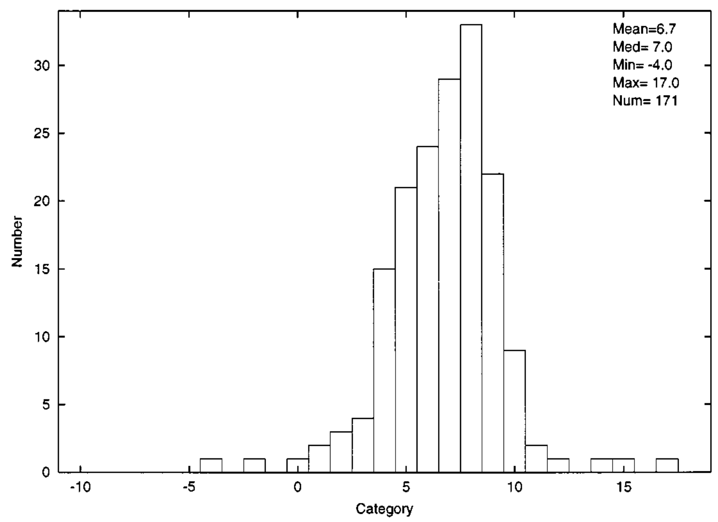
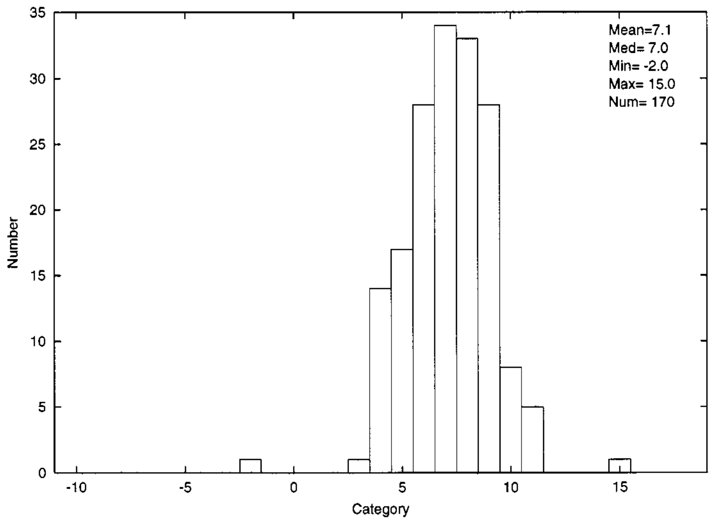


FIG. 1.—The distribution of arithmetic equity premia forecasts by financial economists. The surveys from which these histograms were computed are reproduced in appendices B and C. Statistics are over both the first and second survey (after adjustments to first-survey responses explained in app. A). *A,* Distribution of the 5-year expected equity premium; *B,* distribution of the 1-year expected equity premium; *C,* distribution of the 30-year expected equity premium; and *D,* distribution of the 10-year expected equity premium. 1*D* reports responses to the second survey as impulse lines inside the bars.

C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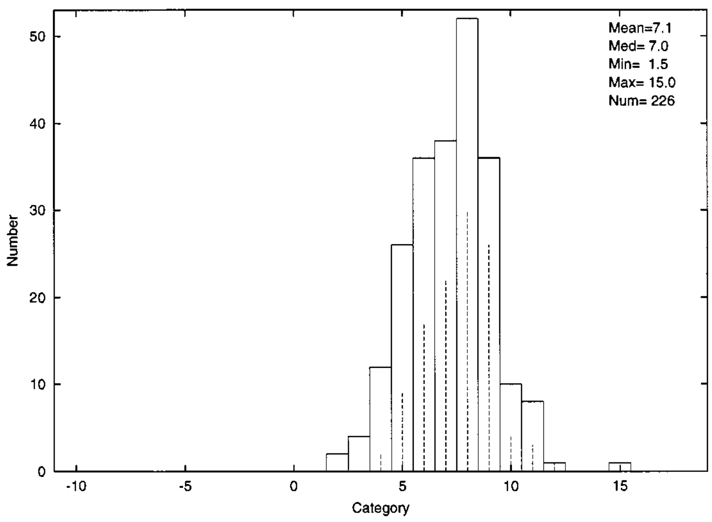
Med= 7.0
Min= -2.0
Max= 15.0
Num= 170
Number
Category

D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Med= 7.0
Min= 1.5
Max= 15.0
Num= 226
Number
Category

TABLE 2 Univariate Statistics for Arithmetic Equity Premia Forecasts

Description	Mean5 (%)	Mean (%)	SD5 (%)	SD (%)	Minimum (%)	Q1 (%)	Median (%)	Q3 (%)	Maximum (%)	*N*
30-year forecast	7.1	7.2	1.7	2.0	1.5	6	7	8.4	15	226
30-year forecast (S2)	6.7	6.8	2.0	2.2	1.5	5	7	8	15	112
10-year forecast	7.0	7.1	1.9	2.0	−2	6	7	8.4	15	170
5-year forecast	6.7	6.7	2.0	2.6	−4	5	7	8.0	17	171
1-year forecast	6.5	5.8	2.4	4.5	−9.5	4	6	8.5	18	158

NOTE.—The table presents the distribution of arithmetic equity premia forecasts by financial economists. The surveys themselves are reproduced in appen dices B and C. The ‘‘S2’’ line reports only responses to the second survey. Other lines report statistics from both surveys after adjustments to first-survey responses, as explained in appendix A. Mean5 and SD5 are the mean and standard deviation after each series is truncated at its fifth and ninety-fifth percentile. Q1 and Q3 are quartiles 1 and 3.

have a 30-year forecast are 0.7% and 1.4%.) This is primarily because of a more frequent presence of negative forecasts rather than a left shift of the distribution. Twelve respondents recommend an estimate that suggests that they believe Treasury bills will outperform stocks over the next year (two believe that this will occur over the next 5 years). Compared to the long-term forecast, there is also considerably more disagreement among economists for what the best short-term equity premium forecast is. The truncated standard deviation across financial economists rises from the 1.7% for 30-year forecasts to about 2.5% for a 1-year forecast; the untruncated standard deviation rises even more.

C. Optimistic and Pessimistic Scenarios

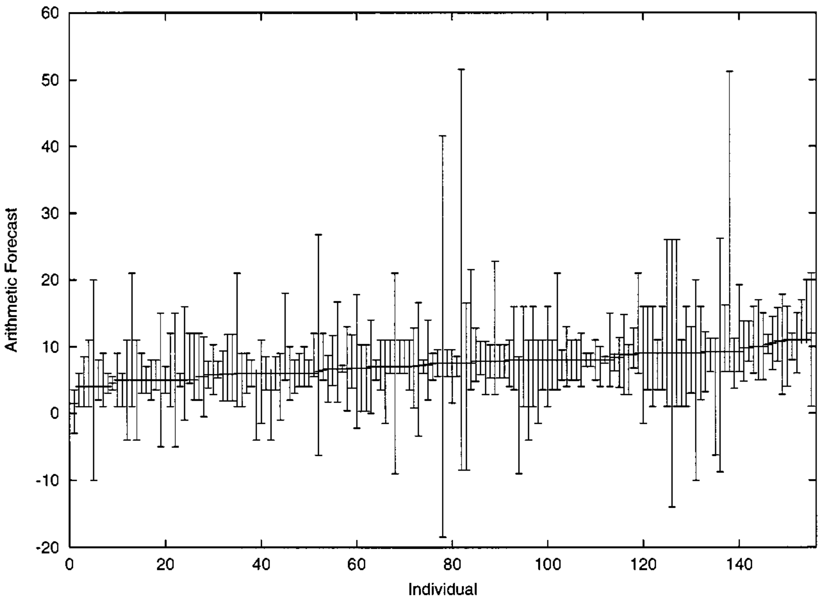
Respondents were also asked to provide their fifth percentile and ninety-fifth percentile scenarios for the equity premium. This was an optional question, so the number of responses to these questions is lower than the number of responses to the earlier question about the 30-year mean forecast. Most finance professors are unlikely to have given much thought to this question, because they do not usually have to provide such figures. Consequently, scenario estimates are intrinsically less reliable than economists' own expected forecasts. This unreliability is reflected in a much wider dispersion of answers and some inconsistencies.[12] The reader should focus primarily on the more robust statistics based on medians and truncated means and not on the simple means.

Figure 2 graphs the expected, most optimistic, and most pessimistic scenarios when individuals are sorted by their 30-year arithmetic forecasts. The statistics are provided in table 3. The top half of table 3 shows that the most optimistic arithmetic 30-year equity premium scenario consensus is somewhere between 11% and 13% per year. (For 56 answers to the second survey, the median and mean is about 11%.) Shorter-term optimistic-case scenarios are successively more optimistic, but the magnitude depends strongly on the central statistic used. The 10-year optimistic scenario arithmetic equity premium forecast lies at around 15%, the 5-year optimistic scenario lies at around 20%, and the 1-year optimistic scenario lies between 25% and 30%. In the minds of many academics, the most recent 3 years were rather unusual (one in 20) realizations.

The bottom half of table 3 shows that the consensus for the pessimistic arithmetic 30-year equity premium scenario (at the 5% level) is between 2% and 3% (median) per year. (For 55 answers to the second survey, the median and mean are about 4%—higher than they are in

12. There were four responses for which the optimistic scenario was not better than the average forecast and one response for which the pessimistic scenario was not worse than the average forecast. These five responses were first eliminated.

A



B

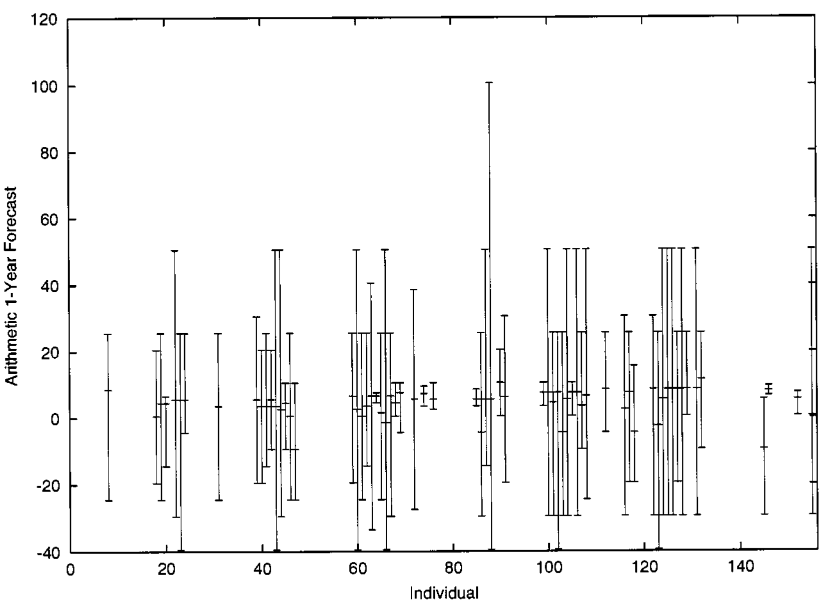


FIG. 2.—The pessimistic-scenario, average, and optimistic-scenario 30-year arithmetic equity premium forecast by 226 financial economists. Forecasts from the first survey were adjusted, as explained in appendix A. In both figures, individuals are indexed (lined up) identically, sorted by their mean forecast. Clustering in 1-year responses is induced because of discreteness in 30-year responses and the sorting procedure. *A*, Distribution of the 1-year expected equity premium; *B*, distribution of the 10-year expected equity premium.

TABLE 3 **Univariate Statistics for Arithmetic Equity Premia Optimistic and Pessimistic Outcome Forecasts**

Description	Mean5 (%)	Mean (%)	SD5 (%)	SD (%)	Minimum (%)	Q1 (%)	Median (%)	Q3 (%)	Maximum (%)	*N*
Optimistic:										
30-year scenario	12.8	13.3	4.9	6.7	3.5	9	11.2	16	51.5	158
10-year scenario	15.4	16.5	5.5	10.9	6	11	15.4	19.1	101.2	104
5-year scenario	21.2	23.1	11.5	22.3	8	11	17.8	26	201	101
1-year scenario	28.6	29.2	14.9	17.0	6	17	26	51	101	71
Pessimistic:										
30-year scenario	2.2	2.2	4.0	4.5	−18.5	1	3.2	5	11	159
10-year scenario	−.8	−1.0	5.4	6.2	−24	−4	1	2.8	8.9	106
5-year scenario	−8.3	−9.0	10.2	12.4	−59	−14	−7.2	.3	8.9	102
1-year scenario	−19.2	−19.6	13.5	11.9	−39	−29	−24	−9	6.5	72

NOTE.—The table presents the distribution of arithmetic equity premia pessimistic and optimistic scenarios (at the 5% level) by financial economists. Th e surveys themselves are reproduced in appendices B and C. The ‘‘S2’’ line reports only responses to the second survey. Other lines report statistics from both surveys after adjustments to first-survey responses, as explained in appendix A. Mean5 and SD5 are the mean and standard deviation after each series is truncated at its fifth and ninety-fifth percentile. Q1 and Q3 are quartiles 1 and 3.

the overall sample [not lower as is the mean forecast].) Shorter-term pessimistic-case scenarios are successively more pessimistic. The 10-year pessimistic scenario forecast lies around 0%, the 5-year pessimistic scenario lies around −8%, and the 1-year pessimistic scenario lies between −20% and −25%.

It is remarkable that even at a probability of one in 20, financial economists tend not to believe that a meltdown of Japanese-style proportion lasts for 10–30 years. Indeed, the confidence of financial economists is remarkable: the typical pessimistic one-in-20-case 30-year scenario foreseen by financial economists is about the equity premium that Mehra and Prescott (1985) consider to be consistent with reasonable risk aversion. This low a number would be consistent with the hypothesis that recent high stock returns are simply reflections of lower required future equity returns, which coincides with the personal view of Siegel (1999) and myself.[13]

There is a negative correlation between the optimistic and pessimistic estimates across economists—economists who indicate a more positive optimistic scenario also indicate a more negative pessimistic scenario. Thus, variation in optimistic/pessimistic scenarios are driven more by differences in confidence than by differences in estimates of the mean. The correlation between the pessimistic and mean equity premium forecast is positive—economists with higher equity premium mean forecasts also provided more favorable pessimistic scenarios. Thus, the pessimistic estimates in the survey tend less to reflect disagreement on where the economy lies in terms of the risk-return tradeoff—in which case one would expect individuals indicating a more positive equity premium mean also to indicate a more negative possible outcome—but more to reflect across-economist views about the attractiveness of the stock market. The term structure of volatility that can be extracted from these extreme forecasts is roughly consistent with a random walk with a volatility of about 15%.

D. The Perceived Consensus

What equity premium do financial economists believe their peers are recommending? This is interesting for a number of reasons. Economists are likely to weigh their otherwise private estimates against what they perceive to be a common consensus and to come up with a posterior estimate that averages the two. An incorrect perception of the estimates of others can delay the process of collective adjustment. If one believes that everyone else believes the equity premium to be 8%, then one may be reluctant to quickly adjust one's view away from 8%. In this sense,

13. To avoid economists' 7% consensus from becoming the ''Welch number,'' I must take the unusual step of quoting my own personal estimate: 2–3% arithmetically over 30 years (see also Welch 1998).

this survey may aid the profession's aggregation of opinions. Further, the perception might indicate the extent to which this survey is informative to researchers. If economists' personal views and views of the profession's consensus already coincided, this article would be less informative and economists' estimates could be considered more reliable.

Table 4 shows that economists' perceived consensus is not monotonic in the horizon, although differences are small. The belief is that the 30-year and 5-year equity premium consensuses are each about 7.5%, about 8% for the 10-year consensus, and 6% for the 1-year consensus. When this is compared to the equity premia forecasts themselves (on the left side), the popular view is that their own consensus is between 0.5% and 1% higher than what it actually is. Except on the 1-year horizon (which has fewer responses and higher standard series deviation), the difference is statistically significant. Note also that economists believe more in their ability to judge the consensus than to judge the equity premium itself, even over 30 years. However, there is still substantial disagreement among economists.

The influence of this overestimate is further explored in table 5. The left part of the table provides the univariate means and standard deviations for the set of researchers with both a forecast and a consensus estimate. Again, the misperception is between 0.5% and 1.0%. However, economists' own estimates need not be influenced by their perceptions of the prevailing consensus—for example, everyone may invariably believe that others use the Ibbotson 8% figure and, thereby, have their own equity premium forecast be unaffected. To explore whether there is an ''anchoring'' effect, that is, whether economists have a perception of the consensus and shade their own equity premium forecast toward this perception, table 5 describes the results of a regression with the demeaned consensus on the demeaned forecasts.[14] A coefficient of one indicates perfect shading, a coefficient of zero perfect irrelevance.

The regressions reported on the right side of table 5 show that the same economists who indicate that they believe the professional consensus to be higher also offer a higher equity premium forecast themselves. This is especially pronounced on the 1-year and 30-year horizons. It is weaker on the 5-year and 10-year horizons. Perhaps financial economists often use either short-horizon (1-year) or long-horizon (30-year) rates but less often use either 5-year or 10-year rates.

14. Naturally, economists may settle on their own forecast and believe that it is also held by the profession. Ross, Greene, and House (1977, p. 280) reported a series of studies in which subjects show a tendency to ''see their own behavior choices and judgments as relatively common and appropriate to existing circumstances while viewing alternative responses as uncommon, deviant, or inappropriate.'' Marks and Miller (1987) summarize this literature and describe some explanations. However, in this equity premium survey context (in which there is no temporal precedence), it is not even clear if there is a philosophical difference between this view (in which own choices influence the consensus perception) and the view stated in the text.

TABLE 4 Univariate Statistics for Economists' Arithmetic Equity Premia Consensus Estimates

Actual Mean (%)	Description	Mean5 (%)	Mean (%)	SD5 (%)	SD (%)	Minimum (%)	Q1 (%)	Median (%)	Q3 (%)	Maximum (%)	*N*
7.1	Perception 30-year	7.6	7.6	1.5	1.7	1	6.5	7.8	9	12	216
6.7	Perception 30-year (S2)	7.5	7.4	1.6	1.9	1	6	7	9	12	112
7.0	Perception 10-year	8.1	8.2	1.3	1.4	4	7	8	9	12	101
6.7	Perception 5-year	7.7	7.6	1.6	1.7	1	7	8	9	11	99
6.5	Perception 1-year	6.0	6.0	2.3	2.4	0	6	7	8	12	69

NOTE.—The table presents the distribution of economists' perception of the prevailing equity premia forecast. The surveys themselves are reproduced in appendices B and C. The ''S2'' line reports only responses to the second survey. Other lines report statistics from both surveys after adjustments to first-survey responses, as explained in appendix A. Mean5 and SD5 are the mean and standard deviations after each series is truncated at its fifth and ninety-fifth percentile. Q1 and Q3 are quartiles 1 and 3.

TABLE 5 **Statistics for Economists' Arithmetic Equity Premia Consensus Estimates**

	Univariate Statistics, Common				$\hat{A}_i - \hat{A}_i = \alpha_0 + \alpha_1(\hat{C}_i - \hat{C}_i) + e_i$			
Description	Mean_A (%)	SD_A (%)	Mean_C (%)	SD_C (%)	α_0	α_1	SE (α_1)	N
30-year	7.1	1.9	7.6	1.7	.0	.62	.06	214
30-year (S2)	6.7	2.1	7.4	1.9	.0	.73	.08	111
10-year	7.2	1.8	8.2	1.4	.0	.31	.12	99
5-year	6.7	2.3	7.7	1.7	.0	.28	.14	97
1-year	4.7	4.2	6.0	2.4	.0	.79	.19	67

NOTE.—The left side of the table presents the mean and standard deviation of economists' arithmetic equity premia forecasts (A_i) and their perceptions of the prevailing equity premia consensus forecast (C_i), provided an individual supplied both an equity premium estimate and a consensus estimate for the same horizon. The right side provides ordinary least squares regression output when the demeaned arithmetic forecast ($\hat{A}_i - \hat{A}_i$) is regressed on this economist's demeaned perception of the professional consensus about the same-horizon arithmetic forecast ($\hat{C}_i - \hat{C}_i$). The surveys themselves are reproduced in appendices B and C. The ''S2'' line reports only responses to the second survey. Other lines report statistics from both surveys after adjustments to first-survey responses, as explained in appendix A.

In sum, the regressions are consistent with an attempt by economists to provide a forecast that lies between their personal estimate and their perceived consensus belief. If this is the case, the results of this survey may help economists improve their anchoring their own predictions relative to the profession, which would cause a downward revision in the aggregate consensus forecast.

E. Other Statistics

The most interesting remaining question concerns the influence of market movements. Almost all finance professors subscribe to the view that markets follow a random walk in the short run. Updating of equity premia opinions is likely to be a very slow process, and changes in opinion are likely to be marginal only. Still, participants on the second survey were also asked to indicate whether they would be positively, negatively, or not at all influenced by stock market movements on the margin. Coding this feedback rule as $+1$, -1, and 0, respectively, the mean response by 112 participants to this question was -0.367, with a standard deviation of 0.5. Thus, average participants claim that a bull market leads them to predict a lower future equity premium.[15]

Finally, the second survey asked whether financial economists considered themselves to be relatively better informed with respect to the equity premium and whether they have published in the area. Fifty-one respondents indicated no prior relevant publication, 13 of whom considered themselves less qualified (mean arithmetic 30-year equity premium: 6.6%), three of whom considered themselves better qualified (mean: 7.3%), and 35 of whom considered themselves equally qualified (mean: 7.3%). Of the 17 individuals who indicated a relevant publication, six considered themselves better qualified (mean: 6.4%) and 11 considered themselves equally qualified (mean: 6.6%). Thus, lower forecasts tend to be either by individuals who had published related work or by individuals who felt ill-qualified to answer the survey.

IV. Questions Debated in Academic Finance

The first survey took the opportunity to add a set of questions that asked respondents' views on issues that are commonly debated in the academic literature and on which most researchers who attend finance

15. Respondents indicating that they follow a positive feedback rule are also more optimistic about the market. Sixty-six individuals indicate they are not influenced by stock market movements on the margin and provide 7.3% as their equivalent average; 43 individuals follow a negative feedback rule, with 5.7% as their equivalent average; and only two individuals follow a positive feedback rule (with 4% and 8% as their average arithmetic 30-year equity premium estimates). The fact that there is a correlation between the indicated feedback rule and the forecast should not be surprising, given the stellar recent stock market performance.

conferences and seminars are likely to have an interest in (or at least an opinion on). Answers could range from 1 (strongly disagree) to 3 (neither agree nor disagree) to 5 (strongly agree). Table 6 lists both the questions and the received responses (see also app. B).

The first question asked whether the stock market is more likely to follow a random walk or more likely to have long-horizon negative autocorrelation. It turns out that more professors have an opinion (''agree'' or ''disagree'') than no opinion (''neither agree nor disagree''), but when they do, this opinion is roughly evenly split. The jury is still out.

The second question concerned the use of the capital asset pricing model (CAPM) for capital budgeting purposes. Although a sizable minority of professors do not believe that it is ''good enough'' to be used for capital budgeting purposes, a majority feels that it is.

The third question asked whether size and book-market values are more likely to be characteristics (in the Daniel and Titman [1997] sense) or more likely to be risk factors (in the Fama and French [1993] sense). The respondents mildly favored the view that they are characteristics.

The fourth question asked whether the risk factors or characteristics (size, book-market, price-earnings, or momentum) are likely to be useful for portfolio selection in the future. The profession does not have a strong view on this issue. The ambivalent view is remarkable, given the large number of publications and strong ongoing interest in detecting past ''anomalies.'' Prior to conducting this survey, it had seemed to me that the common working hypothesis in finance is that at least the major anomalies are universally viewed to represent persistent phenomena. This survey does not confirm this hypothesis.

The fifth and sixth questions asked whether markets are basically efficient and arbitrage-free. There was much agreement here: financial economists feel that, by and large, financial markets are efficient. The sixth question asked whether economists believe in arbitrage opportunities—an ability to make money without risk. Apparently, the respondents did pay attention and also marked a strong view in favor of absence of arbitrage.

The only question that elicited more support than absence of arbitrage was the question about whether governments should intervene more in financial markets. The profession strongly feels that this would be counterproductive.

Finally, there are two questions related to corporate finance. The eighth question asked whether large Fortune 500 firms have too little debt in the capital structure and whether share repurchases dominate dividends as a means of payout. The profession has no views on whether large Fortune 500 firms would be better off with more debt

TABLE 6 Questions on Issues Debated in Academic Finance

Question		Univariate Statistics		Response Count					
		Mean	SD	1	2	3	4	5	Total
Q1	I believe that the true stock-market index's 3–5-year return autocorrelations are zero (random walk [à la Richardson, choose agree]), rather than negative (à la Fama-French, Shiller, choose disagree).	2.85	1.1	7	42	17	31	5	102
Q2	I believe that the CAPM is a good enough approximation of reality to deserve use in capital budgeting contexts.	3.41	1.1	5	22	19	51	13	110
Q3	I believe that size/book-market/price-earnings/momentum power can explain cross-sectional returns primarily because they are **risk** factors (in the Fama-French sense) and not just firm **characteristics** (in the Daniel-Titman sense).	2.64	1.2	18	33	19	20	7	97
Q4	I believe that size/book-market/price-earnings/momentum factors are **stationary** enough, so that they will work well in the future in explaining cross-sectional expected return differences.	2.77	1.0	9	37	24	26	3	99
Q5	I believe that, by and large, public securities market prices are efficient.	3.84	.8	1	9	13	71	16	110
Q6	I believe that, by and large, public securities market prices offer arbitrage opportunities.	2.16	.9	22	60	17	8	2	109
Q7	I believe that, by and large, government regulation and intervention in public securities markets should be increased. (Please select **middle** if intervention should be held steady, and **strongly disagree** if intervention should be decreased.)	2.13	.8	29	39	40	0	1	109
Q8	I believe that Fortune-500 U.S. corporations, by-and-large, have too little debt in their capital structure.	3.09	1.0	4	26	23	30	6	89
Q9	I believe that Fortune-500 U.S. corporations, by-and-large, should use share repurchases instead of dividends as payout means.	3.68	1.0	4	7	21	42	18	92

NOTE.—''Response Count'' tallies number of respondents selecting each number on a 1–5 scale, where 1 = disagree and 5 = agree; see app. B for details.

in their capital structure. But they perceive dividends to be an unwise mechanism for corporations to disburse funds relative to share repurchases.

In sum, it is remarkable how weak the views of financial economists are, even on issues, such as absence of arbitrage, that are typically seen as relatively uncontroversial: about one-quarter of the participants responded with a value between ''strongly disagree'' and ''neither agree nor disagree.'' On most questions, there was neither strong agreement nor strong disagreement by many participants, even when central issues in finance and stark positions were concerned.

V. Conclusion

This article presents the results of the first comprehensive survey of financial economists. Two hundred and twenty-six finance professors shared their forecasts and perspectives on the equity premium and some related issues. The primary findings are as follows.

1. The average arithmetic 30-year equity premium consensus forecast hovers around 7%. On the one hand, this is not as high as the current historical 9.4% arithmetic average quoted by Ibbotson or even as high as the Brealey and Myers (1996, p. 146) quoted average of 8.4% per year. Practitioners who would prefer to base their estimates on the perceived academic consensus should thus use a lower 7% arithmetic premium instead.

On the other hand, the 7% equity premium consensus forecast seems too high for comfort among macroeconomists, who argue that stock prices have risen because rational, informed investors now require and expect lower future equity rates of return. These rational, informed investors are not the finance professors surveyed here. Indeed, the 1%–3% theoretical estimate is roughly the academic consensus for a worst-case (one in 20) 30-year scenario.

2. There is a term structure of equity premia forecasts: short-term forecasts are lower than long-term forecasts. (Unfortunately, this consensus also prevailed on the first survey in early 1998!)

3. There is evidence for a ''false-consensus effect.'' On average, finance professors believe that their consensus is about 0.5%–1% higher than it actually is, especially on shorter horizons; there is also a strong correlation between researchers' perceptions of the consensus and their own estimate. This is evidence that participants anchored their own responses on their perceptions of the professional consensus—and it may indicate that the publication of this article may shade down the equity premium consensus forecast among financial economists.

4. On average, financial economists claim to revise their forecast down as markets increase (''negative feedback'').

5. There is strong agreement among financial economists that the government ought to decrease its intervention and regulation of public securities markets and that markets are by and large efficient and arbitrage-free. They also would mildly recommend to corporations to use more share repurchases and fewer dividends. And they have no strong views, one way or another, whether the stock market follows a random walk, whether firms can reasonably use the CAPM for capital budgeting, whether large firms should use more debt financing, whether size and book-market are risk factors or characteristics, or even whether size and book-market will continue to predict stock returns in the future.

Appendix A

Adjustments

The first survey considered the request for an average, paired with the well-known Brealey and Myers/Ibbotson 8% estimate, to mean ''arithmetic''; it also considered the use of a long-term bond for long-horizon premia (rather than short-term bonds) to be the relevant definition. Because neither is a standard in this literature, this introduced ambiguities in the first (but not second) survey.

Geometric versus arithmetic averages. A Taylor approximation yields

$$\frac{[(1+r)^T - 1] - T \cdot r}{T} \sim \left(\frac{T-1}{2}\right) r^2 + \left[\frac{(T-1)\cdot(T-2)}{6}\right] r^3 + O(r)^4, \quad \text{(A1)}$$

where r is the rate of return and T is the horizon, which can be used to adjust geometric and arithmetic averages. Because market returns are not perfectly serially uncorrelated (see Roll 1983), the historical 1926–97 differences provide a better adjustment.

	Number of Holding Years						
	1	2	3	4	5	10	30
Equity premium (%)	.0	1.0	1.4	1.7	1.8	1.9	1.8

To correct the casual distinction between geometric versus arithmetic averages, I e-mailed participants of the survey with a request for clarifications of answers generated by the first survey. This revealed that about a third of respondents had originally quoted a geometric average. To adjust answers to the first survey, for the 25 individuals who indicated that their answer was for a geometric average (out of 85 who responded to the request for clarification), the historically appropriate adjustment of 1.8% was added to 5-year, 10-year, and 30-year estimates. For the 31 individuals who did not respond to the request for clarification, the following adjustment was computed. Among the 85 received clarification responses, a regression was fitted with the dependent variable being a dummy indicating whether the response was geometric (G_i) and the independent variable being the quoted 30-year forecast (Q_i):

$$G_i = 0.823 - 0.0877 \cdot Q_i + \text{noise}_i. \tag{A2}$$

The fitted estimate was used as a ''probability'' adjustment ($p_g(Q_i) \equiv \hat{G}_i$) to translate the original answers by the 31 participants who had not responded to the request for clarification into arithmetic averages (a_i):

$$a_i = Q_i + p_g(Q_i) \cdot 1.8\% \tag{A3}$$

for 5-year, 10-year, and 30-year forecasts. Of course, no adjustment was necessary for 1-year forecasts.

Bonds versus bills. Historically, over the 1926–98 period, long-term bonds offered a geometric return of about 5.3% (arithmetic: 5.8%), whereas short-term bills offered a return of about 3.8%. However, these averages can be deceptive. The return on both instruments over the 1926–81 period was identical; the long-term bond has been a much better performer only since 1981. Over the sampling period (October 1997–May 1999), the quoted yield difference between the short-term and long-term bond was about 1.1%. (Other bond features, e.g., the value of a long-term call feature, reduce this figure.)

The first survey asked for the difference between the equity premium and the long bond, whereas the second survey asked for the difference between the equity premium and short-term treasuries. To translate all quoted first-survey forecasts into bill-adjusted equity premia, a reasonable adjustment into Treasury bill–adjusted rates was added (1% for the 5-year, 10-year, and 30-year forecasts, and 0.5% for the 1-year forecasts).[16] A reader interested in using an equity premium forecast relative to a bond rather than a bill should subtract about 0.5% to the 1-year bill-quoted equity premia and about 1% to the longer-term bill rates. These adjustments were applied to all quoted figures from the first survey: long-horizon and short-horizon equity premia, optimistic and pessimistic scenarios, and consensus estimates.

Other adjustments. In addition, there were five extreme outliers on the first survey, in which the respondent quoted either 12% or 1,500%. I sent e-mails to these respondents to ask them if this was their correct estimate of the per annum equity premium. All five respondents replied that they had misread the survey, either assuming that I had asked for the market expected return (not net of the risk-free rate) or that I had asked for a compound figure. Although it is possible that they meant to say 12% and I unduly influenced them, this is unlikely—these particular finance professors happened to have made their relevant views on this issue publicly known in other venues. In four cases, the answer in the survey was corrected. In one case, the respondent indicated that his numbers were wrong but that he was too busy to fill out the survey again. This answer has been removed from the survey. The second survey had some automatic checks to alert respondents to extremely large or small estimates, which were primarily useful for catching individuals quoting total rather than average returns.

Perceived clarity. The second survey also gathered some descriptive statis-

16. This is lower than the historical 1.5% difference because some participants may have assumed a definition of equity premia without reading the question more carefully. (This adjustment adds 112/226*1.0% ~ 0.5% to the overall average.) The closeness of results from the first survey and the second survey, especially after adjusting for the rising equity market, further indicates that this issue has been dealt with appropriately.

tics. For 110 responses, the average time spent on the survey was about 3.5 minutes. On a scale of 1–10, with 1 indicating perfect clarity and 10 indicating perfect opacity, the mean was 1.8. There was a small negative correlation between perceived clarity and equity premia mean estimates, and a small positive correlation between time spent and equity premia mean estimates. In a regression, the coefficients indicate that an individual who felt one point more confused and an individual who spent about 2 minutes less indicated an arithmetic equity premium mean of about 0.25% less.

Other adjustments. Residual adjustment error is likely to play only a small role. Sampling variation and the bull market of 1998 probably account for much of the 0.4% difference between the overall survey figures and the second survey figures. This difference is well within the range of disagreement among economists' answers.

Appendix B

The First Survey

Market Risk Premium (E R_m - r_f) Survey

Dear Colleague:

Please take 5 minutes to answer the questions in this survey. The first set of questions concern the market risk premium. It should take about 3 minutes of your time. The second set of questions concern such issues as "will the size/book-market/etc. characteristics continue to predict expected return characteristics?," and should take another 3 minutes. All survey questions pertain exclusively to the U.S. market.

I hope the consensus view on these questions will be of great interest to the finance profession. I am planning to publish an academic paper that summarizes the results of this survey.

Market Risk Premium

(Background Information: As of October 6, 1997, the S&P-500 stood at 965, the DJ stood at 8,040, the 30-year T-bond stood at 6.3%, the 3-month T-bill stood at 4.9%.)

Define the so-called "market risk premium" as *your* expected return on the SP500 minus the equivalent treasury bond, please give *your* opinion on the *expected* (forward-looking) annualized market risk premium. (Note: use this definition, even if this spread reflects factors other than risk. The famous Ibbotson "historical" equivalent is 8.2%.) I would like your estimate of the future market risk premium, conditional today, i.e., beginning on the day on which you fill out the survey.

Market-Risk-Premium-Survey

Per-Annum Market Risk Premium: Exp. Return on SP500 *MINUS* Risk-Free Bond

	1-year	5-year	10-year	30-year
Total Return Translation Table	not necessary	click here	click here	click here
Your Expectation (Mean, Per-Annum)				
Your "Worst Case" (<5% prob), **Per-Annum**				
Your "Best Case" (<5% prob), **Per-Annum**				
Guess the academic finance profession's mean e.g., as expressed on this survey by other finance professors				

What percentage of their new retirement contributions would you advise a new finance colleague to put into stocks (rather than bonds)? %

I permit publication of my name as one in many in a list of participants **with identification of my name with the risk premium choices above**: yes no

I permit publication of my name as one in many in a list of participants, but I do not permit publication of my choices together with my name. yes no

Additional Questions

The following are 9 "optional" questions. Please answer them. They concern basic debates in finance today. If you do not like a particular question, or do not have a view on it, just leave it blank. Remember: I am asking for your personal view, not whether a null hypothesis can be rejected with 95% probability!

I permit publication of my name as one in many in list of participants on the following questions: yes no

(Unlike answers to the above questions, for which I requested permission to identify the respondent, the answers to the questions below will be strictly anonymous and confidential.)

	Question	Strongly Agree	Agree	Middle	Disagree	Strongly Disagree	No View
1	I believe that the true stock-market index's 3-5-year return autocorrelations are zero (random walk [ala Richardson, choose agree]), rather than negative (ala Fama-French, Shiller, choose disagree).						
2	I believe that the CAPM is good enough an approximation of reality as to deserve use in capital budgeting contexts.						
3	I believe that size/book-market/ price-earnings/momentum power can explain cross-sectional returns primarily because they are **risk** factors (in the Fama-French sense) and not just firm **characteristics** (in the Daniel-Titman sense).						
4	I believe that size/book-market/ price-earnings/momentum factors are **stationary** enough, so that they will work well in the future in explaining cross-sectional expected return differences.						
5	I believe that, by and large, public securities market prices are efficient.						
6	I believe that, by and large, public securities market prices offer arbitrage opportunities.						
7	I believe that, by and large, government regulation and intervention of public securities markets should be increased. (Please select **middle** if intervention should be held steady, and **strongly disagree** if intervention should be decreased.)						
8	I believe that Fortune-500 U.S. corporations, by-and-large, have too little debt in their capital structure.						
9	I believe that Fortune-500 U.S. corporations, by-and-large, should use share repurchases instead of dividends as payout means.						

Identification

Date (Fill in only if printed, not if filled out via WWW)		
Your Email Address:		
Your Name:		
Professional Status:	Professor PhD Student MBA Student	PhD Graduate MBA Graduate Other ;
Area	Finance Accounting	Economics Other ;
Primary specialization:	Asset-Pricing - Empirical Asset-Pricing - Theory Asset-Pricing - Both Asset-Pricing - Derivatives Asset-Pricing - Fixed Income	Corporate Finance Market Microstructure Other Empirical Other Theoretical Other

Feel free to comment, but please note that you should instead send me email about this survey if you think I have made a mistake (or that I could do the survey better). I will not see these comments until I tabulate the surveys.

Submit Survey Answers | Reset Survey Answers

Please do not forget to check your own WWW and email entries in the directory: http://linux.agsm.ucla.edu/dir/ (or to look up anyone of your choice).
For feedback about this website, please send email to ivo.welch@anderson.ucla.edu. To get back to the home page, click homepage.

Appendix C

The Second Survey

Ivo Welch, UCLA
January 1999

[The intent of this survey is to gauge consensus estimates of the equity premium from academic and academically oriented finance and economics professionals, e.g., members of the AFA, WFA, AEA, or ASSA. If you have difficulties filling out this survey, please send an email to Ivo Welch.]

equity-survey

Dear Colleague:

Please take a moment to answer the 5 primary questions in this survey (and to input your email address). After you have filled out the form, please press the "submit" button at the end of the page.

The distribution of answers to this survey will be published in an academic paper, possibly in the Journal of Finance. Your identity will be strictly confidential, i.e., it will not be released or pnblished anywhere, much less jointly with your estimates.

The following 5 questions revolve around 30-year forecasts of the equity premium and the stock market. For your convenience, equivalent historical averages, published by Ibbotson, for the 1926-1997 period are in the right-most column of the table. Please enter percentages without "%". PLEASE send email if you encounter difficulties.

	Please Fill In	Requested (30 year forecast)	Long Definition all over the next 30 years	Historical Ibbotson
1	% per-annum	**Stock Market** (S&P) *Arithmetic* Per-Annum Rate of Return, Nominal	*Your* expected arithmetic per-annum return on the stock market (e.g., the S&P500) over the next 30 years. if unclear, click for mathematical definition.	13.0%*
2	% per-annum	**Equity Premium,** *Arithmetic* Per-Annum Average Rate	*Your* expected arithmetic per-annum average return over the next 30 years on: the stock market (S&P500) return minus the arithmetic per-annum average return on rolled-over 30-day T-bills. if unclear, click for mathematical definition.	9.2%*
3	% per-annum	Equity Premium, **Geometric** Per-Annum Average Rate	*Your* expected *geometric* per-annum average return over the next 30 years on: the stock market (S&P500) return net of the *geometric* per-annum average return on rolled-over 30-day T-bills. if unclear, click for mathematical definition.	6.9%*
4	% per-annum	Other Economists' Forecasts of Equity Premium, Arithmetic Average, 30 Years	What do you think will be the average answer of other economists to this survey's Question 2?	
5	○ Decrease it very slightly (neg feedback) ○ Not even the slightest epsilon change ○ Increase it very slightly (pos feedback)	◉ Presume that the stock market closed up much higher today, while interest rates remained constant. On the margin, how would today's positive stock market return influence your forecast of the 30-year arithmetic equity premium tomorrow?		

Identity Information

The identity information on this page will be held strictly confidential.

Background ◉	○ Finance/Econ Professor ○ Other Professor ○ Finance/Econ PhD or PhD Student ○ Other
Please fill in your email address:	
Please fill in the date:	used to infer current stock price level
How much time did you spend on this survey?	
Was this survey clear? ◉	Very Clear 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10 ○ Not Clear at All

◉ This is my first submission to this survey.
○ This is an update of my earlier submission, indicating how my views have changed.
○ This entry supersedes an earlier erroneous entry.

○ I would likely participate in a future survey.
◉ I would not object to receiving a very short email request for a future survey.
○ I would never participate in such a survey again. Please do not email me any such requests.

After the results of this survey will have been written up in a working paper, and posted on the WWW.

◉ Don't bother sending me a copy---I already have too many papers on my desk.
○ I would like to receive a short email alert with the URL pointing to the paper.
○ I would like to receive a printed copy of the paper by U.S. mail.
Postal Address:

Optional Questions

Please answer any of the following 10 questions, omit what you do not want to answer, then press the submit button below:

	Please Fill In	Requested	Long Definition
6	% per-annum to % per-annum	95% Confidence Range for Your *Arithmetic* Equity Premium Forecast, **30-Years** (Q2)	*Your* 95% confidence interval around *your* 30-year arithmetic equity premium per-annum rate forecast (i.e., your answer to Question 2). if unclear, click for mathematical definition.
7	○ Same ○ Different	◉ Would your answer to question 2 (your equity premium forecast) be the same if the time frame was 1, 5, 10, or 100 years, instead of 30 years? (If different, please fill in differing choices below in questions 8 through 11.)	
8	% per-annum	Equity Premium, Arithmetic Mean, **1 Year**	*Your* expected forecast of the arithmetic equity premium over the next 1 year. (Like Question 2, but different time horizon.) if unclear, click for mathematical definition.
9	% per-annum	Equity Premium, Arithmetic Mean, **5 Years**	*Your* expected forecast of the arithmetic equity premium over the next 5 years. (Like Question 2, but different time horizon.) if unclear, click for mathematical definition.
10	% per-annum	Equity Premium, Arithmetic Mean, **10 Years**	*Your* expected forecast of the arithmetic equity premium over the next 10 years. (Like Question 2, but different time horizon.) if unclear, click for mathematical definition.
11	% per-annum	Equity Premium, Arithmetic Mean, **100 Years**	*Your* expected forecast of the arithmetic equity premium over the next 100 years. (Like Question 2, but different time horizon.) if unclear, click for mathematical definition.
12	• ○ The equity market is essentially a random walk. • ○ There may or may not be mean reversion in equity premia, but the statistical significance thereof is so low that these changing means have almost no influence on my asset allocation decision. • ○ The term structure of (my expected) equity premia has (or should have) a significant influence on my asset allocation decisions. • ◉ No Answer.		
13	○ Above Average ○ About The Same ○ Below Average	◉ How do you consider your ability to forecast the equity premium, relative to the average finance professor?	
14	○ Yes ○ No	◉ Have you published on the subjects of this survey (the equity premium or aggregate stock returns)?	
15	% per-annum	30-Year Inflation, Expected Arithmetic Average	The arithmetic average of the annual CPI inflation rates over the next 30 years. (The historical average from 1926 to 1997 was 2.5%.) if unclear, click for mathematical definition.

Submit Survey Answers | Reset Survey Answers

Your help is highly appreciated.

---

* Ibbotson data are computed from 1926 to 1997 means, and provided only for calibration purposes---these numbers clarify comparables to finance professors familiar with the basic series. They are not guaranteed to be correct---please contact Ibbotson Associates for definite and up-to-date numbers.

Mathematical Definitions of Requested Expectations

Question 1: Stock Market Return, Nominal, Arithmetic Average, 30 Year Horizon

Your expectation for the arithmetic stock market return (ASMR):

$$\text{ASMR}(30) = \left(\frac{1}{30}\right) \cdot \sum_{y=1}^{30} \text{mr}_y$$

where mr_y is the (unknown) one-year stock market return in y years. (Note also that all stock market related questions do not request the performance of stocks as constituted in the current S&P index, but the performance of stocks in the then-prevailing S&P in the future.) click here for more details on requested time frame.

Question 2: Equity Premium, Arithmetic Average, 30 Year Horizon

Your expectation for the arithmetic equity premium (AEQP):

$$\text{AEQP}(30) = \left(\frac{1}{30}\right) \cdot \sum_{y=1}^{30} (\text{mr}_y - \text{tbr}_y)$$

where mr_y is the (unknown) one-year stock market return in y years, and tbr_y is the (unknown) one-year return on rolled-over short-term (30-day) treasury bonds in y years. click here for more details on requested time frame.

Question 3: Equity Premium, Geometric Average, 30 Year Horizon

Your expectation for the **geometric** equity premium (GEQP):

$$\text{GEQP}(30) = \frac{\text{GSMR}(30)}{\text{GTBR}(30)}$$

$$\text{GSMR}(P) = \sqrt[n]{\prod_{y=1}^{P}(1 + \text{mr}_y)} \qquad \text{GTBR}(P) = \sqrt[n]{\prod_{y=1}^{P}(1 + \text{tbr}_y)}$$

where mr_y is the (unknown) one-year stock market return in y years, and tbr_y is the (unknown) one-year return on rolled-over short-term (30-day) treasury bonds in y years. click here for more details on requested time frame.

Questions 7-10: Equity Premium, Arithmetic Average, Different Horizons

Your expectation for

$$\text{AEQP}(P) = \left(\frac{1}{P}\right) \cdot \sum_{y=1}^{P} (\text{mr}_y - \text{tbr}_y)$$

where P=1 in question 7, P=5 in question 8, P=10 in question 9, and P=100 in question 10. As above, mr_y is the (unknown) annual stock market return in y years, and tbr_y is the (unknown) annual return on rolled-over short-term (30-day) treasury bonds in y years. click here for more details on requested time frame.

Question 13: 30-Year Inflation, Arithmetic Average

Your expectation for

$$\text{AIR}(30) = \left(\frac{1}{30}\right) \cdot \sum_{y=1}^{30} i_y$$

where i_y is the (unknown) annual inflation rate "in y years." click here for more details on requested time frame.

Timing Details

The 30-year questions ask you for your forecasts from tomorrow through 30 years after tomorrow. Thus, if you answered this questionaire on 12/31/1998, the 30-year questions asks you for annualized forecasts using returns from 1/1/1999 to 12/31/2028--i.e., from 1999 (inclusive) through 2028 (inclusive). Note also that *within* each year, the returns are compounded (not averaged), even if the requested average is arithmetic.

Similarly, if you answered this questionaire on Dec 31, 1998, the 1-year forecast question 7 asks you for your forecast for 1999, and the 100-year forecast question 10 asks you for your forecast from 1999 (inclusive) through 2028 (inclusive).

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by Willard T. Carleton and Josef Lakonishok

Risk and Return on Equity: The Use and Misuse of Historical Estimates

The task of estimating a company's expected return typically involves an initial estimate of the market's expected return. This, in turn, is usually based on summary statistics about risk premiums drawn from historical average returns. The approach appears simple, but the underlying complexities may trip up unwary analysts.

The authors demonstrate how choice of measurement period, averaging method, portfolio weighting and risk-free rate can cause the equity risk premium to vary from 0.9 to 24.9 per cent. Over the 1926-80 period, for example, the arithmetic mean annual return on an equally weighted portfolio was 17.1 per cent; the geometric mean annual return on a corresponding value-weighted portfolio was 9.1 per cent. Furthermore, differences in historical returns between industries, and company size effects within industries, are also substantial.

FINANCIAL ANALYSTS HAVE come to rely heavily on summary statistics drawn from historical returns on common stocks.[1] Typically, these returns, aggregated over time and over securities, have been compared with historical returns on lower-risk assets such as Treasury bills or U.S. government bonds to provide estimates of the stock market's average risk premium on equities.[2] The considerable complexity underlying the aggregate data seems to have been ignored, for the most part, in practice.

The consequences of ignoring complexity can be substantial in dollar terms. For example, the book value of Duke Power Company's common equity is about $2.4 billion. Each percentage point in estimates of its cost of equity capital thus translates into $24 million of earnings per year, when applied as an earnings rate on book equity. And the differences between estimates of costs of equity generated by different "readings" of historical returns could easily amount to several percentage points—or multiples of $24 million per year—in required earnings.

This article attempts to introduce some caution into the uncritical acceptance and use of aggregated historical return differentials. Using return data for the period 1926–80, we present tables showing how mean or risk-adjusted stock returns are affected by the following dimensions of historical return measurement and presentation:

- geometric vs. arithmetic mean returns,
- equally weighted vs. value-weighted stock portfolios,
- time periods chosen,
- bills vs. bonds as the base for the market risk premium,
- industry risk-adjusted return differentials,
- effect of data point intervals on industry risk adjustments,
- the significance of some industry "alphas,"
- size effects within industries.

We used as our main data base the monthly

1. Footnotes appear at end of article.

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Table I Annualized Historical Returns and Standard Deviations on Market Portfolios

Period	Geometric Mean		Arithmetic Mean		Standard Deviation	
	Val. Wtd.	Eq. Wtd.	Val. Wtd.	Eq. Wtd.	Val. Wtd.	Eq. Wtd.
1926–80	9.1%	12.5%	11.4%	17.1%	21.9%	33.1%
1931–80	9.5	14.4	11.7	18.7	21.3	32.7
1936–80	10.2	13.4	11.8	16.6	18.7	26.8
1941–80	11.4	14.9	12.8	17.7	17.6	25.4
1946–80	10.6	12.2	12.0	14.7	17.7	23.8
1951–80	10.8	13.0	12.3	15.6	18.3	24.7
1956–80	8.9	11.9	10.3	14.7	18.0	25.4
1961–80	8.7	12.2	10.1	15.1	17.9	25.4
1966–80	7.2	11.2	8.9	14.6	19.3	28.2
1971–80	9.1	13.3	11.1	16.9	21.3	29.0
1976–80	15.9	26.3	16.7	27.1	15.2	15.0

CRSP tape, which contains monthly stock returns for all NYSE companies and for various monthly stock indexes. We used the Compustat tape, which provides summaries of financial statements of all major U.S. corporations, to construct firm size measures.[3] The monthly returns on Treasury bills and long-term government bonds constructed by Ibbotson and Sinquefield were also used.

Overall Equity Market Results

Assume that our analytical task is to forecast the expected rate of return (alternatively, the required rate of return) on a given stock. Most such forecasts involve estimation of the expected return on the market and the return on some "risk-free" asset (or, alternatively, the difference between the two as the market's risk premium) and the risk of the particular stock. We therefore start by estimating the expected return on the market as a whole, defining the market portfolio conventionally as a portfolio that includes only common stock.[4]

Table I presents data on annual historical returns and standard deviations for two widely used market portfolios—the value-weighted Fisher index and the equally weighted Fisher index.[5] The results are presented for various periods, all of which have 1980 as an ending date. We selected 1980 to reflect the point of view of an analyst today who is trying to decide how far back into historical data he must go to develop averages that validly represent current investors' beliefs about the future.

Computing Average Returns

The annual returns in Table I are aggregated across time based on both geometric mean and arithmetic mean computations. For example, the value-weighted geometric mean of 9.1 per cent for the 1926–80 period is derived in the following way:

$$[(1 + r_{1926})(1 + r_{1927}) \cdots (1 + r_{1980})]^{1/55} - 1,$$

where r denotes the annual rate of return. The comparable arithmetic mean of 11.4 per cent is derived as:

$$(r_{1926} + r_{1927} + \cdots r_{1980})/55.$$

The difference between the two means of 2.3 per cent is substantial and is directly related to the variability of the return series. The differences between the means would be more pronounced in the case of individual securities, because of their higher variability.

Which of the two means should be used? The truth is, each is appropriate under particular circumstances. The geometric mean measures changes in wealth over more than one period on a buy and hold (with dividends reinvested) strategy. If the average investor rebalanced his portfolio every period, the geometric mean would not be a correct representation of his portfolio's performance over time. The arithmetic mean would provide a better measure of typical performance over a single historical period (in the example, one year).

Portfolio Weights

The differences between returns on a value-weighted index, or portfolio, and those on an equally weighted index are even more striking than the differences between arithmetic and geometric means. For the 1926–80 period, the equally weighted market portfolio had an average mean return of 17.1 per cent versus 11.4 per cent for the value-weighted portfolio. The geometric means of the two portfolios are closer

Table II Annualized Historical Returns and Standard Deviations on Long-Term Government Bonds and Treasury Bills

	Bonds		Bills		Standard Deviation	
Period	*Geo. Mean*	*Arith. Mean*	*Geo. Mean*	*Arith. Mean*	*Bonds*	*Bills*
1926–80	3.0%	3.2%	2.8%	2.8%	5.7%	2.7%
1931–80	2.8	3.0	2.7	2.8	5.9	2.8
1936–80	2.6	2.7	3.0	3.0	5.6	2.8
1941–80	2.3	2.4	3.4	3.4	5.8	2.8
1946–80	2.0	2.2	3.8	3.9	6.0	2.7
1951–80	2.2	2.3	4.3	4.4	6.4	2.6
1956–80	2.3	2.5	4.9	4.9	6.8	2.5
1961–80	2.6	2.8	5.5	5.6	6.4	2.4
1966–80	2.6	2.9	6.3	6.4	7.3	2.2
1971–80	4.0	4.2	6.8	6.8	6.9	2.5
1976–80	1.9	2.1	7.8	7.8	8.3	2.9

(12.5 versus 9.1 per cent) because the equally weighted portfolio has a higher standard deviation than the value-weighted portfolio (33.1 vs. 21.9 per cent).[6]

Again, which index should be used? The value-weighted index obviously provides a better measure of stock market performance in general, hence of the experience of investors as a whole. The difference between AT&T and a small NYSE company cannot be ignored; investors have committed more funds to AT&T than they have to many smaller companies. Equally weighted indexes are very simple to construct and understand, but they probably make no more sense than an index constructed by weighting companies according to the length of their names. Nonetheless, equally weighted indexes may have their uses in determining expected rates of return for specific companies.

Equally weighted indexes give much more weight to smaller companies, and smaller companies are in general riskier than larger companies, so part of the average return difference between the two types of indexes can be explained by risk differences. However, only part of the small firm-large firm return difference can be explained by the conventional measures of risk, beta and unsystematic risk; for reasons still not fully understood, stocks of small companies have outperformed those of large companies on a risk-adjusted basis.[7] (Note that any use of historical return characteristics for forward-looking purposes requires a belief that history tends to repeat itself.) In determining expected rates of return, company size cannot therefore be ignored, and an equally weighted index may be appropriate for certain companies and for particular uses of expected market return estimates.[8] Clearly, investment strategies based on portfolios of small firms fall into this category.

Finally, Table I shows that, with the exception of the 1976–80 results, choice of starting year makes a difference of up to about 4 per cent per year in average equity return for each of the four portfolio measures. The 1976–80 period represents a special case noted by many analysts: During the later part of the decade, probably because of unanticipated changes in inflation and interest rates, average stock returns *and* their variability substantially exceeded their average long-term values.

Choice of Risk-Free Rates

To estimate the equity market's *expected* risk premium (or forward-looking average), one usually computes the *historical* average return on lower-risk securities such as Treasury bills or U.S. government bonds.[9] The difference between the equity and bill or bond historical average provides an estimate of the market risk premium.

The logic of this procedure is straightforward: Expected rates of return on bills, bonds and stocks vary over time, reflecting common underlying changes in interest rates. Over short periods of time, realized return differences between stocks and bills, or between stocks and bonds, will vary because of random and unanticipated repricing of assets. Over a sufficiently large number of observations (number of years), however, investors realize, on average, the return differential consistent with the greater risk of common stocks—i.e., an amount equal to the expected risk premium.

Table II provides historical returns on Treasury bills and long-term U.S. government bonds. For these fixed income securities, the differences between geometric and arithmetic

Table III Annualized Equity Premium Estimates

	Arithmetic Means				Geometric Means			
	– Bonds		– Bills		– Bonds		– Bills	
Period	*Val Wtd*	*Eq Wtd*	*Val Wtd*	*Eq Wtd*	*Val Wtd*	*Eq Wtd*	*Val Wtd*	*Eq Wtd*
1926–80	8.2%	13.9%	8.6%	14.3%	6.1%	9.3%	6.3%	9.7%
1931–80	8.7	15.7	8.9	15.9	6.7	11.4	6.8	11.7
1936–80	9.1	13.9	8.8	13.6	7.6	10.7	7.2	8.2
1941–80	10.4	15.2	9.4	14.2	9.1	10.4	8.0	8.0
1946–80	9.7	12.5	8.0	10.8	8.6	10.0	6.8	6.8
1951–80	9.9	13.3	7.8	11.2	8.6	10.7	6.5	6.5
1956–80	7.8	12.2	5.4	9.8	6.6	9.4	4.0	4.0
1961–80	7.3	12.3	4.5	9.5	6.1	9.4	3.2	3.2
1966–80	6.0	11.7	2.5	8.2	4.6	7.4	0.9	0.9
1971–80	6.9	12.7	4.3	10.1	5.1	9.1	2.3	2.3
1976–80	14.6	24.9	8.9	19.2	14.0	24.2	8.1	8.1

mean rates of return are very small, reflecting the small variability of the return series. For the total 1926–80 period, the arithmetic mean return on long-term government bonds is 3.2 per cent, versus 2.8 per cent for Treasury bills. For any period starting after 1936, however, Treasury bills show higher returns.

The superior performance of Treasury bills is especially striking in the more recent periods. From 1971 through 1980, for example, the average return on long-term government bonds was 4.2 per cent, versus 6.8 per cent for Treasury bills. The main contributor to this behavior was unexpected inflation, which led to higher than expected interest rates, hence lower bond prices. Unanticipated capital losses on bonds offset coupon income, producing lower realized returns.

Assuming that more history is better than less for purposes of estimating the market risk premium, there still remains the serious question of whether to base the premium on Treasury bills or on long-term government bonds. Again, the means will depend on the ends.

Advocates of the Capital Asset Pricing Model (CAPM) routinely employ the stock-bill average return differential. Aside from questions relating to the model's conceptual validity, the stock-bill spread is appropriate for uses involving short-term investment horizons. But the one-period CAPM is valid for multiperiod environments only under implausible and rigid assumptions. And expected market return estimates based on risk premium computations may be used to value expenditures for irreversible, long-term investments (nuclear power generating plants, for example); in these cases, the stock-bond return differential may provide a more appropriate measure of the average long-term risk premium.[10]

Table III presents annual risk premium estimates for equally weighted and value-weighted market portfolios based on Treasury bills and long-term government bonds. There are a number of choices and the differences between them are not trivial. Depending on the particular time period, method of weighting, method of averaging, and risk-free rate used, the market equity risk premium ranges from 0.9 to 24.9 per cent per year.[11]

Equity Returns and Risk Adjustments by Industry

Now that we have estimated the equity market portfolio's risk premium, we can make some adjustments for the difference in risk between our company and a typical company in the market portfolio. The CAPM relates return to risk as follows:

$$E(R_i) = R_f + [E(R_m) - R_f]\beta_i,$$

where:

$E(R_i)$ = the expected return on company i,
R_f = the risk-free rate,
$E(R_m)$ = the expected return on the market portfolio, and
β_i = the company's systematic risk, or beta.

The remaining task, under the CAPM, is to determine the company's beta. Our confidence in choice of any given historical data representation to estimate the market risk premium is at this point somewhat shaken, however. A natural step may be to examine the return experiences of similar firms, given that we are not sure about how to determine a market risk premium, hence expected return. In addition, even in the CAPM framework, it may be appropriate to look at groups of companies or industries, rather than at individual companies.

Thus, rather than concentrate on various issues critical in the case of individual securities (such as measurement error and coefficient instability), we will focus our analysis on the industry level. This will facilitate the presentation of results and enable us to demonstrate better the possible reason for differences in return experiences.[12]

We grouped the sample companies into 15 industries based on their two-digit Standard Industrial Classification codes. Table IV gives the number of companies in each industry. Table V provides for each industry annual geometric returns, arithmetic returns and standard deviations of returns for the 1926–80 period. Three beta coefficients, three intercept (alpha) coefficients, and three coefficients of determination (R-squares) are also presented. Table VI shows the same results for the 1971–80 period. These coefficients were estimated from the following regression:

$$R_{it} - R_{ft} = \alpha_i + \beta_i[R_{mt} - R_{ft}) + e_{it},$$

where R_{it}, R_{ft} and R_{mt} are the period t returns for industry i (each security received the same weight), the risk-free rate (Treasury bill returns), and the return on the market portfolio (equally weighted Fisher index), respectively. Thus the differences between the three sets of coefficients result from differences in the estimation intervals (monthly, quarterly or annual).[13]

Table IV Industry Classifications

Industry	*SIC Code*
1. Mining	10-14
2. Construction	15-17
3. Food	20-21
4. Textile	22-23
5. Paper	24-27
6. Chemicals	28
7. Petroleum	29
8. Rubber	30-31
9. Metals	32-34
10. Machinery	35-39
11. Transportation	40-49
12. Wholesale Trade	50-51
13. Retail Trade	52-59
14. Finance	60-67
15. Services	70-89

Beta and Estimation Intervals

For the 1971–80 period, 10 of the 15 industries exhibit differences in betas of at least 0.1. For the mining industry, the monthly beta is 0.83, the annual 0.63; for the petroleum industry, the quarterly beta is 0.50, the annual 0.73. Assuming an annual risk premium of about 8 per cent, a 0.1 difference in betas will create a 0.8 per cent difference in expected returns; not much in the abstract, perhaps, but one that translates into $1.9 million per year in earnings for Duke Power if beta is used to determine its return on book equity.

The coefficients of determination at the indus-

Table V Returns and Risk Measures by Industries, 1926–1980

Industry	*Geo. Mean*[a]	*Arith. Mean*[a]	*Stan. Dev.*[a]	*Beta (1)*[b]	*Beta (3)*[b]	*Beta (12)*[b]	*Alpha (1)*[a,b]	*Alpha (3)*[a,b]	*Alpha (12)*[a,b]	*R^2 (1)*[b]	*R^2 (3)*[b]	*R^2 (12)*[b]
Mining	16.1	21.7	38.7	1.02	1.10	1.03	3.54[c]	2.91[d]	4.10	0.87	0.92	0.78
Construction	7.2	20.1	62.0	1.43	1.72	1.53	−3.17	−6.09	−4.80	0.60	0.78	0.66
Food	11.9	15.0	27.6	0.75	0.71	0.80	1.33[d]	1.45[d]	0.83	0.92	0.94	0.92
Textile	10.6	16.8	38.7	1.04	1.13	1.11	−1.69[d]	−2.22[c]	−1.93	0.90	0.95	0.89
Paper	13.0	18.4	37.6	1.01	1.07	1.10	0.60	0.12	−0.12	0.92	0.96	0.93
Chemicals	12.7	16.1	28.6	0.86	0.82	0.83	1.33[d]	1.61[c]	1.55[c]	0.92	0.96	0.92
Petroleum	14.7	18.9	31.3	0.80	0.74	0.81	4.28[c]	4.35[c]	4.65[c]	0.71	0.82	0.73
Rubber	10.6	16.8	39.2	1.06	1.10	1.12	−1.94	−2.02[d]	−2.10	0.89	0.95	0.89
Metals	12.2	17.8	38.9	1.11	1.13	1.13	−0.72	−0.96	−1.30	0.96	0.98	0.93
Machinery	12.5	18.4	37.6	1.09	1.07	1.11	−0.24	0.04	−0.40	0.97	0.98	0.96
Transportation	10.4	14.5	29.9	0.99	0.95	0.81	−1.33	−0.68	0.37	0.89	0.91	0.80
Wholesale Trade	11.4	16.7	35.9	0.83	0.91	1.02	1.33	0.28	−0.82	0.69	0.84	0.89
Retail Trade	10.7	16.3	36.1	0.90	0.87	1.01	−0.60	−0.28	−1.03	0.88	0.91	0.86
Finance	11.4	15.8	30.1	0.99	0.94	0.85	−0.60	0.00	1.02	0.94	0.95	0.84
Services	13.0	19.9	40.6	1.04	1.03	1.09	0.84	1.45	1.47	0.86	0.91	0.79
Average	11.9	17.5	36.8	0.99	1.02	1.02	0.24	0.08	0.10	0.86	0.92	0.85

a. Annualized percentages.
b. The number in parentheses is the length of the estimation interval—monthly, quarterly or yearly.
c. Statistical significance of 5 per cent for a two-tailed test.
d. Statistical significance of 10 per cent for a two-tailed test.

Table VI Returns and Risk Measures by Industry, 1971–1980

	Geo Mean[a]	Arith Mean[a]	Stan. Dev.[a]	Beta (1)[b]	Beta (3)[b]	Beta (12)[b]	Alpha (1)[a,b]	Alpha (3)[a,b]	Alpha (12)[a,b]	R^2 (1)[b]	R^2 (3)[b]	R^2 (12)[b]
Mining	24.8	29.4	38.2	0.83	0.70	0.63	12.42[c]	13.43[c]	17.54	0.55	0.51	0.23
Construction	20.1	26.6	41.4	1.21	1.29	1.31	5.79[d]	6.01	6.65	0.86	0.88	0.83
Food	12.6	15.0	25.1	0.81	0.81	0.83	0.24	0.80	−0.15	0.92	0.92	0.91
Textile	7.6	14.3	41.9	1.13	1.17	1.34	−5.41[c]	−5.14[d]	−6.11	0.87	0.88	0.86
Paper	11.6	15.0	28.6	0.99	1.03	0.96	−1.33	−1.61	−1.64	0.94	0.96	0.95
Chemicals	13.7	15.4	20.0	0.81	0.77	0.66	1.33	1.29	1.94	0.86	0.91	0.91
Petroleum	20.7	24.4	31.5	0.69	0.50	0.73	9.25[d]	10.42[d]	10.16	0.49	0.40	0.45
Rubber	11.6	16.4	33.5	1.01	1.02	1.10	−1.45	−1.33	−1.53	0.88	0.89	0.90
Metals	14.8	17.3	25.0	1.01	0.94	0.83	1.33	1.89	2.02	0.94	0.95	0.93
Machinery	16.2	21.2	34.1	1.15	1.18	1.17	2.30	0.08	2.47[c]	0.96	0.96	0.99
Transportation	10.9	13.4	24.3	0.72	0.68	0.82	−0.84	−0.76	−1.83	0.87	0.87	0.97
Wholesale Trade	12.7	17.7	34.0	1.19	1.24	1.13	−1.09	−1.16	−0.50	0.94	0.94	0.92
Retail Trade	8.4	14.4	38.9	1.13	1.26	1.15	−4.91	−5.01[d]	−5.62	0.92	0.94	0.86
Finance	8.9	13.4	30.3	1.06	1.05	1.00	−4.41[d]	−4.06[d]	−3.46	0.89	0.92	0.91
Services	15.2	22.1	38.6	1.28	1.38	1.28	1.09	1.15	2.78	0.94	0.95	0.93
Average	14.0	18.4	32.4	1.00	1.00	1.00	0.84	0.96	1.52	0.86	0.86	0.84

[a] Annualized percentages.
[b] The number in parentheses is the length of the estimation interval—monthly, quarterly or yearly.
[c] Statistical significance of 5 per cent for a two-tailed test.
[d] Statistical significance of 10 per cent for a two-tailed test.

try level are extremely high. For the 1926–80 period, the averages across industry are 0.86, 0.92 and 0.85 for the monthly, quarterly and annual intervals, respectively. Although there is some indication of a better fit for quarterly data, the differences are not large enough to decide on the basis of statistical fit that quarterly data should be used to estimate betas.

We should note that the results in Tables V and VI probably underestimate the impact of estimation intervals on betas of individual companies. We used intervals of one month or longer. Betas estimated from daily or weekly data are subject to biases caused by trading patterns; there are no biases in estimated betas for NYSE securities when monthly data are used.[14] Furthermore, our betas are estimated at the level of industries, not individual securities; differences due to beta estimation intervals are partially suppressed when industry aggregates are employed.[15]

Estimation Intervals and Alpha

According to the CAPM, the theoretical intercept, or alpha, should be zero; estimated deviations from zero should be attributable to conventional estimation problems; and the intercept should be irrelevant in generating industry or company expected returns. Given that our beliefs in CAPM are somewhat shaken, however, the question is whether to retain or discard the intercept when expected returns are being generated.[16]

For the 1926–80 period and the monthly intercept, a two-tailed test shows two intercepts to be different from zero at the 5 per cent significance level and three at the 10 per cent level; 10 intercepts are not significantly different from zero. One approach to the development of an expected industry rate of return would be to discard the intercepts, especially the 10 that are not significantly different from zero, statistically. We feel that this procedure errs. What we want for an expected return estimate is an unbiased point estimate; if the regression equation were correctly specified, retaining estimated beta while discarding estimated alpha would obviously produce bias in estimated expected rate of return.[17]

Unfortunately, the size of the intercepts indicates that the effect on expected industry returns is substantial. For the rubber industry, for example, the monthly intercept is −1.94 per cent per year. Also, Table V indicates that differences in estimation intervals produce differences in intercepts. For the finance industry, the monthly intercept is −0.6 per cent, while the annual intercept is 1.02 per cent per year.

There is one other problem. A high (low) intercept may simply result from a series of unexpectedly favorable (unfavorable) circumstances in the past. For the 1971–80 period, the intercept of the oil industry was 9.25 per cent per year—but a 9.25 per cent intercept for the industry in the future is not a proposition most analysts would accept. The high intercept reflects the misspecification of the return-generating process being used; the intercept captures factors omitted by the model. Unfortunately, the market model regression cannot provide additional insight about the size and origin of such factors.

The intercept can have a substantial effect on expected returns. Table VII presents estimates of the expected return for the construction industry, under a CAPM framework. The returns—based on the results of Table VI, an assumed market risk premium of 8 per cent and a risk-free rate of 9 per cent—range from 18.68 to 26.13 per cent. At the level of individual securities, the effects will be even greater.

Industry Size and Risk Effects

Our examination of equally weighted and value-weighted portfolios suggested the existence of a company size effect on stock returns. Are the effects of size on historical return experience present within industries? The presence of size effects within industries would vastly complicate the estimation of company expected returns.

Tables VIII, IX and X describe in some detail the role of company size within industries. We analyzed the periods 1961–80, 1966–80, 1971–80 and 1976–80, but given the similarity of results, we present here only those for the whole period (Table VIII) and for the last 10 years (Table IX). We measured size by the market value of the

Table VII Expected Return Estimates for the Construction Industry

	Without Intercept	*With Intercept*
Monthly Data Interval	18.68%	24.47%
Quarterly Data Interval	19.32%	25.33%
Annual Data Interval	19.48%	26.13%

common stock as of December 31, and estimated its effect by dividing the companies within the 13 given industries into four size groups, based on their size at the end of the previous year.[18]

Table VIII indicates an almost perfect relation between size and return. For *all* 13 industries, the smallest companies (designated size Group 1) had higher annual returns (on the basis of both arithmetic and geometric means) than the largest companies (size Group 4). Based on the summary in Table X, the difference between Groups 1 and 4 in arithmetic mean across industries for 1961–80 amounts to 11.1 per cent per year (22.3–11.2 per cent).

An almost perfect monotonic relation exists, not only between size and returns, but also between size and risk, as the betas and standard deviations in Tables IX and X indicate. From Table X, the average beta and standard deviation for the smallest companies are 1.14 and 36.7 per cent, respectively, for 1961–80; the corresponding numbers for the largest companies are 0.79 and 23.8 per cent.

Table VIII Returns and Risk Measures by Industries and Size, 1961–1980

Industry	*Size Group*	*Size*	*Geo. Mean*	*Arith. Mean*	*Stan. Dev.*	*Beta*	*Alpha*
Metals	1	29	16.9	20.3	28.9	1.17	0.31*
	2	66	12.4	15.2	25.2	1.04	0.02
	3	169	8.1	10.7	24.3	0.98	−0.28*
	4	822	7.2	8.8	19.0	0.86	−0.30*
Machinery	1	27	17.0	23.5	41.0	1.36	0.27*
	2	78	11.9	16.3	31.9	1.23	−0.08
	3	220	10.9	14.4	28.7	1.09	−0.11
	4	2356	9.1	11.9	24.6	0.88	−0.16**
Transportation	1	63	15.3	17.6	23.5	0.83	0.31*
	2	170	10.9	12.6	20.3	0.73	0.03
	3	396	8.1	9.6	18.1	0.66	−0.14
	4	1800	5.8	7.0	16.8	0.60	−0.28*
Trade	1	23	14.2	21.0	41.9	1.26	0.10
	2	62	12.4	18.0	36.9	1.16	−0.01
	3	157	10.2	14.9	33.8	1.02	−0.13
	4	1186	7.4	11.1	28.8	0.87	−0.28*
Finance	1	29	14.4	19.6	34.3	1.36	0.16
	2	88	14.2	18.9	33.9	1.06	0.18
	3	272	10.3	13.0	23.9	0.95	−0.09
	4	1362	10.3	12.0	19.7	0.78	−0.01
Services	1	36	16.6	22.9	38.9	1.33	0.31*
	2	74	12.0	18.1	37.7	1.28	−0.05
	3	141	12.0	17.0	32.9	1.21	−0.02
	4	381	7.9	14.8	40.9	1.14	−0.30*

(Table continued)

Table VIII continued

Industry	*Size Group*	*Size*	*Geo. Mean*	*Arith. Mean*	*Stan. Dev.*	*Beta*	*Alpha*
Mining	1	40	25.6	34.2	55.1	1.06	1.11*
	2	121	22.2	26.0	32.3	0.79	0.94*
	3	292	18.7	21.8	29.4	0.84	0.63*
	4	1341	16.6	19.5	26.7	0.77	0.49*
Food	1	29	16.6	19.9	29.3	0.92	0.40*
	2	101	13.9	17.0	27.2	0.90	0.19*
	3	363	9.4	12.0	25.0	0.81	−0.11
	4	1428	8.8	10.3	18.2	0.62	−0.07
Textile	1	18	13.1	20.8	45.4	1.22	0.07
	2	43	11.0	16.2	36.1	1.13	−0.08
	3	87	9.1	15.0	36.8	1.01	−0.18**
	4	265	7.9	13.0	33.2	0.96	−0.26*
Paper	1	34	17.4	22.4	38.4	1.18	0.36*
	2	91	11.0	14.4	27.5	1.02	−0.07
	3	300	10.6	13.1	24.2	0.94	−0.06
	4	1344	6.7	8.6	21.0	0.83	−0.32*
Chemicals	1	50	16.4	19.8	28.8	1.11	0.30*
	2	184	11.7	13.8	21.6	0.94	0.01
	3	565	12.3	13.8	18.6	0.80	0.12
	4	2537	6.3	7.2	14.2	0.61	−0.23*
Petroleum	1	134	19.6	24.4	34.5	0.94	0.67*
	2	906	20.4	23.3	26.2	0.72	0.81*
	3	2763	15.2	17.7	25.0	0.55	0.55**
	4	8369	13.5	15.6	22.9	0.50	0.43**
Rubber	1	25	19.1	24.4	37.1	1.12	0.54*
	2	57	9.0	12.9	27.9	1.06	−0.20**
	3	212	10.3	14.5	32.9	0.93	−0.07
	4	847	2.5	5.2	23.5	0.85	−0.63*

* Statistical significance of 5 per cent for a two-tailed test.
** Statistical significance of 10 per cent for a two-tailed test.

Table IX Returns and Risk Measures by Industries and Size, 1971–1980

Industry	*Size Group*	*Size*	*Geo. Mean*	*Arith. Mean*	*Stan. Dev.*	*Beta*	*Alpha*
Metals	1	27	18.6	21.2	27.2	1.22	0.35*
	2	64	17.1	19.4	24.2	1.00	0.30*
	3	162	10.5	13.6	26.7	0.96	−0.18
	4	730	9.8	11.6	21.1	0.83	−0.17
Machinery	1	24	20.8	27.1	40.0	1.40	0.47*
	2	77	16.4	21.4	34.4	1.22	0.18
	3	229	13.6	18.3	33.2	1.06	0.02
	4	2517	9.9	13.3	27.6	0.83	−0.16
Transportation	1	61	14.9	18.1	28.2	0.85	0.19
	2	163	12.0	14.7	25.9	0.72	0.03
	3	387	8.3	10.4	22.7	0.66	−0.22
	4	1660	6.1	8.0	20.7	0.57	−0.34**
Trade	1	22	12.2	19.5	43.2	1.35	−0.14
	2	63	12.3	18.7	40.9	1.25	−0.13
	3	167	9.1	14.9	38.8	1.04	−0.31
	4	1171	4.0	8.8	34.1	0.90	−0.64*
Finance	1	31	15.1	20.8	35.0	1.54	0.09
	2	91	10.3	15.5	33.2	1.06	−0.22
	3	299	8.3	12.2	28.6	0.94	−0.32**
	4	1352	9.3	11.5	22.0	0.74	−0.16
Services	1	27	17.1	24.5	40.8	1.35	0.25
	2	64	12.3	20.1	40.4	1.40	−0.13
	3	148	13.7	20.1	36.6	1.21	0.03
	4	502	11.0	18.5	41.2	1.13	−0.16
Mining	1	50	27.9	36.2	57.9	1.03	1.26*
	2	149	26.3	31.0	37.9	0.82	1.16*
	3	396	24.0	28.0	35.4	0.80	0.99*
	4	2039	18.2	21.9	30.8	0.69	0.58

(Table continued)

Table IX Continued

Industry	*Size Group*	*Size*	*Geo. Mean*	*Arith. Mean*	*Stan. Dev.*	*Beta*	*Alpha*
Food	1	29	18.9	22.1	30.2	0.94	0.46*
	2	118	17.6	20.2	27.1	0.90	0.37*
	3	436	7.9	11.2	29.3	0.79	−0.30*
	4	1753	8.4	10.1	19.9	0.60	−0.17
Textile	1	17	11.5	20.9	52.0	1.30	−0.12
	2	40	4.5	9.9	38.5	1.10	−0.64*
	3	83	2.1	7.9	37.3	0.98	−0.80*
	4	276	4.5	10.8	37.2	0.97	−0.61*
Paper	1	34	15.2	18.9	30.3	1.21	0.12
	2	97	10.5	15.4	32.9	0.99	−0.18
	3	326	12.4	15.5	28.8	0.89	0.00
	4	1500	6.9	9.6	25.4	0.79	−0.36*
Chemicals	1	50	18.7	22.2	30.2	1.08	0.40*
	2	211	13.0	15.3	23.0	0.87	0.05
	3	682	13.8	15.7	21.0	0.73	0.18
	4	2969	5.9	7.0	15.9	0.56	−0.30
Petroleum	1	158	22.0	29.1	42.0	0.95	0.77**
	2	1134	20.4	24.5	32.0	0.73	0.75**
	3	3526	22.5	25.5	29.5	0.47	1.07*
	4	9044	16.2	19.2	28.3	0.49	0.57
Rubber	1	23	22.9	30.6	46.7	1.18	0.74*
	2	52	9.9	14.7	30.4	1.05	−0.20
	3	210	10.8	15.7	37.3	0.94	−0.12
	4	739	−0.6	3.2	28.9	0.85	−0.98*

* Statistical significance of 5 per cent for a two-tailed test.
** Statistical significance of 10 per cent for a two-tailed test.

Table X Returns and Risk Measures Averaged Across Industries, by Size Groups

Period	*Size*	*Geo. Mean*	*Arith. Mean*	*Stan. Dev.*	*Beta*	*Alpha*
1961–80	41	17.1	22.3	36.7	1.14	0.38*
	157	13.3	17.1	29.6	1.01	0.13
	457	11.1	14.4	27.2	0.91	0.01
	1849	8.5	11.2	23.8	0.79	−0.15**
1971–80	43	18.1	23.9	38.8	1.18	0.37*
	179	14.1	18.5	32.3	1.01	0.10
	542	12.1	16.1	31.1	0.88	0.00
	2019	8.4	11.8	27.1	0.77	−0.22*

* Statistical significance of 5 per cent by two-tailed test.
** Statistical significance of 10 per cent by two-tailed test.

Does Alpha Depend on Size?

Did small companies outperform large companies on a risk-adjusted basis? The last column in each table presents the industry alphas, which should theoretically equal zero. Higher intercepts for the smaller companies would suggest superior performance on a risk-adjusted basis. For both 1961–80 and 1971–80 periods, the smallest companies in all 13 industries outperformed the largest. The 1961–80 difference in intercepts between the smallest and the largest group sizes, summarized over all industries in Table X, is 0.53 per cent per month, which translates to 6.55 per cent per year (statistically significant at the 5 per cent level). For 1971–80, the difference is 7.31 per cent per year (also significant at the 5 per cent level).

Our results regarding the effect of size on industry returns are consistent with results of previous studies that did not examine differential returns within industries.[19] As noted, the presence of intraindustry size effects vastly complicates estimation of expected returns for individual companies. Whether the purpose is capital budgeting, rate of return regulation, or investment strategy, the analyst has to decide to include or ignore the size effect. We have no theory that adequately explains the phenomenon, so it is tempting to assume that it will not persist in the future. But discarding it is to deny historical reality and, in the framework of CAPM-based market model regressions, to produce biased return estimates.

Implications for Analysts

The practical applications of expected return estimates entail serious financial consequences (especially in the case of utility regulation). Given our incomplete understanding of how stock returns are determined, we think it is delusionary and misleading not to acknowledge the complexities just under the surface of simple historical average returns. On empirical grounds, if no other, it would appear that the popular recipe of, say, 8 per cent times company beta, added to a bill yield, may not be robust enough for general use.

Footnotes

1. For among other tasks, development of capital budgeting discount rates; estimation of equilibrium stock prices in order to measure deviations against which speculative trading can take place; and estimation of costs of equity capital for utilities, to be employed in rate hearings.
2. See, for example, R.G. Ibbotson and R.A. Sinquefield, *Stocks, Bonds, Bills, and Inflation: The Past (1926–1976) and the Future (1977–2000)* (Charlottesville, Va.: The Financial Analysts Research Foundation, 1977); *Stocks, Bonds, Bills, and Inflation: Historical Returns (1926–1978)* (Charlottesville, Va.: The Financial Analysts Research Foundation, 1979); and *Stocks, Bonds, Bills and Inflation: The Past and the Future* (Charlottesville, Va.: The Financial Analysts Research Foundation, 1982).
3. The Compustat tape provides data only for companies that exist currently. For example, the 1980 Compustat tape provides data only for companies that existed in 1980. The Research Compustat tape was used to provide data on companies that went out of existence.
4. For purposes of this article, we will not deal with the well known problems associated with the validity of a portfolio that excludes such important assets as bonds and real estate. For a comprehensive discussion of these issues see R.R. Roll, "A Critique of the Asset Pricing Theory's Tests, Part I: On Past and Potential Testability of the Theory," *Journal of Financial Economics*, March 1977, pp. 129–176.
5. For a complete description of the Fisher Index, see Lawrence Fisher and James Lorie, "Rates of Return on Investments in Common Stocks: The Year-by-Year Record, 1926–65," *Journal of Business*, July 1968, pp. 291–316. These indexes are available on the CRSP tapes and are adjusted for all changes in capitalization.
6. The difference between the equally weighted and value-weighted indexes would be even larger if AMEX and OTC companies had been included.
7. For a discussion of these issues, see Richard Roll, "A Possible Explanation of the Small Firm Effect," *Journal of Finance*, September 1981, pp. 879–888.
8. There is a further complication we do not pursue in this article, which arises in the context of estimation of expected rates of return for an average investor on an after-tax basis. Everything else constant, companies with high variability in returns provide investors with a higher tax subsidy. This subsidy is related to the distinction made by the IRS between long-term and short-term capital gains. These issues are discussed by George Constantinides, "Optimal Stock Trading with Personal Taxes: Implications for Prices and the Abnormal January Returns" (July 1982).
9. Note the greater returns of equities (Table I) over bonds (Table II) and bonds over bills (Table II), historically consistent with conventional descriptions of their relative risks.
10. For a discussion, see W.T. Carleton, "A Highly Personal Note on the Use of the CAPM in Public Utility Rate Cases," *Financial Management*, Autumn 1978, pp. 57–59, and W.T. Carleton, D.R. Chambers and J. Lakonishok, "Inflation Risk and Regulatory Lag," *Journal of Finance*, May 1983, pp. 419–436.
11. A further complication in the search for a market risk premium is that the variance of the market realized return series changes over time. We do not pursue this topic, as this article is addressed to the fairly typical user of historical returns observed in practice. For an exploration of the issues, see R.C. Merton, "On Estimating the Expected Return on the Market: An Exploratory Investigation," *Journal of Financial Economics*, December 1980, pp. 323–361.
12. It should be pointed out at this stage that a popular alternative to the CAPM for deriving expected returns is based on observing the past performance of similar companies—companies from the same industry.
13. All the computations were repeated for the various time intervals discussed in Table I. Because the results were qualitatively similar we present only the findings for the total period, 1926–80, and the last 10 years, 1971–80.
14. The biases arise from trading patterns and are discussed by E. Dimson, "Risk Measurement When Shares are Subject to Infrequent Trading," *Journal of Financial Economics*, June 1979, pp. 197–226 and M. Scholes and J. Williams, "Estimating Betas from Non-Synchronous Data," *Journal of Financial Economics*, December 1977, pp. 309–327. H. Stoll and R. Whaley ("Transactions Costs and

(continued on page 62)

Cost of Capital Estimation

The Risk Premium Approach to Measuring a Utility's Cost of Equity

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■ In the mid-1960s, Myron Gordon and others began applying the theory of finance to help estimate utilities' costs of capital. Previously, the standard approach in cost of equity studies was the "comparable earnings method," which involved selecting a sample of unregulated companies whose investment risk was judged to be comparable to that of the utility in question, calculating the average return on book equity (ROE) of these sample companies, and setting the utility's service rates at a level that would permit the utility to achieve the same ROE as comparable companies. This procedure has now been thoroughly discredited (see Robichek [15]), and it has been replaced by three market-oriented (as opposed to accounting-oriented) approaches: (i) the DCF method, (ii) the bond-yield-plus-risk-premium method, and (iii) the CAPM, which is a specific version of the generalized bond-yield-plus-risk-premium approach.

Our purpose in this paper is to discuss the risk-premium approach, including the market risk premium that is used in the CAPM. First, we critique the various procedures that have been used in the past to estimate risk premiums. Second, we present some data on estimated risk premiums since 1965. Third, we examine the relationship between equity risk premiums and the level of interest rates, because it is important, for purposes of estimating the cost of capital, to know just how stable the relationship between risk premiums and interest rates is over time. If stability exists, then one can estimate the cost of equity at any point in time as a function of interest rates as reported in *The Wall Street Journal*, the *Federal Reserve Bulletin*, or some similar source.[1] Fourth, while we do not discuss the CAPM directly, our analysis does have some important implications for selecting a market risk premium for use in that model. Our focus is on utilities, but the methodology is applicable to the estimation of the cost of

[1]For example, the Federal Energy Regulatory Commission's Staff recently proposed that a risk premium be estimated every two years and that, between estimation dates, the last-determined risk premium be added to the current yield on ten-year Treasury bonds to obtain an estimate of the cost of equity to an average utility (Docket RM 80-36). Subsequently, the FCC made a similar proposal ("Notice of Proposed Rulemaking," August 13, 1984, Docket No. 84-800). Obviously, the validity of such procedures depends on (i) the accuracy of the risk premium estimate and (ii) the stability of the relationship between risk premiums and interest rates. Both proposals are still under review.

equity for any publicly traded firm, and also for non-traded firms for which an appropriate risk class can be assessed, including divisions of publicly traded corporations.[2]

Alternative Procedures for Estimating Risk Premiums

In a review of both rate cases and the academic literature, we have identified three basic methods for estimating equity risk premiums: (i) the *ex post*, or historic, yield spread method; (ii) the survey method; and (iii) an *ex ante* yield spread method based on DCF analysis.[3] In this section, we briefly review these three methods.

Historic Risk Premiums

A number of researchers, most notably Ibbotson and Sinquefield [12], have calculated historic holding period returns on different securities and then estimated risk premiums as follows:

$$\text{Historic Risk Premium} = \begin{pmatrix}\text{Average of the}\\ \text{annual returns on}\\ \text{a stock index for}\\ \text{a particular}\\ \text{past period}\end{pmatrix} - \begin{pmatrix}\text{Average of the}\\ \text{annual returns on}\\ \text{a bond index for}\\ \text{the same}\\ \text{past period}\end{pmatrix}. \quad (1)$$

Ibbotson and Sinquefield (I&S) calculated both arithmetic and geometric average returns, but most of their risk-premium discussion was in terms of the geometric averages. Also, they used both corporate and Treasury bond indices, as well as a T-bill index, and they analyzed all possible holding periods since 1926. The I&S study has been employed in numerous rate cases in two ways: (i) directly, where the I&S historic risk premium is added to a company's bond yield to obtain an estimate of its cost of equity, and (ii) indirectly, where I&S data are used to estimate the market risk premium in CAPM studies.

There are both conceptual and measurement problems with using I&S data for purposes of estimating the cost of capital. Conceptually, there is no compelling reason to think that investors expect the same relative returns that were earned in the past. Indeed, evidence presented in the following sections indicates that relative expected returns should, and do, vary significantly over time. Empirically, the measured historic premium is sensitive both to the choice of estimation horizon and to the end points. These choices are essentially arbitrary, yet they can result in significant differences in the final outcome. These measurement problems are common to most forecasts based on time series data.

The Survey Approach

One obvious way to estimate equity risk premiums is to poll investors. Charles Benore [1], the senior utility analyst for Paine Webber Mitchell Hutchins, a leading institutional brokerage house, conducts such a survey of major institutional investors annually. His 1983 results are reported in Exhibit 1.

Exhibit 1. Results of Risk Premium Survey, 1983*

Assuming a double A, long-term utility bond currently yields 12½%, the common stock for the same company would be fairly priced relative to the bond if its expected return was as follows:

Total Return	Indicated Risk Premium (basis points)	Percent of Respondents
over 20½%	over 800	
20½%	800	
19½%	700	
18½%	600	10%
17½%	500	8%
16½%	400	29%
15½%	300	35%
14½%	200	16%
13½%	100	0%
under 13½%	under 100	1%
Weighted average	358	100%

*Benore's questionnaire included the first two columns, while his third column provided a space for the respondents to indicate which risk premium they thought applied. We summarized Benore's responses in the frequency distribution given in Column 3. Also, in his questionnaire each year, Benore adjusts the double A bond yield and the total returns (Column 1) to reflect current market conditions. Both the question above and the responses to it were taken from the survey conducted in April 1983.

[2]The FCC is particularly interested in risk-premium methodologies, because (i) only eighteen of the 1,400 telephone companies it regulates have publicly-traded stock, and hence offer the possibility of DCF analysis, and (ii) most of the publicly-traded telephone companies have both regulated and unregulated assets, so a corporate DCF cost might not be applicable to the regulated units of the companies.

[3]In rate cases, some witnesses also have calculated the differential between the yield to maturity (YTM) of a company's bonds and its concurrent ROE, and then called this differential a risk premium. In general, this procedure is unsound, because the YTM on a bond is a *future expected* return on the bond's *market value*, while the ROE is the *past realized* return on the stock's *book value*. Thus, comparing YTMs and ROEs is like comparing apples and oranges.

Benore's results, as measured by the average risk premiums, have varied over the years as follows:

Year	Average RP (basis points)
1978	491
1979	475
1980	423
1981	349
1982	275
1983	358

The survey approach is conceptually sound in that it attempts to measure investors' expectations regarding risk premiums, and the Benore data also seem to be carefully collected and processed. Therefore, the Benore studies do provide one useful basis for estimating risk premiums. However, as with most survey results, the possibility of biased responses and/or biased sampling always exists. For example, if the responding institutions are owners of utility stocks (and many of them are), and if the respondents think that the survey results might be used in a rate case, then they might bias upward their responses to help utilities obtain higher authorized returns. Also, Benore surveys large institutional investors, whereas a high percentage of utility stocks are owned by individuals rather than institutions, so there is a question as to whether his reported risk premiums are really based on the expectations of the "representative" investor. Finally, from a pragmatic standpoint, there is a question as to how to use the Benore data for utilities that are not rated AA. The Benore premiums can be applied as an add-on to the own-company bond yields of any given utility only if it can be assumed that the premiums are constant across bond rating classes. *A priori*, there is no reason to believe that the premiums will be constant.

DCF-Based *Ex Ante* Risk Premiums

In a number of studies, the DCF model has been used to estimate the *ex ante* market risk premium, RP_M. Here, one estimates the average expected future return on equity for a group of stocks, k_M, and then subtracts the concurrent risk-free rate, R_F, as proxied by the yield to maturity on either corporate or Treasury securities:[4]

$$RP_M = k_M - R_F. \tag{2}$$

Conceptually, this procedure is exactly like the I&S approach except that one makes direct estimates of future expected returns on stocks and bonds rather than assuming that investors expect future returns to mirror past returns.

The most difficult task, of course, is to obtain a valid estimate of k_M, the expected rate of return on the market. Several studies have attempted to estimate DCF risk premiums for the utility industry and for other stock market indices. Two of these are summarized next.

Vandell and Kester. In a recently published monograph, Vandell and Kester [18] estimated *ex ante* risk premiums for the period from 1944 to 1978. R_F was measured both by the yield on 90-day T-bills and by the yield on the Standard and Poor's AA Utility Bond Index. They measured k_M as the average expected return on the S&P's 500 Index, with the expected return on individual securities estimated as follows:

$$k_i = \left(\frac{D_1}{P_0}\right)_i + g_i, \tag{3}$$

where,

D_1 = dividend per share expected over the next twelve months,
P_0 = current stock price,
g = estimated long-term constant growth rate, and
i = the i^{th} stock.

To estimate g_i, Vandell and Kester developed fifteen forecasting modėls based on both exponential smoothing and trend-line forecasts of earnings and dividends, and they used historic data over several estimating horizons. Vandell and Kester themselves acknowledge that, like the Ibbotson-Sinquefield premiums, their analysis is subject to potential errors associated with trying to estimate expected future growth purely from past data. We shall have more to say about this point later.

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[4]In this analysis, most people have used yields on long-term bonds rather than short-term money market instruments. It is recognized that long-term bonds, even Treasury bonds, are not risk free, so an RP_M based on these debt instruments is smaller than it would be if there were some better proxy to the long-term riskless rate. People have attempted to use the T-bill rate for R_F, but the T-bill rate embodies a different average inflation premium than stocks, and it is subject to random fluctuations caused by monetary policy, international currency flows, and other factors. Thus, many people believe that for cost of capital purposes, R_F should be based on long-term securities.

We did test to see how debt maturities would affect our calculated risk premiums. If a short-term rate such as the 30-day T-bill rate is used, measured risk premiums jump around widely and, so far as we could tell, randomly. The choice of a maturity in the 10- to 30-year range has little effect, as the yield curve is generally fairly flat in that range.

Malkiel. Malkiel [14] estimated equity risk premiums for the Dow Jones Industrials using the DCF model. Recognizing that the constant dividend growth assumption may not be valid, Malkiel used a nonconstant version of the DCF model. Also, rather than rely exclusively on historic data, he based his growth rates on Value Line's five-year earnings growth forecasts plus the assumption that each company's growth rate would, after an initial five-year period, move toward a long-run real national growth rate of four percent. He also used ten-year maturity government bonds as a proxy for the riskless rate. Malkiel reported that he tested the sensitivity of his results against a number of different types of growth rates, but, in his words, "The results are remarkably robust, and the estimated risk premiums are all very similar." Malkiel's is, to the best of our knowledge, the first risk-premium study that uses analysts' forecasts. A discussion of analysts' forecasts follows.

Security Analysts' Growth Forecasts

Ex ante DCF risk premium estimates can be based either on expected growth rates developed from time series data, such as Vandell and Kester used, or on analysts' forecasts, such as Malkiel used. Although there is nothing inherently wrong with time series-based growth rates, an increasing body of evidence suggests that primary reliance should be placed on analysts' growth rates. First, we note that the observed market price of a stock reflects the consensus view of investors regarding its future growth. Second, we know that most large brokerage houses, the larger institutional investors, and many investment advisory organizations employ security analysts who forecast future EPS and DPS, and, to the extent that investors rely on analysts' forecasts, the consensus of analysts' forecasts is embodied in market prices. Third, there have been literally dozens of academic research papers dealing with the accuracy of analysts' forecasts, as well as with the extent to which investors actually use them. For example, Cragg and Malkiel [7] and Brown and Rozeff [5] determined that security analysts' forecasts are more relevant in valuing common stocks and estimating the cost of capital than are forecasts based solely on historic time series. Stanley, Lewellen, and Schlarbaum [16] and Linke [13] investigated the importance of analysts' forecasts and recommendations to the investment decisions of individual and institutional investors. Both studies indicate that investors rely heavily on analysts' reports and incorporate analysts' forecast information in the formation of their expectations about stock returns. A representative listing of other work supporting the use of analysts' forecasts is included in the References section. Thus, evidence in the current literature indicates that (i) analysts' forecasts are superior to forecasts based solely on time series data, and (ii) investors do rely on analysts' forecasts. Accordingly, we based our cost of equity, and hence risk premium estimates, on analysts' forecast data.[5]

Risk Premium Estimates

For purposes of estimating the cost of capital using the risk premium approach, it is necessary either that the risk premiums be time-invariant or that there exists a predictable relationship between risk premiums and interest rates. If the premiums are constant over time, then the constant premium could be added to the prevailing interest rate. Alternatively, if there exists a stable relationship between risk premiums and interest rates, it could be used to predict the risk premium from the prevailing interest rate.

To test for stability, we obviously need to calculate risk premiums over a fairly long period of time. Prior to 1980, the only consistent set of data we could find came from Value Line, and, because of the work involved, we could develop risk premiums only once a year (on January 1). Beginning in 1980, however, we began collecting and analyzing Value Line data on a monthly basis, and in 1981 we added monthly estimates from Merrill Lynch and Salomon Brothers to our data base. Finally, in mid-1983, we expanded our analysis to include the IBES data.

Annual Data and Results, 1966–1984

Over the period 1966–1984, we used Value Line data to estimate risk premiums both for the electric utility industry and for industrial companies, using the companies included in the Dow Jones Industrial and Utility averages as representative of the two groups. Value Line makes a five-year growth rate forecast, but it also gives data from which one can develop a longer-term forecast. Since DCF theory calls for a truly long-term (infinite horizon) growth rate, we concluded that it was better to develop and use such a forecast than to

[5]Recently, a new type of service that summarizes the key data from most analysts' reports has become available. We are aware of two sources of such services, the Lynch, Jones, and Ryan's Institutional Brokers Estimate System (IBES) and Zack's Icarus Investment Service. IBES and the Icarus Service gather data from both buy-side and sell-side analysts and provide it to subscribers on a monthly basis in both a printed and a computer-readable format.

Exhibit 2. Estimated Annual Risk Premiums, Nonconstant (Value Line) Model, 1966–1984

January 1 of the Year Reported	Dow Jones Electrics			Dow Jones Industrials			
	k_{Avg}	R_F	RP	k_{Avg}	R_F	RP	(3) ÷ (6)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1966	8.11%	4.50%	3.61%	9.56%	4.50%	5.06%	0.71
1967	9.00%	4.76%	4.24%	11.57%	4.76%	6.81%	0.62
1968	9.68%	5.59%	4.09%	10.56%	5.59%	4.97%	0.82
1969	9.34%	5.88%	3.46%	10.96%	5.88%	5.08%	0.68
1970	11.04%	6.91%	4.13%	12.22%	6.91%	5.31%	0.78
1971	10.80%	6.28%	4.52%	11.23%	6.28%	4.95%	0.91
1972	10.53%	6.00%	4.53%	11.09%	6.00%	5.09%	0.89
1973	11.37%	5.96%	5.41%	11.47%	5.96%	5.51%	0.98
1974	13.85%	7.29%	6.56%	12.38%	7.29%	5.09%	1.29
1975	16.63%	7.91%	8.72%	14.83%	7.91%	6.92%	1.26
1976	13.97%	8.23%	5.74%	13.32%	8.23%	5.09%	1.13
1977	12.96%	7.30%	5.66%	13.63%	7.30%	6.33%	0.89
1978	13.42%	7.87%	5.55%	14.75%	7.87%	6.88%	0.81
1979	14.92%	8.99%	5.93%	15.50%	8.99%	6.51%	0.91
1980	16.39%	10.18%	6.21%	16.53%	10.18%	6.35%	0.98
1981	17.61%	11.99%	5.62%	17.37%	11.99%	5.38%	1.04
1982	17.70%	14.00%	3.70%	19.30%	14.00%	5.30%	0.70
1983	16.30%	10.66%	5.64%	16.53%	10.66%	5.87%	0.96
1984	16.03%	11.97%	4.06%	15.72%	11.97%	3.75%	1.08

use the five-year prediction.[6] Therefore, we obtained data as of January 1 from Value Line for each of the Dow Jones companies and then solved for k, the expected rate of return, in the following equation:

$$P_0 = \sum_{t=1}^{n} \frac{D_t}{(1 + k)^t} + \left(\frac{D_n(1 + g_n)}{k - g_n}\right)\left(\frac{1}{1 + k}\right)^n. \qquad (4)$$

Equation (4) is the standard nonconstant growth DCF model; P_0 is the current stock price; D_t represents the forecasted dividends during the nonconstant growth period; n is the years of nonconstant growth; D_n is the first constant growth dividend; and g_n is the constant, long-run growth rate after year n. Value Line provides D_t values for $t = 1$ and $t = 4$, and we interpolated to obtain D_2 and D_3. Value Line also gives estimates for ROE and for the retention rate (b) in the terminal year, n, so we can forecast the long-term growth rate as $g_n = b(ROE)$. With all the values in Equation (4) specified except k, we can solve for k, which is the DCF rate of return that would result if the Value Line forecasts were met, and, hence, the DCF rate of return implied in the Value Line forecast.[7]

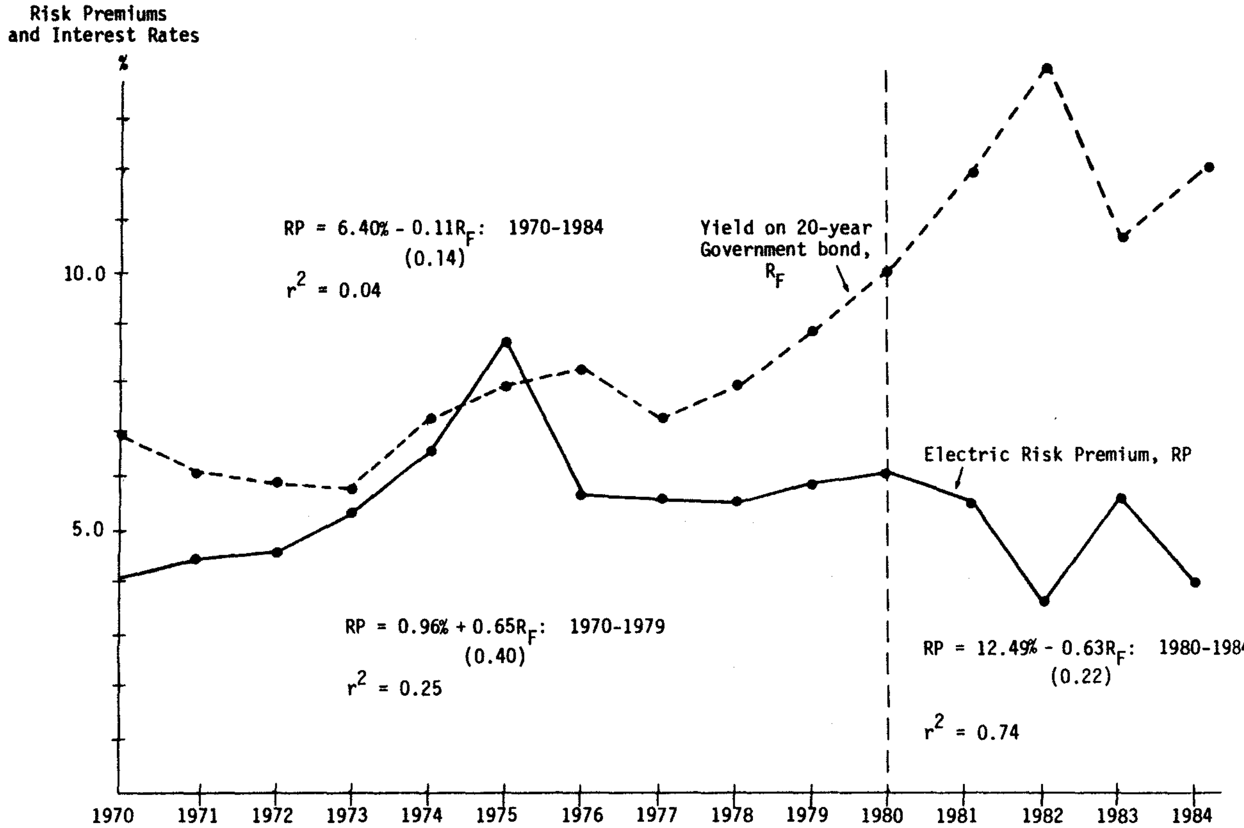
Having estimated a k value for each of the electric and industrial companies, we averaged them (using market-value weights) to obtain a k value for each group, after which we subtracted R_F (taken as the December 31 yield on twenty-year constant maturity Treasury bonds) to obtain the estimated risk premiums shown in Exhibit 2. The premiums for the electrics are plotted in Exhibit 3, along with interest rates. The following points are worthy of note:

1. Risk premiums fluctuate over time. As we shall see in the next section, fluctuations are even wider when measured on a monthly basis.
2. The last column of Exhibit 2 shows that risk premi-

[6]This is a debatable point. Cragg and Malkiel, as well as many practicing analysts, feel that most investors actually focus on five-year forecasts. Others, however, argue that five-year forecasts are too heavily influenced by base-year conditions and/or other nonpermanent conditions for use in the DCF model. We note (i) that most published forecasts do indeed cover five years, (ii) that such forecasts are typically "normalized" in some fashion to alleviate the base-year problem, and (iii) that for relatively stable companies like those in the Dow Jones averages, it generally does not matter greatly if one uses a normalized five-year or a longer-term forecast, because these companies meet the conditions of the constant-growth DCF model rather well.

[7]Value Line actually makes an explicit price forecast for each stock, and one could use this price, along with the forecasted dividends, to develop an expected rate of return. However, Value Line's forecasted stock price builds in a forecasted *change* in k. Therefore, the forecasted price is inappropriate for use in estimating current values of k.

Exhibit 3. Equity Risk Premiums for Electric Utilities and Yields on 20-Year Government Bonds, 1970–1984*



*Standard errors of the coefficients are shown in parentheses below the coefficients.

ums for the utilities increased relative to those for the industrials from the mid-1960s to the mid-1970s. Subsequently, the perceived riskiness of the two groups has, on average, been about the same.

3. Exhibit 3 shows that, from 1970 through 1979, utility risk premiums tended to have a positive association with interest rates: when interest rates rose, so did risk premiums, and vice versa. However, beginning in 1980, an inverse relationship appeared: rising interest rates led to declining risk premiums. We shall discuss this situation further in the next section.

Monthly Data and Results, 1980–1984

In early 1980, we began calculating risk premiums on a monthly basis. At that time, our only source of analysts' forecasts was Value Line, but beginning in 1981 we also obtained Merrill Lynch and Salomon Brothers' data, and then, in mid-1983, we obtained IBES data. Because our focus was on utilities, we restricted our monthly analysis to that group.

Our 1980–1984 monthly risk premium data, along with Treasury bond yields, are shown in Exhibits 4 and 5 and plotted in Exhibits 6, 7, and 8. Here are some comments on these Exhibits:

1. Risk premiums, like interest rates and stock prices, are volatile. Our data indicate that it would not be appropriate to estimate the cost of equity by adding the current cost of debt to a risk premium that had been estimated in the past. Current risk premiums should be matched with current interest rates.
2. Exhibit 6 confirms the 1980–1984 section of Exhibit 3 in that it shows a strong inverse relationship between interest rates and risk premiums; we shall discuss shortly why this relationship holds.
3. Exhibit 7 shows that while risk premiums based on Value Line, Merrill Lynch, and Salomon Brothers

Exhibit 4. Estimated Monthly Risk Premiums for Electric Utilities Using Analysts' Growth Forecasts, January 1980–June 1984

Beginning of Month	Value Line	Merrill Lynch	Salomon Brothers	Average Premiums	20-Year Treasury Bond Yield, Constant Maturity Series
Jan 1980	6.21%	NA	NA	6.21%	10.18%
Feb 1980	5.77%	NA	NA	5.77%	10.86%
Mar 1980	4.73%	NA	NA	4.73%	12.59%
Apr 1980	5.02%	NA	NA	5.02%	12.71%
May 1980	4.73%	NA	NA	4.73%	11.04%
Jun 1980	5.09%	NA	NA	5.09%	10.37%
Jul 1980	5.41%	NA	NA	5.41%	9.86%
Aug 1980	5.72%	NA	NA	5.72%	10.29%
Sep 1980	5.16%	NA	NA	5.16%	11.41%
Oct 1980	5.62%	NA	NA	5.62%	11.75%
Nov 1980	5.09%	NA	NA	5.09%	12.33%
Dec 1980	5.65%	NA	NA	5.65%	12.37%
Annual Avg.	5.35%			5.35%	11.31%
Jan 1981	5.62%	4.76%	5.63%	5.34%	11.99%
Feb 1981	4.82%	4.87%	5.16%	4.95%	12.48%
Mar 1981	4.70%	3.73%	4.97%	4.47%	13.10%
Apr 1981	4.24%	3.23%	4.52%	4.00%	13.11%
May 1981	3.54%	3.24%	4.24%	3.67%	13.51%
Jun 1981	3.57%	4.04%	4.27%	3.96%	13.39%
Jul 1981	3.61%	3.63%	4.16%	3.80%	13.32%
Aug 1981	3.17%	3.05%	3.04%	3.09%	14.23%
Sep 1981	2.11%	2.24%	2.35%	2.23%	14.99%
Oct 1981	2.83%	2.64%	3.24%	2.90%	14.93%
Nov 1981	2.08%	2.49%	3.03%	2.53%	15.27%
Dec 1981	3.72%	3.45%	4.24%	3.80%	13.12%
Annual Avg.	3.67%	3.45%	4.07%	3.73%	13.62%
Jan 1982	3.70%	3.37%	4.04%	3.70%	14.00%
Feb 1982	3.05%	3.37%	3.70%	3.37%	14.37%
Mar 1982	3.15%	3.28%	3.75%	3.39%	13.96%

Beginning of Month	Value Line	Merrill Lynch	Salomon Brothers	Average Premiums	20-Year Treasury Bond Yield, Constant Maturity Series
Apr 1982	3.49%	3.61%	4.29%	3.80%	13.69%
May 1982	3.08%	4.25%	3.91%	3.75%	13.47%
Jun 1982	3.16%	4.51%	4.72%	4.13%	13.53%
Jul 1982	2.57%	4.21%	4.21%	3.66%	14.48%
Aug 1982	4.33%	4.83%	5.27%	4.81%	13.69%
Sep 1982	4.08%	5.14%	5.58%	4.93%	12.40%
Oct 1982	5.35%	5.24%	6.34%	5.64%	11.95%
Nov 1982	5.67%	5.95%	6.91%	6.18%	10.97%
Dec 1982	6.31%	6.71%	7.45%	6.82%	10.52%
Annual Avg.	4.00%	4.54%	5.01%	4.52%	13.09%
Jan 1983	5.64%	6.04%	6.81%	6.16%	10.66%
Feb 1983	4.68%	5.99%	6.10%	5.59%	11.01%
Mar 1983	4.99%	6.89%	6.43%	6.10%	10.71%
Apr 1983	4.75%	5.82%	6.31%	5.63%	10.84%
May 1983	4.50%	6.41%	6.24%	5.72%	10.57%
Jun 1983	4.29%	5.21%	6.16%	5.22%	10.90%
Jul 1983	4.78%	5.72%	6.42%	5.64%	11.12%
Aug 1983	3.89%	4.74%	5.41%	4.68%	11.78%
Sep 1983	4.07%	4.90%	5.57%	4.85%	11.71%
Oct 1983	3.79%	4.64%	5.38%	4.60%	11.64%
Nov 1983	2.84%	3.77%	4.46%	3.69%	11.90%
Dec 1983	3.36%	4.27%	5.00%	4.21%	11.83%
Annual Avg.	4.30%	5.37%	5.86%	5.17%	11.22%
Jan 1984	4.06%	5.04%	5.65%	4.92%	11.97%
Feb 1984	4.25%	5.37%	5.96%	5.19%	11.76%
Mar 1984	4.73%	6.05%	6.38%	5.72%	12.12%
Apr 1984	4.78%	5.33%	6.32%	5.48%	12.51%
May 1984	4.36%	5.30%	6.42%	5.36%	12.78%
Jun 1984	3.54%	4.00%	5.63%	4.39%	13.60%

Exhibit 5. Monthly Risk Premiums Based on IBES Data

Beginning of Month	Average of Merrill Lynch, Salomon Brothers, and Value Line Premiums for Dow Jones Electrics	IBES Premiums for Dow Jones Electrics	IBES Premiums for Entire Electric Industry
Aug 1983	4.68%	4.10%	4.16%
Sep 1983	4.85%	4.43%	4.27%
Oct 1983	4.60%	4.31%	3.90%
Nov 1983	3.69%	3.36%	3.36%
Dec 1983	4.21%	3.86%	3.54%
Jan 1984	4.92%	4.68%	4.18%

Beginning of Month	Average of Merrill Lynch, Salomon Brothers, and Value Line Premiums for Dow Jones Electrics	IBES Premiums for Dow Jones Electrics	IBES Premiums for Entire Electric Industry
Feb 1984	5.19%	5.00%	4.36%
Mar 1984	5.72%	5.35%	4.45%
Apr 1984	5.48%	5.33%	4.23%
May 1984	5.36%	5.26%	4.30%
Jun 1984	4.39%	4.47%	3.40%
Average Premiums	4.83%	4.56%	4.01%

Exhibit 6. Utility Risk Premiums and Interest Rates, 1980–1984

Exhibit 7. Monthly Risk Premiums, Electric Utilities, 1981–1984 (to Date)

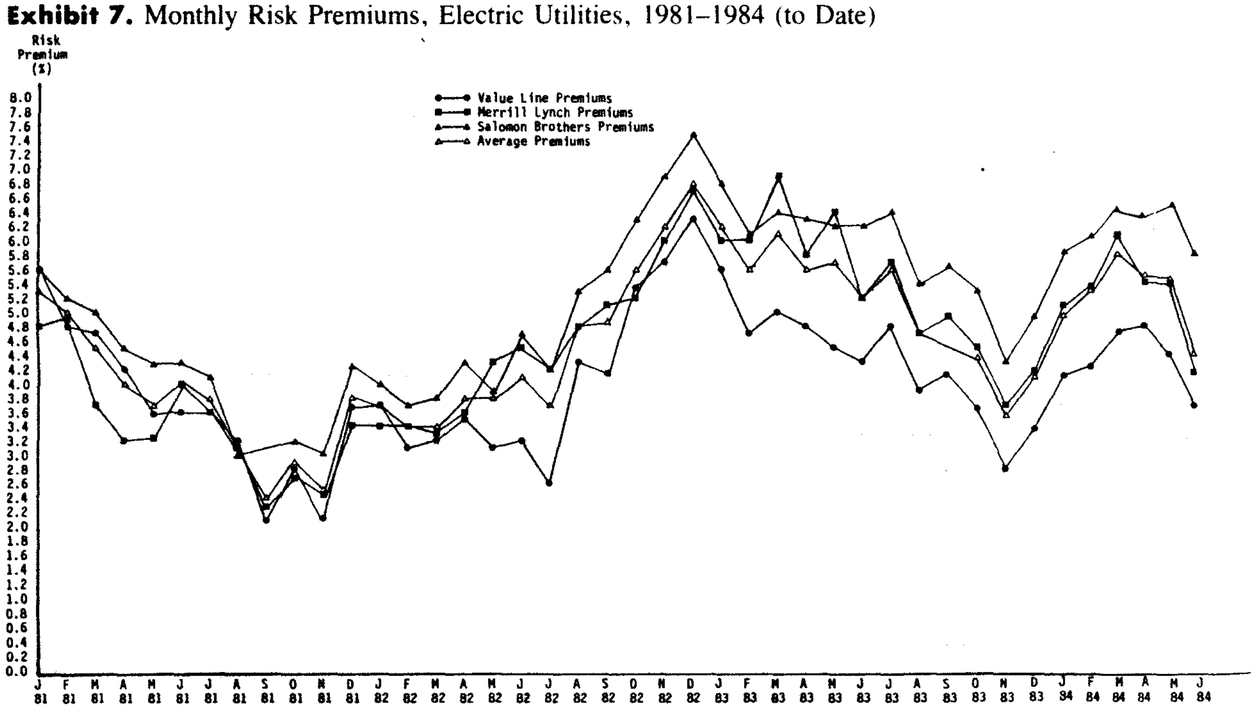
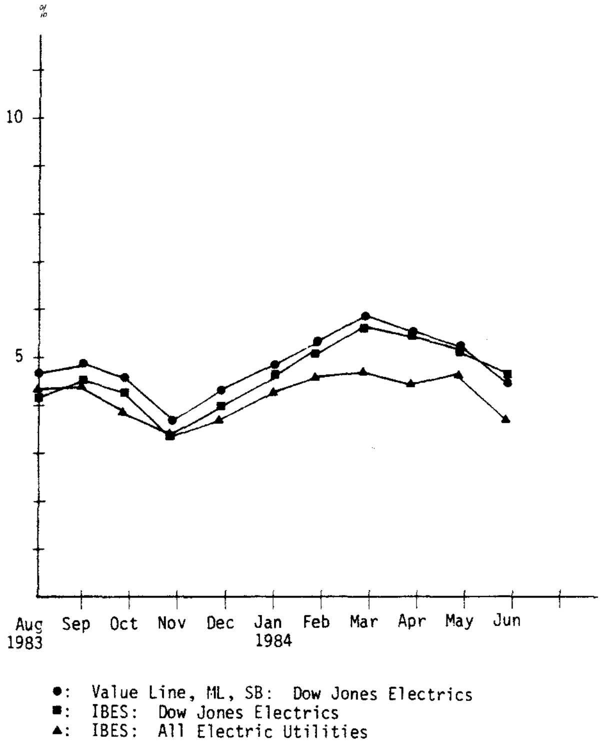


Exhibit 8. Comparative Risk Premium Data



do differ, the differences are not large given the nature of the estimates, and the premiums follow one another closely over time. Since all of the analysts are examining essentially the same data and since utility companies are not competitive with one another, and hence have relatively few secrets, the similarity among the analysts' forecasts is not surprising.

4. The IBES data, presented in Exhibit 5 and plotted in Exhibit 8, contain too few observations to enable us to draw strong conclusions, but (i) the Dow Jones Electrics risk premiums based on our three-analyst data have averaged 27 basis points above premiums based on the larger group of analysts surveyed by IBES and (ii) the premiums on the 11 Dow Jones Electrics have averaged 54 basis points higher than premiums for the entire utility industry followed by IBES. Given the variability in the data, we are, at this point, inclined to attribute these differences to random fluctuations, but as more data become available, it may turn out that the differences are statistically significant. In particular, the 11 electric utilities included in the Dow Jones Utility Index all have large nuclear investments, and this may cause them to be regarded as riskier than the industry average, which includes both nuclear and non-nuclear companies.

Tests of the Reasonableness of the Risk Premium Estimates

So far our claims to the reasonableness of our risk-premium estimates have been based on the reasonableness of our variable measures, particularly the measures of expected dividend growth rates. Essentially, we have argued that since there is strong evidence in the literature in support of analysts' forecasts, risk premiums based on these forecasts are reasonable. In the spirit of positive economics, however, it is also important to demonstrate the reasonableness of our results more directly.

It is theoretically possible to test for the validity of the risk-premium estimates in a CAPM framework. In a cross-sectional estimate of the CAPM equation,

$$(k - R_F)_i = \alpha_0 + \alpha_1\beta_i + u_i, \qquad (5)$$

we would expect

$$\hat{\alpha}_0 = 0 \text{ and } \hat{\alpha}_1 = k_M - R_F = \text{Market risk premium.}$$

This test, of course, would be a joint test of both the CAPM and the reasonableness of our risk-premium estimates. There is a great deal of evidence that questions the empirical validity of the CAPM, especially when applied to regulated utilities. Under these conditions, it is obvious that no unambiguous conclusion can be drawn regarding the efficacy of the premium estimates from such a test.[8]

A simpler and less ambiguous test is to show that the risk premiums are higher for lower rated firms than for higher rated firms. Using 1984 data, we classified the

[8]We carried out the test on a monthly basis for 1984 and found positive but statistically insignificant coefficients. A typical result (for April 1984) follows:

$$(k - R_F)_i = \underset{(0.91)}{3.1675} + \underset{(1.44)}{1.8031}\,\beta_i.$$

The figures in parentheses are standard errors. Utility risk premiums do increase with betas, but the intercept term is not zero as the CAPM would predict, and α_1 is both less than the predicted value and not statistically significant. Again, the observation that the coefficients do not conform to CAPM predictions could be as much a problem with CAPM specification for utilities as with the risk premium estimates.

A similar test was carried out by Friend, Westerfield, and Granito [9]. They tested the CAPM using expectational (survey) data rather than *ex post* holding period returns. They actually found their coefficient of β_i to be negative in all their cross-sectional tests.

Exhibit 9. Relationship between Risk Premiums and Bond Ratings, 1984*

Month	Aaa/AA	AA	Aa/A	A	A/BBB	BBB	Below BBB
January†	—	2.61%	3.06%	3.70%	5.07%	4.90%	9.45%
February	2.98%	3.17%	3.36%	4.03%	5.26%	5.14%	7.97%
March	2.34%	3.46%	3.29%	4.06%	5.43%	5.02%	8.28%
April	2.37%	3.03%	3.29%	3.88%	5.29%	4.97%	6.96%
May	2.00%	2.48%	3.42%	3.72%	4.72%	6.64%	8.81%
June	0.72%	2.17%	2.46%	3.16%	3.76%	5.00%	5.58%
Average	2.08%	2.82%	3.15%	3.76%	4.92%	5.28%	7.84%

*The risk premiums are based on IBES data for the electric utilities followed by both IBES and Salomon Brothers. The number of electric utilities followed by both firms varies from month to month. For the period between January and June 1984, the number of electrics followed by both firms ranged from 96 to 99 utilities.
†In January, there were no Aaa/AA companies. Subsequently, four utilities were upgraded to Aaa/AA.

utility industry into risk groups based on bond ratings. For each rating group, we estimated the average risk premium. The results, presented in Exhibit 9, clearly show that the lower the bond rating, the higher the risk premiums. Our premium estimates therefore would appear to pass this simple test of reasonableness.

Risk Premiums and Interest Rates

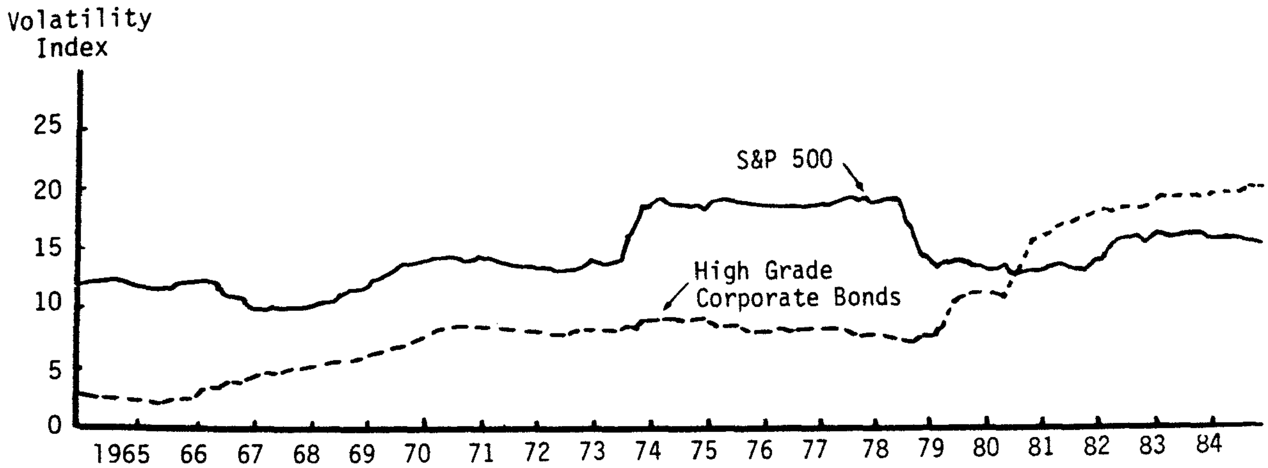
Traditionally, stocks have been regarded as being riskier than bonds because bondholders have a prior claim on earnings and assets. That is, stockholders stand at the end of the line and receive income and/or assets only after the claims of bondholders have been satisfied. However, if interest rates fluctuate, then the holders of long-term bonds can suffer losses (either realized or in an opportunity cost sense) even though they receive all contractually due payments. Therefore, if investors' worries about "interest rate risk" versus "earning power risk" vary over time, then perceived risk differentials between stocks and bonds, and hence risk premiums, will also vary.

Any number of events could occur to cause the perceived riskiness of stocks versus bonds to change, but probably the most pervasive factor, over the 1966–1984 period, is related to inflation. Inflationary expectations are, of course, reflected in interest rates. Therefore, one might expect to find a relationship between risk premiums and interest rates. As we noted in our discussion of Exhibit 3, risk premiums were positively correlated with interest rates from 1966 through 1979, but, beginning in 1980, the relationship turned negative. A possible explanation for this change is given next.

1966–1979 Period. During this period, inflation heated up, fuel prices soared, environmental problems surfaced, and demand for electricity slowed even as expensive new generating units were nearing completion. These cost increases required offsetting rate hikes to maintain profit levels. However, political pressure, combined with administrative procedures that were not designed to deal with a volatile economic environment, led to long periods of "regulatory lag" that caused utilities' earned ROEs to decline in absolute terms and to fall far below the cost of equity. These factors combined to cause utility stockholders to experience huge losses: S&P's Electric Index dropped from a mid-1960s high of 60.90 to a mid-1970s low of 20.41, a decrease of 66.5%. Industrial stocks also suffered losses during this period, but, on average, they were only one third as severe as the utilities' losses. Similarly, investors in long-term bonds had losses, but bond losses were less than half those of utility stocks. Note also that, during this period, (i) bond investors were able to reinvest coupons and maturity payments at rising rates, whereas the earned returns on equity did not rise, and (ii) utilities were providing a rising share of their operating income to debtholders versus stockholders (interest expense/book value of debt was rising, while net income/common equity was declining). This led to a widespread belief that utility commissions would provide enough revenues to keep utilities from going bankrupt (barring a disaster), and hence to protect the bondholders, but that they would not necessarily provide enough revenues either to permit the expected rate of dividend growth to occur or, perhaps, even to allow the dividend to be maintained.

Because of these experiences, investors came to regard inflation as having a more negative effect on utility stocks than on bonds. Therefore, when fears of inflation increased, utilities' measured risk premiums

Exhibit 10. Relative Volatility* of Stocks and Bonds, 1965–1984



*Volatility is measured as the standard deviation of total returns over the last 5 years.
Source: Merrill Lynch, *Quantitative Analysis*, May/June 1984.

also increased. A regression over the period 1966–1979, using our Exhibit 2 data, produced this result:

$$RP = 0.30\% + \underset{(0.22)}{0.73}\, R_F; \qquad r^2 = 0.48.$$

This indicates that a one percentage point increase in the Treasury bond rate produced, on average, a 0.73 percentage point increase in the risk premium, and hence a 1.00 + 0.73 = 1.73 percentage point increase in the cost of equity for utilities.

1980–1984 Period. The situation changed dramatically in 1980 and thereafter. Except for a few companies with nuclear construction problems, the utilities' financial situations stabilized in the early 1980s, and then improved significantly from 1982 to 1984. Both the companies and their regulators were learning to live with inflation; many construction programs were completed; regulatory lags were shortened; and in general the situation was much better for utility equity investors. In the meantime, over most of the 1980–1984 period, interest rates and bond prices fluctuated violently, both in an absolute sense and relative to common stocks. Exhibit 10 shows the volatility of corporate bonds very clearly. Over most of the eighteen-year period, stock returns were much more volatile than returns on bonds. However, that situation changed in October 1979, when the Fed began to focus on the money supply rather than on interest rates.[9]

In the 1980–1984 period, an increase in inflationary expectations has had a more adverse effect on bonds than on utility stocks. If the expected rate of inflation increases, then interest rates *will increase* and bond prices *will fall*. Thus, uncertainty about inflation translates directly into risk in the bond markets. The effect of inflation on stocks, including utility stocks, is less clear. If inflation increases, then utilities should, in theory, be able to obtain rate increases that would offset increases in operating costs and also compensate for the higher cost of equity. Thus, with "proper" regulation, utility stocks would provide a better hedge against unanticipated inflation than would bonds. This hedge did not work at all well during the 1966–1979 period, because inflation-induced increases in operating and capital costs were not offset by timely rate increases. However, as noted earlier, both the utilities and their regulators seem to have learned to live better with inflation during the 1980s.

Since inflation is today regarded as a major investment risk, and since utility stocks now seem to provide a better hedge against unanticipated inflation than do

[9]Because the standard deviations in Exhibit 10 are based on the last five years of data, even if bond returns stabilize, as they did beginning in 1982, their reported volatility will remain high for several more years. Thus, Exhibit 10 gives a rough indication of the current relative riskiness of stocks versus bonds, but the measure is by no means precise or necessarily indicative of future expectations.

bonds, the interest-rate risk inherent in bonds offsets, to a greater extent than was true earlier, the higher operating risk that is inherent in equities. Therefore, when inflationary fears rise, the perceived riskiness of bonds rises, helping to push up interest rates. However, since investors are today less concerned about inflation's impact on utility stocks than on bonds, the utilities' cost of equity does not rise as much as that of debt, so the observed risk premium tends to fall.

For the 1980–1984 period, we found the following relationship (see Exhibit 6):

$$RP = 12.53\% - \underset{(0.05)}{0.63}\ R_F; \qquad r^2 = 0.73.$$

Thus, a one percentage point increase in the T-bond rate, on average, caused the risk premium to fall by 0.63%, and hence it led to a 1.00 − 0.63 = 0.37 percentage point increase in the cost of equity to an average utility. This contrasts sharply with the pre-1980 period, when a one percentage point increase in interest rates led, on average, to a 1.73 percentage point increase in the cost of equity.

Summary and Implications

We began by reviewing a number of earlier studies. From them, we concluded that, for cost of capital estimation purposes, risk premiums must be based on expectations, not on past realized holding period returns. Next, we noted that expectational risk premiums may be estimated either from surveys, such as the ones Charles Benore has conducted, or by use of DCF techniques. Further, we found that, although growth rates for use in the DCF model can be either developed from time-series data or obtained from security analysts, analysts' growth forecasts are more reflective of investors' views, and, hence, in our opinion are preferable for use in risk-premium studies.

Using analysts' growth rates and the DCF model, we estimated risk premiums over several different periods. From 1966 to 1984, risk premiums for both electric utilities and industrial stocks varied widely from year to year. Also, during the first half of the period, the utilities had smaller risk premiums than the industrials, but after the mid-1970s, the risk premiums for the two groups were, on average, about equal.

The effects of changing interest rates on risk premiums shifted dramatically in 1980, at least for the utilities. From 1965 through 1979, inflation generally had a more severe adverse effect on utility stocks than on bonds, and, as a result, an increase in inflationary expectations, as reflected in interest rates, caused an increase in equity risk premiums. However, in 1980 and thereafter, rising inflation and interest rates increased the perceived riskiness of bonds more than that of utility equities, so the relationship between interest rates and utility risk premiums shifted from positive to negative. Earlier, a 1.00 percentage point increase in interest rates had led, on average, to a 1.73% increase in the utilities' cost of equity, but after 1980 a 1.00 percentage point increase in the cost of debt was associated with an increase of only 0.37% in the cost of equity.

Our study also has implications for the use of the CAPM to estimate the cost of equity for utilities. The CAPM studies that we have seen typically use either Ibbotson-Sinquefield or similar historic holding period returns as the basis for estimating the market risk premium. Such usage implicitly assumes (i) that *ex post* returns data can be used to proxy *ex ante* expectations and (ii) that the market risk premium is relatively stable over time. Our analysis suggests that neither of these assumptions is correct; at least for utility stocks, *ex post* returns data do not appear to be reflective of *ex ante* expectations, and risk premiums are volatile, not stable.

Unstable risk premiums also make us question the FERC and FCC proposals to estimate a risk premium for the utilities every two years and then to add this premium to a current Treasury bond rate to determine a utility's cost of equity. Administratively, this proposal would be easy to handle, but risk premiums are simply too volatile to be left in place for two years.

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What Risk Premium Is "Normal"?

Robert D. Arnott and Peter L. Bernstein

The goal of this article is an estimate of the objective forward-looking U.S. equity risk premium relative to bonds through history—specifically, since 1802. For correct evaluation, such a complex topic requires several careful steps: To gauge the risk premium for stocks relative to bonds, we need an expected real stock return and an expected real bond return. To gauge the expected real bond return, we need both bond yields and an estimate of expected inflation through history. To gauge the expected real stock return, we need both stock dividend yields and an estimate of expected real dividend growth. Accordingly, we go through each of these steps. We demonstrate that the long-term forward-looking risk premium is nowhere near the level of the past; today, it may well be near zero, perhaps even negative.

The investment management industry thrives on the expedient of forecasting the future by extrapolating the past. As a consequence, U.S. investors have grown accustomed to the idea that stocks "normally" produce an 8 percent real return and a 5 percent (that is, 500 basis point) risk premium over bonds, compounded annually over many decades.[1] Why? Because long-term historical returns have been in this range with impressive consistency. And because investors see these same long-term historical numbers year after year, these expectations are now embedded in the collective psyche of the investment community.[2]

Both the return and the risk premium assumptions are unrealistic when viewed from current market levels. Few have acknowledged that an important part of the lofty real returns of the past stemmed from rising valuation levels and from high dividend yields, which have since diminished. As we will demonstrate, the long-term forward-looking risk premium is nowhere near the 5 percent level of the past; indeed, today, it may well be near zero, perhaps even negative. Credible studies in and outside the United States are challenging the flawed conventional view. Well-researched studies by Claus and Thomas (2001) and Fama and French (2000) are just two (see also Arnott and Ryan 2001). Similarly, the long-term forward-looking real return from stocks is nowhere near history's 8 percent. We argue that, barring unprecedented economic growth or unprecedented growth in earnings as a percentage of the economy, real stock returns will probably be roughly 2–4 percent, similar to bond returns. In fact, even this low real return figure assumes that current near-record valuation levels are "fair" and likely to remain this high in the years ahead. "Reversion to the mean" would push future real returns lower still.

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Furthermore, if we examine the historical record, neither the 8 percent real return nor the 5 percent risk premium for stocks relative to government bonds has ever been a realistic *expectation*, except from major market bottoms or at times of crisis, such as wartime. But this topic merits careful exploration. After all, according to the Ibbotson Associates data, equity investors earned 8 percent real returns and stocks have outpaced bonds by more than 5 percent over the past 75 years. Intuition suggests that investors should not require such outsized returns in order to bear equity market risk. Should investors have expected these returns in the past, and why shouldn't they continue to do so? We examine these questions expressed in a slightly different way. First, can we derive an objective estimate of what investors had good reasons to expect in the past? Second, why should we expect less in the future than we have earned in the past?

The answers to both questions lie in the difference between the *observed* excess return and the *prospective* risk premium, two fundamentally different concepts that, unfortunately, carry the same label—risk premium. If we distinguish between past excess returns and future expected risk premiums, the idea that future risk premiums should be different from past excess returns is not at all unreasonable.[3]

This complex topic requires several careful steps if it is to be evaluated correctly. To gauge the risk premium for stocks relative to bonds, we need an expected real bond return and an expected real stock return. To gauge the expected real bond return, we need both bond yields and an estimate of expected inflation through history. To gauge the expected real stock return, we need both stock dividend yields and an estimate of expected real dividend growth. Accordingly, we go through each of these steps, in reverse order, to form the building blocks for the final goal—an estimate of the objective forward-looking equity risk premium relative to bonds through history.

Has the Risk Premium Natural Limits?

For equities to have a zero or negative risk premium relative to bonds would be unnatural because stocks are, on average over time, more volatile than bonds. Even if volatility were not an issue, stocks are a secondary call on the resources of a company; bondholders have the first call. Because the risk premium is usually measured for corporate stocks as compared with government debt obligations (U.S. T-bonds or T-bills), the comparison is even more stark. Stocks should be priced to offer a superior return relative to *corporate* bonds, which should offer a premium yield (because of default risk and tax differences) relative to T-bonds, which should typically offer a premium yield (because of yield-curve risk) relative to T-bills. After all, long bonds have greater duration—hence, greater volatility of price in response to yield changes—so a capital loss is easier on a T-bond than on a T-bill.

In other words, the current circumstance, in which stocks appear to have a near-zero (or negative) risk premium relative to government bonds, is abnormal in the extreme. Even if we add 100 bps to the risk premium to allow for the impact of stock buybacks, today's risk premium relative to the more relevant corporate bond alternatives is still negligible or negative. This facet was demonstrated in Arnott and Ryan and is explored further in this article.

If zero is the natural minimum risk premium, is there a natural maximum? Not really. In times of financial distress, in which the collapse of a nation's economy, hyperinflation, war, or revolution threatens the capital base, expecting a large reward for exposing capital to risk is not unreasonable. Our analysis suggests that the U.S. equity risk premium approached or exceeded 10 percent during the Civil War, during the Great Depression, and in the wake of World Wars I and II. That said, however, it is difficult to see how one might objectively measure the forward-looking risk premium in such conditions.

A 5 percent excess return on stocks over bonds compounds so mightily over long spans that most serious fiduciaries, if they believed stocks were going to earn a 5 percent risk premium, would not even consider including bonds in a portfolio with a horizon of more than a few years: The probabilities of stocks outperforming bonds would be too high to resist.[4] Hence, under so-called normal conditions—encompassing booms and recessions, bull and bear markets, and "ordinary" economic stresses—a good explanation is hard to find for why expected long-term real returns should ever reach double digits or why the expected long-term risk premium of stocks over bonds should ever exceed about 5 percent. These upper bounds for expected real returns or for the risk premium, unlike the lower bound of zero, are "soft" limits; in times of real crisis or distress, the sky's the limit.

Expected versus "Hoped-For" Returns

Throughout this article, we deal with *expected* returns and *expected* risk premiums. This concept is rooted in objective data and defensible expectations for portfolio returns, rather than in the returns that an investor might *hope* to earn. The distinction is subtle; both represent expectations, but one is objective and the other subjective. Even at times in the past when valuation levels were high and when stockholders would have had no objective reason to expect any growth in real dividends over the long run, hopes of better-than-market short-term profits have always been the primary lure into the game.[5]

When we refer to expected returns or expected risk premiums, we are referring to the estimated future returns and risk premiums that an objective evaluation—based on past rates of growth of the economy, past and prospective rates of inflation, current stock and bond yields, and so forth—might have supported at the time. We explicitly do not include any extrapolation of past returns per se, because past returns are driven largely by changes in valuation levels (e.g., changes in yields), which in an efficient market, investors should not expect to continue into the indefinite future. By the same token, we explicitly do not presume any reversion to the mean, in which high yields or low yields are presumed to revert toward historical norms. We presume that the current yield is "fair" and is an unbiased estimator of future yields, both for stocks and bonds.

Few investors subjectively expect returns as low as the objective returns produced by this sort of analysis. In a recent study by Welch (2000), 236 financial economists projected, on average, a 7.2 percent risk premium for stocks relative to T-bills over the next 30 years. If we assume that T-bills offer the same 0.7 percent real return in the future that they have offered over the past 75 years, then stocks must be expected to offer a compounded geometric average real return of about 6.6 percent.[6] Given a dividend yield of roughly 1.5 percent in 1998–1999, when the survey was being carried out, the 236 economists in the survey were clearly presuming that dividend and earnings growth will be at least 5 percent a year above inflation, a rate of real growth three to five times the long-term historical norm and substantially faster than plausible long-term economic growth.

Indeed, even if investors take seriously the real return estimates and risk premiums produced by the sort of objective analysis we propose, many of them will continue to believe that their own investments cannot fail to do better. Suppose they agree with us that stocks and bonds are priced to deliver 2–4 percent real returns before taxes.[7] Do they believe that *their* investments will produce such uninspired pretax real returns? Doubtful. If these kinds of projections were taken seriously, markets would be at far different levels from where they are. Consequently, if these objective expectations are correct, most investors will be wrong in their (our?) subjective expectations.

What Were Investors Expecting in 1926

Are we being reasonable to suggest that, after a 75-year span with 8 percent real stock returns and a 5 percent excess return over bonds (the Ibbotson findings), an 8 percent real return or a 5 percent risk premium is abnormal? Absolutely. The relevant question is whether the investors of 1926 would have had reason to *expect* these extraordinary returns. In fact, they would not. What they got was different from what they should have expected, which is a normal result in a world of uncertainty.

At the start of 1926, the beginning of the returns covered in the Ibbotson data, investors had no reason to expect the 8 percent real returns that have been earned over the past 75 years nor that these returns would provide a 5 percent excess return over bonds. As we will describe, these outcomes were the consequence of a series of historical accidents that uniformly helped stocks and/or helped the risk premium.

Consider what investors might objectively have expected at the start of 1926 from their long-term investments in stocks and bonds. In January that year, government bonds were yielding 3.7 percent. The United States was on a gold standard, government was small relative to the economy as a whole, and the price level of consumer goods, although volatile, had been trendless throughout most of U.S. history up to that moment; thus, inflation expectations were nil. It was a time of relative stability and prosperity, so investors would have had no reason to expect to receive less than this 3.7 percent government bond yield. Accordingly, the *real* return that investors would have expected on their government bonds was 3.7 percent, plain and simple.

Meanwhile, the dividend yield on stocks was 5.1 percent. We can take that number as the starting point to apply the sound theoretical notion that the real return on stocks is equal to

- the dividend yield
- plus (or minus) any change in the real dividend (now viewed as participation in economic growth)
- plus (or minus) any change in valuation levels, as measured by P/E multiples or dividend yields.

What did the investors expect of stocks in early 1926? The time was the tail end of the era of "robber baron" capitalism. As Chancellor (1999) observed, investors were accustomed to the fact that company managers would often dilute shareholders' returns if an enterprise was successful but that the shareholder was a full partner in any business decline. More important was the fact that the long-run history of the market was trendless. Thoughts of long-term economic growth, or long-run capital appreciation in equity holdings, were simply not part of the tool kit for return calculations in those days.

Investors generally did not yet consider stocks to be "growth" investments, although a few people were beginning to acknowledge the full import of Smith's extraordinary study *Common Stocks as Long-Term Investments*, which had appeared in 1924. Smith demonstrated how stocks had outperformed bonds over the 1901–22 period.[8] His work became the bible of the bulls as the bubble of the late 1920s progressed. Prior to 1926, however, investors continued to follow J.P. Morgan's dictum that the market would fluctuate, a traditional view hallowed by more than 100 years of stock market history. In other words, investors had no *trend* in mind. The effort was to buy low and to sell high, period.

Assuming that markets were fairly priced in early 1926, investors should have expected little or no benefit from rising valuation levels. Accordingly, the real long-term return that stock investors could reasonably have expected on average, or from the market as a whole, was the 5.1 percent dividend yield, give or take a little. Thus, stock investors would have expected roughly a 1.4 percent risk premium over bonds, not the 5 percent they actually earned in the next 75 years. The market exceeded objective expectations as a consequence of a series of historical accidents:

- *Historical accident #1: Decoupling yields from real yields.* The Great Depression (roughly 1929–1939) introduced a revolutionary increase in the role of government in peacetime economic policy and, simultaneously, drove the United States (and just about the rest of the world) off the gold standard. As prosperity came back in a big way after World War II, expected inflation became a normal part of bond valuation. This change created a one-time shock to bonds that decoupled nominal yields from real yields and drove nominal yields higher even as real yields fell. Real yields at year-end 2001 were 3.4 percent (the Treasury Inflation-Indexed Securities, commonly called TIPS, yield[9]), but nominal yields were 5.8 percent. This rise in nominal yields (with real yields holding steady) has cost bondholders 0.4 percent a year over 75 years. That accident alone accounts for nearly one-tenth of the 75-year excess return for stocks relative to bonds.
- *Historical accident #2: Rising valuation multiples.* Between 1926 and 2001, stocks rose from a valuation level of 18 times dividends to nearly 70 times dividends. This fourfold increase in the value assigned to each dollar of dividends contributed 180 bps to annual stock returns over the past 75 years, even though the entire increase occurred in the last 17 years of the period (we last saw 5.1 percent yields in 1984). This accident explains fully one-third of the 75-year excess return.
- *Historical accident #3: Survivor bias.* Since 1926, the United States has fought no wars on its own soil, nor has it experienced revolution. Four of the fifteen largest stock markets in the world in 1900 suffered a total loss of capital, a –100 percent return, at some point in the past century. The markets are China, Russia, Argentina, and Egypt. Two others came close—Germany (twice) and Japan. Note that war or revolution can wipe out bonds as easily as stocks (which makes the concept of "risk premium" less than relevant). U.S. investors in early 1926 would *not* have considered this likelihood to be zero, nor should today's true long-term investor.
- *Historical accident #4: Regulatory reform.* Stocks have gone from passing relatively little economic growth through to shareholders to passing much of the economic growth through to shareholders. This shift has led to 1.4 percent a year growth in real dividend payments and in real earnings since 1926. This accelerated growth in real dividends and earnings, which no one in 1926 could have anticipated, explains roughly one-fourth of the 75-year excess return.[10]

In short, the equity investors of 1926 probably expected to earn a real return little different from their 5.1 percent yield and expected to earn little more than the 140 bp yield differential over bonds. Indeed, an objective investor might have expected a notch less because of the greater frequency with which investors encountered dividend cuts in those days.

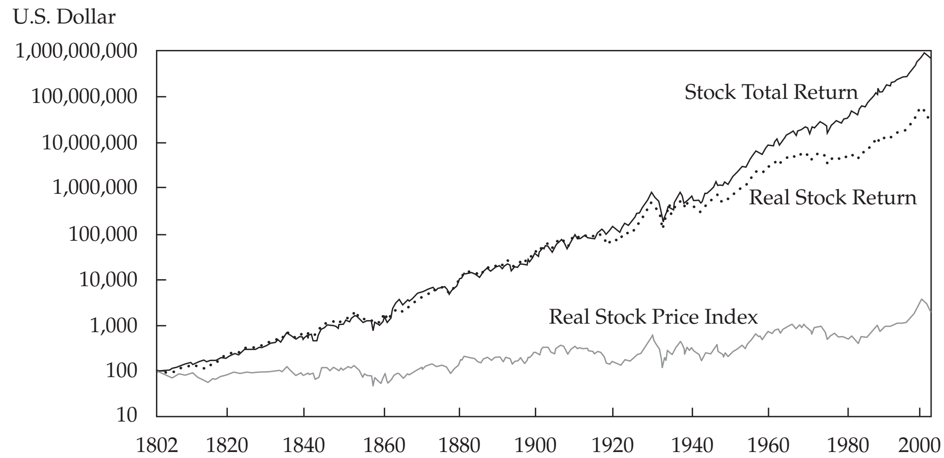
What Expectations Were Realistic in the Past?

To gauge what risk premium an investor might have objectively expected in the longer run past, we need to (1) estimate the real return that investors might reasonably have expected from stocks, (2) estimate the real return that investors might reasonably have expected from bonds, and (3) take the difference. From this exercise, we can gauge what risk premium an investor might reasonably have expected at any point in history, not simply an isolated snapshot of early 1926. A brief review of the sources of stock returns over the past two centuries should help lay a foundation for our work on return expectations and shatter a few widespread misconceptions in the process. The sources of the data are given in Appendix A.[11]

Step I: How Well Does Economic Growth Flow into Dividend Growth? Over the past 131 years, since reliable earnings data became available in 1870, the average earnings yield has been 7.6 percent and the average real return for stocks has been 7.2 percent; this close match has persuaded many observers to the view (which is wholly consistent with finance theory) that the best estimate for real returns is, quite simply, the earnings yield. On careful examination, this hypothesis turns out to be wrong. In the absence of changing valuation levels, real returns are systematically *lower* than earnings yields.

Figure 1 shows stock market returns since 1802 in a fashion somewhat different from that shown in most of the literature. The solid line in Figure 1 shows the familiar cumulative total return for U.S. equities since 1802, in which each $100 invested grows, with reinvestment of dividends, to almost $700 million in 200 years. To be sure, some of this growth came from inflation; as the line "Real Stock Return" shows, $700 million will not buy what it

Figure 1. Return from Inflation and Dividends: Growth of $100, 1801–2001

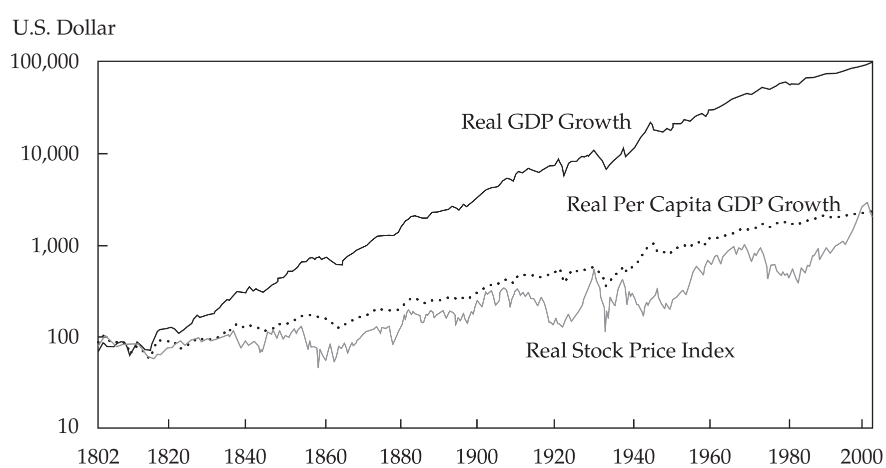


would have in 1802, when one could have purchased the entire U.S. GNP for less than that sum.[12] By removing inflation, we show in the "Real Stock Return" line that the $100 investment grew to "only" $37 million. Thus, adjusted for inflation, our fortune is much diminished but still impressive. Few portfolios are constructed without some plans for future spending, and the dividends that stocks pay are often spent. So, the "Real Stock Price Index" line shows the wealth accumulation from price appreciation alone, net of inflation and dividends. This bottom line (literally and figuratively) reveals that stocks have risen just 20-fold from 1802 levels. Put another way, if an investor had placed $100 in stocks in 1802 and received and spent the average dividend yield of 4.9 percent for the next 200 years, his or her descendants would today have a portfolio worth $2,099, net of inflation. So much for our $700 million portfolio!

Worse, the lion's share of the growth from $100 to $2,099 occurred in the massive bull market from 1982 to date. In the 180 years from 1802 to the start of 1982, the real value of the $100 portfolio had grown to a mere $400. If stocks were priced today at the same dividend yields as they were in 1802 and 1982, a yield of 5.4 percent, the $100 portfolio would be worth today, net of inflation and dividends, just $550. These data put the lie to the conventional view that equities derive most of their returns from capital appreciation, that income is far less important, if not irrelevant.

Figure 2 allows a closer look at the link between equity price appreciation and economic growth. It shows that the growth in share prices is much more closely tied to the growth in real *per capita* GDP (or GNP) than to growth in real GDP per se. The solid line shows that, compounding at about 4 percent in the 1800s and 3 percent in the 1900s, the economy itself delivered an impressive 1,000-fold growth.

Figure 2. The Link between Stock Prices and Economic Growth, 1802–2001



But net of inflation and dividend distributions, stock prices (the same "Real Stock Price Index" line in Figure 1) fell far behind, with cumulative real price appreciation barely 1/50 as large as the real growth in the economy itself.

How can this be? Can't shareholders expect to participate in the growth of the economy? No. Shareholders can expect to participate *only in the growth of the enterprises they are investing in*. An important engine for economic growth is the creation of new enterprises. The investor in today's enterprises does not own tomorrow's new enterprises—not without making a separate investment in those new enterprises with new investment capital.

Finally, the "Real Per Capita GDP Growth" line in Figure 2 shows the growth of the economy measured net of inflation *and population growth.* This growth in real per capita GDP tracks much more closely with the real price appreciation of stocks (the bottom line) than does real GDP itself.

Going one step further, **Figure 3** shows the internal growth of real dividends—that is, the growth that an index fund would expect to see in its own real dividends in the absence of additional investments, such as reinvestment of dividends.[13] Real dividends exhibit *internal* growth that is similar to the growth in real per capita GDP. Because growth in per capita GDP is a measure of productivity growth, the internal growth that can be sustained in a diversified market portfolio should closely match the growth of *productivity* in the economy, not the growth in the economy per se. Therefore, the dotted line traces per capita real GDP growth, the "Real Stock Price Index" line shows real stock prices, and the bottom line shows real dividends (× 10).[14] Figure 3 reveals the remarkable resemblance between real dividend growth and growth in real per capita GDP.

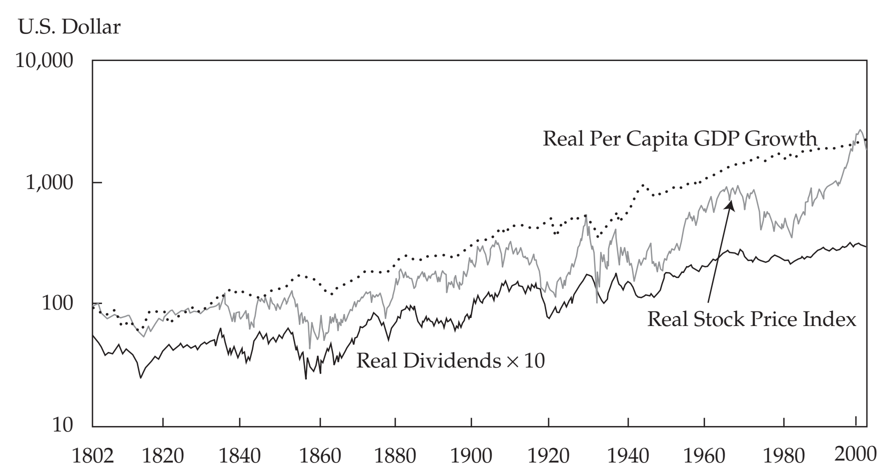
When we measure the internal growth of real dividends as in Figure 3, we see that real dividends have risen a modest fivefold from 1802 levels. In other words, the real dividends for a $100 portfolio invested in 1802 have grown merely 0.9 percent a year net of inflation. To be sure, the price assigned to each dollar of dividends has quadrupled, which leads to the 20-fold real price gain in the 200 years.

Although real dividends have tracked remarkably well with real per capita GDP, they have consistently fallen short of GDP gains. Not only have real dividends failed to match real GDP growth (as many equity investors seem to think is a *minimal* future growth rate for earnings and dividends), they have even had a modest shortfall, at an average of about 70 bps a year, relative to per capita economic growth.

In short, more than 85 percent of the return on stocks over the past 200 years has come from (1) inflation, (2) the dividends that stocks have paid, and (3) the rising valuation levels (rising P/Es and falling dividend yields) since 1982, not from growth in the underlying fundamentals of real dividends or earnings.[15] Furthermore, real dividends and real per capita GDP both grew faster in the 20th century than in the 19th century. Conversely, GDP grew faster in the 19th century than in the 20th century, *unless* we convert to per capita GDP.

Many observers think that earnings growth is far more important than dividend growth. We respectfully disagree. As noted by Hicks (1946), ". . . any increase in the present value of prospective net receipts must raise profits." In other words, properly stated, earnings should represent a proportional share of the net present value of all future

Figure 3. Dividends and Economic Growth, 1802–2001



profits. The problem is that reported earnings often do not follow this theoretical definition. For example, negative earnings should almost never be reported, yet reported operating losses are not uncommon. Furthermore, the quality of earnings reports prior to the advent of the U.S. SEC is doubtful at best; worse, we were unable to find any good source for earnings information prior to 1870. Accordingly, the dividend is the one reliable aspect of stock ownership over the past two centuries. It is the cash income returned to the shareholders; it is the means by which the long-term investor earns most of his or her internal rate of return. Finally, with earnings growth barely 0.3 percent faster than dividend growth over the past 131 years, an analysis based on earnings would reach conclusions nearly identical to our conclusions based on dividends.

Finance theory tells us that capital is fungible; that is, equity and debt, retained earnings and dividends—all should flow to the best use of capital and should (in the absence of tax-related arbitrages and other nonsystematic disruptions) produce a similar risk-adjusted return on capital. Thus, the retained earnings should deliver a return similar to the return an investor could have earned on that capital had it been paid out as dividends. Consider an example: If a company has an earnings yield of 5 percent (corresponding to a P/E of 20), it can pay out all of the earnings and thereby deliver a 5 percent yield to the shareholder. The real value of the company should not be affected by this full earnings distribution (unless the earnings are themselves being misstated), so the 5 percent earnings yield should also be the expected real return. Now, if the company, instead, pays a 2 percent yield and retains earnings worth 3 percent of the stock price, the company ought to achieve 3 percent real growth in earnings; otherwise, it should have distributed the cash to the shareholders. How does this theory stand up to reality?

Over the past 200 years, dividend yields have averaged 4.9 percent, yet real returns have been far higher, 6.6 percent. Since 1870, earnings yields have averaged 7.6 percent, close to the real returns of 7.2 percent over that span. This outcome is consistent with the notion of fungible capital, that the return on capital reinvested in an enterprise ought to match the return an investor might otherwise have earned on that same capital if it had been distributed as a dividend. However, if we take out the changes in valuation levels since 1982 (regardless of whether dividend yields or P/Es are used for those levels), the close match between earnings yield and real stock returns evaporates.

Moreover, with an average earnings yield of 7.6 percent and an average dividend yield of 4.7 percent since 1871, the average "retained earnings yield" has been nearly 3 percent. This retained earnings yield should have led to real earnings and dividend growth of 3 percent; otherwise, management ought to have paid this money out to the shareholders. Instead, real dividends and earnings grew at annual rates of, respectively, 1.2 percent and 1.5 percent. Where did the money go? The answer is that during the era of "pirate capitalism," success often led to dilution: Company managers issued themselves more stock![16]

Furthermore, retained earnings often chase poor internal reinvestment opportunities. If existing enterprises experienced only 1.2–1.5 percent internal growth of real dividends and earnings in the past two centuries, most of the 3.6 percent economic growth the United States has enjoyed has clearly not come from reinvestment in existing enterprises. In fact, it has stemmed from entrepreneurial capitalism, from the creation of new enterprises. Indeed, dividends on existing enterprises have fallen relative to GDP growth by approximately 100-fold in the past 200 years.[17]

The derring-do of the pirate capitalists of the 19th and early 20th centuries is not the only or even the most compelling explanation for this phenomenon. All the data we used are from indexes, which are a particular kind of sampling of the market. Old companies fading from view lose their market weight as the newer and faster growing companies gain a meaningful share in the economy. The older enterprises often have the highest earnings yield and the worst internal reinvestment opportunities, but the new companies do not materialize in the indexes the minute they start doing business or even the minute they go public. When they do enter the index, their starting weight is often small.

Furthermore, an index need only change the divisor whenever a new enterprise is added, whereas we cannot add a new enterprise to our portfolio without cost. The index changing the divisor is mathematically the same as selling a little bit of *all other* holdings to fund the purchase of a new holding, but when we add a new enterprise to our portfolios, we must commit some capital to effect the purchase. Whether through reinvestment of dividends or infusion of new capital, this new enterprise cannot enter our portfolio through the *internal* growth of an existing portfolio of assets. In effect, we must rebalance out of existing stocks to make room for the new stock—which produces the natural dilution that takes place as a consequence of the creation of new enterprises in a world of entrepreneurial capitalism: The same dollar cannot own an existing enterprise and simultaneously fund a new enterprise.[18]

The dynamics of the capitalist system inevitably lead to these kinds of results. Good business leads to expansion; in a competitive environment, expansion takes place on a wide scale; expansion on a wide scale intensifies the competitive environment; margins begin to decline; earnings growth slows; in time, earnings begin to decline; then, expansion slows, profit margins improve, and the whole thing repeats itself. We can see this drama playing out in the relationship between payout ratios in any given year and earnings growth: Since 1984, the payout ratio has explained more than half of the variation in five-year earnings growth rates with a t-statistic of 9.51.[19]

Few observers have noticed that much of the difference between stock dividend yields and the real returns on stocks can be traced directly to the upward revaluation of stocks since 1982. The historical data are muddied by this change in valuation levels—which is why we find the current fashion of forecasting the future by extrapolating the past to be so alarming. The earnings yield is a better estimate of future real stock returns than any extrapolation of the past. And the dividend yield plus a small premium for real dividend growth is even better, because in the absence of changes in valuation levels, the earnings yield systematically overstates future real stock returns.

If long-term real growth in dividends had been 0.9 percent, real stock returns would have been only 90 bps higher than the dividend yield if it were not for the enormous jump in the price-to-dividend ratio since 1982. Even if we adjust today's 1.4 percent dividend yield sharply upward to include "dividends by another name" (e.g., stock repurchases), making a case for real returns higher than the 3.4 percent currently available in the TIPS market would be a stretch.[20]

Step II: Estimating Real Stock Returns. To estimate the historical equity risk premium, we must compare (1) a realistic estimate of the *expected* real stock return that objective analysis might have supported in past years with (2) the *expected* real bond return available at the time. Future long-term real stock return is defined as[21]

$$RSR(t) = DY(t) + RDG(t) + \Delta PD(t) + \varepsilon, \qquad (1)$$

where

$DY(t)$ = percentage dividend yield for stocks at time t

$RDG(t)$ = percentage real dividend growth rate over the applicable span starting at time t

$\Delta PD(t)$ = percentage change in the price assigned to each dollar of dividends starting at time t

ε = error term for sources of return not captured by the three key constituents (this term will be small because it will reflect only compounding effects)

Viewed from the perspective of forecasting future real returns, the $\Delta PD(t)$ term is a valuation term, which we deliberately exclude from our analysis. If markets exhibit reversion to the mean, valuation change should be positive when the market is inexpensive and negative when the market is richly priced. If markets are efficient, this term should be random. We choose not to go down the slippery slope of arguing valuation, even though we believe that valuation matters. Rather, we prefer to make the simplifying assumption that market valuations at any stage are "fair" and, therefore, that the real return stems solely from the dividend yield and real growth of dividends.

That said, the estimation process becomes more complex when we consider a sensible estimate for real dividend growth. For example, what real dividend growth rate might an investor in 1814 have expected on the heels of the terrible 1802–14 bear market and depression, during which real per capita GDP, real dividends, and real stock prices all contracted 40–50 percent? How can we objectively put ourselves in the position of an investor almost 200 years ago? For this purpose, we partition the real growth in dividends into two constituent parts, real economic growth and the growth of dividends relative to the economy.

Why not simply forecast dividend growth directly? Because countless studies have shown that analysts' forecasts are too optimistic, especially at market turning points. In fact, dividends (and earnings) in aggregate cannot grow as fast as the economy on a sustainable long-term basis, in large part because of the secular increase in shares outstanding and introduction of new enterprises. So, long-term dividend growth should be equal to long-term economic growth minus a haircut for dilution or entrepreneurial capitalism (the share of economic growth that is tied to new enterprises not yet available in the stock market) or plus a premium for hidden dividends, such as stock buybacks. So, real dividend growth is given by

$$RDG(t) = RGDP(t) + DGR(t) + \varepsilon, \qquad (2)$$

where

$RGDP(t)$ = percentage real per capita GDP growth over the applicable span starting at time t

$DGR(t)$ = annual percentage dilution of real GDP growth as it flows through to real dividends starting at time t

ε = error term for compounding effects (it will be small)

Basically, in Equation 2, we are substituting $RGDP(t) + DGR(t)$ for $RDG(t)$ and rolling the $\Delta PD(t)$ term into the error term (to avoid getting into the debates about valuation and regression to the mean). With these two changes, and converting to an expectations model, our model for expected real stock market returns, *ERSR*, becomes

$$ERSR(t) = EDY(t) + ERGDP(t) + EDGR(t), \quad (3)$$

where

$EDY(t)$ = *expected* percentage dividend yield for stocks at time t

$ERGDP(t)$ = *expected* percentage real per capita GDP growth over the applicable span starting at time t

$EDGR(t)$ = *expected* annual percentage dilution of real per capita GDP growth as it flows through to real dividends starting at time t

A complication in this structure is the impact of recessions. In serious recessions, dividends are cut and GDP growth stops or reverses, possibly leading to a decline in even the long-term GDP growth. The result is a dividend yield that is artificially depressed, real per capita GDP growth that is artificially depressed, and long-term dividend growth relative to GDP growth that is artificially depressed, all three of which lead, in recessionary troughs, to understated expected real stock returns. The simplest way to deal with this issue is to use the last peak in dividends before a business downturn and the last peak in GDP before a business downturn in computing each of the three constituents of expected real stock returns.[22]

We illustrate how we constructed an objective real stock return forecast for the past 192 years in **Figure 4**; Panel A spans 1810 to 2001, and Panel B shows the same data after 1945. To explain these graphs, we will go through them line by line.

The easiest part of forecasting real stock returns, the "Estimated Real Stock Return" line in Figure 4, is the dividend yield: It is a known fact. We have adjusted dividends to correct for the artificially depressed dividends during recessions to get the $EDY(t)$ term shown as the "Dividend Yield" line in Figure 4. This step allows us to avoid understating the equity risk premium in recessions when dividends are artificially depressed. This adjustment boosts the expected dividend yield slightly relative to the raw dividend yield because the deepest recessions are often deeper than the average recessions of the prior 40 years. Against an average dividend yield of 4.9 percent, we found an average *expected* dividend yield of 5.0 percent.

Most long-run forecasts of earnings or dividend growth ignore the simple fact that aggregate earnings and dividends in the economy cannot sustainably grow faster than the economy itself. If new enterprise creation and secondary equity offerings dilute the share of the economy held by the shareholders in existing enterprises, then one sensible way to forecast dividend growth is to forecast economic growth and then forecast how rapidly this dilution will take place.[23] Stated another way, we want to know how much *less* rapidly dividends (and earnings) on existing enterprises can grow than the economy at large. The sum of real economic growth less this shortfall is the real growth in dividends.

The resulting line, "Dilution of GDP Growth in Dividends," in the two graphs of Figure 4 represents the $EDGR(t)$ term in our model (Equation 3). Note the persistent tendency for dividend growth to lag GDP growth: Real dividends have grown at 1 percent a year over the past 192 years, whereas the real economy has grown at 3.8 percent a year, and even real per capita GDP has grown at 1.8 percent a year. Why should real dividends have grown so much more slowly than the economy?

First, much of the growth in the economy has come from innovation and entrepreneurial capitalism. More than half of the capitalization of the Russell 3000 today consists of enterprises that did not exist 30 years ago. The 1971 buy-and-hold investor could not participate in this aspect of GDP growth or market growth because the companies did not exist. So, today's dividends and earnings on the existing companies from 1971 are only part of the dividends and earnings on today's total market.

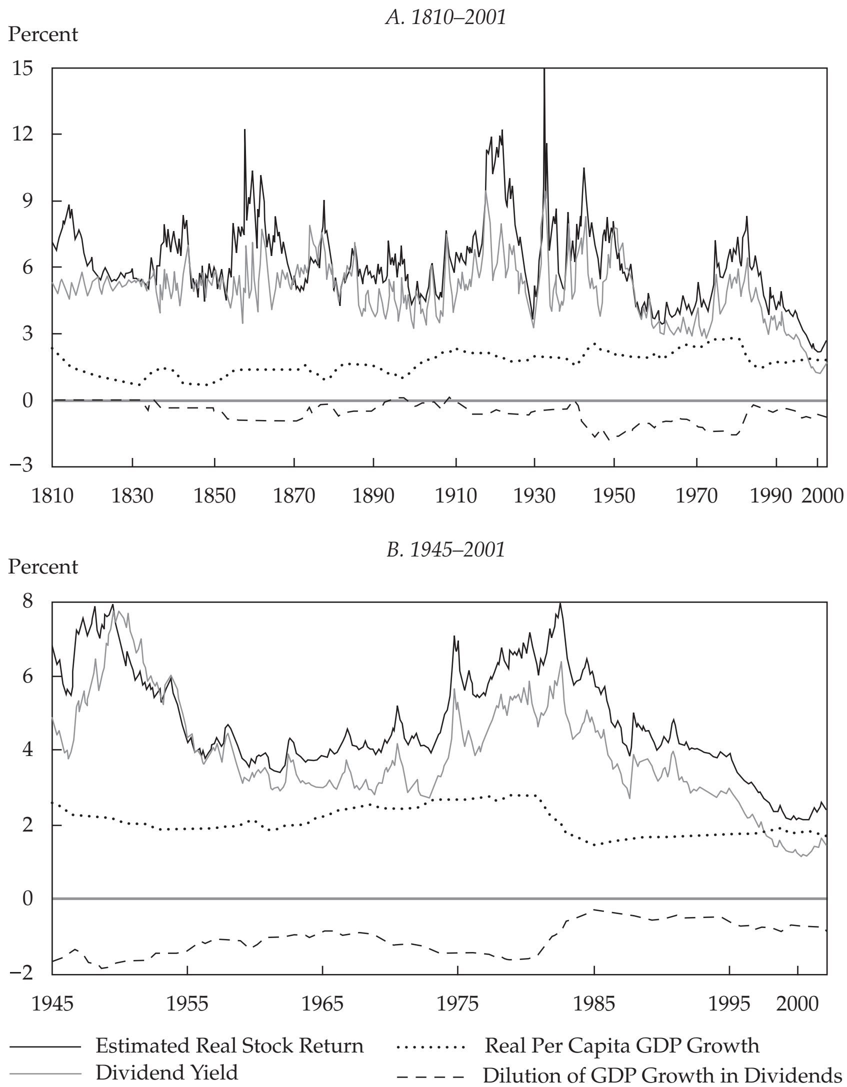
Second, as was demonstrated in Bernstein (2001b), retained earnings are often not reinvested at a return that rivals externally available investments; earnings and dividend growth are faster when payout ratios are high than when they are low, perhaps because corporate managers are then forced to be more selective about reinvestment alternatives.[24]

Finally, as we have emphasized, corporate growth typically leads to more shares outstanding, which automatically imposes a drag on the growth in dividends per share.

As a sensible estimate of the future dividend/GDP shortfall, the rational investor of any day might forecast dividend growth by using the prior 40-year shortfall in dividend growth relative to per capita GDP or might choose to use the cumulative (by now, 200-year) history. We chose the simple expedient of averaging the two.

The dilution effect we found from the 40-year and cumulative data for real dividends and real per capita GDP averages –60 bps. So, in the past 40 years, the dilution of dividend growth is almost

Figure 4. Estimating Real Stock Returns



exactly the same as the long-term average, –80 bps. With a standard deviation of just 0.5 percent, this shortfall of dividend growth relative to economic growth is the steadiest of any of the components of real stock returns or real bond returns. It has never been materially positive on a long-term sustained basis; it has never risen above +10 bps for any 40-year span in the entire history since 1810.

The history of dividend growth shows no evidence that dividends can ever grow materially faster than per capita GDP. Indeed, they almost always grow more slowly. Suppose real GDP growth in the next 40 years is 3 percent a year and population growth is 1 percent a year. These assumptions would appear to put an *upper limit* on real dividend growth at a modest 2 percent a year, far below consensus expectations. If the historical average dilution of dividend growth relative to real per capita GDP growth prevails, then the future real growth in dividends should be only about 1 percent, even with relatively robust, 2.5–3.0 percent, real GDP growth.

Now consider the third part of forecasting real stock returns in this fashion—the forecast of long-term real per capita GDP growth, *ERGDP*(t) in our model. How much real per capita GDP growth would an investor have expected at any time in the past 200 years? Again, a simple answer might come from the most recent 40 years' growth rate; another might come from the cumulative record going back as far as we have dividend and GDP data, to 1802. These historical data are shown in the "Real per Capita GDP Growth" line in Figure 4. And again, we chose the simple expedient of averaging the average of the two. Real per capita GDP growth has been remarkably stable over the past 200 years, particularly if we adjust it to correct for temporary dips during recessions. If we examine truly long-term results, the 40-year real growth rate in real per capita GDP has averaged 1.8 percent with a standard deviation of only 0.9 percent.[25]

Note from Figure 4 that the total economy grew faster during the 19th century than the 20th century whereas stock returns (and the underlying earnings and dividends) grew faster in the 20th century than the 19th. Why would the rapid growth of the 19th century flow through to the shareholder less than the slower growth of the 20th century? We see two possible answers. First, the base from which industrial growth started in the 19th century was so much smaller that much faster new enterprise creation occurred then than in the 20th century. Second, with nearly 3 percent growth in the population from 1800 to 1850, the growing talent and labor pool fueled a faster rate of growth than the 1.25 percent annual population growth rate of the most recent 50 years. It is not surprising that the pace of dilution, both from the creation of new enterprises and from secondary equity offerings, is faster when the population is growing faster. Population growth fuels growth in human capital, in available labor, and in both demand *and* supply of goods and services. As a result, when population growth is rapid, the pace of dilution of growth in the economy (as it flows through to a shareholder's earnings and dividends) is far more stable relative to real per capita GDP than relative to real GDP itself.

The simple framework we have presented for estimating real stock returns reveals few surprises. As Panels A and B of Figure 4 show, the expected stock return is the sum of the three constituent parts graphed in the other lines. We estimate that expected real stock returns for the past 192 years averaged about 6.1 percent with the following constituent parts: an expected yield averaging 5.0 percent plus real per capita GDP growth of 1.7 percent a year minus an expected *shrinkage* in dividends relative to real per capita GDP averaging –0.6 percent. Meanwhile, investors actually earned real returns of 6.8 percent. Most of this 70 bp difference from the 6.1 percent rational expectation over the past 192 years can be traced to the rise in valuation levels since 1982; the rest consists of the other happy accidents detailed previously.

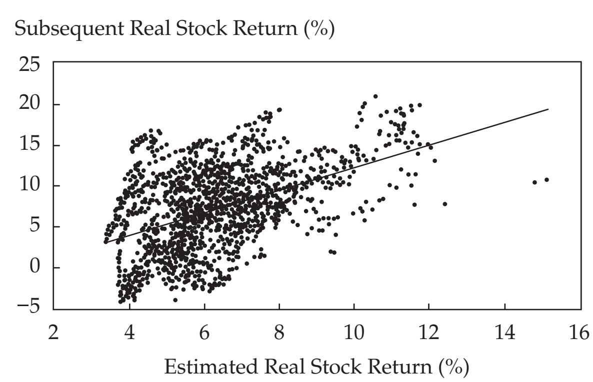
Expectations for real stock returns have soared above 6 percent often enough that many actuaries even today consider 8 percent a "normal" real return for equities. Our estimate for real stock returns, however, exceeds 8 percent only during the depths of the Great Depression, in the rebuilding following the War of 1812, the Civil War, World War I, and World War II, and in the Crash of 1877. In the past 50 years, expected real stock returns above 7 percent have been seen only in the aftermath of World War II, when many investors still feared a return to Depression conditions, and in the depths of the 1982 bear market.

When viewed from the vantage point of this formulation for expected real stock returns, the full 192-year record shows that expected real stock returns fell below 3.5 percent only once before the late 1990s, at the end of 1961 just ahead of the difficult 1962–82 span, real stock prices fell by more than 50 percent. Since 1997, expected real stock returns have fallen well below the 1961 levels, where they remain at this writing.

This formulation for expected real stock returns reveals the stark paradigm shift that took place in the 1950s. Until then, the best estimate for real dividend growth was rarely more than 1 percent, so the best estimate for real stock returns was approximately the dividend yield plus 100 bps—considerably less than the earnings yield! From the 1950s to date, as Panel B of Figure 4 shows, the shortfall of dividends relative to GDP growth improved (perhaps because the presence of the SEC discourages company managers from ignoring shareholder interests) and the real return that one could objectively expect from stocks finally and persuasively rose above the dividend yield. Today, it stands at almost twice the dividend yield, but it is still a modest 2.4 percent.

Figure 5 shows the strong correlation between our formulation for expected real stock returns and the actual real returns that stocks have delivered over the subsequent 10-year span. The correlation is good—at 0.62 during the modern market era after World War II and 0.46 for the full 182 years.[26] If we test the correlation between this simple metric of expected real stock returns and the actual subsequent 20-year real stock returns (not shown), the correlations grow to 0.95 and 0.60 for the post-1945 period and the full 182 years, respectively.

Figure 5. Estimated and Subsequent Actual Real Stock Returns, 1802–2001



The regression results given in Panel A **Table 1** show that the coefficient in the regression is larger than 1.00. So, that 100 bp increase in the expected real stock return, *ERSR*, is worth more than 100 bps in the subsequent 10-year actual real stock return, *RSR*. The implication is that some tendency for reversion to the mean does exist and that it will magnify the effect of unusually high or low expected real stock returns. This suggestion has worrisome implications for the recent record low levels for expected real stock returns.

Because rolling 10-year returns (and expected returns in our model) are highly serially correlated, the *t*-statistics given in Panel A of Table 1 are not particularly meaningful. One way to deal with overlapping data is to eliminate the overlap by using nonoverlapping samples—in this case, examining only our 19 nonoverlapping samples beginning December 1810. The Panel B results, with a coefficient larger than 1.00, confirm the previous results (and approach statistical significance, even with only 17 degrees of freedom).[27] One worrisome fact, in light of the recent large real stock returns, is that the nonoverlapping real stock returns by decades have a –31 percent serial correlation. Although it is not a statistically significant correlation, it is large enough to be interesting: It suggests that spectacular decades or wretched decades may be considerably more likely to reverse than to repeat.

Evaluating the real returns on stocks is clearly a useful exercise if the metric of success for a model is subsequent actual real returns, but we live in a relative world. The future real returns on all assets will rise and fall; so, real returns are an insufficient metric of success. What is of greater import is whether this metric of prospective real stock returns helps us identify the attractiveness of stocks *relative to other assets.*

Step III: Estimating Future Real Bond Returns. On the bond side, real realized returns are equal to the nominal yield minus inflation (or plus deflation) and plus or minus yield change times duration:

$$RBR(t) = BY(t) - INFL(t) + \Delta BY(t)DUR(t) + \varepsilon, \quad (4)$$

where

$BY(t)$ = percentage bond yield at time t

$INFL(t)$ = percentage inflation over the applicable span starting at time t

$\Delta BY(t)DUR(t)$ = annual change in yield over the applicable span times duration at time t (under the assumption that rolling reinvestment is in bonds of similar duration)

ε = error term (compounding effects lead to a small error term in this simple formulation)

As with stocks, we prefer to take current yields as a fair estimate of future bond yields. So, we eliminate the variable that focuses on changes in yields, $\Delta BY(t)DUR(t)$. We also need to shift our focus from measuring past real bond returns to forecasting future real bond returns. Therefore, our model is

$$ERBR(t) = BY(t) - EINFL(t), \quad (5)$$

where $BY(t)$ is the percentage bond yield at time t and $EINFL(t)$ is the expected percentage inflation over the applicable span starting at time t.

Equation 5 is difficult only in the sense that expectations for inflation in past economic environs are difficult to estimate objectively. How, for example, are we to gauge how much inflation an investor in February 1864 would have expected at a time when inflation had averaged 20 percent over the prior three years because of wartime shortages?

Table 1. Regression Results: Estimated Real Stock Return versus Actual 10-Year Real Stock Return
(*t*-statistics in parentheses)

Period	*a*	*b*	R^2	Correlation	Serial Correlation
A. Raw data: RSR(t) = a + b[ERSR(t – 120)]					
1810–2001	–1.51%	1.38%	0.214	0.46	0.992
	(–4.2)	(24.4)			0.990
1945–2001	–7.80	3.15	0.391	0.62	0.996
	(–8.8)	(19.0)			0.995
B. Using 19 nonoverlapping samples, beginning December 1810					
1810–2000	–0.35%	1.22%	0.182	0.430	–0.315
	(–0.1)	(1.9)			0.021

Expectations would depend strongly on the outcome of the war: A victory by the North would have been expected to result in a restoration of the purchasing power of the dollar as wartime shortages disappeared; a victory by the South could have had severe consequences on the ultimate purchasing power of the North's dollar as a consequence of debt that could no longer be serviced. A rational expectation might have been for inflation greater than 0 (reflecting the possibility of victory by the South) but less than the 20 percent three-year inflation rate (reflecting the probability of victory by the North).

We based the estimate for expected future inflation on an *ex ante* regression forecast of 10-year future inflation based, in turn, on recent three-year inflation.[28] **Figure 6** shows how the expected rate of inflation has steadily become more closely tied to recent actual inflation in recent decades. Bond yields responded weakly to bursts of inflation up until the time of the Great Depression; they responded more strongly as inflation became a structural component of the economy in the past four decades.

Until the last 40 years, inflation was generally associated with wars and was virtually nonexistent—even negative—in peacetime. Figure 6 shows a burst of double-digit inflation on the heels of the War of 1812, in the late stages of the Civil War, during World War I, and in the rebuilding following World War II. And more recently, double-digit inflation characterized the "stagflation" of 1978–1981 that followed the Vietnam War and the oil shocks of the 1970s. The most notable changes since the Great Depression, especially since World War II, involve the magnitude and perceived role of government and loss of the automatic brakes once applied by the gold standard. From the end of World War II to the great inflationary crisis at the end of the 1970s, the dread of unemployment that was inherited from the Great Depression was the driving factor in both fiscal and monetary policy.

With the introduction of TIPS in January 1997, we finally have a U.S. government bond that pays a real return, which allows us to simplify the expected real bond returns to be the TIPS yield itself from that date forward; that is,

$$ERBR(t) = YTIPS(t), \tag{6}$$

where $YTIPS(t)$ is the percentage TIPS yield at time t.

Figure 7 shows how the current government bond yield (the "Bond Yield" line) minus expected inflation ("Estimated Inflation") leads to an estimate of the real bond return and hence the long-term expected real bond return ("Estimated Real Bond Yield"), which is the estimate through March of 1998 and the TIPS yield thereafter.[29] From the Equation 5 (or, more recently, Equation 6) formulation, expected real bond returns averaged 3.7 percent over the full period, a very respectable real yield, given the limited risk of government bonds, and good recompense for an investor's willingness to bear some bond-price volatility. Investors may not always have viewed government debt as the rock-solid investment, however, that it is generally considered today.

The 3.7 percent real bond return consists of an average nominal bond yield of 4.9 percent minus an expected inflation rate of 1.2 percent. For comparison, the average actual inflation rate has been 1.4 percent. In the years after World War II, the rate of peacetime inflation embedded in investors' memory banks was essentially zero, perhaps even slightly negative. Consequently, bond investors kept expecting inflation to go away, despite its persistence at a modest rate in the 1950s and early 1960s and an accelerating rate thereafter. As a result, bonds were badly priced for reality during most of

Figure 6. Estimating Future Inflation, 1810–2001

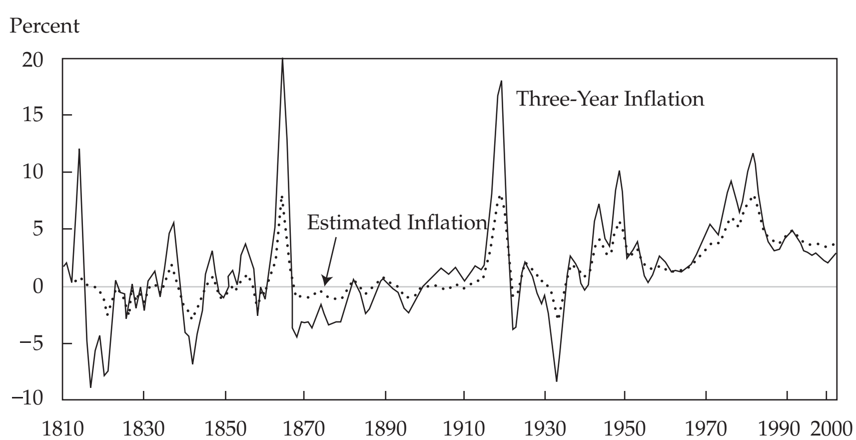
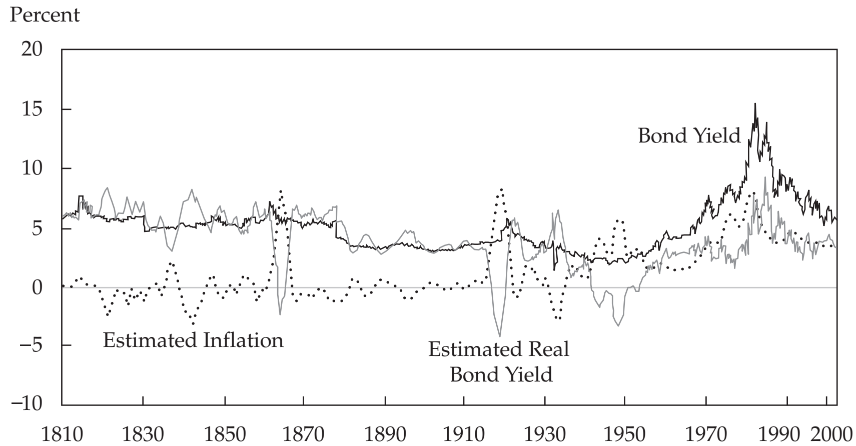


Figure 7. Estimating Real Bond Yields, 1810–2001



these two decades; they turned out to be certificates of confiscation for their holders until people finally woke up in the 1970s and 1980s. Actual inflation exceeded expected inflation with few exceptions from the start of World War II until roughly 1982; as can be seen in Figure 7, our model captures this phenomenon. Expectations are lower than actual outcomes during this span.

Figure 7 also shows several regimes of real yield with distinct structural change from one regime to the next. From the time the United States was in its infancy until the end of Reconstruction in the late 1870s, investors would not have viewed U.S. government bonds as a secure investment. They would have priced these bonds to deliver a 5–7 percent real yield, except during times of war. The overall stability of the yields is impressive: Unlike the history of stock prices, the surprise elements have been small.

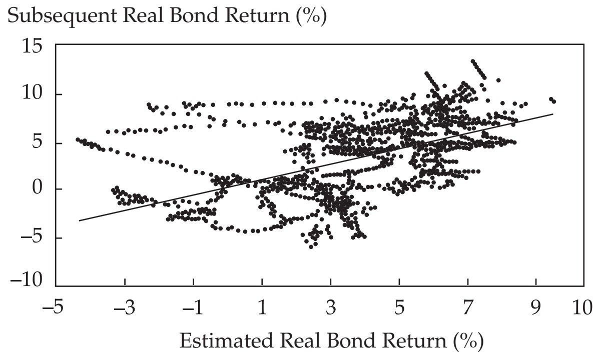
Once the United States had survived the Civil War and the security of U.S. government debt had been demonstrated repeatedly, investors began to price government debt at a 3–5 percent real yield. As Figure 7 shows, this level held, with a brief interruption in World War I, until the country went off the gold standard in 1933. This record is remarkable in view of the high rate of economic growth, but revolutionary technological change in those days, especially in transportation and agriculture, led to such stunning reductions in product costs that inflation was kept at bay except for very brief intervals.

For the next 20–25 years, the nation struggled with the Great Depression, World War II, and the war's aftermath. Investors slowly began to realize that deflationary price drops did not rebound fully after the trough of the Depression and that inflationary price increases did not retreat after the end of the war. The changed role of government plus the end of the gold standard had altered the picture, perhaps irrevocably. During this span, investors priced bonds to offer a 2–4 percent *notional* yield but a rocky –3 percent to +3 percent real yield. As Figure 7 shows, bond investors woke up late to the fact that inflation was now a normal part of life.

From the mid-1950s to date, investors have struggled with more structural inflation and more inflation uncertainty than ever before. Although investors sought to price bonds to deliver a real yield, inflation consistently exceeded their expectations. Only during the down cycle of the inflation roller coaster of 1980–1985 did bonds finally provide real yields to their owners. After this experience, bond investors developed an anxiety about inflation far greater than objective evidence would support. The result was a brief spike in real bond returns in 1984, as Figure 7 shows, with bond yields still hovering at 13.8 percent, even though three-year inflation had fallen to 4.7 percent (and our regression model for future inflation would have suggested expected inflation of 4.6 percent). The "expected" real yield was a most unusual 9.2 percent because investors were not yet prepared to believe that double-digit inflation was a thing of the past.

Another interesting fact is evident in **Figure 8**: The expected real bond returns produced by our formulation are highly correlated with the actual real returns earned over the subsequent decade. For 1810 to 1991, the expected real bond return has a 0.52 correlation with the actual real bond return earned over the next 10 years; from 1945 to date, the correlation rises to an impressive 0.63. Panel A of **Table 2** shows that the coefficient is reliably positive but not reliably more than 1.00, which suggests that, unlike expected real stock returns, no powerful tendency for reversion to the mean is at work in real bond yields. When we used the 19 available nonoverlapping samples (Panel B), we found the resulting correlation to be 0.64, which is a statistically significant relationship.[30]

Figure 8. Estimated and Subsequent Actual Real Bond Yield, 1802–2001



Why is the bond model a better predictor, when raw data are used, than the stock model for the two-century history? Two reasons seem evident. First, stocks have been more volatile than bonds for almost all 200 years of U.S. data. Therefore, any model for expected real stock returns should have a larger error term. Second, stocks are by their very nature longer term than bonds: A 10-year bond expires in 10 years; stocks have no maturity date.

The bond market correlations would be even better were it not for the negative real yields during times of war, when people tend to consider the inflation a temporary phenomenon. These episodes show up as the "loops" to the left of the body of the scatterplot in Figure 8. At these times, many U.S. investors apparently subordinated their own interests in a strong real yield to the needs of the nation: Long Treasury rates were essentially pegged during World War II and up to 1951, but that did not stop investors from buying them.

Step IV: Estimating the Equity Risk Premium. If we now take the difference between the expected real stock return and the expected real bond return, we are left with the expected equity risk premium:

$$ERP(t) = ERSR(t) - ERBR(t), \tag{7}$$

where $ERSR(t)$ is the expected real stock return starting at time t and $ERBR(t)$ is the expected real bond return starting at time t.

Figure 9 shows the results of this simple framework for estimating the risk premium over the past 192 years. Many observers may be startled to see that this estimate of the forward-looking risk premium for stocks has rarely been above 5 percent in the past 200 years; the exceptions are war, its aftermath, and the Great Depression. The historical average risk premium is a modest 2.4 percent, albeit with a rather wide range. The wide range is more a result of the volatility of expected real bond returns than the volatility of expected real stock returns, which are surprisingly steady except in times of crisis.[31]

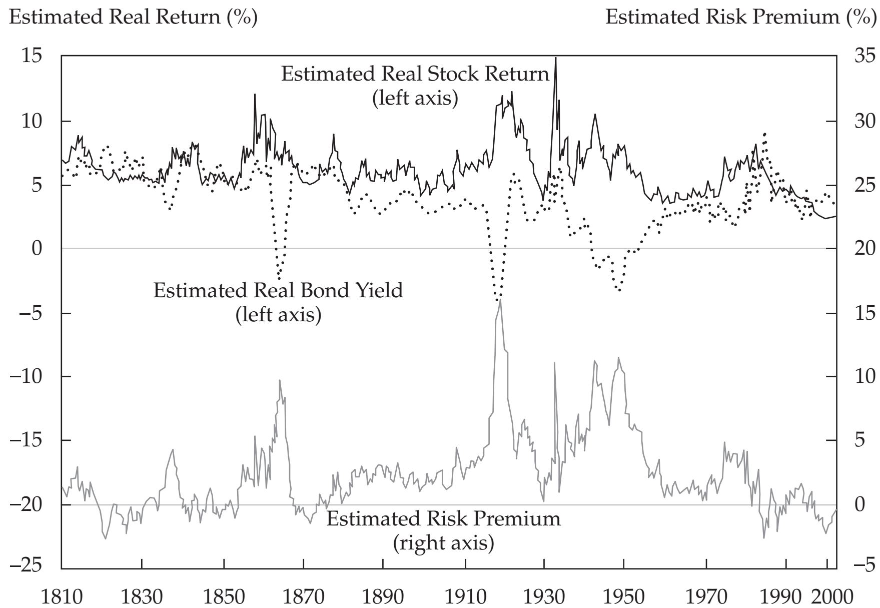
Over the past 192 years, our model (Equation 3) suggests that an objective evaluation would have pegged expected real stock returns at about 6.1 percent on average, only 120 bps higher than the average dividend yield. Investors have earned fully 70 bps more than this objective expectation, but they did not have objective reasons to expect to earn as much as they did. Our model suggests that an objective evaluation would have pegged expected real bond returns at about 3.7 percent. Investors have earned 20 bps less because of the inflationary shocks of the 1960s to 1980s; they expected more than they got.

The difference between the expected real returns for stocks and bonds reveals a stark reality. An objective estimate of the expected risk premium would have averaged 2.4 percent (240 bps) during this history (6.1 percent expected real stock returns minus 3.7 percent expected real bond returns), not the oft-cited 5 percent realized excess return that

Table 2. Regression Results: Estimated Real Bond Return versus Actual 10-Year Real Bond Return
(t-statistics in parentheses)

Period	*a*	*b*	R^2	Correlation	Serial Correlation
A. Raw data: RBR(t) = a + b[ERBR(t – 120)]					
1810–2001	0.45%	0.81%	0.266	0.52	0.999
	(3.5)	(28.1)			0.997
1945–2001	–0.74	1.05	0.399	0.63	0.997
	(–4.0)	(19.3)			0.980
B. Using 19 nonoverlapping samples, beginning December 1810					
1810–2001	–1.81%	1.31%	0.4120	0.64	0.182
	(–1.1)	(3.5)			0.677

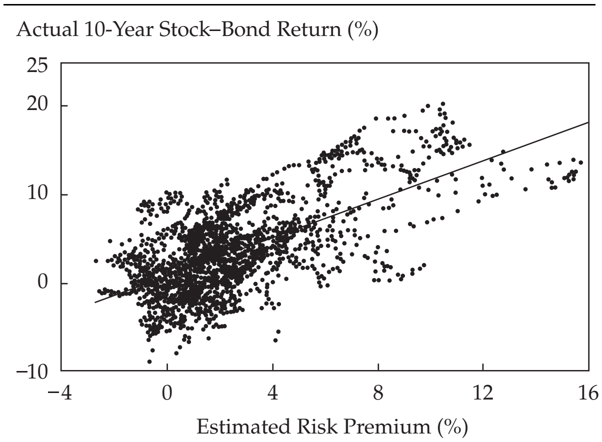
Figure 9. Estimating the Equity Risk Premium, 1810–2001



much of the investment world now depends on. Investors have *earned* a higher 3.3 percent (330 bps) excess return for stocks (6.8 percent actual real stock returns minus 3.5 percent for bonds), but the reason is the array of happy accidents for stocks and one extended unhappy accident for bonds.

All of this analysis is of mere academic interest, however, unless we can establish a link between our estimated risk premium and actual subsequent relative returns. Indeed, such a link does exist. The result of our formulation for the equity risk premium has a 0.79 correlation with the actual 10-year excess return for stocks over bonds since 1945 and a 0.66 correlation for the full span. This strong link is clear in **Figure 10**, for 1810–2001, and **Table 3**

Figure 10. Risk Premium and Subsequent 10-Year Excess Stock Returns: Correlations, 1810–1991



(where, for convenience, we have defined the 10-year excess return of stocks relative to bonds as *ERSB*); each 100 bp change in the equity risk premium is worth modestly more than 100 bps in subsequent annual excess returns for stocks relative to bonds over the next 10 years. As with the expected stock return model (Equation 3), the link for 20-year results is stronger, with correlations over the full span and since 1945 of, respectively, 0.64 and 0.95.

This strong link between objective measures of the risk premium and subsequent stock–bond excess returns is also clear for the 1945–2001 period shown in **Figure 11**, in which every wiggle of our estimate for the risk premium is matched by a similar wiggle in the subsequent 10-year excess return that stockholders earned relative to bondholders. Figure 11 shows that the excess returns on stocks relative to bonds became negative in the late 1960s on a 10-year basis, following low points in the risk premium, and again touched zero 10 years after the 1981 peak in bond yields.

We can also see in Figure 11 how the gap in 10-year results opened up sharply for the 10 years of the 1990s; it opened to unprecedented levels, even wider than in the early 1960s. Prior to this gap opening, the fit between the risk premium and subsequent excess returns is remarkably tight. The question is whether this anomaly is sustainable or is destined to be "corrected." History suggests that such anomalies are typically corrected, especially when the theoretical case to support them is so weak. This reminder should be sobering to investors who are depending on a large equity risk premium.

Table 3. Regression Results: Estimated Equity Risk Premium versus Actual 10-Year Excess Return of Stocks versus Bonds
(*t*-statistics in parentheses)

Period	*a*	*b*	R^2	Correlation	Serial Correlation
A. Raw data: ERSB(t) = a + b[ERP(t – 120)]					
1810–2001	0.91%	1.08%	0.430	0.66	0.993
	(8.8)	(40.6)			0.995
1945–2001	2.85	1.41	0.621	0.79	0.995
	(15.4)	(30.4)			0.996
B. Using 19 nonoverlapping samples, beginning December 1810					
1810–2001	0.84%	1.36%	0.490	0.70	0.055
	(0.8)	(4.0)			0.371

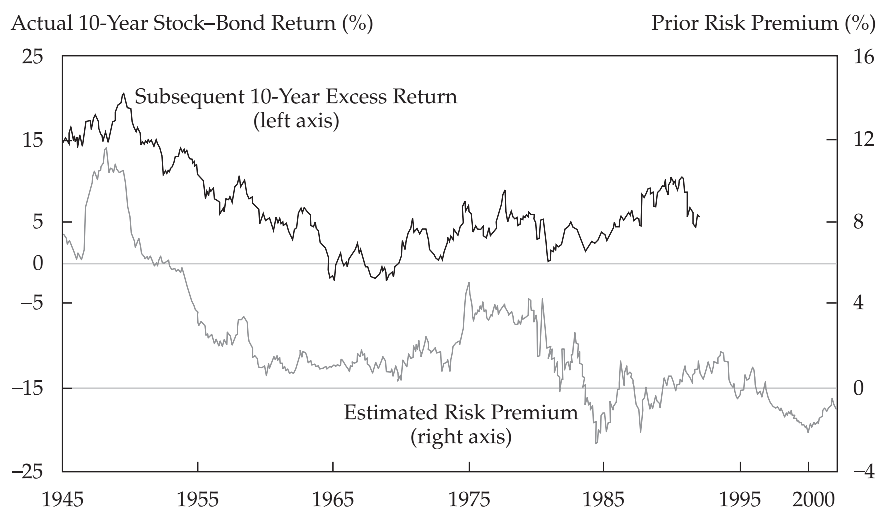
As with the models for real stock returns and for real bond returns, we also used nonoverlapping spans to take out the effect of the strong serial correlation in the estimated risk premium. For the 19 nonoverlapping spans (Panel B of Table 3), the correlation for the full period jumps to 0.70, with a highly significant *t*-statistic of 4.0.[32]

Conclusions

We have advanced several provocative assertions.

- The observed real stock returns and the excess return for stocks relative to bonds in the past 75 years have been extraordinary, largely as a result of important nonrecurring developments.
- It is dangerous to shape future expectations based on extrapolating these lofty historical returns. In so doing, an investor is tacitly assuming that valuation levels that have doubled, tripled, and quadrupled relative to underlying earnings and dividends can be expected to do so again.
- The investors of 75 years ago would not have had an objective basis for expecting the 8 percent real returns or 5 percent risk premium that stocks subsequently delivered. The estimated equity risk premium at the time was above average, however, which makes 1926 a better-than-average starting point for the historical risk premium.
- The real internal growth that companies generated in their dividends averaged 0.9 percent a year over the past 200 years, whereas earnings growth averaged 1.4 percent a year over the past 131 years.
- Dividends and earnings growth was slower than the increase in real per capita GDP, which averaged 1.6 percent over the past 200 years and 2.0 percent over the past 131 years. This internal growth is far less than the consensus expectations for future earnings and dividend growth.

Figure 11. Risk Premium and Subsequent 10-Year Excess Returns, 1945–2001



- The historical average equity risk premium, measured relative to 10-year government bonds as the risk premium investors might objectively have expected on their equity investments, is about 2.4 percent, half what most investors believe.
- The "normal" risk premium might well be a notch lower than 2.4 percent because the 2.4 percent objective expectation preceded *actual* excess returns for stocks relative to bonds that were nearly 100 bps higher, at 3.3 percent a year.
- The current risk premium is approximately zero, and a sensible expectation for the future real return for both stocks and bonds is 2–4 percent, far lower than the actuarial assumptions on which most investors are basing their planning and spending.[33]
- On the hopeful side, because the "normal" level of the risk premium is modest (2.4 percent or quite possibly less), current market valuations need not return to levels that can deliver the 5 percent risk premium (excess return) that the Ibbotson data would suggest. If reversion to the mean occurs, then to restore a 2 percent risk premium, the difference between 2 percent and zero still requires a near halving of stock valuations or a 2 percent drop in real bond yields (or some combination of the two). Either scenario is a less daunting picture than would be required to facilitate a reversion to a 5 percent risk premium.
- Another possibility is that the modest difference between a 2.4 percent normal risk premium and the negative risk premiums that have prevailed in recent quarters permitted the recent bubble. Reversion to the mean might not ever happen, in which case, we should see stocks sputter along delivering bondlike returns, but at a higher risk than bonds, for a long time to come.

The consensus that a normal risk premium is about 5 percent was shaped by deeply rooted naiveté in the investment community, where most participants have a career span reaching no farther back than the monumental 25-year bull market of 1975–1999. This kind of mind-set is a mirror image of the attitudes of the chronically bearish veterans of the 1930s. Today, investors are loathe to recall that the real total returns on stocks were negative for most 10-year spans during the two decades from 1963 to 1983 or that the excess return of stocks relative to long bonds was negative as recently as the 10 years ended August 1993.[34]

When reminded of such experiences, today's investors tend to retreat behind the mantra "things will be different this time." No one can kneel before the notion of the long run and at the same time deny that such circumstances will occur in the decades ahead. Indeed, such crises are more likely than most of us would like to believe. Investors greedy enough or naive enough to expect a 5 percent risk premium and to substantially overweight equities accordingly may well be doomed to deep disappointments in the future as the realized risk premium falls far below this inflated expectation.

What if we are wrong about today's low equity risk premium? Maybe real yields on bonds are lower than they seem. This chance is a frail reed to rely on for support. At this writing, at the end of 2001, an investor can buy TIPS, which provide government-guaranteed yields of about 3.4 percent, but inflation-indexed bond yields are a relatively recent phenomenon in the United States. So, we could not estimate historical real yields for prior years directly, only through a model such as the one described here. If we compare our model for real stock returns, at 2.4 percent in mid-2001, with a TIPS yield of 3.4 percent, we get an estimate for the equity risk premium of –100 bps.

Perhaps real earnings and dividend growth will exceed economic growth in the years ahead, or perhaps economic growth will sharply exceed the historical 1.6 percent real per capita GDP growth rate. These scenarios are certainly possible, but they represent the dreams of the "new paradigm" advocates. The scenarios are unlikely. Even if they prove correct, it will likely be in the context of unprecedented entrepreneurial capitalism, unprecedented new enterprise creation, and hence, unprecedented dilution of shareholders in existing enterprises.

The recurring pattern of history is that exceptionally poor or exceptionally rapid economic growth is never sustained for long. The best performance that dividend growth has ever managed, relative to real per capita GDP, is a scant 10 bp outperformance. This rate, the best 40-year real dividend growth *ever seen*, fell far short of real GDP growth: Real dividend growth was some 2 percent a year below real GDP growth during those same 40-year spans. So, history does not support those who hope that dividend growth will exceed GDP growth. This evidence is not encouraging for those who wish to see a 1.4 percent dividend yield somehow transformed into a 5 percent (or higher) real stock return.

The negative risk premium that precipitated the writing of "The Death of the Risk Premium" (Arnott and Ryan) in early 2000 was not without precedent, although most of the precedents, until recently, are found in the 19th century. In 1984 and again just before the 1987 market crash, real bond yields rose materially above the estimated real return on stocks. How well did this development predict subsequent relative returns? Stated more provocatively, why didn't our model work? Why didn't bonds beat stocks in the past decade? After all, with the 1984 peak in real bond returns and again shortly before the 1987 crash, the risk premium dipped even lower than the levels seen at the market peak in early 2000. Yet, stocks subsequently outpaced bonds. For an answer, recall that the context was a more than doubling of stock valuations, whether measured in price-to-book ratios, price-to-dividend ratios, or P/E multiples. If valuation multiples had held constant, the bonds would have prevailed.[35]

Appendix A. Estimating the Constituents of Return

An analysis of historical data is only as good as the data themselves. Accordingly, we availed ourselves of multiple data sources whenever possible. We were encouraged by the fact that the discrepancies between the various sources led to compounded rates of return that were no more than 0.2 percent different from one another.

Long Government Bond Yields, *BY*(*t*). Our data sources are as follows: for January 1800 to May 2001, 10-year government bond yields from Global Financial Data of the National Bureau of Economic Research (NBER) (data were annual until 1843 and were interpolated for monthly estimates); for June 2001 to December 2001, Bloomberg; and for January 1926 to December 2000, Ibbotson Associates, long-term government bond yields and returns. In cases of differences, we (1) averaged the yield data and (2) recomputed monthly total returns based on an assumed 10-year maturity standard.

Inflation, *INF*(*t*). We used two sources of inflation and U.S. Consumer Price Index data. For January 1801 to May 2001, NBER (annual until 1950; interpolated for monthly estimates); for June 2001 to December 2001, Bloomberg; and for January 1926 to December 2000, Ibbotson Associates. In cases of differences, we averaged the available data. Ibbotson data were given primary (two-thirds) weighting for 1926–1950 because the NBER data are annual through 1950.

Gross Domestic Product, *GDP*(*t*). For January 1800 to September 2001, NBER GNP data annually through 1920, interpolated July-to-July; for 1921–2001, quarterly GDP data; and for December 2001, *Wall Street Journal* consensus estimates.

Dividend Yield in Month *t*, *DY*(*t*), and Return on Stocks in Month *t*, *RS*(*t*). For January 1802 to December 1925, G. William Schwert (1990); for February 1871 to March 2001, Robert Shiller (2000); for January 1926 to December 2000, Ibbotson Associates (2001); and for April 2001 to December 2001, Bloomberg. In cases of differences, we averaged the available data. In Shiller's data, monthly dividend and earnings data are computed from the S&P four-quarter data for the quarter since 1926, with linear interpolation to monthly figures. Dividend and earnings data before 1926 are from Cowles (1939), interpolated from annual data.

Notes

1. The "bible" for the return assumptions that drive our industry is the work of Ibbotson Associates, building on the pioneering work of Ibbotson and Sinquefield (1976a, 1976b). The most recent update of the annual Ibbotson Associates data (2001) shows returns for U.S. stocks, bonds, bills, and inflation of, respectively, 11.0 percent, 5.3 percent, 3.8 percent, and 3.1 percent. These figures imply a real return for stocks of 7.9 percent and a risk premium over bonds of 5.7 percent (570 bps), both measured over a 75-year span. These data shape the expectations of the actuarial community, much of the consulting community, and many fund sponsors.
2. Fischer Black was fond of pointing out that examining the same history again and again with one new year added each passing year is an insidious form of data mining (see, for example, Black 1976). The past looks best when nonrecurring developments and valuation-level changes have distorted the results; extrapolating the past tacitly implies a belief that these nonrecurring developments can recur and that the changes in valuation levels will continue.
3. We strongly suggest that the investment community draw a distinction between past excess returns (observed returns from the past) and expected risk premiums (expected return differences in the future) to avoid continued confusion and to reduce the dangerous temptation to merely extrapolate past excess returns in shaping expectations for the risk premium. This habit is an important source of confusion that, quite literally, (mis)shapes decisions about the management of trillions in assets worldwide. We propose that the investment community begin applying the label "risk premium" *only* to expected future return differences and apply the label "excess returns" to observed historical return differences.
4. To see the effect of compounding at this rate, consider that if our ancestors could have earned a mere 1.6 percent real return on a $1 investment from the birth of Christ in roughly 4 B.C. to today, we would today have enough to buy more than the entire world economy. Similarly, the island of Manhattan was ostensibly purchased for $24 of goods, approximately the same as an ounce of gold when the dollar was first issued. This modest sum invested to earn a mere 5 percent real return would have grown to more than $20 billion in the 370 years since the transaction. At an 8 percent real return, as stocks earned from 1926 to 2000 in the Ibbotson data, this $24 investment would now suffice to buy more than the entire world economy.

5. No rational investor buys if he or she expects less than 1 percent real growth a year in capital, but objective analysis will demonstrate that this return is what stocks have actually delivered, plus their dividend yield, plus or minus any profits or losses from changes in yields. As Asness pointed out in "Bubble Logic" (2000), few buyers of Cisco would have *expected* a 1 percent internal rate of return at the peak, although the stock was priced to deliver just that, even if the overly optimistic consensus earnings and growth forecasts at the time were used. These buyers were focused on the view that the stock would produce handsome gains, as it had in the past, rather than on pursuing an objective evaluation, by using IRR or similar objective valuation tools, of expected returns. Such a focus plants the seeds of major disappointment.
6. The Welch study investigated an expected *arithmetic* risk premium for stocks relative to *cash*, not bonds. The difference between arithmetic and geometric returns is often illustrated by someone earning 50 percent in one year and –50 percent in the next. The arithmetic average is zero, but the person is down 25 percent (or 13.4 percent a year). Most practitioners think in terms of compounded geometric returns; in this example, practitioners would focus on the 13 percent a year loss, not on the zero arithmetic mean. If stocks have 16 percent average annual volatility (the average since World War II), the result is that the arithmetic mean is 130 bps higher than the geometric mean return (the difference is approximately half the variance, or 16 percent × 16 percent/2). Such a difference might be considered a "penalty for risk." If we add a 70 bp real cash yield (the historical average) plus a 720 bp risk premium minus a 130 bp penalty for risk, we find 6.6 percent to be the implied consensus of the economists for the geometric real stock return.
7. Such a return could easily fall to 0–2 percent net of taxes, especially in light of government's taxes on the inflation component of returns.
8. Smith's work even won a favorable review from John Maynard Keynes (for Keynes' approach, see his 1936 classic).
9. TIPS is the acronym for Treasury Inflation-Protected Securities, which have been replaced by Treasury Inflation-Indexed Securities.
10. In fairness, growth is now an explicit part of the picture. Dividend payout ratios are substantially lower than in the early 1920s and the 19th century as a result, at least in part, of corporate desires to finance growth. That said, our own evidence would suggest that internal reinvestment is not necessarily successful: High payout ratios precede higher growth than do low payout ratios.
11. We are indebted to G. William Schwert and Jeremy Siegel for some of the raw data for this analysis (see also Schwert 1990 and Siegel 1998). Although multiple sources exist for data after 1926 and a handful of sources provide data beginning in 1855 or 1870, Professor Schwert was very helpful in assembling these difficult early data. Professor Siegel provided earnings data back to 1870. We have not found a source for earnings data before 1870.
12. The U.S. Bureau of Labor Statistics maintains GDP data from 1921 to date; the earlier data are for GNP (gross national product). Because the two were essentially the same thing until international commerce became the substantial share of the economy that it is today, we used the GNP data from the Bureau of Labor Statistics for the 19th century and the first 20 years of the 20th century.
13. We stripped out reinvestment in the measure of real dividend growth shown in Figure 3 because investors are already receiving the dividend. To include dividends in the real dividend growth would double-count these dividends. What should be of interest to us is the internal growth in dividends stemming from reinvestment of the retained earnings.
14. We multiplied the real dividends by 10 to bring the line visually closer to the others; the result is that on those few occasions when the price line and dividend line touch, the dividend yield is 10 percent.
15. The fact that growth in real dividends and earnings is closer to per capita GDP growth than it is to overall GDP growth is intuitively appealing on one fundamental basis: Real per capita GDP growth measures the growth in productivity. It is sensible to expect real income, real per share earnings, and real per share dividends to grow with productivity rather than to mirror overall GDP growth.
16. This history holds a cautionary tale with regard to today's stock option practices.
17. This fall in dividends of existing enterprises is not surprising when one considers that the companies that existed in 1802 probably encompass, at most, 1 percent of the economy of 2001. The world has so changed that, at least from the perspective of the dominant stocks, today's economy would be unrecognizable in 1802.
18. Another way to think about this idea is to recognize the distinction between a market portfolio and a market index. The market portfolio shows earnings and dividend growth that are wholly consistent with growth in the overall economy (Bernstein 2001a). But if one were to unitize that market portfolio, the unit values would not grow as fast as the total capitalization and the earnings and dividends per unit (per "share" of the index) would not keep pace with the growth in the aggregate dollar earnings and dividends of the companies that compose the market portfolio. (When one stock is dropped and another added to a market index, typically the added stock is larger in capitalization than the deletion, which increases the divisor for constructing the index.) Precisely the same thing would happen in the management of an actual index fund. When a stock was replaced, the proceeds from the deleted stock would rarely suffice to fund the purchase of the added stock. So, all stocks would be trimmed slightly to fund that purchase; this consequence is implied by the change in the divisor for an index. It is this mechanism that drives the difference between the growth of the aggregate dollar earnings and dividends for the market portfolio, which will keep pace with GDP growth over time, and the growth of the "per share" earnings and dividends for the market *index* that creates the dilution we attribute to entrepreneurial capitalism. After all, entrepreneurial capitalism creates the companies that we must add to the market portfolio, thus changing our divisor and driving a wedge between the growth in market earnings or dividends and the growth in earnings and dividends per share in a market index.
19. See Bernstein (2001b). Over the past 131 years, the correlation between payout ratios and subsequent 10-year growth in real earnings has been 0.39; over the past 50 years, this correlation has soared to 0.66. Apparently, the larger the fraction of earnings paid out as dividends, the faster earnings subsequently grow, which is directly contrary to the Miller–Modigliani maxim (see Miller and Modigliani 1961 and Modigliani and Miller 1958).
20. To produce a 3.4 percent real return from stocks, matching the yield on TIPS, real growth in dividends needs to be 1.9 percent (twice the long-term historical real growth rate) while valuation levels remain where they are. Less than twice the historical growth in real dividends, or a return to the 3–6 percent yields of the past, will not get us there.
21. We have made the simplifying assumption that "long term" is a 10-year horizon. Redefining the long-term returns over a 5-year or 20-year horizon produces similar results.
22. Because this adjusted dividend is always at or above the true dividend, we have introduced a positive error into the average dividend yield. We offset this error by subtracting the 40-year average difference between the adjusted dividend and the true dividend. In this way, $EDY(t)$ is not overstated, on average, over time.

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23. Of course, stock buybacks increase the share of the economy held by existing shareholders.
24. Arnott and Asness (2002) have shown that since 1945, the payout ratio has had a 77 percent correlation with subsequent real earnings growth. That is, higher retained earnings have historically led to slower, not faster, earnings growth.
25. Throughout this article, when we refer to a 10-year average or a 40-year average, we have used the available data if fewer years of data were available. For instance, for 1820, we used the 20-year GDP growth rate because 40 years of data were unavailable. We followed a convention of requiring at least 25 percent of the intended data; so, if the analysis was based on a 40-year average, we tolerated a 10-year average if necessary. To do otherwise would have forced us to begin our analysis in about 1840 and lose decades of interesting results. Because data before 1800 are very shaky and we required at least 10 years of data, our analysis begins, for the most part, in 1810.
26. We cannot know the 10-year returns from starting dates after 1991, so 192 years of expected return data lead to 182 years of correlation with subsequent 10-year actual returns.
27. Another way to deal with serially correlated data is to test correlations of differenced data. When we carried out such tests, we found that over the full span, the R^2 actually *rose* to 0.446 from the 0.214 shown in Panel A of Table 1; moreover, since 1945, the differenced results showed a still impressive 46 percent correlation. These results are available from the authors on request.
28. In an *ex ante* regression, the model is respecified for each monthly forecast with the use of all previously available data only.
29. We made the simplifying assumption that "long term" is a 10-year horizon. Redefining the long-term returns over a 5-year or 20-year horizon produced similar results.
30. Even when we considered successive differences to eliminate the huge serial correlation of real bond yields and 10-year real bond returns, the result from 1945 to date (available from the authors) was identical to the result for the raw data—a correlation of 0.63.
31. For investors accustomed to the notion that stock returns are uncertain and bond returns are assured over the life of the bond, this result will come as a surprise. But conventional bonds do *not* assure real returns; their expected real returns, therefore, should be highly uncertain. Stocks do, in a fashion, pass inflation through to the shareholder. So, nominal returns for stocks may be volatile and uncertain, but expected real stock returns are much more tightly defined than expected real bond returns.
32. Differencing caused the correlation for the full 182-year span to fall from 0.66 to 0.61 and, for the span following World War II, caused it to fall from 0.79 to 0.48.
33. For the taxable investor, the picture is worse, of course. In the United States, investors are even taxed on the inflation component of returns. From valuation levels that are well above historical norms, a negative real after-tax return is not at all improbable.
34. The excess return of stocks over bonds was negative also in the decades ended September 1991, November 1990, most 10-year spans ending August 1977 to June 1979, and the spans ending September 1974 to January 1975.
35. Consider the 10 years starting just before the stock market crash in September 1987. This span began with double-digit bond yields. The bond yield of 9.8 percent minus a regression-based inflation expectation of 3.6 percent led to an expected real bond return of 6.2 percent. The stock yield of 2.9 percent plus expected real per capita GDP growth of 1.6 percent minus an expected dividend shortfall relative to per capita GDP of 0.4 percent led to an expected real stock return of 4.0 percent. The risk premium was –2.0 percent. But stocks beat bonds by 4.9 percent a year over the next 10 years ending September 1997. What happened? The dividend yield plunged to 1.7 percent. This plunge in yields contributed 5.8 percent a year to stock returns; in the absence of this revaluation, stocks would have underperformed bonds by –0.9 percent. So, the –2.0 percent forecast was not bad; dividends rose a notch faster than normal, and more importantly, the price that the market was willing to pay for each dollar of dividends nearly doubled.

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Comments invited

THE WORLDWIDE EQUITY PREMIUM: A SMALLER PUZZLE

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Abstract: We use a new database of long-run stock, bond, bill, inflation, and currency returns to estimate the equity risk premium for 17 countries and a world index over a 106-year interval. Taking U.S. Treasury bills (government bonds) as the risk-free asset, the annualised equity premium for the world index was 4.7% (4.0%). We report the historical equity premium for each market in local currency and US dollars, and decompose the premium into dividend growth, multiple expansion, the dividend yield, and changes in the real exchange rate. We infer that investors expect a premium on the world index of around 3–3½% on a geometric mean basis, or approximately 4½–5% on an arithmetic basis.

JEL classifications: G12, G15, G23, G31, N20.

Keywords: Equity risk premium; long run returns; survivor bias; financial history; stocks, bonds, bills, inflation.

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Abstract: We use a new database of long-run stock, bond, bill, inflation, and currency returns to estimate the equity risk premium for 17 countries and a world index over a 106-year interval. Taking U.S. Treasury bills (government bonds) as the risk-free asset, the annualised equity premium for the world index was 4.7% (4.0%). We report the historical equity premium for each market in local currency and US dollars, and decompose the premium into dividend growth, multiple expansion, the dividend yield, and changes in the real exchange rate. We infer that investors expect a premium on the world index of around 3–3½% on a geometric mean basis, or approximately 4½–5% on an arithmetic basis.

In their seminal paper on the equity premium puzzle, Mehra and Prescott (1985) showed that the historical equity premium in the United States—measured as the excess return on stocks relative to the return on relatively risk-free Treasury bills—was much larger than could be justified as a risk premium on the basis of standard theory. Using the accepted neoclassical paradigms of financial economics, combined with estimates of the mean, variance and auto-correlation of annual consumption growth in the U.S. economy and plausible estimates of the coefficient of risk aversion and time preference, they argued that stocks should provide at most a 0.35% annual risk premium over bills. Even by stretching the parameter estimates, they concluded that the premium should be no more than 1% (Mehra and Prescott (2003)). This contrasted starkly with their historical mean annual equity premium estimate of 6.2%.

The equity premium puzzle is thus a quantitative puzzle about the magnitude, rather than the sign, of the risk premium. Ironically, since Mehra and Prescott wrote their paper, this puzzle has grown yet more quantitatively puzzling. Over the 27 years from the end of the period they examined to the date of completing this contribution, namely over 1979–2005, the mean annual U.S. equity premium relative to bills using Mehra-Prescott's definition and data sources was 8.1%.

Logically, there are two possible resolutions to the puzzle: either the standard models are wrong, or else the historical premium is misleading and we should expect a lower premium in the future. Over the last two decades, researchers have tried to resolve the puzzle by generalising and adapting the Mehra-Prescott (1985) model. Their efforts have focused on alternative assumptions about preferences, including risk aversion, state separability, leisure, habit formation and precautionary saving; incomplete markets and uninsurable income shocks; modified probability distributions to admit rare, disastrous events; market imperfections, such as borrowing constraints and transactions costs; models of limited participation of consumers in the stock market, and behavioural explanations. There are several excellent surveys of this work, including Kocherlakota (1996), Cochrane (1997), Mehra and Prescott (2003), and most recently, Mehra and Prescott (2006).

While some of these models have the potential to resolve the puzzle, as Cochrane (1997) points out, the most promising of them involve "deep modifications to the standard models" and "every quantitatively successful current story…still requires astonishingly high risk aversion". This leads us back to the second possible resolution to the puzzle, namely, that the historical premium may be misleading. Perhaps U.S. equity investors simply enjoyed good fortune and the twentieth century for them represented the "triumph of the optimists" (Dimson, Marsh, and Staunton (2002)). As Cochrane (1997) puts it, maybe it was simply "100 years of good luck"—the opposite of the old joke about Soviet agriculture being the result of "100 years of bad luck."

This good luck story may also be accentuated by country selection bias, making the historical data even more misleading. To illustrate this, consider the parallel with selection bias in the choice of stocks, and the task facing a researcher who wished to estimate the required risk premium and expected return on the common stock of Microsoft. It would be foolish to extrapolate from Microsoft's stellar past performance. Its success and survival makes it non-typical of companies as a whole. Moreover, in its core business Microsoft has a market share above 50%. Since, by definition, no competitor can equal this accomplishment, we should not extrapolate expected returns from this one example of success. The past performance of individual stocks is anyway largely uninformative about their future returns, but when there is *ex post* selection bias based on past success, historical mean returns will provide an upward biased estimate of future expected returns. That is one reason why equity premium projections are usually based on the performance of the entire market, including unsuccessful as well as successful stocks.[1]

For similar reasons, we should also be uncomfortable about extrapolating from a stock market that has survived and been successful, and gained a market share of above 50%. Organized trading in marketable securities began in Amsterdam in 1602 and London in 1698, but did not commence in New York until 1792. Since then, the U.S. share of the global stock market as measured by the percentage of overall world equity market capitalization has risen from zero to around 50% (see Dimson, Marsh, and Staunton (2004)). This reflects the superior performance of the U.S. economy, as evidenced by a large volume of initial public offerings (IPOs) and seasoned equity offerings (SEOs) that enlarged the U.S. equity market, and the substantial returns from U.S. common stocks after they had gained a listing. No other market can rival this long-term accomplishment.

Mehra and Prescott's initial focus on the United States and the ready availability of U.S. data has ensured that much of the subsequent research prompted by their paper has investigated the premium within the context of the U.S. market. The theoretical work usually starts with the assumption that the equity premium is of the magnitude that has been observed historically in the United States, and seeks to show why the Mehra-Prescott observations are not (quite so much of) a puzzle. Some empirical work has looked beyond the United States, including Jorion and Goetzmann (1999) and Mehra and Prescott (2003). However, researchers have hitherto been hampered by the paucity of long-run equity returns data for other countries. Most research seeking to resolve the equity premium puzzle has thus focused on empirical evidence for the United States. In emphasizing the U.S.—a country that must be a relative outlier—this body of work may be starting from the wrong set of beliefs about the past.

The historically measured equity premium could also be misleading if the risk premium has been non-stationary. This could have arisen if, over the measurement interval, there have been changes in risk, or the risk attitude of investors, or investors' diversification opportunities. If, for example, these have caused a reduction in the risk premium, this fall in the discount rate will

[1] Another key reason is that equilibrium asset pricing theories such as the CAPM or CCAPM assign a special role to the value weighted market portfolio. However, our argument for looking beyond the United States is not dependent on the assumption that the market portfolio should necessarily be the world portfolio. Instead, we are simply pointing out that if one selects a country which is known after the event to have been unusually successful, then its past equity returns are likely to be an upward biased estimate of future returns.

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have led to re-pricing of stocks, thus adding to the magnitude of historical returns. The historical mean equity premium will then overstate the prospective risk premium, not only because the premium has fallen over time, but also because historical returns are inflated by past repricings that were triggered by a *reduction* in the risk premium.

In this paper, we therefore revisit two fundamental questions: How large has the equity premium been historically, and how big is it likely to be in the future? To answer these questions, we extend our horizon beyond just the United States and use a new source of long-run returns, the Dimson-Marsh-Staunton (2006) database, to examine capital market history in 17 countries over the 106-year period from 1900 to 2005. Initially, we use the DMS database to estimate the historical equity premium around the world on the assumption that the premium was stationary. We then analyse the components of the premium to provide insights into the impact on historical returns of (i) luck and (ii) repricing resulting from changes in the underlying risk premium. This then enables us to make inferences about the likely future long-run premium.

Our paper is organized as follows. The next section reviews previous estimates and beliefs about the size of the equity premium. Section 3 describes the new DMS global database and explains why it represents a significant advance over previous data. Section 4 utilizes the database to present summary data on long-run returns, and to illustrate why we need long-run histories to estimate premiums with any precision—even if the underlying processes are non-stationary. Section 5 presents new evidence on the historical equity premium around the world, assuming stationarity. Section 6 decomposes historical equity premiums into several elements, documenting the contribution of each to historical returns. Section 7 uses this decomposition to infer expectations of the equity premium, discusses why these are lower than the historical realizations, and provides a summary and conclusion. There are two appendices, one formalising the methodology behind our decomposition, and the other documenting our data sources.

2. PRIOR ESTIMATES OF THE EQUITY PREMIUM

Prior estimates of the historical equity premium draw heavily on the United States, with most researchers and textbooks citing just the American experience. The most widely cited source is Ibbotson Associates whose U.S. database starts in 1926. At the turn of the millennium, Ibbotson's estimate of the U.S. arithmetic mean equity premium from 1926–1999 was 9.2%. In addition, before the DMS database became available, researchers such as Mehra and Prescott (2003), Siegel (2002), and Jorion and Goetzmann (1999) used the Barclays Capital (1999) and Credit Suisse First Boston (CSFB) (1999) data for the United Kingdom. In 1999, both Barclays and CSFB were using identical U.K. equity and Treasury bill indexes that started in 1919 and gave rise to an arithmetic mean equity premium of 8.8%.

In recent years, a growing appreciation of the equity premium puzzle made academics and practitioners increasingly concerned that these widely cited estimates were too high. This distrust proved justified for the historical numbers for the U.K., which were wrong. The former Barclays/CSFB index was retrospectively constructed, and from 1919–35, was based on a sample of 30 stocks chosen from the largest companies (and sectors) in 1935. As we show in Dimson, Marsh and Staunton (2001), the index thereby suffered from *ex post* bias. It represented a potential investment strategy only for investors with perfect foresight in 1919 about which companies were destined to survive (survivorship bias). Even more seriously, it incorporated hindsight on which stocks and sectors were destined in 1919 subsequently to perform well and grow large (success bias).[2]

After correcting for this *ex post* selection bias, the arithmetic mean equity premium from 1919–35 fell from 10.6% to 5.2%. The returns on this index were also flattered by the choice of start-date. By starting in 1919, it captured the post-World War I recovery, while omitting wartime losses and the lower pre-war returns. Adding in these earlier years gave an arithmetic mean U.K. equity premium over the entire twentieth century of 6.6%, some 2¼% lower than might have been inferred from the earlier, incorrect data for 1919–99.

The data used by Ibbotson Associates to compute the historical U.S. equity premium is of higher quality and does not suffer from the problems that afflicted the old U.K. indexes. Those believing that the premium is "too good to be true" have therefore pointed their finger of suspicion mainly at success bias—a choice of market that was influenced by that country's record of success. Bodie (2002) argued that high U.S. and U.K. premiums are likely to be anomalous, and underlined the need for comparative international evidence. He pointed out that long-run studies are almost always of U.S. or U.K. premiums: "There were 36 active stock markets in 1900, so why do we only look at two? I can tell you—because many of the others don't have a 100-year history, for a variety of reasons."

There are indeed relatively few studies extending beyond the United States and the United Kingdom. Mehra and Prescott (2003) report comparative premiums for France, Japan, and Germany. They find a similar pattern to the United States, but their premiums are based on post-1970 data and periods of 30 years or less. Ibbotson Associates (2005) compute equity premiums for 16 countries, but only from 1970. Siegel (2002) reports premiums for Germany and Japan since 1926, finding magnitudes similar to those in the United States. Jorion and Goetzmann (1999) provide the most comprehensive long-run global study by assembling a database of capital gain indexes for 39 markets, 11 of which started as early as 1921. However, they were able to identify only four markets, apart from the United States and the United Kingdom, with pre-1970 dividend information. They concluded that, "the high equity premium obtained for U.S. equities appears to be the exception rather than the rule." But in the absence of reliable dividend information, this assertion must be treated with caution. We therefore return to this question using comprehensive total returns data in section 5 below.

Expert Opinion

The equity premium has thus been a source of controversy, even among experts. Welch (2000) studied the opinions of 226 financial economists who were asked to forecast the average annual equity premium over the next 30 years. Their forecasts ranged from 1% to 15%, with a mean and median of 7%. No clear consensus emerged: the cross-sectional dispersion of the forecasts was as large as the standard error of the mean historical equity premium.

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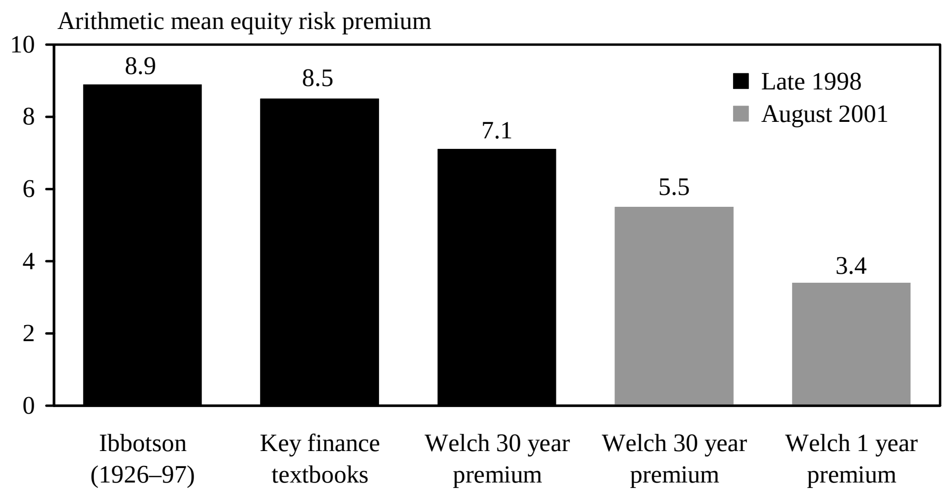
[2] After becoming aware of our research, Barclays Capital (but not CSFB) corrected their pre-1955 estimates of U.K. equity returns for bias and extended their index series back to 1900.

Most respondents to the Welch survey would have viewed the Ibbotson Associates Yearbook as the definitive study of the historical U.S. equity premium. At that time, the most recent Yearbook was the 1998 edition, covering 1926–1997. The first bar of **Figure 1** shows that the arithmetic mean equity premium based on the Yearbook data was 8.9% per annum.[3] The second bar shows that the key finance textbooks were on average suggesting a slightly lower premium of 8.5%. This may have been based on earlier, slightly lower, Ibbotson estimates, or perhaps the authors were shading the estimates down. The Welch survey mean is in turn lower than the textbook figures, but since the respondents claimed to lower their forecasts when the equity market rises, this may reflect the market's strong performance in the 1990s.

Figure 1: Estimated Arithmetic Equity Premiums Relative to Bills, 1998 and 2001



At the time of this survey, academics' forecasts of the long-run premium thus seemed strongly influenced by the historical record. Certainly, leading textbooks advocated the use of the historical mean, including Bodie, Kane, and Marcus (1999) and Brealey and Myers (2000). The latter states, "Many financial managers and economists believe that long-run historical returns are the best measure available." This was supported by researchers such as Goyal and Welch (2006) who could not identify a single predictive variable that would have been of robust use for forecasting the equity premium, and recommended "assuming that the equity premium is 'like it always has been'." Even Mehra and Prescott (2003) state, "…over the long horizon the equity premium is likely to be similar to what it has been in the past and the returns to investment in equity will continue to dominate that in T-bills for investors with a long planning horizon."

The survey and textbook figures shown in the second and third bars of Figure 1 indicate what was being taught at the end of the 1990s in the world's top business schools and economics departments. But by 2001, longer-term estimates were gaining publicity. Our own estimate (Dimson, Marsh, and Staunton (2000)) of the U.S. arithmetic mean premium over the entire twentieth century of 7.7% was 1.2% lower than Ibbotson's estimate of 8.9% for 1926–1997.

[3] This is the arithmetic mean of the one-year geometric risk premiums. The arithmetic mean of the one-year arithmetic risk premiums, i.e., the average annual difference between the equity return and the Treasury bill return, was slightly higher at 9.1%.

In August 2001, Welch (2001) updated his survey, receiving 510 responses. Respondents had revised their estimates downward by an average of 1.6%. They now estimated an equity premium averaging 5.5% over a 30-year horizon, and 3.4% over a one-year horizon (see Figure 1). Those taking part for the first time estimated the same mean premiums as those who had participated in the earlier survey. While respondents to the earlier survey had indicated that, on average, a bear market would raise their equity premium forecast, Welch reports that "this is in contrast with the observed findings: it appears as if the recent bear market correlates with lower equity premium forecasts, not higher equity premium forecasts."

The academic consensus now appears to be lower still (e.g., see Jagannathan, McGrattan and Scherbina (2000) and Fama and French (2002)). Investment practitioners typically agree (see Arnott and Ryan (2001) and Arnott and Bernstein (2002), and the latest editions of many textbooks have reduced their equity premium estimates (for a summary of textbook prescriptions, see Fernandez (2004)). Meanwhile, surveys by Graham and Harvey (2005) indicate that U.S. CFOs have reduced their forecasts of the equity premium from 4.65% in September 2000 to 2.93% by September 2005. Yet predictions of the long-term premium should not be so sensitive to short-term market fluctuations. Over this period, the long-run historical mean premium—which just a few years earlier had been the anchor of beliefs—has fallen only modestly, as adding in the years 2000–05 reduces the long-run mean by just 0.4%, despite the bear market of 2000–02. The sharp lowering of the consensus view about the future premium must therefore reflect more than this, such as new ways of interpreting the past, new approaches to forecasting the premium, or new facts about global long-term performance, such as evidence that the U.S. premium was higher than in most other countries.

3. LONG-RUN INTERNATIONAL DATA

We have seen that previous research has been hampered by the quality and availability of long-run global data. The main problems were the short time-series available and hence the focus on recent data, the absence of dividends, *ex post* selection bias, and emphasizing data that is "easy" to access.

Historically, the most widely used database for international stock market research has been the Morgan Stanley Capital International (MSCI) index series, but the MSCI data files start only in 1970. This provides a rather short history for estimating equity premiums, and spans a period when equities mostly performed well, so premiums inevitably appear large. Researchers interested in longer-term data have found no shortage of earlier stock price indexes but, as is apparent in Jorion and Goetzmann (1999), they have encountered problems over dividend availability. We show in section 6 that this is a serious drawback, because the contribution of dividends to equity returns is of the same order of magnitude as the equity premium itself, and since there have been considerable cross-country differences in average dividend yield. The absence of dividends makes it hard to generate meaningful estimates of equity premiums.

Even for countries where long-run total returns series were available, we have seen that they sometimes suffered from *ex post* selection bias, as had been the case in the U.K. Finally, the data sources that pre-dated the DMS database often suffered from "easy data" bias. This refers to the tendency of researchers to use data that is easy to obtain, excludes traumatic intervals such as wars and their aftermath, and typically relates to more recent periods. Dimson, Marsh, and Staunton (2002) identify the most widely cited prior data source for each of 16 countries and show that equity returns over the periods covered are higher than the 1900–2000 returns from the DMS database by an average of 3% per year. Easy data bias almost certainly led researchers to believe that equity returns over the twentieth century were higher than was really the case.

The DMS Global Database: Composition and Start-date

These deficiencies in existing data provided the motivation for the DMS global database. This contains annual returns on stocks, bonds, bills, inflation, and currencies for 17 countries from 1900–2005, and is described in Dimson, Marsh, and Staunton (2006a and 2006b). The countries include the United States and Canada, seven markets from what is now the Euro currency area, the United Kingdom and three other European markets that have not embraced the Euro, two Asia-Pacific markets, and one African market. Together, they made up 91% of total world equity market capitalization at the start of 2006, and we estimate that they constituted 90% by value at the start of our period in 1900 (see section 5 for more details).

The DMS database also includes four “world” indexes based on the countries included in the DMS dataset. There is, first, a World equity index: a 17-country index denominated in a common currency, here taken as U.S. dollars, in which each country is weighted by its starting-year equity market capitalization or, in years before capitalizations were available, by its GDP. Second, there is an analogous 16-country worldwide equity index that excludes the United States (“World ex-U.S.”). Third and fourth, we compute a World bond index and a World ex-U.S. bond index, both of which are constructed in the same way, but with each country weighted by its GDP.

The DMS series all commence in 1900, and this common start-date aids international comparisons. The choice of start-date was dictated by data availability and quality. At first sight, it appears feasible to start earlier. Jorion and Goetzmann (1999) note that, by 1900, stock exchanges existed in at least 33 of today’s nations, with markets in seven countries dating back another 100 years to 1800. An earlier start-date would in principle be desirable, as a very long series of stationary returns is needed to estimate the equity premium with any precision. Even with non-stationary returns, a long time-series is still helpful,[4] and it would anyway be interesting to compare nineteenth century premiums with those from later years. Indeed, some researchers report very low premiums for the nineteenth century. Mehra and Prescott (2003) report a U.S. equity premium of zero over 1802–62, based on Schwert’s (1990) equity series and Siegel’s (2002) risk free rate estimates, while Hwang and Song (2004) claim there was no U.K. equity premium puzzle in the nineteenth century, since bonds outperformed stocks.

These inferences, however, are unreliable due to the poor quality of nineteenth century data. The equity series used by Hwang and Song omits dividends, and before 1871, suffers from *ex post*

[4] Pástor and Stambaugh (2001) show that a long return history is useful in estimating the current equity premium even if the historical distribution has experienced structural breaks. The long series helps not only if the timing of breaks is uncertain but also if one believes that large shifts in the premium are unlikely or that the premium is associated, in part, with volatility.

bias and poor coverage. From 1871–1913, they use a broader index (Grossman (2002)), but this has problems with capital changes, omitted data, and stocks disappearing. Within the range of likely assumptions about these disappearances, Grossman shows that he can obtain a 1913 end-value of anywhere between 400 and 1700 (1871=100). Mehra and Prescott (2003) list similar weaknesses in Schwert's 1802–71 U.S. data, such as the lack of dividends, tiny number of stocks, frequent reliance on single sectors, and likelihood of *ex post* bias. These flaws undermine the reliability of equity premium estimates for the nineteenth century.

Unfortunately, better nineteenth century U.K. equity indexes do not exist, and, until recently, Schwert's series was the only source of pre-1871 U.S. data. However, most recently, Goetzmann and Ibbotson (2006) employ a new NYSE database for 1815–1925 (see Goetzmann, Ibbotson, and Peng (2001)) to estimate the nineteenth century U.S. equity premium. But they highlight two problems. First, dividend data is absent pre-1825, and incomplete from 1825–71. Equity returns for 1825–71 are thus estimated in two ways based on different assumptions about dividends, producing two widely divergent estimates of the mean annual return, namely, 6.1% and 11.5%, which are then averaged. Second, since Treasury bills or their equivalents did not yet exist, the risk free rate proves even more problematic and has to be estimated from risky bonds. These two factors make it hard to judge the efficacy of their nineteenth century equity premium estimates.

Returning to the question of the start-date for the DMS database, it is clear that, even for the United States, the world's best-documented capital market, pre-1871 data is still problematic. Wilson and Jones (2002) observe that after 1871, U.S. equity returns are of higher quality; but while a few other DMS countries also have acceptable series over this period, most, including the United Kingdom, have no suitable data prior to 1900. Before then, there are virtually no stock indexes to use as a starting point, and creating new nineteenth century indexes would be a major task, requiring hand collection of stock data from archives.[5] For practical purposes, 1900 is thus the earliest plausible common start-date for a comparative international database.

The DMS Global Database: General Methodology and Guiding Principles

The DMS database comprises annual returns, and is based on the best quality capital appreciation and income series available for each country, drawing on previous studies and other sources. Where possible, data were taken from peer-reviewed academic papers, or highly rated professional studies. From the end point of these studies, the returns series are linked into the best, most comprehensive, commercial returns indexes available. The DMS database is updated annually (see Dimson, Marsh, and Staunton (2006a and 2006b)). Appendix 2 lists the data sources used for each country.

To span the entire period from 1900 we link multiple index series. The best index is chosen for each period, switching when feasible to better alternatives, as they become available. Other factors equal, we have chosen equity indexes that afford the broadest coverage of their market.

[5] The Dow Jones Industrial Average was, we believe, the first index ever published. It began in 1884 with 11 constituents. Charles Dow had neither computer nor calculator, hence his limited coverage. While today, computation is trivial, creating indexes more than 100 years after the event poses a major data challenge. While it is often fairly easy to identify hard copy sources of stock prices, the real problems lie in identifying (i) the full population, including births, name changes, and deaths and their outcome, and (ii) data on dividends, capital changes, shares outstanding, and so on. Archive sources tend to be poorer, or non-existent, the further back one goes in time.

The evolution of the U.S. equity series illustrates these principles. From 1900–25, we use the capitalization weighted Cowles Index of all NYSE stocks (as modified by Wilson and Jones (2002)); from 1926–61, we use the capitalization weighted CRSP Index of all NYSE stocks; from 1962–70, we employ the extended CRSP Index, which over this period also includes Amex stocks; and from 1971 on, we utilize the Wilshire 5000 Index, which contains over 7,000 U.S. stocks, including those listed on Nasdaq.

The creation of the DMS database was in large part an investigative and assembly operation. Most of the series needed already existed, but some were long forgotten, unpublished, or came from research in progress. In other cases, the task was to estimate total returns by linking dividends to existing capital gains indexes. But for several countries, there were periods for which no adequate series existed. For example, U.K. indexes were of poor quality before 1962, and far from comprehensive thereafter. To remedy this, we compiled an index spanning the entire U.K. equity market for 1955–2005 (Dimson and Marsh (2001)), while for 1900–1955, we built a 100-stock index by painstaking data collection from archives. Similarly, we used archive data to span missing sub-periods for Canada, Ireland, Norway, Switzerland, and South Africa.

Virtually all of the DMS countries experienced trading breaks at some point in their history, often in wartime. Jorion and Goetzmann (1999) provide a list and discuss the origins of these interruptions. In assembling our database, we needed to span these gaps. The U.K. and European exchanges, and even the NYSE, closed at the start of World War I, but typically reopened 4–6 months later. Similarly, the Danish, Norwegian, Belgian, Dutch and French markets were closed for short periods when Germany invaded in 1940, and even the Swiss market closed from May to July 1940 for mobilization. There were other temporary closures, notably in Japan after the Great Tokyo Earthquake of 1923. These relatively brief breaks were easy to bridge.[6] But three longer stock exchange closures proved more difficult: Germany and Japan from towards the end of World War II, and Spain during the Civil War. We were able to bridge these gaps,[7] but as markets were closed or prices were controlled, the end-year index levels recorded for Germany for 1943–47, Japan for 1945, and Spain for 1936–38 cannot be regarded as market-determined values. This needs to be borne in mind when reviewing arithmetic means, standard deviations, and other statistics relating to annual returns computed using these values. Over each of these stock exchange closures, more reliance can be placed on the starting and ending values than on the intermediate index levels. We are therefore still able to compute changes in investors' wealth and geometric mean returns over periods spanning these closures.

Finally, there was one unbridgeable discontinuity, namely, bond and bill (but not equity) returns in

[6] Since the DMS database records annual returns, trading breaks pose problems only when they span a calendar year boundary. For example, at the start of World War I, the NYSE was closed from 31 July until 11 December 1914, so it was still possible to calculate equity and bond returns for 1914. However, the London Stock Exchange closed in July 1914 and did not reopen until 5 January 1915, so prices for the latter date were used as the closing prices for 1914 and the opening prices for 1915. A similar approach was adopted for French returns during the closure of the Paris Exchange from June 1940 until April 1941.

[7] Wartime share dealing in Germany and Japan was subject to strict controls. In Germany, stock prices were effectively fixed after January 1943; the market closed in 1944 with the Allied invasion, and did not reopen until July 1948. Both Gielen (1944) and Ronge (2002) provide data that bridges the gap between 1943 and 1948. In Japan, stock market trading was suspended in August 1945, and although it did not officially reopen until May 1949, over-the-counter trading resumed in May 1946, and the Oriental Economist Index provides relevant stock return data. In Spain, trading was suspended during the Civil War from July 1936 to April 1939, and the Madrid exchange remained closed through February 1940; over the closure we assume a zero change in nominal stock prices and zero dividends.

Germany during the hyperinflation of 1922–23, when German bond and bill investors suffered a total loss of –100%. This episode serves as a stark reminder that, under extreme circumstances, bonds and bills can become riskier than equities. When reporting equity premiums for Germany, whether relative to bonds or bills, we thus have no alternative but to exclude the years 1922–23.

All DMS index returns are computed as the arithmetic average of the individual security returns, and not as geometric averages (an inappropriate method encountered in certain older indexes); and all the DMS security returns include reinvested gross (pre-tax) income as well as capital gains. Income reinvestment is especially important, since, as we saw above, many early equity indexes measure just capital gains and ignore dividends, thus introducing a serious downward bias. Similarly, many early bond indexes record only yields, ignoring price movements. Virtually all DMS equity indexes are capitalization weighted, and are calculated from year-end stock prices, but in the early years, for a few countries, we were forced to use equally weighted indexes or indexes based on average- or mid-December prices (see Appendix 2).

Our guiding principle was to avoid survivorship, success, look-ahead, or any other form of *ex post* selection bias. The criterion was that each index should follow an investment policy that was specifiable in advance, so that an investor could have replicated the performance of the index (before dealing costs) using information that would have been available at the time. The DMS database and its world indexes do, however, suffer from survivorship bias, in the sense that all 17 countries have a full 106-year history. In 1900, an investor could not have known which markets were destined to survive. Certainly, in some markets that existed in 1900, such as Russia and China, domestic equity and bond investors later experienced total losses. In section 5 below, we assess the likely impact of this survivorship bias on our worldwide equity premium estimates.

The DMS inflation rates are derived from each country's consumer price index (CPI), although for Canada (1900–10), Japan (1900), and Spain (1900–14) the wholesale price index is used, as no CPI was available. The exchange rates are year-end rates from *The Financial Times* (1907–2005) and *The Investors' Review* (1899–1906). Where appropriate, market or unofficial rates are substituted for official rates during wartime or the aftermath of World War II. DMS bill returns are in general treasury bill returns, but where these instruments did not exist, we used the closest equivalent, namely, a measure of the short-term interest rate with the lowest possible credit risk.

The DMS bond indexes are based on government bonds. They are usually equally weighted, with constituents chosen to fall within the desired maturity range. For the United States and United Kingdom, they are designed to have a maturity of 20 years, although from 1900−55, the U.K. bond index is based on perpetuals, since there were no 20-year bonds in 1900, and perpetuals dominated the market in terms of liquidity until the 1950s. For all other countries, 20-year bonds are targeted, but where these are not available, either perpetuals (usually for earlier periods) or shorter maturity bonds are used. Further details are given in Appendix 2.

In summary, the DMS database is more comprehensive and accurate than the data sources used in previous research and it spans a longer period. This allows us to set the U.S. equity premium alongside comparable 106-year premiums for 16 other countries and the world indexes, thereby helping us to put the U.S. experience in perspective.

4. LONG-RUN HISTORICAL RATES OF RETURN

In this section we use the DMS dataset to examine real equity market returns around the world. In Table **1**, we compare U.S. returns with those in 16 other countries, and long run returns with recent performance, to help show why we need long time series when analyzing equity returns.

The second column of Table 1 reports annualized real returns over the early years of the twenty-first century, from 2000–2005, the most recent 6-year period at the time of writing. It shows that real equity returns were negative in seven of the seventeen countries and that the return on the world index was -1.25%. Equities underperformed bonds and bills (not shown here) in twelve of the seventeen countries. Inferring the expected equity premium from returns over such a short period would be nonsense: investors cannot have required or expected a negative return for assuming risk. This was simply a disappointing period for equities.

It would be just as misleading to project the future equity premium from data for the previous decade. Column three of Table 1 shows that, with the exception of one country, namely, Japan, which we discuss below, real equity returns between 1990 and 1999 were typically high. Over this period, U.S. equity investors achieved a total real return of 14.2% per annum, increasing their initial stake five-fold. This was a golden age for stocks, and golden ages are, by definition, untypical, providing a poor basis for future projections.

Table 1: Real Equity Returns in 17 Countries, 1900–2005

	Annualized Returns (% p.a.)			**Properties of Annual (%) Real Returns, 1900–2005**					
Country	**2000 to 2005**	**1990 to 1999**	**1900 to 2005**	**Arith. Mean**	**Std. Error**	**Std. Devn.**	**Skew-ness**	**Kurt-osis**	**Serial Corr.**
Belgium	3.99	9.13	**2.40**	4.58	2.15	22.10	0.95	2.33	0.23
Italy	-0.73	6.42	**2.46**	6.49	2.82	29.07	0.76	2.43	0.03
Germany	-4.08	9.89	**3.09**	8.21	3.16	32.53	1.47	5.65	-0.12
France	-1.64	12.53	**3.60**	6.08	2.25	23.16	0.41	-0.27	0.19
Spain	2.48	12.16	**3.74**	5.90	2.12	21.88	0.80	2.17	0.32
Norway	10.91	8.25	**4.28**	7.08	2.62	26.96	2.37	11.69	-0.06
Switzerland	1.11	13.95	**4.48**	6.28	1.92	19.73	0.42	0.38	0.18
Japan	0.64	-5.23	**4.51**	9.26	2.92	30.05	0.49	2.36	0.19
Ireland	5.14	11.79	**4.79**	7.02	2.15	22.10	0.60	0.81	-0.04
World ex-U.S (USD)	0.11	3.41	**5.23**	7.02	1.92	19.79	0.58	1.41	0.25
Denmark	9.41	7.52	**5.25**	6.91	1.97	20.26	1.83	6.71	-0.13
Netherlands	-5.41	17.79	**5.26**	7.22	2.07	21.29	1.06	3.18	0.09
United Kingdom	-1.34	11.16	**5.50**	7.36	1.94	19.96	0.66	3.69	-0.06
World (USD)	-1.25	7.87	**5.75**	7.16	1.67	17.23	0.13	1.05	0.15
Canada	4.32	8.28	**6.24**	7.56	1.63	16.77	0.09	-0.13	0.16
United States	-2.74	14.24	**6.52**	8.50	1.96	20.19	-0.14	-0.35	0.00
South Africa	11.05	4.61	**7.25**	9.46	2.19	22.57	0.94	2.58	0.05
Australia	7.78	8.98	**7.70**	9.21	1.71	17.64	-0.25	0.06	-0.02
Sweden	-0.70	15.02	**7.80**	10.07	2.20	22.62	0.55	0.92	0.11

Extremes of History

While the 1990s and early 2000s were not typical, they are not unique. The top panel of Table **2** highlights other noteworthy episodes of world political and economic history since 1900. It shows real equity returns over the five worst episodes for equity investors, and over four "golden ages" for the world indexes and the world's five largest markets. These five markets are of interest not just because of their economic importance, but also because they experienced the most extreme returns out of all 17 countries in our database.

The five worst episodes for equity investors comprise the two World Wars and the three great bear markets—the Wall Street Crash and Great Depression, the first oil shock and recession of 1973–74, and the 2000–02 bear market after the internet bubble. While the World Wars were in

Table 2: Real Equity Returns in Key Markets over Selected Periods

		Real Rate of Return (%) over the Period						
Period	**Description**	**U.S.**	**U.K.**	**France**	**Germany**	**Japan**	**World**	**World ex-US**
Selected Episodes								
1914–18:	World War I	-18	-36	-50	-66	66	-20	-21
1919–28	Post-WWI recovery	372	234	171	18	30	209	107
1929–31	Wall Street Crash	-60	-31	-44	-59	11	-54	-47
1939–48	World War II	24	34	-41	-88	-96	-13	-47
1949–59	Post-WWII recovery	426	212	269	4094	1565	517	670
1973–74	Oil shock/recession	-52	-71	-35	-26	-49	-47	-37
1980–89	Expansionary 80s	184	319	318	272	431	255	326
1990–99	90s tech boom	279	188	226	157	-42	113	40
2000–02	Internet 'bust'	-42	-40	-46	-57	-49	-44	-46
Periods with Highest Returns								
1-year	Return	57	97	66	155	121	70	79
periods	*Period*	*1933*	*1975*	*1954*	*1949*	*1952*	*1933*	*1933*
2-year	Return	90	107	123	186	245	92	134
periods	*Period*	*1927–28*	*1958–59*	*1927–28*	*1958–59*	*1951–52*	*1932–33*	*1985–86*
5-year	Return	233	176	310	652	576	174	268
periods	*Period*	*1924–28*	*1921–25*	*1982–86*	*1949–53*	*1948–52*	*1985–89*	*1985–89*
Periods with Lowest Returns								
1-year	Return	-38	-57	-40	-91	-86	-35	-41
periods	*Period*	*1931*	*1974*	*1945*	*1948*	*1946*	*1931*	*1946*
2-year	Return	-53	-71	-54	-90	-95	-47	-52
periods	*Period*	*1930–31*	*1973–74*	*1944–45*	*1947–48*	*1945–46*	*1973–74*	*1946–47*
5-year	Return	-45	-63	-78	-93	-98	-50	-56
periods	*Period*	*1916–20*	*1970–74*	*1943–47*	*1944–48*	*1943–47*	*1916–20*	*1944–48*
Longest Runs of Negative Real Returns								
Longest	Return	-7	-4	-8	-8	-1	-9	-11
runs over	*Period*	*1905–20*	*1900–21*	*1900–52*	*1900–54*	*1900–50*	*1901–20*	*1928–50*
106 years	Number of Years	16	22	53	55	51	20	23

aggregate negative for equities, there were relative winners and losers, corresponding to each country's fortunes in war. Thus in World War I, German equities performed the worst (–66%), while Japanese stocks fared the best (+66%), as Japan was a net gainer from the war. In World War II and its aftermath,[8] Japanese and German equities were decimated (–96% and –88% respectively), while both U.S. and U.K. equities enjoyed small positive real returns.

Table 2 shows that the world wars were less damaging to world equities than the peacetime bear markets. From 1929–31, during the Wall Street Crash and ensuing Great Depression, the world index fell by 54% in real, U.S. dollar terms, compared with 20% during World War I and 13% in World War II. For the United States, Germany, and the world index this was the most savage of the three great bear markets, and from 1929–31 the losses in real terms were 60%, 59%, and 54%, respectively. From peak to trough, the falls were even greater. Table 2 records calendar year returns, but the U.S. equity market did not start falling until September 1929, reaching its nadir in June 1932, 79% (in real terms) below its 1929 peak.

British and Japanese investors, in contrast, suffered greater losses in 1973–74 than during the 1930s. This was the time of the first OPEC oil squeeze after the 1973 October War in the Middle East, which drove the world into deep recession. Over 1973–74, the real returns on U.K., U.S., Japanese, and world equities were –71%, –52%, –49%, and –47%, respectively. The last row of the top panel of Table 2 shows that the world equity index fell by almost as much (44% in real terms) in the bear market of 2000–02, which followed the late 1990s internet bubble. Table 2 shows the returns over calendar years, and from the start of 2000 until the trough of the bear market in March 2003, the real returns on U.S., U.K., Japanese, and German equities were even lower at –47%, –44%, –53%, and –65%, respectively.

The top panel of Table 2 also summarizes real returns over four "golden ages" for equity investors. The 1990s, which we highlighted in Table 1 as a recent period of exceptional performance, was the most muted of the four, with the world index showing a real return of 113%. While the 1990s was an especially strong period for the U.S. market (279% real return), the world index was held back by Japan.[9] The world index rose by appreciably more during the 1980s (255% in real terms) and the two post-world war recovery periods (209% in the decade after World War I and 517% from 1949–59). During the latter period, a number of equity markets enjoyed quite staggering returns. For example, Table 2 shows that during these nascent years of the German and Japanese "economic miracles", their equity markets rose in real terms by 4094% (i.e., 40.4% p.a.) and 1565% (29.1% p.a.), respectively.

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[8] To measure the full impact of World War II on German and Japanese equity returns, it is necessary to extend the period through to 1948 to include the aftermath of the war. This is because, as noted above, stock prices in Germany were effectively fixed after January 1943, and the exchanges closed in 1944 with the Allied invasion, and did not reopen until July 1948, when prices could finally reflect the destruction from the war. Meanwhile, German inflation from 1943–48 was 55%. In Japan, the stock market closed in 1944, but over-the-counter trading resumed from 1946 onwards. In Japan, the sharp negative real returns recorded in 1945, 1946, and 1947 thus reflect the hyperinflation that raged from 1945 onward (inflation from 1945–48 was 5,588%), the resumption of trading at market-determined prices in 1946, and the break-up of the zaibatsu industrial cartels and the distribution of their shares to the workforce.

[9] Table 2 shows that Japan experienced a real return of –42% during the 1990s (equivalent to an annualized real return of –5.2% p.a. as shown in the third column of Table 1). At the start of the 1990s, the Japanese stock market was the largest in the world by market capitalization, with a 40.4% weighting in the world index, compared with 32.2% for the United States. Japan's poor performance, coupled with its high weighting in the world index, and even higher weighting (60%) in the world ex-U.S. naturally had a depressing effect on the returns on the world and world-ex U.S indexes (see Table 2 and column 2 of Table 1).

The second and third panels of Table 2 show the returns for, and dates of, the one-, two-, and five-year periods during which each country and the world indexes experienced their highest and lowest returns. The picture that emerges reinforces the discussion above: in nearly all cases, the best and worst periods are drawn from, and are subsets of, the episodes listed in the top panel. Note that the spreads between worst and best are wide. One-year real returns range from –35% to +70% (world), –38% to +57% (United States), –91% to +155% (Germany), and –86% to 121% (Japan). Five-year real returns extend from –50% to +174% (world), –45% to +233% (United States), –93% to +652% (Germany), and –98% to 576% (Japan).

Finally, the bottom panel of Table 2 reports the longest period over which each country (or world index) has experienced a cumulative negative real return. It shows that for the United States, the longest such period was the 16 years from 1905–20, when the cumulative return was –7%. This reconfirms Siegel's (2002) observation that U.S. investors have historically always enjoyed a positive real return as long as they have held shares for at least 20 years. However, Table 2 shows that investors in other countries have not been so fortunate, with Japan, France, and Germany suffering extended periods lasting over half a century during which cumulative equity returns remained negative in real terms. Dimson, Marsh, and Staunton (2004) report that three-quarters of the DMS countries experienced intervals of negative real stock market returns lasting for more than two decades.

The Long-Run Perspective

The statistics presented in Tables 1 and 2 and the discussion in the previous section serve to emphasize the volatility of stock markets, and the substantial variation in year-to-year and period-to-period returns. Clearly, because of this volatility, we need to examine intervals that are much longer than five years or a decade when estimating means or equity premiums. The fourth column of Table 1 (shown in boldface) illustrates the perspective that longer periods of history can bring by displaying real equity returns over the 106-year period 1900–2005. Clearly, these 106-year returns contrast favourably with the disappointing returns over 2000–2005 (second column), but they are much lower than the returns in the 1990s (third column).

The remaining columns of Table 1 present formal statistics on the distribution of annual real returns over 1900–2005, and again, they emphasize how volatile stock markets were over this period. The arithmetic means of the 106 one-year real returns are shown in the fifth column. These exceed the geometric means (fourth column) by approximately half the variance of the annual returns. The standard deviation column shows that the U.S., U.K., Swiss, and Danish equity markets all had volatilities of around 20%. While this represents an appreciable level of volatility, these countries are at the lower end of the risk spectrum, with only Australia and Canada having lower standard deviations. The highest volatility markets were Italy, Japan, and Germany, with volatilities close to, or above, 30%. These high levels of volatility imply that the arithmetic means are estimated with high standard errors (see column six), and we return to this issue below when we discuss the precision of equity premium estimates.

The skewness and excess kurtosis columns in Table 1 show that returns were positively skewed except in the United States, and in most countries, they were noticeably more fat-tailed than would be expected if they were normally distributed.[10] Finally, the serial correlation column shows that to a good approximation, returns are serially independent. The average serial correlation coefficient was 0.07, and only two out of 17 coefficients were significant at the 95% level—only slightly higher than the proportion that would be expected from chance.

The fourth column of Table 1 shows that the 106-year annualized real return on U.S. equities was 6.5%. The equivalent real return on non-U.S. equities—from the perspective of a U.S. investor, and as measured by the world index excluding the United States—was lower at 5.2%. This lends initial support to the concern about success bias from focusing solely on the United States. At the same time, the gap is not large, and it is also clear from Table 1 that the stock markets of several other countries performed even better than the United States. Table 1 shows real returns in local currency terms, however, rather than equity premiums, and we defer presenting comprehensive comparisons of the latter until Section 5 below.

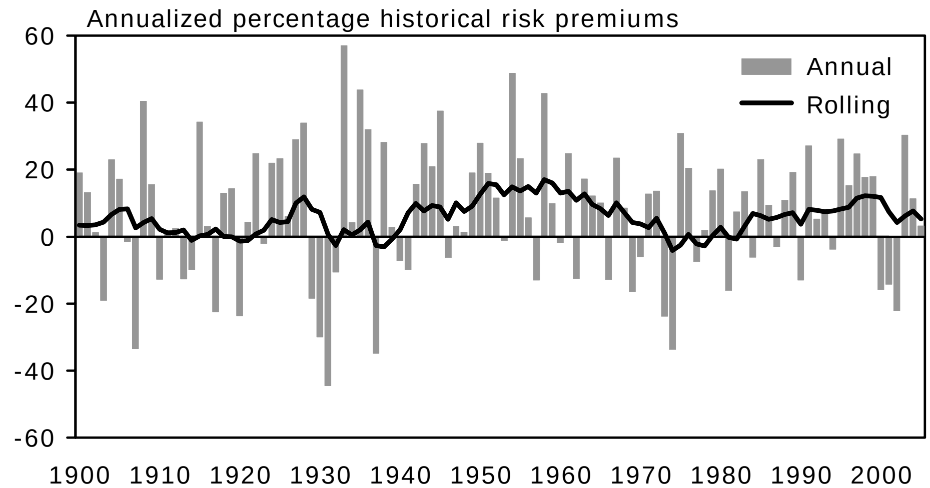
However, to reinforce the importance of focusing on long-run data, we briefly preview the equity premium data for the U.S. market. The bars in **Figure 2** show the year-by-year historical U.S. equity premium calculated relative to the return on Treasury bills over 1900–2005.[11] The lowest premium was –45% in 1931, when equities earned –44% and Treasury bills 1%; the highest was 57% in 1933, when equities earned 57.6% and bills 0.3%. Over the entire 106-year interval, the mean annual excess return over treasury bills was 7.4%, while the standard deviation was 19.6%. On average, therefore, this confirms that U.S. investors received a positive, and large, reward for exposure to equity market risk.

Because the range of year-to-year excess returns is very broad, it would be misleading to label these as "risk premiums." As noted above, investors cannot have expected, let alone required, a negative risk premium from investing in equities. Many low and all negative premiums must therefore reflect unpleasant surprises. Nor could investors have required premiums as high as the 57% achieved in 1933. Such numbers are quite implausible as a required reward for risk, and the high realizations must therefore reflect pleasant surprises. To avoid confusion, it is helpful to refer to a return in excess of the risk free rate, measured over a period in the past, simply as an excess return or as the "historical" equity premium (rather than equity premium). When looking to the future, it is helpful to refer to the "expected" or "prospective" equity premium.

[10] The average coefficients of skewness and kurtosis for the 17 countries were 0.76 and 2.60. This is consistent with our expectation that the distribution of annual stock returns would be lognormal, rather than normal, and hence positively skewed. But when we examine the distribution of log returns (i.e., the natural logarithm of one plus the annual return), we find average skewness and kurtosis of –0.48 and 3.25, i.e., the skewness switches from positive to negative, and the distributions appear even more leptokurtic. This finding is heavily influenced by the extreme negative returns for Germany in 1948 and Japan in 1946. As noted in section 3 above, German returns from 1943–48 and Japanese returns from 1945–46 must be treated with caution, as although the total return over these periods is correct, the values for individual years cannot be regarded as market-determined. The values recorded for Germany in 1948 and Japan in 1946 thus almost certainly include accumulated losses from previous years. Excluding Germany and Japan, the coefficients of skewness and kurtosis based on log returns were –0.20 and 1.40, which are much closer to the values we would expect if annual returns were lognormally distributed.

[11] For convenience, we estimate the equity premium from the arithmetic difference between the logarithmic return on equities and the logarithmic return on the riskless asset. Equivalently, we define *1+Equity Premium* to be equal to *1+Equity Return* divided by *1+Riskless Return*. Defined this way, the equity premium is a ratio and therefore has no units of measurement. It is identical if computed from nominal or real returns, or if computed from dollar or euro returns.

Figure 2: Annual and Rolling Ten-Year U.S. Premiums Relative to Bills, 1900–2005



The ten-year excess returns were sometimes negative, most recently in the 1970s and early 1980s. Figure 2 also reveals several cases of double-digit ten-year premiums. Clearly, a decade is too brief for good and bad luck to cancel out, or for drawing inferences about investor expectations. Indeed, even with over a century of data, market fluctuations have an impact. Taking the United Kingdom as an illustration, the arithmetic mean annual excess return from 1900–49 was only 3.1%, compared to 8.8% from 1950–2005. As over a single year, all we are reporting is the excess return that was realized over a period in the past.

To quantify the degree of precision in our estimates, we can compute standard errors. Assuming that each year's excess return is serially independent,[12] the standard error of the mean historical equity premium estimate is approximately $\sigma/\sqrt{T}$, where σ is the standard deviation of the annual excess returns, and T is the period length in years. Since we have seen that σ was close to 20% for the U.S. market, this implies that the standard error of the mean historical equity premium estimated over ten years is 6.3%, while the standard error using 106 years of data remains quite high at approximately 2%. Since we saw in Table 1 above that most countries had a standard deviation that exceeded that of the U.S. market, the standard error of the mean equity premium is typically larger in non-American markets.

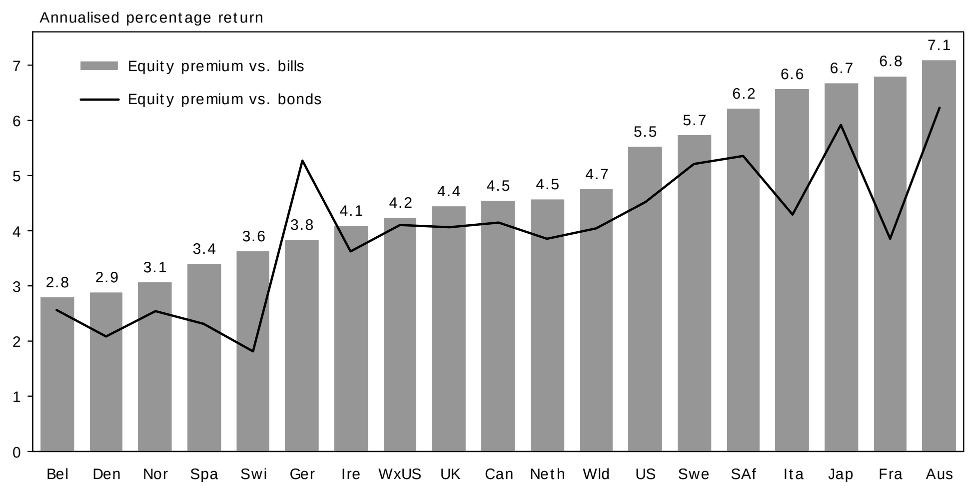
When estimating the historical equity premium, therefore, the case for using long-run data is clear. Stock returns are so volatile that it is hard to measure the mean historical premium with precision. Without long-run data, the task is impossible, and even with over a century of data, the standard error remains high—even if we assume that the underlying series is stationary.

[12] We saw in Table 1 above that this was a good approximation for real returns, and the same holds true for excess returns. For the United States, the serial correlation of excess returns over 1900–2005 was 0.00, while the average across all 17 countries was 0.05. For excess returns defined relative to bonds rather than bills, the average serial correlation was 0.04.

5. NEW GLOBAL EVIDENCE ON THE EQUITY PREMIUM

Figure 3 shows the annualized (geometric mean) historical equity premiums over the 106-year period from 1900–2005 for each of the 17 countries in the DMS database, as well as the world index and the world excluding the United States. Countries are ranked by the equity premium relative to bills (or the nearest equivalent short-term instrument), displayed as bars. The line-plot shows each country's equity premium relative to bonds (long-term government bonds). Since the world indexes are computed here from the perspective of a U.S. (dollar) investor, the world equity premiums relative to bills are calculated with reference to the U.S. risk-free (Treasury bill) rate. The world equity premiums relative to bonds are calculated relative to the world bond indexes.

Figure 3: Worldwide Annualized Equity Premiums 1900–2005*



* Germany omits 1922-23

Figure 3 shows that equities outperformed both bills and bonds in all 17 countries over this period, and that, in general, the equity premium was large. The chart lends support to the concern about generalizing from the U.S. experience by showing that the U.S. equity premium relative to bills was 5.5% compared with 4.2% for the rest of the world. But while noteworthy, this difference is not that large, and Figure 3 shows that several countries had larger premiums than the United States. For the world index (with its large U.S. weighting), the premium relative to bills was 4.7%. The U.K. equity premium was a little below the world average at 4.4%.

Relative to long bonds, the story for the 17 countries is similar, although on average, the premiums were around 0.8% lower, reflecting the average term premium, i.e., the annualized amount by which bond returns exceeded bill returns. The annualized U.S. equity premium relative to bonds was 4.5% compared with 4.1% for the world ex-U.S. Across all 17 countries, the equity premium relative to bonds averaged 4.0%, and for the world index it was also 4.0%.[13] Thus,

[13] Over the entire period, the annualized world equity risk premium relative to bills was 4.74%, compared with 5.51% for the United States. Part of this difference, however, reflects the strength of the dollar. The world risk premium is computed here from the world equity index expressed in dollars, in order to reflect the perspective of a U.S.-based global investor. Since the currencies of most other countries depreciated against the dollar over the twentieth century, this lowers our estimate of the world equity risk premium relative to the (weighted) average of the local-currency-based estimates for individual countries.

while U.S. and U.K. equities have performed well, both countries are toward the middle of the distribution of worldwide equity premiums, and even the United States is not hugely out of line compared to other markets.

The Equity Premium Around the World

Table 3 provides more detail on the historical equity premiums. The left half of the table shows premiums relative to bills, while the right half shows premiums relative to government bonds. In each half of the table we show the annualized, or geometric mean, equity premium over the entire 106 years (i.e., the data plotted in Figure 3); the arithmetic mean of the 106 one-year premiums; the standard error of the arithmetic mean; and the standard deviation of the 106 one-year premiums. The geometric mean is, of course, always less than the arithmetic mean, the difference being approximately one-half of the variance of the historical equity premium.

Table 3 shows that the *arithmetic* mean annual equity premium relative to bills for the United States was 7.4% compared with 5.9% for the world excluding the United States. This difference of 1.5% again lends support to the notion that it is dangerous to extrapolate from the U.S. experience because of *ex post* success bias. But again we should note that Table 3 shows that the United States was by no means the country with the largest arithmetic mean premium. Indeed, on a strict ranking of arithmetic mean premiums, it was eighth largest out of 17 countries.

Table 3: Annualized Equity Premiums for 17 Countries, 1900–2005

% p.a.	**Historical Equity Premium Relative to Bills**				**Historical Equity Premium Relative to Bonds**			
Country	**Geometric Mean**	**Arithmetic Mean**	**Standard Error**	**Standard Deviation**	**Geometric Mean**	**Arithmetic Mean**	**Standard Error**	**Standard Deviation**
Australia	7.08	8.49	1.65	17.00	6.22	7.81	1.83	18.80
Belgium	2.80	4.99	2.24	23.06	2.57	4.37	1.95	20.10
Canada	4.54	5.88	1.62	16.71	4.15	5.67	1.74	17.95
Denmark	2.87	4.51	1.93	19.85	2.07	3.27	1.57	16.18
France	6.79	9.27	2.35	24.19	3.86	6.03	2.16	22.29
Germany*	3.83	9.07	3.28	33.49	5.28	8.35	2.69	27.41
Ireland	4.09	5.98	1.97	20.33	3.62	5.18	1.78	18.37
Italy	6.55	10.46	3.12	32.09	4.30	7.68	2.89	29.73
Japan	6.67	9.84	2.70	27.82	5.91	9.98	3.21	33.06
Netherlands	4.55	6.61	2.17	22.36	3.86	5.95	2.10	21.63
Norway	3.07	5.70	2.52	25.90	2.55	5.26	2.66	27.43
South Africa	6.20	8.25	2.15	22.09	5.35	7.03	1.88	19.32
Spain	3.40	5.46	2.08	21.45	2.32	4.21	1.96	20.20
Sweden	5.73	7.98	2.15	22.09	5.21	7.51	2.17	22.34
Switzerland	3.63	5.29	1.82	18.79	1.80	3.28	1.70	17.52
U.K.	4.43	6.14	1.93	19.84	4.06	5.29	1.61	16.60
U.S.	5.51	7.41	1.91	19.64	4.52	6.49	1.96	20.16
Average	**4.81**	**7.14**	**2.21**	**22.75**	**3.98**	**6.08**	**2.11**	**21.71**
World-ex U.S.	**4.23**	**5.93**	**1.88**	**19.33**	**4.10**	**5.18**	**1.48**	**15.19**
World	**4.74**	**6.07**	**1.62**	**16.65**	**4.04**	**5.15**	**1.45**	**14.96**

* Germany omits 1922–23

Care is needed, however, in comparing and interpreting long-run arithmetic mean equity premiums. For example, Table 3 shows that, relative to bills, Italy had the highest arithmetic equity premium at 10.5%, followed by Japan at 9.8%, France at 9.3%, and Germany at 9.1%. Yet these four countries had below average equity returns (see Table 1). Table 3 shows that part of the explanation lies in the high historical volatilities in these four markets, 32%, 28%, 24% and 33%, respectively. As we saw above, much of this volatility arose during the first half of the twentieth century, during, or in the aftermath of, the World Wars. In all four cases, therefore, the long-run equity premium earned by investors (the geometric mean) was well below the arithmetic mean. But this is only part of the story, since Table 3 shows that these countries still had above-average geometric equity premiums, despite their below-average equity market returns. (Italy, Japan, and France had above average premiums relative to bills, while Italy, Japan, and Germany had above average premiums relative to bonds). The explanation, of course, lies in the very poor historical bill and/or bond returns in these four countries, and we return below to the issue of poor equity returns coinciding with poor bill and bond returns.

Table 3 shows that both the U.S. and U.K. equity premiums relative to bills had similar standard deviations of close to 20% per annum, and that only four other countries had standard deviations that were as low, or lower than this. As noted above, the relatively high standard deviations for the equity premiums for the 17 countries, ranging from 17–33%, indicate that, even with 106 years of data, the potential inaccuracy in historical equity premiums is still fairly high. Table 3 shows that the standard error of the equity premium relative to bills is 1.9% for the United States, and the range runs from 1.6% (Canada) to 3.3% (Germany).

A Smaller Risk Premium

By focusing on the world, rather than the United States, and by extending the time span to 1900–2005, the equity premium puzzle has become quantitatively smaller. We saw in Section 2 that, before our new database became available in 2000, the most widely cited number for the U.S. arithmetic mean equity premium relative to bills was the Ibbotson (2000) estimate for 1926–99 of 9.2%. Table 3 shows that by extending the time period backwards to include 1900–25 and forwards to embrace 2000–05, while switching to more comprehensive index series, the arithmetic mean equity premium shrinks to 7.4%. Table 3 also shows that the equivalent world equity premium over this same period was 6.1%.

But while the puzzle has become smaller than it once was, 6.1% remains a large number. Indeed, Mehra and Prescott's original article documented a premium of 6.2%, albeit for a different time period. As we noted in the introduction to this paper, the equity premium, and hence the equity premium puzzle, continued to grow larger in the years after their paper was written. By extending the estimation period, and expanding our horizons to embrace the world, we have simply succeeded in reducing the puzzle back down to the magnitude documented in Mehra-Prescott's original paper. If 6.2% was a puzzle, it follows that 6.1% is only a very slightly smaller puzzle.

In terms of the empirical evidence, if we are to further shrink our estimate of the expected premium, two further possibilities remain. The first is that our world index is still upward biased because of survivorship bias in terms of the countries included. The second possibility relates to "good luck" and/or a systematic repricing of equities and their riskiness to investors over the last century. As we have seen, however, although the U.S. equity market has performed well, it was not a massive outlier. The challenge for the good luck/repricing hypothesis is thus to explain not just why the United States had "100 years of good luck", but why the rest of the world was almost as fortunate. In the next subsection, we assess the possible impact of survivorship bias. Section 6 then addresses the issues of good luck and repricing.

Survivorship of Markets

Several researchers, most notably Brown, Goetzmann, and Ross (1995) and Jorion and Goetzmann (1999), have suggested that survivorship bias may have led to overestimates of the historical equity premium. Li and Xu (2002) argue on theoretical grounds that this is unlikely to explain the equity premium puzzle, since, for survival models to succeed, the *ex ante* probability of long-term market survival has to be extremely small, which they claim contradicts the history of the world's financial markets. In this section, we look at the empirical evidence on returns and survivorship, and reach the same conclusion as Li and Xu, namely that concerns over survivorship are overstated, especially with respect to true survivorship bias, namely, the impact of markets that failed to survive.

In practice, however, the term "survivorship bias" is often used to also embrace *ex post* success bias as well as true survivorship bias. By comparing U.S. history with that of 16 other countries, we have already addressed the issue of success bias. While a legitimate concern, we are still left with a high historical 17-country world equity premium. Mehra (2003) has also noted that, with respect to its impact on the equity premium, success bias is partly mitigated by the tendency of successful markets to enjoy higher bond and bill returns, as well as higher equity returns; similarly, unsuccessful markets have tended to have lower real returns for both government securities and equities. In other words, there has been a positive correlation between real equity and real bill (or bond) returns.[14] Among markets with high *ex post* equity premiums there are naturally countries with excellent equity performance (like Australia); but there are also countries whose below-average equity returns nevertheless exceeded their disastrous bond returns (like Germany or Japan). Consequently, the cross-sectional dispersion of equity premiums is narrower than the cross-sectional dispersion of equity returns.

Our equity premiums are, of course, measured relative to bills and bonds. In a number of countries, these yielded markedly negative real returns, often as a result of periods of very high or hyperinflation. Since these "risk-free" returns likely fell below investor expectations, the corresponding equity premiums for these countries are arguably overstated. Even this is not clear, however, as equity returns would presumably have been higher if economic conditions had not given rise to markedly negative real fixed-income returns. Depressed conditions were a particular feature of the first half of the twentieth century, a period in which hyperinflations were relatively prevalent.[15] Had economic conditions been better, it is possible that the equity premium could have been larger. Similarly, it could be argued that in the more successful economies, the *ex post* bill and bond returns may, over the long run, have exceeded investors' expectations.

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[14] Over the entire 106-year period, the cross-sectional correlation between the 17 real equity and 17 real bill (bond) returns was 0.63 (0.66). Measured over 106 individual years, the time-series correlations between real equity and real bill returns ranged from 0.01 in The Netherlands to 0.44 in Japan, with a 17-country mean correlation of 0.22, while the time-series correlations between real equity and real bond returns ranged from 0.11 in The Netherlands to 0.55 in the United Kingdom, with a 17-country mean correlation of 0.37.

[15] In our sample of countries over 1900–1949, the cross-sectional correlation between real equity and real bill (bond) returns was 0.68 (0.80). The time-series correlations between annual real equity and real bill (bond) returns had a 17-country mean of 0.31 (0.42).

We concluded above, therefore, that provided a very long run approach is taken, inferences from the United States do not appear to have given rise to very large overestimates of the historical world equity premium. It is still possible, however, that our world index overstates worldwide historical equity returns by omitting countries that failed to survive. The most frequently cited cases are those of Russia and China, whose equity markets experienced a compound rate of return of –100%.[16] However, there are other stock markets, apart from Russia and China, which we have so far been unable to include in our sample due to data unavailability.[17]

At noted earlier, at the start-date of our database in 1900, stock exchanges already existed in at least 33 of today's nations. Our database includes 17 of these, and we would ideally like to assess their importance in terms of market capitalization relative to the countries for which we have no data. Unfortunately, the required data are not available. Such aggregate data were neither recorded nor even thought of in 1900.[18] Rajan and Zingales (2003), however, do report a set of market capitalization to GDP ratios for 1913. By combining these with Maddison (1995) GDP data, coupled with some informed guesses for countries not covered by Rajan and Zingales, we can calculate approximate equity market capitalizations at that date.

Based on these estimates, it is clear that the 17 DMS database countries dominated the early twentieth century world equity market. The largest omitted market is Russia, which we estimate in those days represented just under 5% of total world capitalization. Next is Austria-Hungary, which then incorporated Austria, Hungary, the Czech Republic, Slovakia, Slovenia, Croatia, Bosnia, and parts of modern-day Ukraine, Poland, and even Italy (Trieste), and which accounted for some 2% of world capitalization. Data described in Goetzmann, Ukhov, and Zhu (2006) suggest that the Chinese equity market accounted for 0.4% of world equity market capitalization in 1900. In addition, there was a group of Latin American markets, including Argentina, Brazil, Mexico, and Chile that in total made up around 1½% of overall capitalization; and a number of small markets that total less than 1%.[19] In addition to Russia and China, several other exchanges from 1900 did not survive World War II and ended in disaster, notably those in Czechoslovakia (now the Czech Republic and Slovakia), Hungary, and Poland (though these three countries were not independent states in 1900, being part of the Russian and the Austria-Hungary empires). We believe that the DMS database accounted for 90% of world equity capitalization at the start of the twentieth century, and that omitted countries represented just 10%.

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[16] It could be argued that the nationalization of corporations in Russia after the revolution of 1917 and in China after the communist victory in 1949 represented a redistribution of wealth, rather than a total loss. But this argument would not have been terribly persuasive to investors in Russian and Chinese equities at the time. It is possible, however, that some small proportion of equity value was salvaged in Russian and Chinese companies with large overseas assets, e.g., in Chinese stocks with major assets in Hong Kong and Formosa (now Taiwan).

[17] We are endeavouring to assemble total return index series over 1900-2005 for countries such as New Zealand, Finland, and Austria; and we believe that, in principle, series for Argentina, India, Hong Kong, and other markets might also be compiled.

[18] The few snippets of historical data that exist, e.g., Conant (1908) are expressed in terms of the nominal value of the shares outstanding rather than the total market value of the shares. Furthermore, figures are often given only for the total nominal value of all securities, rather than that of equities. For the U.S., U.K., and two other countries we have meticulously constructed market capitalization data from archival sources relating to individual stocks. But for many of the other markets, it is possible that even the disaggregated archive source data may not have survived from the end of the nineteenth century to the present time.

[19] The Latin American stock markets suffered several episodes of political and economic instability and hyperinflation; today, they account for some 1.15% of world market capitalization, which is roughly three-quarters of their weighting in 1913. The other markets, that in 1913 totalled less than 1% of world market capitalization, today account for some 2.3% of the world market; this group includes countries such as Egypt, Finland, Greece, Hong Kong (China), India, New Zealand, and Sri Lanka.

Survivorship Bias is Negligible

Our estimates of the equity premium are based on 17 surviving markets and, as noted earlier, ignore at least 16 non-surviving markets. To quantify the global impact of omitted markets, it is unnecessary to focus on individual markets as in Li and Xu (2002). We assume the annualized historical equity return for markets that survived for T years was $R_{survivors}$ and that for markets which are missing from the DMS database, it was $R_{omitted}$. Assume a proportion S of the worldwide equity market survived the entire period. Then the cumulative worldwide equity premium $ERP_{worldwide}$ is given by:

$$(1 + ERP_{worldwide})^T = [S\,(1 + R_{survivors})^T + (1\text{-}S)\,(1 + R_{omitted})^T] \,/\, [(1 + R_{riskfree})^T] \qquad \textbf{[1]}$$

where $R_{riskfree}$ is the riskfree interest rate for the reference country. An extreme assumption would be that all omitted markets became valueless, namely $R_{omitted} = -1$; and that this outcome occurred, for every omitted country in a single disastrous year, rather than building up gradually. The worldwide equity premium, incorporating omitted as well as surviving markets, would therefore be given by:

$$(1 + ERP_{worldwide}) = S^{1/T}\,(1 + R_{survivors}) \,/\, (1 + R_{riskfree}) = S^{1/T}\,(1 + ERP_{survivors}) \qquad \textbf{[2]}$$

where $ERP_{survivors}$ is the historical equity premium for markets that survived. In our case, we estimate the proportion of the world equity market capitalization that survived was at least S=0.9 and our time horizon is T=106 years. To account for the omission of markets that existed in 1900 but did not survive, we must therefore adjust the *ex post* equity premium of the 17-country world index using a factor of $S^{1/T} = 0.9^{1/106} = 0.999$. The survivorship bias in the estimated equity premium is therefore the following:

$$ERP_{survivors} - ERP_{worldwide} = (1 - S^{1/T})(1 + ERP_{survivors}) = (1 - 0.999)(1 + ERP_{survivors}) \approx 0.001 \qquad \textbf{[3]}$$

where the final approximation reflects the fact that $ERP_{survivors}$ is an order of magnitude below 1. We see that, at most, survivorship bias could give rise to an overstatement of the geometric mean risk premium on the world equity index by about one-tenth of a percentage point. If disappearance were a slower process, the index weighting of countries destined to disappear would have declined gradually and the impact of survivorship bias would have been even smaller. Similarly, if omitted markets did not all become valueless, the magnitude of survivorship bias would have been smaller still.

While there is room for debate about the precise impact of the bias arising because some, but not all, equity markets experienced a total loss of value, the net impact on the worldwide geometric mean equity premium is no more than 0.1%. The impact on the arithmetic mean is similar.[20] At worst, an adjustment for market survivorship appears to reduce the arithmetic mean world equity premium relative to bills from around 6.1% (see Table 3 above) to approximately 6.0%. Thus the equity premium puzzle has once again become smaller, but only slightly so.

[20] It is duplicative to derive this formally. The intuition involves disappearance of 10% of the value of the market over a century, which represents a loss of value averaging 0.1% per year.

6. DECOMPOSING THE HISTORICAL EQUITY PREMIUM

The conventional view of the historical equity premium is that, at the start of each period, investors make an unbiased, albeit inaccurate, appraisal of the end-of-period value of the stock market. Consequently, the *ex post* premium, averaged over a sufficiently long interval, is expected to be a relatively accurate estimate of investors' expectations. A key question is whether the historical premium may nevertheless be materially biased as a proxy for expectations because the past was in some sense unrepresentative. For instance, investors may have benefited from a century of exceptional earnings, or stock prices may have enjoyed a major, but non-sustainable, expansion in their valuation ratios. Our argument, which has some roots in Mehra and Prescott (1988), is that the historical equity premium may have beaten expectations not because of survivorship, but because of unanticipated success within the equity market. This analysis therefore draws on, and complements, Fama and French (2002), Ibbotson and Chen (2003), and Arnott and Bernstein (2003).

Unanticipated Success

To examine whether history may have witnessed exceptional earnings and/or expanding valuation ratios, consider how the stock market's past performance could, over multiple decades, be below or above expectations. The twentieth century opened with much promise, and only a pessimist would have believed that the next 50 years would involve widespread civil and international wars, the 1929 Crash, the great depression, episodes of hyperinflation, the spread of communism, conflict in Korea, and the Cold War. During 1900–1949 the annualized real return on the world equity index was 3.5%, while for the world excluding the U.S. it was just 1.5%. By 1950, only the most rampant optimist would have dreamt that over the following half-century, the annualized real return on world equities would be 9.0%. Yet the second half of the twentieth century was a period when many events turned out better than expected. There was no third world war, the Cuban missile crisis was defused, the Berlin Wall fell, the Cold War ended, productivity and efficiency accelerated, technology progressed, and governance became stockholder driven. As noted by Fama and French (2002), among others, the 9.0% annualized real return on world equities from 1950 to 1999 probably exceeded expectations.

In many countries valuation ratios expanded, reflecting—at least in part—reduced investment risk. Over the course of the twentieth century, the price/dividend ratio rose in all the DMS countries. Davis et al (2000) and Siegel (2002) report that for the U.S. over the period since the 1920s, the aggregate stock market price/earnings and price/book ratios also rose, and Dimson, Nagel and Quigley (2003) make similar observations for the U.K. In 1900 investors typically held a limited number of domestic securities from a few industries (Newlands (1997)). As the century evolved, new industries appeared, economic and political risk declined, closed- and open-ended funds appeared, liquidity and risk management improved, institutions invested globally, and finally, wealthier investors probably became more risk tolerant. Yet even if their risk tolerance were unchanged, as equity risk became more diversifiable, the required risk premium is likely to have fallen. These trends must have driven stock prices higher, and it would be perverse to interpret higher valuation ratios as evidence of an *increased* risk premium. Furthermore, insofar as stock prices rose because of disappearing barriers to diversification, this phenomenon is non-repeatable and should not be extrapolated into the future.

To unravel whether twentieth-century equity premiums were on balance influenced by exceptional earnings and expanding valuation ratios, we decompose long-term premiums into several elements. We use the fact that the historical equity premium is equal to the sum of the growth rate of real dividends, expansion in the price/dividend ratio, the mean dividend yield, and the change in the real exchange rate, *less* the risk-free real interest rate. As shown in Appendix 1, provided the summations and subtractions are geometric, this relationship is an identity.[21]

Decomposition of the Equity Premium

Table 4 reports these five components of the equity premium for each country. The first two columns show the growth rate of real dividends and the expansion in the price/dividend ratio. There is a widespread belief, largely based on the long-term record of the U.S. (Siegel (2002)), that nominal dividends can be expected to grow at a rate that exceeds inflation. In fact, only three countries have recorded real dividend growth since 1900 of more than 1% per year, and the average growth rate is –0.1%, i.e., the typical country has not benefited from dividends (or, in all likelihood, earnings) growing faster than inflation. Equally, there is the belief that superior stock market performance may be attributed to the expansion of valuation ratios. While there is some truth in this, it should not be overstated. Over the last 106 years, the price/dividend ratio of the average country grew by just 0.6% per year. Given the improved opportunities for stock market diversification, 0.6% seems a modest contribution to the historical equity premium.

Each country's real (local currency) capital gain is attributable to the joint impact of real dividend growth and expansion in the price/dividend ratio. Although the real capital gain is not reported explicitly in Table 4, note that only two countries achieved a real, local-currency capital gain of at least 2% per year: the U.S. (2.1%) and Sweden (3.6%). We should be cautious about extrapolating from these relatively large rates of capital appreciation to other markets around the world.

The middle column of Table 4 is the geometric mean dividend yield over the 106-year sample period. Averaged across all 17 countries, the mean dividend yield has been 4.5%, though it has been as large as 6.0% (in South Africa) and as low as 3.5% (in Switzerland). Interestingly, the countries whose mean dividend yield is closest to the cross-sectional average are Canada (4.5%) and the U.S. (4.4%). Drawing on Grullon and Michaely (2002) and Mauboussin (2006) to adjust for the impact of repurchases,[22] which are more important in the U.S. than elsewhere, that country's (adjusted) historical dividend yield rises to approximately 4.7%, which is just above the (unadjusted) 17-country average of 4.5%.

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[21] Let G_{dt} be the growth rate of real dividends; G_{PDt} be the rate at which the price/dividend ratio has expanded; $Y_t = D_t / P_t$ be the dividend yield, the ratio of aggregate dividends paid during period t divided by the aggregate stock price at the end of period t; X_t be the change in the real exchange rate; and R_{ft} be the risk-free real interest rate. The geometric mean from period 1 through period t, denoted by boldface italic, is calculated like this for all variables: $(1 + \boldsymbol{Y}_t) = [(1 + Y_1)(1 + Y_2)\ldots(1 + Y_t)]^{1/t}$. Appendix 1 shows that the equity risk premium is given by: $(1 + \boldsymbol{ERP}_t) = (1 + \boldsymbol{G}_{dt})(1 + \boldsymbol{G}_{PDt})(1 + \boldsymbol{Y}_t)(1 + \boldsymbol{X}_t) / (1 + \boldsymbol{R}_{ft})$ where boldface italic indicates a t-period geometric mean.

[22] Since the 1980s, U.S. yields have been low relative to the past partly because, under prior tax rules, companies could return capital to shareholders more effectively on an after-tax basis by means of stock repurchases. From 1972–2000, Grullon and Michaely (2002) estimate that annual repurchases averaged 38.0% of cash dividends (57.5% from 1984–2000), while over 1977–2005, Mauboussin (2006) estimates the average to be 64.8%. Adding repurchases to the yield, the "adjusted dividend yield" for the U.S. rises from its raw historical average of 4.4% to 4.7%, whether we use the data from Grullon and Michaely (2002) or Mauboussin (2006). The impact of a similar adjustment to other countries' dividend yield is smaller and often zero (see Rau and Vermaelen (2002)).

Table 4: Decomposition of the Historical Equity Premium for 17 Countries, 1900–2005

% p.a. Country	Real dividend growth rate	*plus** Expansion in the P/D ratio	*plus* Geometric mean dividend yield	*plus* Change in real exchange rate	*minus* U.S. real interest rate	*equals* Equity premium for U.S. investors
Australia	1.30	0.46	5.83	-0.24	0.96	6.42
Belgium	-1.57	0.08	3.95	0.62	0.96	2.05
Canada	0.72	0.98	4.46	-0.04	0.96	5.18
Denmark	-0.87	1.43	4.68	0.47	0.96	4.74
France	-0.74	0.42	3.93	-0.14	0.96	2.47
Germany	-1.54	0.97	3.69	0.23	0.96	2.35
Ireland	-0.25	0.38	4.66	0.25	0.96	4.05
Italy	-1.46	-0.08	4.05	0.10	0.96	1.58
Japan	-2.39	1.59	5.39	0.32	0.96	3.85
Netherlands	-0.16	0.41	5.00	0.27	0.96	4.54
Norway	-0.25	0.50	4.02	0.25	0.96	3.54
South Africa	0.91	0.31	5.95	-0.80	0.96	5.38
Spain	-0.62	0.24	4.13	0.00	0.96	2.75
Sweden	2.88	0.67	4.09	-0.05	0.96	6.72
Switzerland	0.32	0.60	3.52	0.72	0.96	4.22
U.K.	0.61	0.18	4.68	-0.03	0.96	4.46
U.S.	1.32	0.75	4.36	0.00	0.96	5.51
Average	**-0.10**	**0.58**	**4.49**	**0.11**	**0.96**	**4.11**
Std deviation	**1.32**	**0.45**	**0.71**	**0.35**	**0.00**	**1.51**
World (USD)	0.77	0.68	4.23	0.00	0.96	4.74

* Note: Premiums are relative to bill returns. All summations and subtractions are geometric

To examine the equity premium from the perspective of a global investor located in a specific home country, such as the U.S., we convert from real, local-currency returns to real, common-currency returns. Taylor (2002) demonstrates that, over the very long term, exchange rate changes reflect purchasing power changes. It is unsurprising, then, to see that the annualized change in our 17 countries' real exchange rate averages only 0.1% per year, and that every country's real exchange rate change was within the range ±1%. Note that, for the average country, the capital gain in real U.S. dollars (the sum of the second, third and fifth columns) was just 0.6% per year (not reported in Table 4). Measured in real U.S. dollars, only two countries achieved a capital gain that exceeded 2% per year. Nine countries achieved a real U.S. dollar capital gain that was between zero and +2%; and six achieved between zero and –2%.

The annualized real, local-currency returns were reported for all countries in Table 1; across all 17 countries, the average 106-year return is 5.0%. The real, USD-denominated returns (the sum of the second to the fifth columns in Table 4) average 5.1%. Deducting the U.S. risk-free interest rate of 0.96% in real terms, the equity premium for a U.S. investor buying stocks in each of the 17 markets is as listed on the right of Table 4: on average the premium is 4.1%.

The *ex post* equity premiums on the right of Table 4 vary cross-sectionally for two reasons: the expected reward for risk, and the impact of chance. In 1900 the expected premium for higher risk markets may have merited a high reward that was subsequently realised; if Australia, Canada, South Africa and Sweden were such economies, they achieved relatively large *ex post* premiums of over 5%. The expected premium for safer markets may have been low; if these markets are typified by Belgium, France, Germany, Italy and Spain, their *ex post* premiums were below 3%. However, this rationalization is not a credible explanation for historical performance. It is more likely that, in 1900, investors underestimated the probability of wars in Europe, not to mention the ultimate value of resource-rich economies like the U.S. and Canada. National returns thus probably had more to do with noise than with the expected premium in 1900, and averaging mitigates the impact of noise. In projecting the equity premium into the future, we therefore focus on the equally weighted worldwide average of 4.1% and on the market-capitalization weighted world index. The world index is shown in the bottom-right corner of Table 4; from the point of view of a U.S. based investor, the world equity premium was 4.7%.[23]

From the Past to the Future

Over the long run, real returns accrued largely from dividend payments, but Dimson, Marsh and Staunton (2000, 2002), Arnott and Ryan (2001), and Ritter (2005) highlight the time-series and cross-sectional variation of global equity premiums. Given the large standard errors of historical estimates, and the likelihood that risks and equity premiums are nonstationary, one cannot determine a precise, forward-looking expected premium. However, by considering separately each component of the historical equity premium, we can develop a framework for making inferences. We start by discussing the real dividend growth rate, followed by expansion in the price/dividend ratio, and then the average dividend yield. We also consider changes in the real exchange rate.

The second column of Table 4 indicates that, over the last 106 years, real dividends in the average country fell by 0.1% per year; in the world index, they rose by +0.8%; and in the U.S., they rose by +1.3%. Siegel (2005) and Siegel and Schwartz (2006), among others, observe that these long-term dividend growth rates were not achieved by a cohort of common stocks. The growth is that of a portfolio whose composition evolved gradually; today it contains almost no stocks from 1900, and largely comprises companies that gained a listing subsequently.[24] In large part, the long-term increase in index dividends reflects companies that not only gained a listing after 1900, but ceased to exist quite some years ago.[25] So what real dividend growth can we anticipate for the future? The worldwide growth rate was 0.8% per year; relative pessimists might project real dividend growth that is zero or less (Arnott and Bernstein (2002)), while relative optimists might forecast indefinite real growth in excess of 1% (Ibbotson and Chen (2003)).

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[23] We also computed the premium from the viewpoint of investors in the other 16 countries (for example, with a Japanese investor's premium based on every market's local-currency return converted into yen); the 17-country average equity premium varied between 2.3% for Denmark and 9.2% for Italy, with an average across all 17 reference currencies of 4.8%. Similarly, we computed the world premium from the viewpoint of investors in the other 16 countries (again converting every market's return into yen, and so on); the world equity premium varied between 2.9% for Denmark and 9.9% for Italy, with an average across all 17 reference currencies of 5.4%. This wide range of values is attributable mostly to differences in the annualized real risk-free rate between countries, rather than to exchange rate differences.

[24] To illustrate how much the listed equity market has evolved, Dimson, Marsh and Staunton (2002) report that almost two-thirds of the value of the U.S. market and half the value of the U.K. market was represented by railroad stocks at the end of 1899.

[25] There can also be a spurious jump in measured dividends when indexes are chain-linked. As a dividend series switches from narrower to broader composition, or from pre-tax to net-of-tax dividend payments, this can give rise to a step in income that impacts dividend growth estimates and (in the opposite direction) changes in the price/dividend ratio. We experimented with making adjustments for this for the U.S. and U.K. but the impact on estimated long-term dividend growth from splicing index series was small, and we abandoned this idea.

The third column of Table 4 reports that, over the last 106 years, the price/dividend ratio in the average country expanded by +0.6% per year; in the world and U.S. indexes it expanded by +0.7% and +0.8% respectively. As discussed earlier, this expansion reflected, at least in part, the enhanced opportunity to reduce portfolio risk as institutions increased the scope for diversification both domestically and internationally. If investors' risk tolerances are today similar to the past, we have already argued that the required risk premium is likely to have fallen and valuation ratios to have risen. There is no reason to expect the required risk premium to fall further over the long haul, so persistent multiple expansion seems unlikely. Without further expansion in the price/dividend ratio, this source of historical performance cannot contribute to forward-looking equity premiums.

The fourth column of Table 4 shows that, over the last 106 years, the geometric mean dividend yield in the U.S. was 4.4%, compared with 4.5% for the average country and 4.2% for the world index. Contemporary dividend yields (i.e., yields at end-2005, at the conclusion of the 106-year period) are lower than the historical average, even when buybacks are incorporated (see footnote 22 above). Whether adjusted for stock repurchases or not, projected levels for the long-term, geometric mean dividend yield are unlikely to be as large as the worldwide historical average of 4.2%. To the extent that the current (end-2005) level of dividends is indicative, the mean yield is likely to be lower in the future by at least ½–1%.

Over the long term, nominal exchange rates tend to follow fluctuations in relative purchasing power. The consensus forecast for changes over the long term in the real (inflation adjusted) exchange rate is zero. While the fifth column of Table 4 indicates that, historically, Americans gained (and others lost) from the rising real value of the U.S. dollar, this pattern cannot be extrapolated. We may assume that, over the long term, the real exchange rate change is expected to average zero.

The historical equity premium comprises the sum of the factors discussed in the preceding paragraphs, minus the real interest rate (see the penultimate column of Table 4). The final column of Table 4 reports the historical equity premiums for our 17 countries; they have an average of a 4.1% premium, with a cross-sectional standard deviation of 1.5%. While forward-looking estimates cannot be precise, a long-term projection of the annualized equity premium might, at the very least, involve making an adjustment to the historical record for components of performance that cannot be regarded as persistent. First, the expected change in the real exchange rate may be assumed to be zero, which implies an upward bias of 0.1% in the cross-sectional average of the country equity premiums. Second, the historical expansion in the price/dividend ratio cannot be extrapolated and might be assumed to be zero, which implies an upward bias of 0.6% in the cross-sectional average. These two adjustments, alone, attenuate the average country equity premium from 4.1% to 3.4%. When the same adjustments are made to the world index, the world equity premium shrinks from 4.7% to 4.0%. We noted above that if current dividend levels are a guide to the future, then the prospective mean dividend yield on the world index is likely to be lower than the historical average by at least ½–1%. This suggests a current equity premium of approximately 3–3½%.

Goyal and Welch (2006) conclude that for forecasting the equity risk premium one cannot do better than to project the historical average equity premium into the future, and Mehra (2003) contends that "over the long term, the equity premium is likely to be similar to what it has been in the past." However, as Campbell and Thompson (2005) point out, this cannot be the full story. History suggests that some part of the historical premium represents equity investors' good luck, and Fama and French (2002) say in relation to the period 1951–2000 that their "main message is that the unconditional expected equity premium…is probably far below the realized premium."

Jorion and Goetzmann (1999) justified estimating equity premiums from capital-appreciation indexes, stating "to the extent that cross-sectional variations in [dividend return minus real interest rate] are small, this allows comparisons of equity premiums across countries." They compared six markets with and without dividends, with similar conclusions, albeit over a sample period differing from the 1900-2005 interval used here. However, there is a cross-country standard deviation in dividend yields of 0.7% (see Table 4). If one computes the sum for each country of dividend yield plus dividend growth, the cross-sectional standard deviation is 1.6%. Our estimates of the equity premium avoid the inaccuracies that arise from the Jorion-Goetzmann approximation.

The debate on the size of the equity premium is sometimes conducted in terms of the arithmetic mean. For a stationary series the arithmetic mean is straightforward to interpret, but as Lettau and Nieuwerburgh (2006) highlight, the underlying parameters are unstable. This makes arithmetic means harder to interpret, which is why we undertake our decompositions using annualized returns.[26] For those who focus on the arithmetic mean equity premium, for the world index the latter is 1.3% larger than the geometric mean (see Table 3), and our forward-looking estimate of the arithmetic mean premium for the world index would be approximately 4½–5%.

Twentieth-century financial history was a game of two halves. In the first half, markets were harsh on equity investors; but in the second half they were benevolent.[27] As we show in Dimson, Marsh and Staunton (2002), early in the century dividend yields were mostly high relative to interest rates, whereas more recently yields have generally been lower. Looking at the 1900-2005 period as a whole, the world equity market experienced dividend growth and price/dividend multiple expansion that contributed 0.8% and 0.7% per year respectively to long-run real returns and hence to the *ex post* equity premium. The remainder was contributed by the annualized dividend yield of 4.2% (for the world index) and a real exchange rate adjustment. This suggests that the equity premium *expected* by investors was lower than the realized premium. The fact that *ex post* equity premiums were enhanced by this rate of dividend growth and multiple expansion is the "triumph" experienced by twentieth-century stock market investors.

[26] For example, consider a hypothetical index that provides a zero equity premium over a two-period interval. Assume that, within this interval, it suffers from transient volatility; for instance, the single-period returns might be +900% and –90%. Unless there is reason to suppose that volatility will persist at its historical level, the expected equity premium will be lower than the high arithmetic mean of +405% per period. In contrast with formerly turbulent countries like Germany, Italy and Japan, the U.S. and world indexes did not experience volatility on this scale—at least, not during the twentieth century.

[27] Averaged across all 17 countries, the real, local-currency annualised equity returns were 2.7% in the first half of the twentieth century, versus 7.1% over the following 55 years. Note, however, that adverse stock market conditions also tended to impact the real returns from bonds and bills (see section 5).

7. CONCLUSION

We have presented new evidence on the historical equity premium for 17 countries over 106 years. Our estimates, including those for the U.S. and U.K., are lower than frequently quoted historical averages. The differences arise from bias in previous index construction for the U.K. and, for both countries, our use of a longer time frame that incorporates the earlier part of the twentieth century as well as the opening years of the new millennium. Prior views have been heavily influenced by the U.S. experience, yet we find that the U.S. equity premium is somewhat higher than the average for the other 16 countries.

The historical equity premium, presented here as an annualized estimate (i.e., as a geometric mean), is equal to investors' *ex ante* expectations plus the impact of luck. In particular, expanding multiples have underpinned past returns. In part, this reflects a general decline in the risk faced by investors as the scope for diversification has increased, and stocks have become more highly valued. In addition, past returns have also been enhanced during the second half of the twentieth century by business conditions that improved on many dimensions.

We cannot know today's consensus expectation for the equity premium. However, after adjusting for non-repeatable factors that favoured equities in the past, we infer that investors expect an equity premium (relative to bills) of around 3–3½% on a geometric mean basis and, by implication, an arithmetic mean premium for the world index of approximately 4½–5%. These estimates are lower than the historical premiums quoted in most textbooks or cited in surveys of finance academics. From a long-term historical and global perspective, the equity premium is smaller than was once thought. The equity premium survives as a puzzle, however, and we have no doubt that it will continue to intrigue finance scholars for the foreseeable future.

APPENDIX 1: DECOMPOSITION OF THE EQUITY PREMIUM

This appendix explains how we decompose the historical equity premium into five elements. These are, firstly, the average dividend yield over the sample period; next, the impact of real dividend growth, expansion of the price/dividend ratio, and the change in the real exchange rate; and finally, the risk-free interest rate that is used to compute the equity premium. Without loss of generality, the decomposition is in real (inflation adjusted) terms.

Capital Appreciation and Income

We assume the dividend payment on the equity index portfolio is received at the end of period t and is equal to D_t, that the price at the end of period t-1 is P_{t-1}, and that inflation over period t runs at the rate I_t.

Real dividends are $d_t = D_t / (1 + \boldsymbol{I}_t)^t$, where the denominator measures the inflation rate from period 1 to period t, namely $(1 + \boldsymbol{I}_t)^t = (1 + I_1)(1 + I_2)\ldots(1 + I_t)$. The price/dividend ratio is $PD_t = P_t / D_t$. The real capital gain over period t is given by:

$$
\begin{aligned}
1+ \text{Real gain}_t &= (P_t / P_{t-1}) / (1 + I_t) \\
&\equiv [(D_t / D_{t-1}) / (1 + I_t)] \; (PD_t / PD_{t-1}) \\
&= (d_t / d_{t-1}) (PD_t / PD_{t-1}) \\
&= (1 + G_{dt}) (1 + G_{PDt}) \qquad \textbf{[A1]}
\end{aligned}
$$

where the growth rate of real dividends is $G_{dt} = d_t / d_{t-1} - 1$, and the rate at which the price/dividend ratio has expanded is $G_{PDt} = PD_t / PD_{t-1} - 1$.

As a proportion of the initial investment, real dividend income during period t is:

$$
\begin{aligned}
\text{Real income}_t &= (D_t / P_{t-1}) / (1 + I_t) \\
&\equiv (D_t / P_t) (P_t / P_{t-1}) / (1 + I_t) \\
&= Y_t (P_t / P_{t-1}) / (1 + I_t) \qquad \textbf{[A2]}
\end{aligned}
$$

where $Y_t = D_t / P_t$ is the dividend yield, defined as the ratio of aggregate dividends paid over period t divided by the aggregate stock price at the end of period t. Note that the terms to the right of Y_t measure (one plus) the real capital gain over period t, as defined above.

Total Returns

The real return is equal to the arithmetic sum of [1] real capital gain and [2] real income, namely:

$$
\begin{aligned}
1+ \text{Real return}_t &\equiv [D_t / P_{t-1} + (P_t / P_{t-1})] / (1 + I_t) \\
&= (1 + G_{dt}) (1 + G_{PDt}) (1 + Y_t)
\end{aligned}
$$

So far we have decomposed returns denominated in a single currency. If the assets are purchased in unhedged foreign currency, we assume that each period's return is converted from foreign currency into home currency. The real return is then:

$$1+ \text{Real return}_t = (1 + G_{dt}) (1 + G_{PDt}) (1 + Y_t) (1 + X_t) \qquad \textbf{[A3]}$$

where X_t is the increase in the inflation-adjusted value of the home currency relative to the foreign currency, namely the change in the real exchange rate.[28]

The Equity Premium

Finally, we define the equity premium as the geometric difference between the real return defined in [3] and the risk-free real interest rate, R_{ft}. Hence the historical equity premium is:

$$1 + ERP_t = (1+ \text{Real return}_t) / (1 + R_{ft})$$

$$= (1 + G_{dt}) (1 + G_{PDt}) (1 + Y_t) (1 + X_t) / (1 + R_{ft}) \qquad \textbf{[A4]}$$

The historical equity premium is therefore equal to the sum of the real dividend growth rate, expansion in the price/dividend ratio, the dividend yield, and the change in the real exchange rate; less the risk-free real interest rate. All additions and subtractions are geometric.

Consequently, the geometric mean equity premium from period 1 through period t may be decomposed as follows:

$$1 + \boldsymbol{ERP}_t = (1 + \boldsymbol{G_{dt}}) (1 + \boldsymbol{G_{PD}}_t) (1 + \boldsymbol{Y}_t) (1 + \boldsymbol{X}_t) / (1 + \boldsymbol{R_f}_t) \qquad \textbf{[A5]}$$

where each term on the right hand side of [5] is the geometric mean of t single-period components. That is, $(1 + \boldsymbol{Y}_t)^t = (1 + Y_1) (1 + Y_2)\ldots(1 + Y_t)$, and so on.

To sum up, the annualized historical equity premium may be decomposed geometrically into five elements. These are as follows: firstly, the mean growth rate in real dividends; secondly, the mean rate of expansion in the price/dividend multiple; thirdly, the mean dividend yield; fourthly, the mean change in the real exchange rate; and finally, the mean risk-free real interest rate.

Finally, note that the reference country for the real exchange rate and the real interest rate must correspond. For example, the exchange rate may be relative to the U.S. dollar; and if so, the real interest rate should be the rate on the U.S. risk-free asset.

[28] Obviously, when the investment is in domestic securities, the change in the real exchange rate is $X_t = 0$.

APPENDIX 2: DATA SOURCES FOR THE DMS DATABASE

Section 3 outlined the general methodology and guiding principles underlying the construction of the DMS database (see also Dimson, Marsh, and Staunton (2002, 2006a, and 2006b)). This appendix describes the data sources used for each country.

Australian equities are described in Officer's chapter in Ball, Brown, Finn, and Officer (1989). Ball and Bowers (1986) provide a complementary, though brief, historical analysis. We are grateful to Bob Officer for making his database available to us. Officer compiled equity returns from a variety of indexes. The early period made use of data from Lamberton's (1958) classic study. This is linked over the period 1958–74 to an accumulation index of fifty shares from the Australian Graduate School of Management (AGSM) and over 1975–79 to the AGSM value-weighted accumulation index. Subsequently, we use the Australia All-Ordinary index. Bond returns are based on the yields on New South Wales government securities from the start of the century until 1914. For the period 1915–49 the yields were on Commonwealth Government Securities of at least five years maturity. During 1950–86 the basis is ten-year Commonwealth Government Bonds. From 1986 we use the JP Morgan Australian government bond index with maturity of over seven years. For 1900–28 the short-term rate of interest is taken as the three-month time deposit rate. From 1929 onward we use the Treasury bill rate. Inflation is based on the retail price index (1900–48) and consumer price index (1949 onward). The switch in 1966 from Australian pounds to Australian dollars has been incorporated in the Exchange Rate index history.

Belgium is being researched by Annaert, Buelens, de Ceuster, Cuyvers, Devos, Gemis, Houtman-deSmedt, and Paredaens (1998). We are grateful for access to their interim results for 1900–28, which are subject to correction. From 1929 we use the National Bank of Belgium's 80-share index. The market was closed from August 1944 to May 1945, and we take the closing level for 1944 as the year-end value. For 1965–79 we use the Banque Bruxelles Lambert 30 share index and from 1980 the Brussels Stock Exchange All Share Index. Up to 1956, bond returns are based on estimated prices for 4% government bonds. During the 1944–45 closure, we take the last available value from 1944 as the year-end level. Over 1957–67 the index is for bonds with a five to twenty year maturity, for 1968–85 for bonds with maturity over five years. Subsequent years use the JP Morgan Belgian government bond index with maturity of over five years. Short-term interest rates are represented over the period 1900–26 by the central bank discount rate, followed during 1927–56 by the commercial bill rate. From 1957 onward, we use the return on Treasury bills. Inflation is estimated for 1900–13 using the consumer price index, and for 1914 we take the French inflation rate. Over 1915–20 and 1941–46 we interpolate the Belgian consumer price index from Mitchell (1998). From 1921 inflation is measured using the Institut National de Statistique's consumer price index.

Canadian stocks, bonds, bills, and inflation since 1924 are presented in Panjer and Tan (2002), with supplementary data kindly compiled for us by Lorne Switzer. For 1900–14 the annual index returns are based on Switzer's equally weighted (2000) Montreal index, adjusted for dividends. The equity series for 1915–46 is taken from Urquhart and Buckley (1965). Houston (1900–14) provides dividends for 1900 and hence the Canadian yield premium relative to the 1900 S&P, and Panjer and Tan (2002) estimate the Canadian yield relative to the 1924 S&P. To compute yearly total returns over 1900–23, we interpolate the Canadian yield premium relative to the S&P. For the period 1947–56 returns are for the TSE corporates, and from 1957 the TSE 300 total return index. The bond index for 1900–23 is based on a 4% bond from Global Financial Data (GFD). For 1924–36 we use the Government of Canada long bond index from Panjer and Tan (2002). Starting in 1936 the index is the Cansim index of bonds with maturity of over ten years, switching in 2002 to the JP Morgan Canadian government bond index with maturity of over ten years. For 1900–33 the short-term rate is represented by U.S. Treasury bills or equivalent. From 1934 onward the short-term rate is based on Canadian Treasury bills. Inflation is measured using the Canadian wholesale price index for 1900–10. For 1911–23 we switch to the Canadian consumer price index, and thereafter consumer price inflation is taken from Cansim.

Danish stock market data has involved working with Claus Parum to extend his research back to 1900. We have also referred to the papers by Steen Nielsen and Ole Risager (1999, 2000) and Allan Timmermann (1992). Over the period 1900–14 we use Parum's (2002) equally weighted index of equity returns, which covers some forty to fifty constituents each year. Thereafter, all the studies cited above are based on equity price indexes from Statistics Denmark, though we incorporate Parum's adjustments for capital changes that are not incorporated into the published index numbers. For 1915–2001 we use the data compiled in Parum (1999a,b and 2002) switching from 2002 to the Copenhagen KAX Index. Danish bond returns are estimated from yields on government bonds until 1924. For 1925–2001 our data is from Parum (1999a,b and 2002) who uses the return on mortgage bonds, a large and liquid asset class throughout the period, in contrast to more thinly traded government bonds, as described in

Christiansen and Lystbaek (1994). From 2002 we use the JP Morgan Danish government bond index with maturity of over seven years. Short-term interest rates are represented by the central bank discount rate until 1975, and thereafter by the return on Treasury bills.

France is documented by Laforest (1958) then Laforest and Sallee (1977), for the first half of the twentieth century, followed by Gallais-Hamonno and Arbulu (1995) for the period commencing in 1950. The common basis for equity returns in all the primary studies is the index series compiled by the Institut National de la Statistique et des Etudes Economiques (INSEE). The INSEE equity index is a weighted average of price relatives with about three hundred constituents. Over the period from 1914-18 we interpolate, assuming constant real returns. We use the SBF-250 from 1991 onward. The bond series for France, also compiled by INSEE, is based on consol yields. Over the period from 1914-18 we interpolate, assuming constant nominal returns. We switch in 1950 to the Gallais-Hamonno and Arbulu (1995) series, which is the INSEE General Bonds Index, with coupons reinvested monthly as received. From 1993 we use the JP Morgan French government bond index with maturity of over ten years. The short-term interest rate for France is based on the central bank discount rate until 1930. The rate is measured by the return on Treasury bills starting in 1931. To measure consumer price inflation, we use the consumption price index that is compiled by the Institut National de la Statistique et des Etudes Economiques, taken from Laforest (1958), Gallais-Hamonno and Arbulu (1995) and directly since 1981.

German data was provided by George Bittlingmayer (1998) and Richard Stehle (1997); also see Stehle, Wulff, and Richter (1999),and also Gregor Gielen (1994) and Ulrich Ronge (2002). We use Ronge's reconstruction of the DAX 30 share index to provide nominal equity returns for 1900-53. For August 1914–October 1918 Ronge uses the Gielen over-the-counter index. For 1954–94 we use the Stehle (1997) comprehensive index, switching in 1995 to the CDAX as given in Stehle/Hartmond-Reihe. For 1900–23, German bond returns are based on the price of 3% perpetuals, which essentially lost all value during the 1922–23 hyperinflation. For 1924–35 the bond index is based on mortgage bonds, and for 1936–51 it is based on 4.5% conversion (to 1943), 4.5% western zone (1946–47) and 5% tax-free (from 1948) bonds. We use the REX performance index starting in 1968, switching in 1986 to the JP Morgan German government bond index with maturity of over seven years. The short-term rate of interest is represented by the discount rate on private bills through 1945. We assume rates of 2% during 1946–50, 3% for 1951–53, and use Treasury bills beginning in 1954. Inflation in Germany is from Gielen (1994), using consumer price level data from the Imperial Statistical Office (see Bittlingmayer (1998)). Inflation rates during 1922 and 1923 were inferred from exchange rates against the dollar. From 1993 we use the CPI from the Federal Statistical Office.

Ireland was first studied by Shane Whelan (1999), who used Irish Central Statistical Office (CSO) data from 1934, and British data before that. Thomas (1986) provides some additional early data, but only in graphical form. We therefore created a new, market capitalization-weighted index of Irish equity prices for 1900–33 from original archive stock price and dividend sources (and this index has now been adopted by Whelan (2002)). For 1934–83 we use the Irish CSO Price Index of Ordinary Stocks and Shares. Until 1987, we incorporate our estimates of U.K. dividend yields. From 1988 we use the Irish Stock Exchange Equity (ISEQ) total return index. The bond series for Ireland uses U.K. returns for 1900–78. For 1979–98, we use Whelan's (1999) return on a twenty-year representative Irish gilt, as estimated by Raida Stockbrokers, turning thereafter to the Datastream ten-year Irish government bond index. Short-term Irish interest rates again use U.K. Treasury bills for 1900-1969. From 1970 we use Irish Treasury bills. Up to the date of political independence from Britain, inflation is measured using Bowley's (1937) cost of living index for 1900–13 and the working-class cost of living index for 1914–22. For 1923–52 we use Meghen's (1970) Irish cost of living index, and from 1953, the Irish consumer price index.

Italian data was provided by Fabio Panetta and Roberto Violi (1999). The equity data for 1900–07 are from the Official List and supplementary sources, and this is extended through 1911 with data from Aleotti (1990). From 1912–77 the share price and dividend series are based on the Bank of Italy index, which covers at least three-quarters of the total market capitalization of the Italian equity market. Thereafter, the Bank of Italy's index is calculated from the bank's monthly share price database, which covers all listed shares. From 1999 onward, we use the Milan BCI performance index. The government bond returns over 1900–44 are from Bianchi (1979). For the period 1945–83, the index of total bond returns is based on a treasury bond index with a coverage of over half, and often over three-quarters, of the value of all treasury bonds in issue. Thereafter, the data are sourced from Panetta and Violi's (1999) study. From 1988, we use the JP Morgan Italian government bond index with maturity of over three years. The short-term bank deposit rate to 1940 is from Biscaini Cotula and Ciocca (1982). Panetta and Violi estimate the values for the period 1941–46, and for 1947–61 the figures are from the Bank of Italy's Bollettino Economico. After that, the source is the Bank of Italy's Bollettino Statistico.

Japanese data of good quality are available from the Hamao (1991) database, and from the study by Schwartz and Ziemba (1991). We are grateful to Kenji Wada for facilitating provision of pre–World War I equity data. For 1900–14 we use the Laspeyres price index for the Tokyo Stock Exchange (TSE), as published in Fujino and Akiyama (1977). Thereafter, share prices are represented by the Japan National Bank index for 1915–32; the Oriental Economist Index from 1933 until September 1948 (although trading was suspended in August 1945, and no index values were published again until May 1946 when black market trading resumed in Tokyo); the Fisher index from September 1948 until the market officially reopened in May 1949; and the Nikkei-225 from May 1949 to 1951. During 1952–70 we use the Japan Securities Research Institute total return index. From 1971 we use total returns from Hamao and Ibbotson (1989). Returns continue from 1995 with the TSE TOPIX index. The Japanese government bond index data is taken from Global Financial Data. Until 1957, the returns are estimated from yield data. No yield information is available for the end of 1947, and the yield for 1946 is used instead. The data for 1948–57 represent the yields on newly issued bonds. From 1957 through 1968, the bonds are those issued by Nippon Telephone and Telegraph. From 1971 we use the government bond index from Hamao and Ibbotson (1989), followed from 1995 by the JP Morgan Japanese government bond index with maturity of over ten years. The short-term riskless rate is available from 1900. It is based on call money rates to 1959, and on Treasury bills thereafter. Inflation is measured by the wholesale price index for 1900, the retail price index for 1901–46 and the consumer price index from 1947 onward.

The Netherlands is based on work by Eichholtz, Koedijk, and Otten (2000). The equity returns over 1900–18 are based on the Central Bureau of Statistics (CBS) general index of share prices, and historical yield data. For the period 1919–51 returns are based on the 50-stock, CBS weighted arithmetic index. The exchange was closed from August 1944 to April 1946, so the end-year index levels are represented by the intra-year values that are closest to the turn of the year. During 1952–80, returns are based on the CBS All Share index, with dividends estimated by the Dutch central bank. For 1981 onward we use the CBS total return index, which went live in 1989 with retrospective estimation of the impact of income reinvestment, changing to the Amsterdam AMS All Share index from 2004. During 1900–14, Dutch bond returns are represented by 2.5% and 3% consols. During 1915–73, the Eichholtz-Koedijk-Otten bond index is based on a series of 3.5% bonds. From 1974, the index is the JP Morgan Netherlands government bond index with maturity of over seven years. For the riskless rate, during 1900–40 we use the discount rate on three-month private bills. The rate is assumed unchanged when data were unavailable during August 1914 to December 1918, and from mid-May 1940 to the end of that year. From 1941 to date we use the rate on Dutch Treasury bills. Inflation is measured using the consumer price index. No data were available between August 1944 and June 1945, and the index was interpolated for end-1944.

Norway was introduced into the study through Thore Johnsen, Knut Kjær and Bernt Ødegaard who provided data and sources. Equity returns for 1900–17 are derived from an equally weighted index based on all stocks listed in Statistisk Arbok and supplemented with those shares listed in Kierulf's Handbook for which there was information on year-end prices and dividends. The index contained between 33–36 shares until the end of 1914, but this fell to 21 by the start of 1918. For the period 1918–72 we use an all-share index including industrial, banking and whaling/shipping shares calculated by Statistics Norway. From 1973 we use a comprehensive index compiled by Thore Johnsen, switching in 1981 to the Oslo Stock Exchange indexes. We first use the Industrial index, switching in 1983 to the General Index and then, from 1996, to the All Share index. During 1900–92 Norwegian bond returns are based on Global Financial Data's government bond yields. From 1993, the index is the Datastream government bond index with maturity of ten years. For the riskless rate, during 1900–71 we use the central bank discount rate, followed by money market rates until 1983. From 1984 to date we use the rate on Norwegian Treasury bills. Inflation is measured using the consumer price index published by Statistics Norway.

South African stocks, bonds, bills, and inflation since 1925 are presented in Firer and McLeod (1999) who, in turn, draw on earlier work going back to 1910 by Schumann and Scheurkogel (1948). These studies provide indexes for industrial and commercial companies in South Africa. However, mining and financial companies are of particular importance, especially early last century. We therefore create a market capitalization weighted index of mining and financial shares for 1900–59, based on London price quotations. We blend our mining and financial indexes with the Firer and McLeod industrial index, by starting with a weighting of 5% in the industrial index at the start of 1910, with weights increasing to 25% by the start of 1950. From 1960–78 we use the Rand Daily Mail Industrial Index and, from 1979, the Johannesburg Stock Exchange–Actuaries Equity Index. Up to 1924, bond returns are based on the yields for 4% government bonds. Subsequently we use the bond returns from Firer and McLeod, based first on market yields together with a notional twenty-year bond prior to 1980, followed by the JSE-Actuaries Fixed Interest Index (to 1985), the JSE-Actuaries All Bond Index (to 2000) and the BESA Government total return index from 2001 onward. Before 1925, short-term interest rates are represented by U.K. Treasury bills.

Subsequently, we use the bill returns from Firer and McLeod, based on three-month fixed deposits (1925–59), bankers' acceptances (1960–66), and thereafter negotiable certificates of deposits. Inflation is estimated prior to 1925 using the consumer price index and thereafter using the official price index from Central Statistical Services. The switch in 1961 from pounds to rand has been incorporated in the Exchange Rate index index history.

Spanish stock returns are presented in Gonzalez and Suarez (1994) for the period commencing in 1941. Valbuena (2000) provides a longer-term perspective. Valbuena's equity index for Spain over 1900–18 is from Bolsa de Madrid. For 1919–36 we use a total returns index from Valbuena (2000) that rectifies some problems in the Sandez and Benavides (2000) index. Trading was suspended during the Civil War from July 1936 to April 1939, and the Madrid exchange remained closed through February 1940. Over the closure we assume a zero change in nominal stock prices and zero dividends. During 1941–85 we use the Gonzalez and Suarez (1994) data, subsequently linking this to the Bolsa de Madrid total return index. The bond series for 1900–26 is based on the price of Spanish 4% traded in London through 1913 and in Madrid thereafter. For 1926–57 and 1979-87 it is based on Global Financial Data's (GFD) estimates for government bonds, with prices kept unaltered during the Civil War. A private bond index is used for 1958–78. From 1988 we use the JP Morgan Spanish government bond index series with maturity of over three years. The short-term interest rate over 1900–73 is the central bank discount rate. From 1974 we use the return on Treasury bills. Inflation during 1900–14 is measured using the wholesale price index from Mitchell (1998). For 1915–35 we use the consumer price index from Mitchell (1998); see also Vandellos (1936). During 1936–40 we revert to the wholesale price index from Mitchell. For 1941–85 we use the Spanish consumer price index from Gonzalez and Suarez (1994) and thereafter from the Instituto Nacional de Estadistica.

Sweden is studied in a series of papers by Per Frennberg and Bjorn Hansson's (1992a, 1992b, 2000) whose database on stocks, bonds, bills, and inflation covers the period 1919–99. The Swedish stock market data we use starts at the end of 1900, and we assume that stock prices did not move over 1900; thereafter we use the index values of the Swedish Riksbank. Over the period 1900–18, Swedish equity dividends are estimated from contemporaneous bond yields adjusted upwards by 1.33% (the mean yield premium over 1919–36). From the start of 1919, the Swedish equity series is based on the share price index published in the journal Affarsvarlden, plus the dividend income estimated by Frennberg and Hansson (1992b). The government bond series uses data for 1900–18 from The Economist. For 1919–49 the returns are for perpetuals, and after that the series measures the return on a portfolio of bonds with an average maturity of ten years. We use the JP Morgan Swedish government bond index with maturity of over five years from 2000. The short-term riskless rate of interest from 1900 is represented by the official discount rate of the Swedish Riksbank. Frennberg and Hansson (1992b) switch in 1980 to the return on short-term money market instruments, and from 1982 to Treasury bills. Inflation is represented by the Myrdal-Bouvin consumer price index before 1914, the cost of living index between 1914-54 and the Swedish consumer price index for 1955 onward.

Switzerland is investigated using the series spliced together by Daniel Wydler (1989, 2001) coupled with extra data kindly provided by Urs Walchli and Corina Steiner. We have created a new, equally-weighted index of Swiss equity prices for 1900-10. This used the series of annual prices and dividend yields collected from Neue Zurcher Zeitung, with an average of 66 year-end stock prices over the period. Over 1911–25 we use the index of 21 industrial shares from Statistiches Jahrbuch. The Swiss exchanges were closed during September 1914 to December 1915, so for end-1914 and end-1915 we use the index at the date closest to the year-end. For 1926–59 Ratzer (1983) estimates total returns. For 1960–83 Huber (1985) computes the returns from index levels and dividends on the SBC index. Over 1984–98 we use the Pictet return index, and then the Swiss All Share index. For Switzerland only, and solely for the period 1900–15, we estimate bond returns from the short rate. We use the latter as a proxy for the yield on seven-year bonds, and infer the annual returns for this series. For 1915–25 we use annual data from the Statistischen Bureau. The interval 1926–59 employs Ratzer's (1983) estimates based on redemption yields for new Swiss bond issues. The 1960–80 period is represented by Huber's (1985) bond index based on actual trading prices. From 1981 we use the Datastream ten-year Swiss government bond index. During 1900–55 short-term rates are represented by the central bank discount rate, and for 1956–79, by the return on three-month time deposits. From 1980 onward, we use the return on Treasury bills. Nominal returns are adjusted for inflation using movements in the Swiss consumer prices index.

The United Kingdom is analysed using index series described in Dimson and Marsh (2001) for the interval from 1955 to date, and in Dimson, Marsh, and Staunton (2002, 2006a) for the period 1900–1954. Because of biases and inaccuracies in prior index series, the last half-century is based on the fully representative record of equity prices maintained by London Business School and described in Dimson and Marsh (1983). The period up to the end of 1954 is based on an index of the returns from the 100 companies that, before each New Year, have the largest equity market capitalization. Share capital was checked against the annual Stock Exchange Official Yearbook up to 1955, to account for capital changes and corporate events. Before 1955, all cash flows are assumed to occur at the end of each year, including dividends, special dividends, returns of capital, and cash from acquisitions. Where companies are acquired for shares or merge, we base returns on the end-year share price of the acquirer or merged entity, taking account of the exchange ratio. Dividends were obtained from the Stock Exchange Ten-Year Record published by Mathiesons. The U.K. bond index was compiled from original British government bond data. For the 1900–54 period the returns are based on 2½% Consols, and for 1955–2000 the bond index measures the return on a portfolio comprising high-coupon government bonds with a mean maturity of twenty years. Throughout the century, Treasury bills are used to measure the short-term riskless rate of interest. Inflation is calculated using the retail price index and, before 1962, the index of retail prices.

The United States was first researched in the Ibbotson and Sinquefield (1976) article and subsequent Ibbotson Associates updates. The broadest index of U.S. stock market returns is in Wilson and Jones (2002), and we use the latter for this study. Earlier sources are described in Goetzmann, Ibbotson, and Peng (2001). Our series, however, commences with the Wilson-Jones index data over 1900–25. For 1926–61 we use the University of Chicago's Center for Research in Security Prices (CRSP) capitalization-weighted index of all New York Stock Exchange stocks. For 1962–70 we use the CRSP capitalization-weighted index of NYSE, American, and Nasdaq stocks. From 1971 onward we employ the Dow Jones Wilshire 5000 index. All indexes include reinvested dividends. The government bond series for 1900–18 is based on 4% government bonds. Over 1919–25 we use the Federal Reserve ten-to-fifteen year bond index. After that bond returns are based on Ibbotson Associates' long bond index. The bill index uses commercial bills during 1900–18. From 1919 onward, the series is based on U.S. Treasury bills. Inflation is based on the consumer price index.

The World is represented by an equity series that comprises a 17-country, common-currency (here taken as U.S. dollars) index. For each period, we take a market's local-currency return and convert it to U.S. dollars. We therefore have the return that would have been received by a U.S. citizen who bought foreign currency at the start of the period, invested it in the foreign market throughout the period, liquidated his or her position, and converted the proceeds back at the end of the period into U.S. dollars. We assume that at the beginning of each period our investor bought a portfolio of 16 such positions in each of the foreign markets in this study, plus domestic equities, weighting each country by its size. We use GDP weights with start-decade rebalancing before 1968 due to a lack of reliable data on capitalizations prior to that date. Thereafter, we use country capitalizations taken from Morgan Stanley Capital International (MSCI). The above procedure results in an index expressed in U.S. dollars. To convert this to real terms, we then adjust by the U.S. inflation rate. This gives rise to a global index return denominated in real terms, from the point of view of our notional U.S. investor. Our 17-country world bond market index is constructed in the same way. This is again weighted by country size, to avoid giving, say, Belgium the same weight as the United States. Equity capitalization weights are inappropriate here, so the bond index is GDP-weighted throughout. The short-term risk free rate is taken as the return on U.S. Treasury bills. The inflation rate is as for the United States.

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Research Roundtable
The Equity Premium

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I. A BRIEF INTRODUCTION TO THE EQUITY PREMIUM

Loosely speaking, the equity premium is the difference between the return on risky stocks and return on safe bonds. It is the prime input both in the CAPM (the model used by most practitioners in computing an appropriate hurdle rate), and in asset allocation decisions (the choice of whether an investor should hold stocks or bonds).

Unfortunately, there is no universally accepted definition of the equity premium. In particular, one can compute equity premia using different stock market indices, different bonds (either long-term or short-term), different methods of compounding or cumulating returns over time, and different historical time periods. Such computational differences can lead to valid historical equity premium quotations ranging from 4.3% per year up to about 9.4% per year, depending also on the time period quoted (e.g., Welch [2000]). It is important for a user of equity premium estimates to be clear about which definition is used and why it is the appropriate definition for the particular purpose it is used for.

There are three inter-related questions of primary interest to researchers:

[1] Why has the historical equity premium been so high?

[2] What is a good forward-looking prediction for the equity premium for the long run?

[3] Can one use other variables, such as dividend yields, to come up with a good forecast of the equity premium, at least over a 1-5 year period?

As first pointed out by Mehra and Prescott [1985], a return differential of, say, 8% per year is enormous especially over a long enough horizon. Ibbotson and Associates, the "gold-standard" provider of historical equity premium data, show that an investment of $1 in 1925 would be worth $5,116 by 1998, whereas an investment in treasury bills would only be worth $15. (And it is well known that treasury bill returns generally suffer higher taxes than capital gains!)

The profession falls into three loosely defined camps with respect to why equity premia have been so high and whether they will continue to be high. The first camp argues that these high equity premia were necessary to induce investors to participate in the stock market (e.g., Benartzi and Thaler [1995], Campbell and Cochrane [1999]). This argument implies an equity premium (possibly) as high in the future as in the past. The second camp argues that the expected returns necessary to entice investors have fallen in the last few years. This means, stocks can trade for much higher prices today, which itself is both responsible for the recent stock market appreciation, and for the expectation of much lower returns in the future (e.g., Heaton and Lucas [1999]). Closely related are arguments that historical equity premia are mismeasured, and not indicative of ex-ante equity premium expectations (e.g., Goetzmann and Jorion [1999], Siegel [1999]). The third camp argues that the stock market has gone crazy and we are all in a bubble right now. Again, this implies much lower future returns in the future. In contrast to the second camp, this camp would be less surprised by a crash or crash-like rapid drop in the stock-market. Although few academics have published this view (except Shiller [2000])---not necessarily because they do not dare, but because it is difficult to bring unambiguous evidence to bear on this matter---many seem to individually subscribe to it. [Footnote: This issue is closely connected to the question of whether Internet stocks are right now overvalued. Once willing to concede that internet stocks are overvalued, it is not a far step to concede that it is possible that the stock market as a whole is overvalued, too.]

One can also bring additional evidence to bear on the second question without taking a stance on the first question: There are a number of publicly accessible forecasts from investors, academics, corporations. (Welch [2000]). Typically, investors seem to expect higher equity premia, academics seem to expect equal (or just slightly lower) equity premia, and corporations and consulting firms seem to expect lower equity premia than those realized in the past. In sum, these forecasts run counter to the view that equity premia have recently been so high, because everyone expects them to be lower in the near future. Finally, a new set of working papers are attempting to attribute "plausible" equity premia based on long-term forecasts of real growth (e.g., Diamond [2000], Welch [1998]).

The third question is equally tricky as the first two questions. There is universal consensus that the equity premium cannot be easily predicted over shorter horizons, such as one month; and that even if the equity premium can be predicted over a longer horizon (e.g., over a 30-year forecast), we do not have enough historical data to run regressions to validate 30-year forecasting claims.

The variable most often mentioned as a possible predictor of equity premia is the prior-year dividend-yield. This predictability was first explored in a rigorous manner by the seminal papers of Campbell and Shiller [1988], Fama and French [1988], and Blanchard [1993], which came to the conclusion that dividend-yields do seem to have predictive ability. In a simple regression predicting equity premia one-year ahead with dividend-yields, the dividend yield shows great statistical significance. However, a long line of subsequent research has pointed to various statistical issues in this early work. Furthermore, most such models predict one-year-ahead forecasts of negative equity premia as of the year 2000---not a sensible prediction. Yet, even if there is disagreement of whether documented forecasting ability of dividend yields was real, there is little disagreement that this predictive ability has disappeared in the 1990s (Goyal-Welch [2000]).

Where does this leave us? The equity premium is not only the single most important number of finance, but estimating it is also our most perplexing problem. If the profession fails to make progress in understanding the process driving the equity premium, progress on many of the most important problems in finance---proper asset allocation and hurdle rates--are likely to be phyrric victories only.

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III. REACTIONS BY DISCUSSANTS

Each of the discussants was given the article above and asked to address the question, "What do you teach MBA students about the equity premium?" We thank them for their willingness to share their ideas and experiences.

PETER BOSSAERTS
California Institute of Technology

The available attempts at explaining the historic U.S. equity premium have been based too much on the very narrow, stationary, single-consumer, rational expectations equilibrium of Lucas. Too little is done to deviate from this implausibly strong notion of equilibrium. Rational expectations equilibria do allow for mistaken expectations. They even allow for disagreement. And incomplete markets. Moreover, there is an objectionable assumption behind all of modern empirical analysis, namely that recorded market prices are always equilibrium prices. Too little attention is paid to genuine dynamics (equilibrium price discovery). Finally, any scientifically relevant attempt at explaining the historic U.S. equity premium simultaneously will have to explain historic evidence over other countries (e.g., Japan in the 1990s) that is diametrically opposed (low real rates of interest, negative equity premium).

JOHN COCHRANE
University of Chicago, Graduate School of Business

I don't really have much to add. My own view is about 3-4% unconditional and much lower but positive conditional. Did the average investor in 1947 really think that average stock returns would be 9% over bonds, with a 16% volatility, and say "no thanks, I don't want to buy more stocks because that volatility scares me?" Probably not! Hence, much of the postwar sample must be good luck rather than the unconditional mean.

GENE FAMA
University of Chicago, Graduate School of Business

The Gordon constant dividend growth model and realized returns produce similar estimates of the real equity premium for 1872-1949, about 4.0 percent per year. For 1950-1999, the Gordon estimate, 3.40 percent per year, is only about forty percent of the estimate from realized returns, 8.28 percent. The difference between the realized return for 1950-1999 and the Gordon estimate of the expected return is largely due to unexpected capital gains, the result of a decline in discount rates. Forward-looking Gordon estimates of the expected equity premium are about one to two percent per year. (Comments based on work by Gene F. Fama and Kenneth R. French)

WILL GOETZMANN
Yale University, School of Management

The equity premium is commonly defined as the percentage by which stock market returns are expected to exceed a riskless bond investment. Theory argues for a positive equity premium. A rational, risk-averse investor with a riskless investment opportunity should demand greater compensation for holding a riskier asset -- but how much greater? Empirical estimates of the equity premium are typically based upon historical realizations of stock and riskless bond returns. As such a "pure" estimate of the historical equity premium may be impossible. The composition and leverage of the equity markets continually changes and a purely riskless asset does not exist. Never-the-less, the average U.S. equity premium generally exceeded 6% per annum over extended historical periods. Is the historically realized equity premium a good forecast for the future? The answer depends upon whether the economic factors contributing to the historical premium can be expected to continue as well.

ROBERT S. HARRIS
University of Virginia, Darden Graduate School of Business

The Market Risk Premium: Expectational Estimates

Ivo Welch's comments nicely capture much recent academic thinking on the market risk premium. I'd like to add observations from work that directly uses expectational data from financial analysts to estimate the U. S. market premium. The results do not resolve the equity risk premium puzzle but provide interesting additions to what counsel might be provided to practitioners and students.

Investigators have most often used averages of historical realizations to estimate a market premium. This choice has some appealing characteristics but is subject to many arbitrary assumptions such as the relevant period for taking an average. Practice seems to mirror this framing around historical returns. Recent survey results on best practices by corporations and financial advisors (see Bruner et al (1998)) reveals that almost all respondents used some average of past data in estimating a market risk premium and displayed considerable variation in the choice of time period and method (arithmetic versus geometric) for averaging. Few respondents cited use of expectational data to supplement or replace historical returns in estimating the market premium. Many textbook treatments also rely on historical returns citing the Ibbotson data for the U.S.

As Welch notes, however, shareholder required rates of return and risk premia are based on theories about investors' expectations for the future. Fortunately, there is a relatively longstanding tradition of estimating a market premium using publicly available expectational data from financial analysts. This approach uses some variant of a discounted cash flow model to infer the market premium from the combination of analysts' forecasts of future performance and current stock prices (1).

In my view, four key findings are instructive (2).

First, for the last two decades, the market premium implied by expectational data from financial analysts is comparable in magnitude to long-term differences (1926 to 1998) in historical returns between stocks and bonds. As a result, the evidence does not resolve the equity premium puzzle and suggests that investors still expect to receive large spreads to invest in equity versus debt instruments.

Second, at least based on current evidence through 1998 the market premium does not appear to have declined dramatically in the 1990s.

Third: the market risk premium changes over time. Moreover, these changes appear linked to the level of interest rates as well as ex ante proxies for risk drawn from financial markets. Higher interest rates appear associated with lower market premia. The significant economic links between the market premium and a wide array of risk variables suggests that the notion of a constant risk premium over time is not an adequate explanation of pricing in equity versus debt markets.

Fourth, using analyst forecasts as a proxy for investor expectations has many desirable features but more work is need to understand the extent to which optimism by analysts may affect the empirical estimates of market premia.

In the face of this evidence as well as Welch's comments, what is the message for practice and education? Humility seems a useful starting point. More research in the area is certainly warranted. That having been said we should not "throw the baby out with the bathwater". At a conceptual level the market premium provides large benefits in sharpening thinking about resource allocation. One conclusion for practice that I draw is that common application of models such as the CAPM will overstate changes in shareholder return requirements when government interest rates change because risk premia seem to move inversely with interest rates. This is consistent with much corporate practice that does not revise hurdle rates for modest variations in interest rate conditions. A second conclusion is that we should sensitize students to the potential for risk premium variation. Having debunked the notion that the risk premium is, like Avogadro's number, a constant from on high, I adopt an administrative standard of a particular market premium (say 6%) for any class so that we do not constantly revisit the issue. A third implication is that we should in teaching, practice and research look for objective yet forward looking data that can be deployed to give insights on the market premium. Finally, our humility on the level of the market premium should make us take pains to invest in understanding the true underlying risks and opportunity inherent in an investment (say through sensitivity analysis, simulation or options frameworks).

(1) See for example Malkiel (1982), Brigham, Vinson, and Shome (1985), Harris (1986) Harris and Marston (1992,1999). Ibbotson Associates (1998) use a variant of the DCF model with forward-looking growth rates as one means to estimate cost of equity; however, they do this as a separate technique and not as part of the CAPM. For their CAPM estimates they use historical averages for the market risk premium. The DCF approach with analysts' forecasts has been used frequently in regulatory settings.

(2) These findings are drawn from Harris and Marston (1992,1999) who also summarize some of the earlier work.

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JOHN HEATON
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Over the last century the average return to holding stocks was much higher than the average return to holding bonds. If this difference reflected expected returns then the high returns on stocks should represent compensation for risk. When viewed in isolation the stock market does appear to be quite volatile. The economy as a whole is much less risky, however. This is important because the typical household in the United States receives income from wages, salaries and other sources that more closely resembles aggregate GNP than stock market returns. The typical household should therefore be willing to invest a substantial amount in the stock market since the return is high and the risk can be diversified away using the household's other sources of income. The resulting large demand for stocks would ultimately increase stock prices and reduce expected returns. The fact that this did not occur historically results in the "equity premium puzzle." Viewed in this way the equity premium puzzle is really a diversification puzzle.

There are several potential explanations for this diversification puzzle. First is the fact that stock ownership is relatively concentrated among wealthy individuals. These individuals tend to have business income that is less like aggregate income and more like stock returns than the average household [see, for example, Heaton and Lucas (2000)]. For these people the diversification possibilities that can be obtained by holding stocks are small. Second, in the past, holding a diversified portfolio of financial assets was difficult due to high costs of trading, brokerage fees and the like.

As a result, the typical investor held a portfolio that was much more risky than the stock market index. This lack of diversification implies that the actual portfolios individuals held were much riskier than a stock index. Both of these effects imply that historically investors required high returns to hold equity.

Over time the level of diversification seems to have increased both because investors have been able to hold better diversified portfolios by holding mutual funds and because wealthy individuals are able to better diversify their privately held equity. As a result, the required return to holding stocks may have fallen in recent years which possibly explains the recent dramatic increase in stock prices.

This argues that looking forward the average premium investors will receive by holding stocks is likely to be much lower than it was in the past.

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ROGER IBBOTSON
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The first way that I would estimate ERP is to look at the historical payoff for risk. I would use the Ibbotson and Sinquefield results reported in the Stocks, Bonds, Bills and Inflation 2000 Yearbook, published by Ibbotson Associates (www.ibbotson.com) which shows that over the 1926-1999 period common stocks had a 11.3% compound annual return and a 13.3% annual arithmetic mean return. In contrast, long-term government bond income returns were 5.2%, giving a long horizon historical arithmetic mean ERP of 8.1%.

The historical payoff for risk is a good guide to the future risk premium, but it is not perfect. First, there is considerable estimation error even assuming the 74 years returns were drawn from a stationary distribution. A standard deviation of 20% gives a standard error of 2.7%. Using shorter estimation periods increases the estimation error. Goetzmann, Ibbotson and Liang (2000) have constructed a raw data series based upon individual security prices and dividends over the period 1815-1925. This longer series may help us estimate the ERP with lower estimation error.

Another way to estimate the ERP is to recognize that the stock market is a part of the economy. In Diermeier, Ibbotson, and Siegel (1984), we assume that the stock market remains a constant share of the economy. Using historical estimates of real GNP growth, and inflows and outflows of the stock market, we can calculate the expected return on the stock market. The supply side estimate of the stock market is substantially lower than the historical ERP, since the stock market has been increasing its share of the economy. We would not expect this to continue indefinitely, so that we would consider both methods in making an ERP estimate. I am currently updating and revising our supply side estimate.

There are several caveats to any estimation method. Is the U.S. the successful survivor, so that past returns or GNP growth are artificially high? Are we at an artificial peak in the stock market or economy (a bubble) which makes historical growth an upward biased prediction of the future? Is the ERP too high based upon reasonable risk aversion parameters? Has the risk decreased, lowering the ERP?

On the other hand, some caveats might cause us to increase our estimate of ERP. Is future stock market risk in fact higher than past risk, perhaps because of potential shocks? Are we in a faster moving "new economy" so that time moves faster, increasing the ERP?

Overall, I think the best estimate of the ERP is to use some combination of the historical ERP and the supply side estimate of the ERP.

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There are three points I stress in discussing the equity risk premium (ERP). First, it is important to acknowledge that the capital asset pricing model-for all of its elegance-is unlikely to be the last word on our understanding of risk and reward. Second, the ERP should be estimated ex-ante.

Ex-post definitions come with a lot of calculational baggage, most notably choice of time period and data non-stationarity. Finally, use a long-term discounted cash flow model to estimate expected return, and then subtract a long-term Treasury yield to estimate the ex-ante ERP. A long-term Treasury is used because it matches the duration of most stocks and properly incorporates expected inflation. I believe that the ERP has been in a range of 2-5% in recent years. We currently use about 4.0% at CSFB. This suggests an expected long-term nominal stock market return of about 10%.

One final note. A proper estimate of ERP has obvious significance in asset allocation. But for the active equity manager-the avocation of many of my students-stock selection is a relative endeavor. So stock selection distills to anticipating expectation shifts in key operating value drivers. As a result, ERP is not a defining issue.

ANDRÉ PEROLD
Harvard University, Harvard Business School

In my MBA investments course, I ask students to value the stock market on the basis of a discounted cash flow analysis. The essential conclusion of this analysis is that if stocks are not overvalued, the forward looking risk premium is low (about 3%); or long-run future real cash flow growth must be extremely high. The result seems robust to the choice of cash flow model.

For example, in the growth perpetuity model applied to stock dividends; the discount rate, k, the dividend yield y, and the long-run future growth rate of expected dividends, g, are related through $k = y + g$. Presently, in the U.S. market, y is less than 2% for cash dividends, and y is less than 3% when net share repurchases are counted as dividends. The U.S. Treasury yield curve is more or less flat at 6%. If the risk premium is 8%, future dividend growth must be 11% in perpetuity, or 9% real (assuming the 2% inflation rate imbedded in TIPS), versus the historical real growth rate of stock dividends of around 3%. If the risk premium is 3%, then future real dividend growth must be 4% in perpetuity.

We discuss possible explanations for the low ex ante risk premium. Mine is risk management. There are today the institutions, instruments and technologies to permit efficient risk management and risk sharing by households, firms and governments. The result is investor portfolios that are better diversified and a global economy that is safer.

JAY RITTER
University of Florida, Warrington College of Business

In the 1980s, I followed the textbook mantra that the equity risk premium should be based on extrapolating the historical average into the future. By the late 1980s, I began to realize how wrong this was, as the Japanese market soared. This approach predicted that in the 1990s there would be extremely high returns on Japanese stocks, just as today it implies that there will be unrealistically high returns on US stocks in the future.

In recent years, I have relied on the dividend growth model: E(r)= div yield + expected growth rate. Today, with the dividend yield being 1.1% and expected real growth of maybe 3% (stock option exercise largely cancels out share repurchases in the aggregate), this gives an expected real return on US equities of about 4%. With inflation-indexed T-bonds giving a real yield of 4% today, this results in an equity premium of zero. The only way to get a positive equity premium is to assume that the growth of real EPS will be far above historical trend. The high stock market has lowered the expected real return on stocks, and the high real rate of interest has squeezed the equity premium from below.

ROBERT WHITELAW
New York University, Stern School of Business

What do you teach your students about the market risk premium?

There is substantial disagreement about the magnitude of the market risk premium, and I try to convey this uncertainty in the classroom. The starting point of my discussion is the historical US premium. I then talk about why this value might not be a good estimate of the true ex ante premium (e.g., survivorship bias, estimation error) or of the current forward looking premium (e.g., changes in risk aversion). I also bring up international evidence and information about the current expectations of practitioners and individual investors. Finally, I briefly mention predictable time-variation, but I emphasize that variation over business cycle frequencies is probably not as important for long-term decision-making. I make a big effort not to pretend to have a definitive answer (in general, MBA students can handle ambiguity), but I will give my opinion if asked.

IV. BULLETIN BOARD FOR DISCUSSION OF THE EQUITY PREMIUM

In order to foster discussion about this (and other) issues, we have set up an self-moderated electronic bulletin board where readers can share their opinions about this topic. The address of this board is http://ssrn.com/forum/. The board will contain a copy of the materials above, and we encourage you to post your own thoughts on the topic so the discussion can continue with the entire profession.

Equity Risk Premiums (ERP): Determinants, Estimation and Implications – The 2011 Edition

Updated: February 2011

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Equity Risk Premiums (ERP): Determinants, Estimation and Implications

Equity risk premiums are a central component of every risk and return model in finance and are a key input into estimating costs of equity and capital in both corporate finance and valuation. Given their importance, it is surprising how haphazard the estimation of equity risk premiums remains in practice. We begin this paper by looking at the economic determinants of equity risk premiums, including investor risk aversion, information uncertainty and perceptions of macroeconomic risk. In the standard approach to estimating equity risk premiums, historical returns are used, with the difference in annual returns on stocks versus bonds over a long time period comprising the expected risk premium. We note the limitations of this approach, even in markets like the United States, which have long periods of historical data available, and its complete failure in emerging markets, where the historical data tends to be limited and volatile. We look at two other approaches to estimating equity risk premiums – the survey approach, where investors and managers are asked to assess the risk premium and the implied approach, where a forward-looking estimate of the premium is estimated using either current equity prices or risk premiums in non-equity markets. We also look at the relationship between the equity risk premium and risk premiums in the bond market (default spreads) and in real estate (cap rates) and how that relationship can be mined to generated expected equity risk premiums. We close the paper by examining why different approaches yield different values for the equity risk premium, and how to choose the "right" number to use in analysis.

(This is the fourth update of this piece. The first update was in the midst of the banking crisis in 2008 and there were annual updates for 2009 and 2010.)

The notion that risk matters, and that riskier investments should have higher expected returns than safer investments, to be considered good investments, is both central to modern finance and intuitive. Thus, the expected return on any investment can be written as the sum of the riskfree rate and a risk premium to compensate for the risk. The disagreement, in both theoretical and practical terms, remains on how to measure the risk in an investment, and how to convert the risk measure into an expected return that compensates for risk. A central number in this debate is the premium that investors demand for investing in the 'average risk' equity investment, i.e., the equity risk premium.

In this paper, we begin by examining competing risk and return models in finance and the role played by equity risk premiums in each of them. We argue that equity risk premiums are central components in every one of these models and consider what the determinants of these premiums might be. We follow up by looking at three approaches for estimating the equity risk premium in practice. The first is to survey investors or managers with the intent of finding out what they require as a premium for investing in equity as a class, relative to the riskfree rate. The second is to look at the premiums earned historically by investing in stocks, as opposed to riskfree investments. The third is to back out an equity risk premium from market prices today. We consider the pluses and minuses of each approach and how to choose between the very different numbers that may emerge from these approaches.

Equity Risk Premiums: Importance and Determinants

Since the equity risk premium is a key component of every valuation, we should begin by looking at not only why it matters in the first place but also the factors that influence its level at any point in time and why that level changes over time. In this section, we look at the role played by equity risk premiums in corporate financial analysis, valuation and portfolio management, and then consider the determinants of equity risk premiums.

Why does the equity risk premium matter?

The equity risk premium reflects fundamental judgments we make about how much risk we see in an economy/market and what price we attach to that risk. In the process, it affects the expected return on every risky investment and the value that we estimate for that investment. Consequently, it makes a difference in both how we allocate wealth across different asset classes and which specific assets or securities we invest in within each asset class.

A Price for Risk

To illustrate why the equity risk premium is the price attached to risk, consider an alternate (though unrealistic) world where investors are risk neutral. In this world, the value of an asset would be the present value of expected cash flows, discounted back at a risk free rate. The expected cash flows would capture the cash flows under all possible scenarios (good and bad) and there would be no risk adjustment needed. In the real world, investors are risk averse and will pay a lower price for risky cash flows than for riskless cash flows, with the same expected value. How much lower? That is where equity risk premiums come into play. In effect, the equity risk premium is the premium that investors demand for the average risk investment, and by extension, the discount that they apply to expected cash flows with average risk. When equity risk premiums rise, investors are charging a higher price for risk and will therefore pay lower prices for the same set of risky expected cash flows.

Expected Returns and Discount Rates

Building on the theme that the equity risk premium is the price for taking risk, it is a key component into the expected return that we demand for a risky investment. This expected return, is a determinant of both the cost of equity and the cost of capital, essential inputs into corporate financial analysis and valuation.

While there are several competing risk and return models in finance, they all share some common views about risk. First, they all define risk in terms of variance in actual returns around an expected return; thus, an investment is riskless when actual returns are always equal to the expected return. Second, they argue that risk has to be measured from the perspective of the marginal investor in an asset, and that this marginal investor is well diversified. Therefore, the argument goes, it is only the risk that an investment adds on to a diversified portfolio that should be measured and compensated. In fact, it is this view of risk that leads us to break the risk in any investment into two components. There is a firm-specific component that measures risk that relates only to that investment or to a few investments like it, and a market component that contains risk that affects a large subset or all investments. It is the latter risk that is not diversifiable and should be rewarded.

All risk and return models agree on this fairly crucial distinction, but they part ways when it comes to how to measure this market risk. In the capital asset pricing model (CAPM), the market risk is measured with a beta, which when multiplied by the equity risk premium yields the total risk premium for a risky asset. In the competing models, such as the arbitrage pricing and multi-factor models, betas are estimated against individual market risk factors, and each factor has it own price (risk premium). Table 1 summarizes four models, and the role that equity risk premiums play in each one:

Table 1: Equity Risk Premiums in Risk and Return Models

	Model	*Equity Risk Premium*
The CAPM	Expected Return = Riskfree Rate + $\text{Beta}_{\text{Asset}}$ (Equity Risk Premium)	Risk Premium for investing in the market portfolio, which includes all risky assets, relative to the riskless rate.
Arbitrage pricing model (APM)	$\text{Expected Return} = \text{Riskfree Rate} + \sum_{j=1}^{j=k} \beta_j (\text{Risk Premium}_j)$	Risk Premiums for individual (unspecified) market risk factors.
Multi-Factor Model	$\text{Expected Return} = \text{Riskfree Rate} + \sum_{j=1}^{j=k} \beta_j (\text{Risk Premium}_j)$	Risk Premiums for individual (specified) market risk factors
Proxy Models	Expected Return = a + b (Proxy 1) + c (Proxy 2) (where the proxies are firm characteristics such as market capitalization, price to book ratios or return momentum)	No explicit risk premium computation, but coefficients on proxies reflect risk preferences.

All of the models other than proxy models require three inputs. The first is the riskfree rate, simple to estimate in currencies where a default free entity exists, but more complicated in markets where there are no default free entities. The second is the beta (in the CAPM) or betas (in the APM or multi-factor models) of the investment being analyzed, and the third is the appropriate risk premium for the portfolio of all risky assets (in the CAPM) and the factor risk premiums for the market risk factors in the APM and multi-factor models. While I examine the issues of riskfree rate and beta estimation in companion pieces, I will concentrate on the measurement of the risk premium in this paper.

Note that the equity risk premium in all of these models is a market-wide number, in the sense that it is not company specific or asset specific but affects expected returns on all risky investments. Using a larger equity risk premium will increase the expected returns for all risky investments, and by extension, reduce their value. Consequently, the choice of an equity risk premium may have much larger consequences for value than firm-specific inputs such as cashflows, growth and even firm-specific risk measures (such as betas).

Investment and Policy Implications

It may be tempting for those not in the midst of valuation or corporate finance analysis to pay little heed to the debate about equity risk premium, but it would be a mistake to do so, since its effects are far reaching.

- ¥ The amounts set aside by both corporations and governments to meet future pension fund and health care obligations are determined by their expectations of returns from investing in equity markets, i.e., their views on the equity risk premium. Assuming that the equity risk premium is 6% will lead to far less being set aside each year to cover future obligations than assuming a premium of 4%. If the actual premium delivered by equity markets is only 2%, the fund's assets will be insufficient to meet its liabilities, leading to fund shortfalls which have to be met by raising taxes (for governments) or reducing profits (for corporations) In some cases, the pension benefits can be put at risk, if plan administrators use unrealistically high equity risk premiums, and set aside too little each year.
- ¥ Business investments in new assets and capacity is determined by whether the businesses think they can generate higher returns on those investments than the cost that they attach to the capital in that investment. If equity risk premiums increase, the cost of equity and capital will have to increase with them, leading to less overall investment in the economy and lower economic growth.
- ¥ Regulated monopolies, such as utility companies, are often restricted in terms of the prices that they charge for their products and services. The regulatory commissions that determine "reasonable" prices base them on the assumption that these companies have to earn a fair rate of return for their equity investors. To come up with this fair rate of return, they need estimates of equity risk premiums; using higher equity risk premiums will translate into higher prices for the customers in these companies.[1]
- ¥ Judgments about how much you should save for your retirement or health care and where you should invest your savings are clearly affected by how much return you think you can make on your investments. Being over optimistic about equity risk premiums will lead you to save too little to meet future needs and to over investment in risky asset classes.

Thus, the debate about equity risk premiums has implications for almost every aspect of our lives.

What are the determinants of equity risk premiums?

Before we consider different approaches for estimating equity risk premiums, we should examine the factors that determine equity risk premiums. After all, equity risk

[1] The Society of Utility and Regulatory Financial Analysts (SURFA) has annual meetings of analysts involved primarily in this debate. Not surprisingly, they spend a good chunk of their time discussing equity risk premiums, with analysts working for the utility firms arguing for higher equity risk premiums and analysts working for the state or regulatory authorities wanting to use lower risk premiums.

premiums should reflect not only the risk that investors see in equity investments but also the price they put on that risk.

Risk Aversion

The first and most critical factor, obviously, is the risk aversion of investors in the markets. As investors become more risk averse, equity risk premiums will climb, and as risk aversion declines, equity risk premiums will fall. While risk aversion will vary across investors, it is the collective risk aversion of investors that determines equity risk premium, and changes in that collective risk aversion will manifest themselves as changes in the equity risk premium. While there are numerous variables that influence risk aversion, we will focus on the variables most likely to change over time.

a. Investor Age: There is substantial evidence that individuals become more risk averse as they get older. The logical follow up to this is that markets with older investors, in the aggregate, should have higher risk premiums than markets with younger investors, for any given level of risk. Bakshi and Chen (1994), for instance, examine risk premiums in the United States and noted an increase in risk premiums as investors aged.[2]
b. Preference for current consumption: We would expect the equity risk premium to increase as investor preferences for current over future consumption increase. Put another way, equity risk premiums should be lower, other things remaining equal, in markets where individuals are net savers than in markets where individuals are net consumers. Consequently, equity risk premiums should increase as savings rates decrease in an economy.

Relating risk aversion to expected equity risk premiums is not as easy as it looks. While the direction of the relationship is fairly simple to establish – higher risk aversion should translate into higher equity risk premiums- getting beyond that requires us to be more precise in our judgments about investor utility functions, specifying how investor utility relates to wealth (and variance in that wealth). As we will see later in this paper, there has been a significant angst among financial economics that most conventional utility models do not do a good job of explaining observed equity risk premiums.

Economic Risk

The risk in equities as a class comes from more general concerns about the health and predictability of the overall economy. Put in more intuitive terms, the equity risk

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[2] Bakshi, G. S., and Z. Chen, 1994, *Baby Boom, Population Aging, and Capital Markets*, The Journal of Business, LXVII, 165-202.

premium should be lower in an economy with predictable inflation, interest rates and economic growth than in one where these variables are volatile. Lettau, Ludwigson and Wachter (2007) link the changing equity risk premiums in the United States to shifting volatility in the real economy.[3] In particular, they attribute that that the lower equity risk premiums of the 1990s (and higher equity values) to reduced volatility in real economic variables including employment, consumption and GDP growth. One of the graphs that they use to illustrate the correlation looks at the relationship between the volatility in GDP growth and the dividend/ price ratio (which is the loose estimate that they use for equity risk premiums), and it is reproduced in figure 1.

Figure 1: Volatility in GDP growth and Equity Risk Premiums (US)

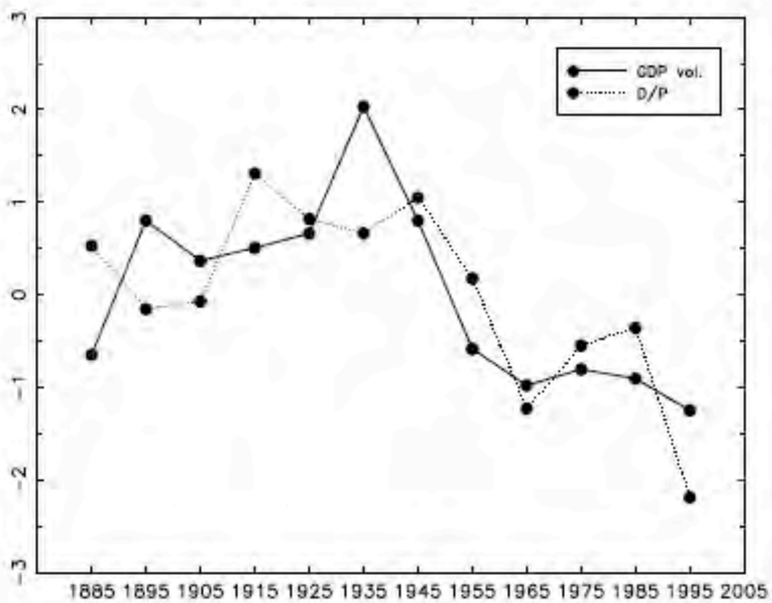

Figure 3
GDP volatility and the D/P ratio—Prewar evidence
This figure plots the standard deviations of GDP growth and the mean D/P ratio by decade starting in 1880 until 2000. Both series are demeaned and divided by their standard deviation. The GDP data are from Ray Fair's website (http://fairmodel.econ.yale.edu/RAYFAIR/PDF/2002DTBL.HTM) based on Balke and Gordon (1989). The dividend yield data is from Robert Shiller's website (http://aida.econ.yale.edu/~shiller/data/ie_data.htm).

Note how closely the dividend yield has tracked the volatility in the real economy over this very long time period.

A related strand of research examines the relationship between equity risk premium and inflation, with mixed results. Studies that look at the relationship between the level of inflation and equity risk premiums find little or no correlation. In contrast, Brandt and Wang (2003) argue that news about inflation dominates news about real

[3] Lettau, M., S.C. Ludvigson and J.A. Wachter, 2008. *The Declining Equity Risk Premium: What role does macroeconomic risk play?* Review of Financial Studies, v21, 1653-1687.

economic growth and consumption in determining risk aversion and risk premiums.[4] They present evidence that equity risk premiums tend to increase if inflation is higher than anticipated and decrease when it is lower than expected. Reconciling the findings, it seems reasonable to conclude that it is not so much the level of inflation that determines equity risk premiums but uncertainty about that level.

Information

When you invest in equities, the risk in the underlying economy is manifested in volatility in the earnings and cash flows reported by individual firms in that economy. Information about these changes is transmitted to markets in multiple ways, and it is clear that there have been significant changes in both the quantity and quality of information available to investors over the last two decades. During the market boom in the late 1990s, there were some who argued that the lower equity risk premiums that we observed in that period were reflective of the fact that investors had access to more information about their investments, leading to higher confidence and lower risk premiums in 2000. After the accounting scandals that followed the market collapse, there were others who attributed the increase in the equity risk premium to deterioration in the quality of information as well as information overload. In effect, they were arguing that easy access to large amounts of information of varying reliability was making investors less certain about the future.

As these contrary arguments suggest, the relationship between information and equity risk premiums is complex. More precise information should lead to lower equity risk premiums, other things remaining equal. However, precision here has to be defined in terms of what the information tells us about future earnings and cash flows. Consequently, it is possible that providing more information about last period's earnings may create more uncertainty about future earnings, especially since investors often disagree about how best to interpret these numbers. Yee (2006) defines earnings quality in terms of volatility of future earnings and argues that equity risk premiums should increase (decrease) as earnings quality decreases (increases).[5]

Empirically, is there a relationship between earnings quality and observed equity risk premiums? The evidence is mostly anecdotal, but there are several studies that point to the deteriorating quality of earnings in the United States, with the blame distributed

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[4] Brandt, M.W., K.Q. Wang (2003). *Time-varying risk aversion and unexpected inflation*, Journal of Monetary Economics, v50, pp. 1457-1498.
[5] Yee, K. K. (2006), *Earnings Quality and the Equity Risk Premium: A Benchmark Model*, Contemporary Accounting Research, 23: 833–877.

widely. First, the growth of technology and service firms has exposed inconsistencies in accounting definitions of earnings and capital expenditures – the treatment of R&D as an operating expense is a prime example. Second, audit firms have been accused of conflicts of interest leading to the abandonment of their oversight responsibility. Finally, the earnings game, where analysts forecast what firms will earn and firms then try to beat these forecasts has led to the stretching (and breaking) of accounting rules and standards. If earnings have become less informative in the aggregate, it stands to reason that equity investors will demand large equity risk premiums to compensate for the added uncertainty.

Information differences may be one reason why investors demand larger risk premiums in some emerging markets than in others. After all, markets vary widely in terms of transparency and information disclosure requirements. Markets like Russia, where firms provide little (and often flawed) information about operations and corporate governance, should have higher risk premiums than markets like India, where information on firms is not only more reliable but also much more easily accessible to investors.

Liquidity

In addition to the risk from the underlying real economy and imprecise information from firms, equity investors also have to consider the additional risk created by illiquidity. If investors have to accept large discounts on estimated value or pay high transactions costs to liquidate equity positions, they will be pay less for equities today (and thus demand a large risk premium).

The notion that market for publicly traded stocks is wide and deep has led to the argument that the net effect of illiquidity on aggregate equity risk premiums should be small. However, there are two reasons to be skeptical about this argument. The first is that not all stocks are widely traded and illiquidity can vary widely across stocks; the cost of trading a widely held, large market cap stock is very small but the cost of trading an over-the-counter stock will be much higher. The second is that the cost of illiquidity in the aggregate can vary over time, and even small variations can have significant effects on equity risk premiums. In particular, the cost of illiquidity seems to increase when economies slow down and during periods of crisis, thus exaggerating the effects of both phenomena on the equity risk premium.

While much of the empirical work on liquidity has been done on cross sectional variation across stocks (and the implications for expected returns), there have been attempts to extend the research to look at overall market risk premiums. Gibson and

Mougeot (2002) look at U.S. stock returns from 1973 to 1997 and conclude that liquidity accounts for a significant component of the overall equity risk premium, and that its effect varies over time.[6] Baekart, Harvey and Lundblad (2006) present evidence that the differences in equity returns (and risk premiums) across emerging markets can be partially explained by differences in liquidity across the markets.[7]

Catastrophic Risk

When investing in equities, there is always the potential for catastrophic risk, i.e. events that occur infrequently but can cause dramatic drops in wealth. Examples in equity markets would include the great depression from 1929-30 in the United States and the collapse of Japanese equities in the last 1980s. In cases like these, many investors exposed to the market declines saw the values of their investments drop so much that it was unlikely that they would be made whole again in their lifetimes.[8] While the possibility of catastrophic events occurring may be low, they cannot be ruled out and the equity risk premium has to reflect that risk.

Rietz (1988) uses the possibility of catastrophic events to justify equity risk premiums and Barro (2006) extends this argument. In the latter's paper, the catastrophic risk is modeled as both a drop in economic output (an economic depression) and partial default by the government on its borrowing.[9] Gabaix (2009) extended the Barro-Rietz model to allow for time varying losses in disasters.[10] Barro, Nakamura, Steinsson and Ursua (2009) use panel data on 24 countries over more than 100 years to examine the empirical effects of disasters.[11] They find that the average length of a disaster is six years and that half of the short run impact is reversed in the long term. Investigating the asset pricing implications, they conclude that the consequences for equity risk premiums will depend upon investor utility functions, with some utility functions (power utility, for

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[6] Gibson R., Mougeot N., 2004, *The Pricing of Systematic Liquidity Risk: Empirical Evidence from the US Stock Market*. Journal of Banking and Finance, v28: 157–78.

[7] Bekaert G., Harvey C. R., Lundblad C., 2006, *Liquidity and Expected Returns: Lessons from Emerging Markets*, The Review of Financial Studies.

[8] An investor in the US equity markets who invested just prior to the crash of 1929 would not have seen index levels return to pre-crash levels until the 1940s. An investor in the Nikkei in 1987, when the index was at 40000, would still be facing a deficit of 50% (even after counting dividends) in 2008,

[9] Rietz, T. A., 1988, *The equity premium~: A solution*, Journal of Monetary Economics, v22, 117-131; Barro R J., 2006, *Rare Disasters and Asset Markets in the Twentieth Century*, Quarterly Journal of Economics, August, 823-866.

[10] Gabaix, Xavier. (2009), "Variable Rare Disasters: An Exactly Solved Framework for Ten Puzzles in Macro-Finance." AFA 2009 San Francisco Meetings Paper. Available at http://ssrn.com/abstract=1106298.

[11] Barro, R., E. Nakamura, J. Steinsson and J. Ursua, 2009, Crises and Recoveries in an Empirical Model of Consumption Disasters, Working Paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1594554.

instance) yielding low premiums and others generating much higher equity risk premiums.

The banking and financial crisis of 2008, where financial and real estate markets plunged in the last quarter of the year, has provided added ammunition to this school. As we will see later in the paper, risk premiums in all markets (equity, bond and real estate) climbed sharply during the weeks of the market crisis.

The behavioral/ irrational component

Investors do not always behave rationally, and there are some who have argued that equity risk premiums are determined, at least partially, by quirks in human behavior. While there are several strands to this analysis, we will focus on two:

a. The Money Illusion: As equity prices declined significantly and inflation rates increased in the late 1970s, Modigliani and Cohn (1979) argued that low equity values of that period were the consequence of investors being inconsistent about their dealings with inflation. They argued that investors were guilty of using historical growth rates in earnings, which reflected past inflation, to forecast future earnings, but current interest rates, which reflected expectations of future inflation, to estimate discount rates.[12] When inflation increases, this will lead to a mismatch, with high discount rates and low cash flows resulting in asset valuations that are too low (and risk premiums that are too high). In the Modigliani-Cohn model, equity risk premiums will rise in periods when inflation is higher than expected and drop in periods when inflation in lower than expected. Campbell and Voulteenaho (2004) update the Modigliani-Cohn results by relating changes in the dividend to price ratio to changes in the inflation rate over time and find strong support for the hypothesis.[13]

b. Narrow Framing: In conventional portfolio theory, we assume that investors assess the risk of an investment in the context of the risk it adds to their overall portfolio, and demand a premium for this risk. Behavioral economists argue that investors offered new gambles often evaluate those gambles in isolation, separately from other risks that they face in their portfolio, leading them to over estimate the risk of the gamble. In the context of the equity risk premium, Benartzi and Thaler (1995) use this "narrow framing" argument to argue that

[12] Modigliani, Franco and Cohn, Richard. 1979, *Inflation, Rational Valuation, and the Market*, Financial Analysts Journal, v37(3), pp. 24-44.

[13] Campbell, J.Y. and T. Vuolteenaho, 2004, *Inflation Illusion and Stock Prices,* American Economic Review, v94, 19-23.

investors over estimate the risk in equity, and Barberis, Huang and Santos (2001) build on this theme.[14]

The Equity Risk Premium Puzzle

While many researchers have focused on individual determinants of equity risk premiums, there is a related question that has drawn almost as much attention. Are the equity risk premiums that we have observed in practice compatible with the theory? Mehra and Prescott (1985) fired the opening shot in this debate by arguing that the observed historical risk premiums (which they estimated at about 6% at the time of their analysis) were too high, and that investors would need implausibly high risk-aversion coefficients to demand these premiums.[15] In the years since, there have been many attempts to provide explanations for this puzzle:

1. <u>Statistical artifact</u>: The historical risk premium obtained by looking at U.S. data is biased upwards because of a survivor bias (induced by picking one of the most successful equity markets of the twentieth century). The true premium, it is argued, is much lower. This view is backed up by a study of large equity markets over the twentieth century, which concluded that the historical risk premium is closer to 4% than the 6% cited by Mehra and Prescott.[16] However, even the lower risk premium would still be too high, if we assumed reasonable risk aversion coefficients.
2. <u>Disaster Insurance</u>: A variation on the statistical artifact theme, albeit with a theoretical twist, is that the observed volatility in an equity market does not fully capture the potential volatility, which could include rare but disastrous events that reduce consumption and wealth substantially. Reitz, referenced earlier, argues that investments that have dividends that are proportional to consumption (as stocks do) should earn much higher returns than riskless investments to compensate for the possibility of a disastrous drop in consumption. Prescott and Mehra (1988) counter than the required drops in consumption would have to be of such a large magnitude to explain observed premiums that this solution is not viable. [17] Berkman, Jacobsen and Lee (2010) use data from 447 international political crises

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[14] Benartzi, S. and R. Thaler, 1995, *Myopic Loss Aversion and the Equity Premium Puzzle*, Quarterly Journal of Economics.

[15] Mehra, Rajnish, and Edward C.Prescott, 1985, *The Equity Premium: A Puzzle*, Journal of Monetary Economics, v15, 145–61. Using a constant relative risk aversion utility function and plausible risk aversion coefficients, they demonstrate the equity risk premiums should be much lower (less than 1%).

[16] Dimson, E., P. March and M. Staunton, 2002, *Triumph of the Optimists*, Princeton University Press.

[17] Mehra, R. and E.C. Prescott, 1988, *The Equity Risk Premium: A Solution?* Journal of Monetary Economics, v22, 133-136.

between 1918 and 2006 to create a crisis index and note that increases in the index increase equity risk premiums, with disproportionately large impacts on the industries most exposed to the crisis.[18]

3. Taxes: One possible explanation for the high equity returns in the period after the Second World War is the declining marginal tax rate during that period. McGrattan and Prescott (2001), for instance, provide a hypothetical illustration where a drop in the tax rate on dividends from 50% to 0% over 40 years would cause equity prices to rise about 1.8% more than the growth rate in GDP; adding the dividend yield to this expected price appreciation generates returns similar to the observed equity risk premium.[19] In reality, though, the drop in marginal tax rates was much smaller and cannot explain the surge in equity risk premiums.
4. Alternative Preference Structures: There are some who argue that the equity risk premium puzzle stems from its dependence upon conventional expected utility theory to derive premiums. In particular, the constant relative risk aversion (CRRA) function used by Mehra and Prescott in their paper implies that if an investor is risk averse to variation in consumption across different states of nature at a point in time, he or she will also be equally risk averse to consumption variation across time. Epstein and Zin consider a class of utility functions that separate risk aversion (to consumption variation at a point in time) from risk aversion to consumption variation across time. They argue that individuals are much more risk averse when it comes to the latter and claim that this phenomenon explain the larger equity risk premiums.[20] Put in more intuitive terms, individuals will choose a lower and more stable level of wealth and consumption that they can sustain over the long term over a higher level of wealth and consumption that varies widely from period to period. Constantinides (1990) adds to this argument by noting that individuals become used to maintaining past consumption levels and that even small changes in consumption can cause big changes in marginal utility. The returns on stocks are correlated with consumption, decreasing in

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[18] Berkman, H., B. Jacobsen and J. Lee, 2010, Time-varying Disaster Risk and Stock Returns, Working Paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1572042.

[19] McGrattan, E.R., and E.C. Prescott. 2001, *Taxes, Regulations, and Asset Prices*, Working Paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=292522.

[20] Epstein, L.G., and S.E. Zin. 1991. *Substitution, Risk Aversion, and the Temporal Behavior of Consumption and Asset Returns: An Empirical Analysis*, Journal of Political Economy, v99, no. 2 (April):263–286.

periods when people have fewer goods to consume (recessions, for instance); the additional risk explains the higher observed equity risk premiums.[21]

5. Myopic Loss Aversion: Myopic loss aversion refers to the finding in behavioral finance that the loss aversion already embedded in individuals becomes more pronounced as the frequency of their monitoring increases. Thus, investors who receive constant updates on equity values actually perceive more risk in equities, leading to higher risk premiums. The paper that we cited earlier by Benartzi and Thaler yields estimates of the risk premium very close to historical levels using a one-year time horizon for investors with plausible loss aversion characteristics (of about 2, which is backed up by the experimental research).

In conclusion, it is not quite clear what to make of the equity risk premium puzzle. It is true that historical risk premiums are higher than could be justified using conventional utility models for wealth. However, that may tell us more about the dangers of using historical data and the failures of classic utility models than they do about equity risk premiums.

Estimation Approaches

There are three broad approaches used to estimate equity risk premiums. One is to survey subsets of investors and managers to get a sense of their expectations about equity returns in the future. The second is to assess the returns earned in the past on equities relative to riskless investments and use this historical premium as the expectation. The third is to attempt to estimate a forward-looking premium based on the market rates or prices on traded assets today; we will categorize these as implied premiums.

Survey Premiums

If the equity risk premium is what investors demand for investing in risky assets today, the most logical way to estimate it is to ask these investors what they require as expected returns. Since investors in equity markets number in the millions, the challenge is often finding a subset of investors that best reflects the aggregate market. In practice, se see surveys of investors, managers and even academics, with the intent of estimating an equity risk premium.

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[21] Constantinides, G.M. 1990. *Habit Formation: A Resolution of the Equity Premium Puzzle*, Journal of Political Economy, v98, no. 3 (June):519–543.

Investors

When surveying investors, we can take one of two tacks. The first is to focus on individual investors and get a sense of what they expect returns on equity markets to be in the future. The second is to direct the question of what equities will deliver as a premium at portfolio managers and investment professionals, with the rationale that their expectations should matter more in the aggregate, since they have the most money to invest.

a. Individual Investors: The oldest continuous index of investor sentiment about equities was developed by Robert Shiller in the aftermath of the crash of 1987 and has been updated since.[22] UBS/Gallup has also polled individual investors since 1996 about their optimism about future stock prices and reported a measure of investor sentiment.[23] While neither survey provides a direct measure of the equity risk premium, they both yield broad measure of where investors expect stock prices to go in the near future. The Securities Industry Association (SIA) surveyed investors from 1999 to 2004 on the expected return on stocks and yields numbers that can be used to extract equity risk premiums. In the 2004 survey, for instance, they found that the medina expected return across the 1500 U.S. investors they questioned was 12.8%, yielding a risk premium of roughly 8.3% over the treasury bond rate at that time.[24]

b. Institutional Investors/ Investment Professionals: Investors Intelligence, an investment service, tracks more than a hundred newsletters and categorizes them as bullish, bearish or neutral, resulting in a consolidated advisor sentiment index about the future direction of equities. Like the Shiller and UBS surveys, it is a directional survey that does not yield an equity risk premium. Merrill Lynch, in its monthly survey of institutional investors globally, explicitly poses the question about equity risk premiums to these investors. In its February 2007 report, for instance, Merrill reported an average equity risk premium of 3.5% from the survey, but that number jumped to 4.1% by March, after a market downturn.[25] As markets settled down in 2009, the survey premium has also settled back to 3.76% in January 2010. Through much of 2010, the survey premium stayed in a tight

[22] The data is available at http://icf.som.yale.edu/Confidence.Index.
[23] The data is available at http://www.ubs.com/1/e/about/research/indexofinvestoroptimism/pressroomeu_5/uspressroom/archive.html
[24] See http://www.sifma.org/research/surveys/Surveys.html. The 2004 survey seems to be the last survey done by SIA. The survey yielded expected stock returns of 10% in 2003, 13% in 2002, 19% in 2001, 33% in 2000 and 30% in 1999.
[25] See http://www.ml.com/index.asp?id=7695_8137_47928.

range (3.85% - 3.90%) and the premium in the January 2011 survey, with 287 panelists, was 3.86%.

While survey premiums have become more accessible, very few practitioners seem to be inclined to use the numbers from these surveys in computations and there are several reasons for this reluctance:

1. Survey risk premiums are responsive to recent stock prices movements, with survey numbers generally increasing after bullish periods and decreasing after market decline. Thus, the peaks in the SIA survey premium of individual investors occurred in the bull market of 1999, and the more moderate premiums of 2003 and 2004 occurred after the market collapse in 2000 and 2001.
2. Survey premiums are sensitive not only to whom the question is directed at but how the question is asked. For instance, individual investors seem to have higher (and more volatile) expected returns on equity than institutional investors and the survey numbers vary depending upon the framing of the question.[26]
3. In keeping with other surveys that show differences across sub-groups, the premium seems to vary depending on who gets surveyed. Kaustia, Lehtoranta and Puttonen (2011) surveyed 1,465 Finnish investment advisors and note that not only are male advisors more likely to provide an estimate but that their estimated premiums are roughly 2% lower than those obtained from female advisors, after controlling for experience, education and other factors.[27]
4. Studies that have looked at the efficacy of survey premiums indicate that if they have any predictive power, it is in the wrong direction. Fisher and Statman (2000) document the negative relationship between investor sentiment (individual and institutional) and stock returns.[28] In other words, investors becoming more optimistic (and demanding a larger premium) is more likely to be a precursor to poor (rather than good) market returns.

As technology aids the process, the number and sophistication of surveys of both individual and institutional investors will also increase. However, it is also likely that these survey premiums will be more reflections of the recent past rather than good forecasts of the future.

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[26] Asking the question "What do you think stocks will do next year?" generates different numbers than asking "What should the risk premium be for investing in stocks?"

[27] Kaustia, M., A. Lehtoranta and V. Puttonen, 2011, *Sophistication and Gender Effects in Financial Advisers Expectations*, Working Paper, Aalto University.

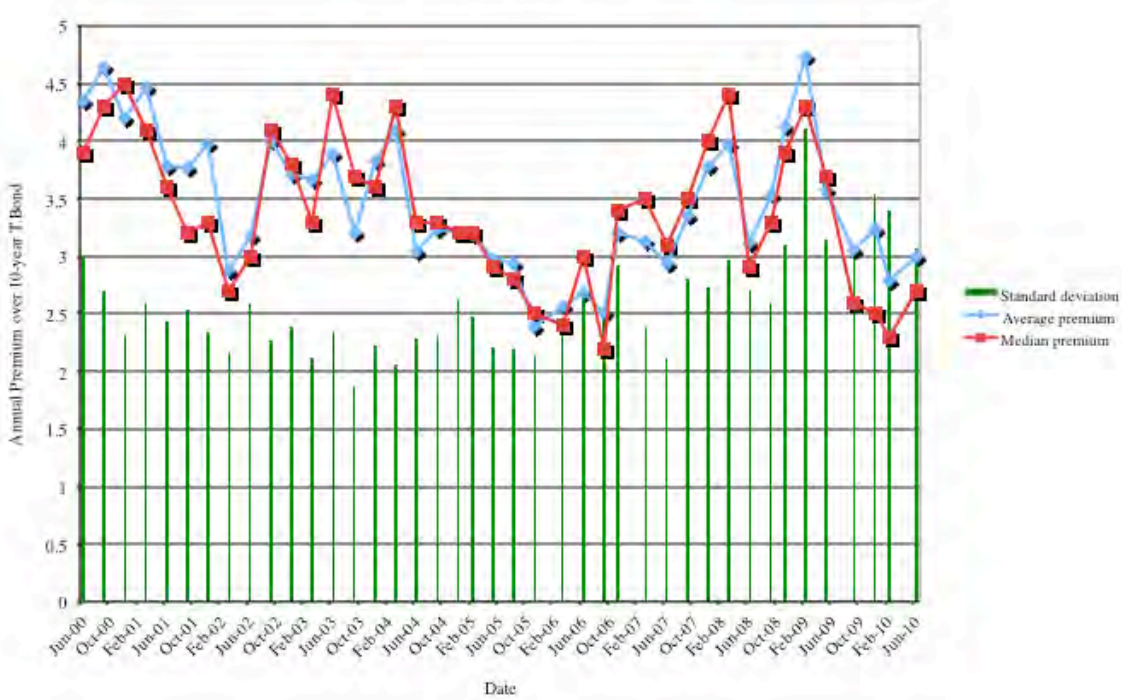
[28] Fisher, K.L., and M. Statman, 2000, *Investor Sentiment and Stock Returns*, Financial Analysts Journal, v56, 16-23.

Managers

As noted in the first section, equity risk premiums are a key input not only in investing but also in corporate finance. The hurdle rates used by companies – costs of equity and capital – are affected by the equity risk premiums that they use and have significant consequences for investment, financing and dividend decisions. Graham and Harvey have been conducting annual surveys of Chief Financial Officers (CFOs) or companies for roughly the last decade with the intent of estimating what these CFOs think is a reasonable equity risk premium (for the next 10 years over the ten-year bond rate). In their June 2010 survey, they report an average equity risk premium of 3% across survey respondents and a median premium of 2.7%, down from 4.74% and 4.3% in February 2009.[29]

To get a sense of how these assessed equity risk premiums have behaved over time, we have graphed the average and median values of the premium and the cross sectional standard deviation in the estimates in each CFO survey, from 2001 to 2010, in Figure 2.

Figure 2: CFO Survey Premiums



[29] Graham, J.R. and C.R. Harvey, 2010, *The Equity Risk Premium in 2010: Evidence from the Global CFO Outlook Survey*, Working paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1654026. See also Graham, J.R. and C.R. Harvey, 2009, *The Equity Risk Premium amid a Global Financial Crisis*, Working paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1405459.

Note the previous survey premium peak was in September 2000 at 4.65% and had its lowest recording (2.47%) in September 2006. The average across all 10 years of surveys (about 9000 responses) was 3.38%, but the standard deviation in the survey responses has crept up in recent years.

Academics

Academics are neither big players in equity markets nor do they make many major corporate finance decisions. Notwithstanding this lack of real world impact, what they think about equity risk premiums may matter for two reasons. The first is that many of the portfolio managers and CFOs that were surveyed in the last two sub-sections received their first exposure to the equity risk premium debate in the classroom and may have been influenced by what was presented as the right risk premium in that setting. The second is that practitioners often offer academic work (textbooks and papers) as backing for the numbers that they use.

Welch (2000) surveyed 226 financial economists on the magnitude of the equity risk premium and reported interesting results. On average, economists forecast an average annual risk premium (arithmetic) of about 7% for a ten-year time horizon and 6-7% for one to five-year time horizons. As with the other survey estimates, there is a wide range on the estimates, with the premiums ranging from 2% at the pessimistic end to 13% at the optimistic end. Interestingly, the survey also indicates that economists believe that their estimates are higher than the consensus belief and try to adjust the premiums down to reflect that view.[30] Fernandez (2009) examined widely used textbooks in corporate finance and valuation and noted that equity risk premiums varied widely across the books and that the moving average premium has declined from 8.4% in 1990 to 5.7% in 2008 and 2009.[31] His survey of academics in 2010 concluded that professors in the US used an average equity risk premium of 6%, compared to 5.3% being used by European professors.[32]

At the risk of sounding harsh, the risk premiums in academic surveys indicate how far removed most academics are from the real world of valuation and corporate finance and how much of their own thinking is framed by the historical risk premiums

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[30] Welch, I., 2000, *Views of Financial Economists on the Equity Premium and on Professional Controversies*, Journal of Business, v73, 501-537.

[31] Fernandez, P., 2010, *The Equity Premium in 150 Textbooks,* Working Paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1473225. He notes that the risk premium actually varies within the book in as many as a third of the textbooks surveyed.

[32] Fernandez, P., 2010, Market Risk Premium used in 2010 by Professors: A Survey with 1500 Answers, Working Paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1606563.

they were exposed to back when they were graduate students. The risk premiums that are presented in classroom settings are not only much higher than the risk premiums in practice but also contradict other academic research (see the equity risk premium puzzle) that indicates that even the more moderate premiums used by practitioners in too high. In fact, if academics were investors and CFOs, not only would they seldom invest in equities, but few firms would ever make real investments and fewer still would add value by doing so.

Historical Premiums

While our task is to estimate equity risk premiums in the future, much of the data we use to make these estimates is in the past. Most investors and managers, when asked to estimate risk premiums, look at historical data. In fact, the most widely used approach to estimating equity risk premiums is the historical premium approach, where the actual returns earned on stocks over a long time period is estimated, and compared to the actual returns earned on a default-free (usually government security). The difference, on an annual basis, between the two returns is computed and represents the historical risk premium. In this section, we will take a closer look at the approach.

Estimation Questions and Consequences

While users of risk and return models may have developed a consensus that historical premium is, in fact, the best estimate of the risk premium looking forward, there are surprisingly large differences in the actual premiums we observe being used in practice, with the numbers ranging from 3% at the lower end to 12% at the upper end. Given that we are almost all looking at the same historical data, these differences may seem surprising. There are, however, three reasons for the divergence in risk premiums: different time periods for estimation, differences in riskfree rates and market indices and differences in the way in which returns are averaged over time.

1. Time Period

Even if we agree that historical risk premiums are the best estimates of future equity risk premiums, we can still disagree about how far back in time we should go to estimate this premium. Ibbotson Associates, which is the most widely used estimation service, has stock return data and risk free rates going back to 1926,[33] and there are other less widely used databases that go further back in time to 1871 or even to 1792.[34]

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[33] Ibbotson Stocks, Bonds, Bills and Inflation Yearbook (SBBI), 2010 Edition, Morningstar.

[34] Siegel, in his book, Stocks for the Long Run, estimates the equity risk premium from 1802-1870 to be 2.2% and from 1871 to 1925 to be 2.9%. (Siegel, Jeremy J., Stocks for the Long Run, Second Edition,

While there are many analysts who use all the data going back to the inception date, there are almost as many analysts using data over shorter time periods, such as fifty, twenty or even ten years to come up with historical risk premiums. The rationale presented by those who use shorter periods is that the risk aversion of the average investor is likely to change over time, and that using a shorter and more recent time period provides a more updated estimate. This has to be offset against a cost associated with using shorter time periods, which is the greater noise in the risk premium estimate. In fact, given the annual standard deviation in stock prices[35] between 1926 and 2010 of 20%, the standard error[36] associated with the risk premium estimate can be estimated in table 2 follows for different estimation periods:

Table 2: Standard Errors in Historical Risk Premiums

Estimation Period	*Standard Error of Risk Premium Estimate*
5 years	20%/ √5 = 8.94%
10 years	20%/ √10 = 6.32%
25 years	20% / √25 = 4.00%
50 years	20% / √50 = 2.83%
80 years	20% / √80 = 2.23%

Even using the entire Ibbotson data (a little more than 80 years) yields a substantial standard error of 2.2%. Note that that the standard errors from ten-year and twenty-year estimates are likely to be almost as large or larger than the actual risk premium estimated. This cost of using shorter time periods seems, in our view, to overwhelm any advantages associated with getting a more updated premium.

What are the costs of going back even further in time (to 1871 or before)? First, the data is much less reliable from earlier time periods, when trading was lighter and record keeping more haphazard. Second, and more important, the market itself has changed over time, resulting in risk premiums that may not be appropriate for today. The U.S. equity market in 1871 more closely resembled an emerging market, in terms of

McGraw Hill, 1998). Goetzmann and Ibbotson estimate the premium from 1792 to 1925 to be 3.76% on an arithmetic average basis and 2.83% on a geometric average basis. Goetzmann. W.N. and R. G. Ibbotson, 2005, History and the Equity Risk Premium, Working Paper, Yale University. Available at **http://papers.ssrn.com/sol3/papers.cfm?abstract_id=702341**.

[35] For the historical data on stock returns, bond returns and bill returns check under "updated data" in http://www.damodaran.com.

[36] The standard deviation in annual stock returns between 1928 and 2010 is 20.21%; the standard deviation in the risk premium (stock return – bond return) is a little higher at 21.64%. These estimates of the standard error are probably understated, because they are based upon the assumption that annual returns are uncorrelated over time. There is substantial empirical evidence that returns are correlated over time, which would make this standard error estimate much larger.

volatility and risk, than a mature market. Consequently, using the earlier data may yield premiums that have little relevance for today's markets.

There are two other solutions offered by some researchers. The first is to break the annual data down into shorter return intervals – quarters or even months – with the intent of increasing the data points over any given time period. While this will increase the sample size, the effect on the standard error will be minimal.[37] The second is to use the entire data but to give a higher weight to more recent data, thus getting more updated premiums while preserving the data. While this option seems attractive, weighting more recent data will increase the standard error of the estimate. After all, using only the last ten years of data is an extreme form of time weighting, with the data during that period being weighted at one and the data prior to the period being weighted at zero.

2. Riskfree Security and Market Index

The second estimation question we face relates to the riskfree rate. We can compare the expected return on stocks to either short-term government securities (treasury bills) or long term government securities (treasury bonds) and the risk premium for stocks can be estimated relative to either. Given that the yield curve in the United States has been upward sloping for most of the last eight decades, the risk premium is larger when estimated relative to short term government securities (such as treasury bills) than when estimated against treasury bonds.

Some practitioners and a surprising number of academics (and textbooks) use the treasury bill rate as the riskfree rate, with the alluring logic that there is no price risk in a treasury bill, whereas the price of a treasury bond can be affected by changes in interest rates over time. That argument does make sense, but only if we are interested in a single period equity risk premium (say, for next year). If your time horizon is longer (say 5 or 10 years), it is the treasury bond that provides the more predictable returns.[38] Investing in a 6-month treasury bill may yield a guaranteed return for the next six months, but rolling over this investment for the next five years will create reinvestment risk. In contrast, investing in a ten-year treasury bond, or better still, a ten-year zero coupon bond will generate a guaranteed return for the next ten years.[39]

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[37] If returns are uncorrelated over time, the variance in quarterly (monthly) risk premiums will be approximately one-quarter (one twelfth) the variance in annual risk premiums.

[38] For more on risk free rates, see Damodaran, A., 2008, *What is the riskfree rate*, Working Paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1317436.

[39] There is a third choice that is sometimes employed, where the short term government security (treasury bills) is used as the riskfree rate and a "term structure spread" is added to this to get a normalized long term rate.

The riskfree rate chosen in computing the premium has to be consistent with the riskfree rate used to compute expected returns. Thus, if the treasury bill rate is used as the riskfree rate, the premium has to be the premium earned by stocks over that rate. If the treasury bond rate is used as the riskfree rate, the premium has to be estimated relative to that rate. For the most part, in corporate finance and valuation, the riskfree rate will be a long-term default-free (government) bond rate and not a short-term rate. Thus, the risk premium used should be the premium earned by stocks over treasury bonds.

The historical risk premium will also be affected by how stock returns are estimated. Using an index with a long history, such as the Dow 30, seems like an obvious solution, but returns on the Dow may not be a good reflection of overall returns on stocks. In theory, at least, we would like to use the broadest index of stocks to compute returns, with two caveats. The first is that the index has to be market-weighted, since the overall returns on equities will be tilted towards larger market cap stocks. The second is that the returns should be free of survivor bias; estimating returns only on stocks that have survived that last 80 years will yield returns that are too high. Stock returns should incorporate those equity investments from earlier years that did not make it through the estimation period, either because the companies in question went bankrupt or were acquired.

Finally, there is some debate about whether the equity risk premiums should be computed using nominal returns or real returns. While the choice clearly makes a difference, if we estimate the return on stocks or the government security return standing alone, it is less of an issue, when computing equity risk premiums, where we look at the difference between the two values.

3. Averaging Approach

The final sticking point when it comes to estimating historical premiums relates to how the average returns on stocks, treasury bonds and bills are computed. The arithmetic average return measures the simple mean of the series of annual returns, whereas the geometric average looks at the compounded return[40]. Many estimation services and academics argue for the arithmetic average as the best estimate of the equity risk premium. In fact, if annual returns are uncorrelated over time, and our objective was to estimate the risk premium for the next year, the arithmetic average is the best and most

[40] The compounded return is computed by taking the value of the investment at the start of the period (Value_0) and the value at the end (Value_N), and then computing the following:

$$\text{Geometric Average} = \left(\frac{\text{Value}_N}{\text{Value}_0}\right)^{1/N} - 1$$

unbiased estimate of the premium. There are, however, strong arguments that can be made for the use of geometric averages. First, empirical studies seem to indicate that returns on stocks are negatively correlated[41] over time. Consequently, the arithmetic average return is likely to over state the premium. Second, while asset pricing models may be single period models, the use of these models to get expected returns over long periods (such as five or ten years) suggests that the estimation period may be much longer than a year. In this context, the argument for geometric average premiums becomes stronger. Indro and Lee (1997) compare arithmetic and geometric premiums, find them both wanting, and argue for a weighted average, with the weight on the geometric premium increasing with the time horizon.[42]

In closing, the averaging approach used clearly matters. Arithmetic averages will be yield higher risk premiums than geometric averages, but using these arithmetic average premiums to obtain discount rates, which are then compounded over time, seems internally inconsistent. In corporate finance and valuation, at least, the argument for using geometric average premiums as estimates is strong.

Estimates for the United States

The questions of how far back in time to go, what riskfree rate to use and how to average returns (arithmetic or geometric) may seem trivial until you see the effect that the choices you make have on your equity risk premium. Rather than rely on the summary values that are provided by data services, we will use raw return data on stocks, treasury bills and treasury bonds from 1928 to 2010 to make this assessment.[43] In figure 3, we begin with a chart of the annual returns on stock, treasury bills and bonds for each year:

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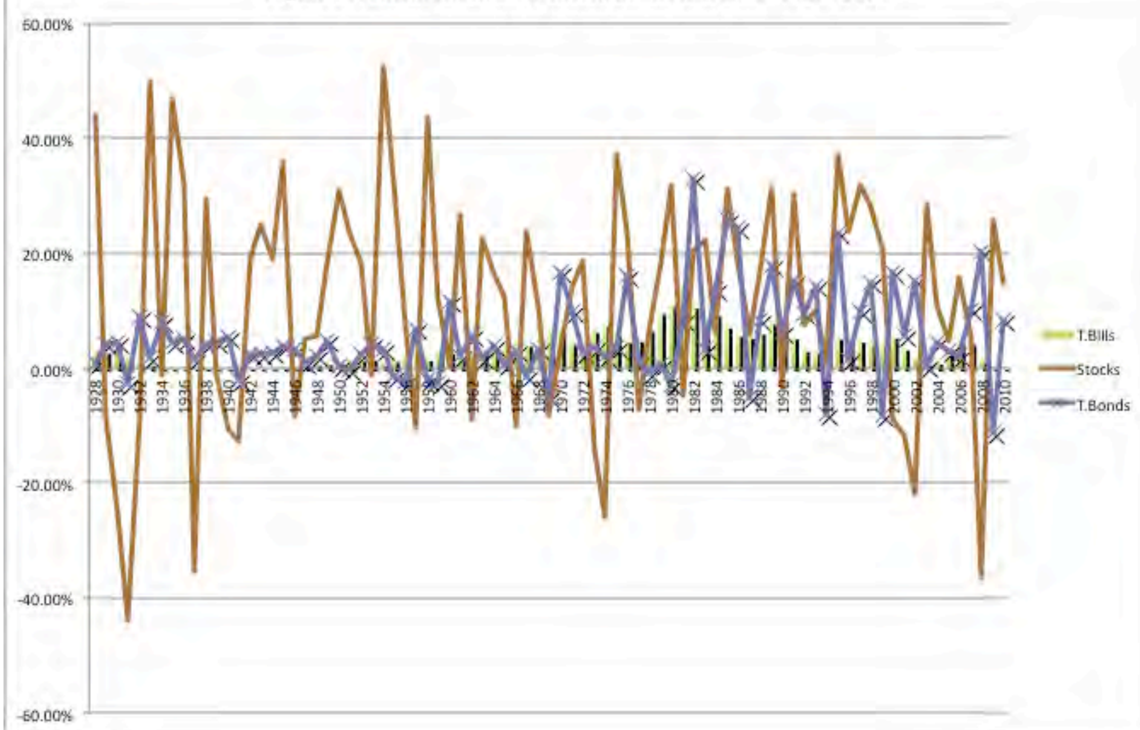
[41] In other words, good years are more likely to be followed by poor years, and vice versa. The evidence on negative serial correlation in stock returns over time is extensive, and can be found in Fama and French (1988). While they find that the one-year correlations are low, the five-year serial correlations are strongly negative for all size classes. Fama, E.F. and K.R. French, 1992, *The Cross-Section of Expected Returns*, Journal of Finance, Vol 47, 427-466.

[42] Indro, D.C. and W. Y. Lee, 1997, *Biases in Arithmetic and Geometric Averages as Estimates of Long-run Expected Returns and Risk Premium*, Financial Management, v26, 81-90.

[43] The raw data for treasury rates is obtained from the Federal Reserve data archive (http://research.stlouisfed.org/fred2/) at the Fed site in St. Louis, with the 6-month treasury bill rate uses for treasury bill returns and the 10-year treasury bond rate used to compute the returns on a constant maturity 10-year treasury bond. The stock returns represent the returns on the S&P 500. Appendix 1 provides the returns by year on stocks, bonds and bills.

Figure 3: Annual Returns on Stock, Bonds and Bills- 1928 -2010



It is difficult to make much of this data other than to state the obvious, which is that stock returns are volatile, which is at the core of the demand for an equity risk premium in the first place. In table 3, we present summary statistics for stock, 6-month Treasury bill and ten-year Treasury bond returns from 1928 to 2010:

Table 3: Summary Statistics- U.S. Stocks, T.Bills and T. Bonds- 1928-2010

	Stocks	*T. Bills*	*T. Bonds*
Mean	11.31%	3.70%	5.28%
Standard Error	2.22%	0.33%	0.85%
Median	14.22%	3.23%	3.61%
Standard Deviation	20.21%	3.04%	7.74%
Kurtosis	290.17%	383.22%	462.34%
Skewness	-39.27%	94.55%	106.29%
Minimum	-43.84%	0.03%	-11.12%
Maximum	52.56%	14.30%	32.81%
25th percentile	-1.67%	1.09%	1.20%
75th percentile	26.10%	5.54%	8.54%

While U.S. equities have delivered much higher returns than treasuries over this period, they have also been more volatile, as evidenced both by the higher standard deviation in returns and by the extremes in the distribution. Using this table, we can take a first shot at estimating a risk premium by taking the difference between the average returns on stocks and the average return on treasuries, yielding a risk premium of 7.61% for stocks over

T.Bills (11.31%-3.70%) and 6.03% for stocks over T.Bonds (11.31%-5.28%). Note, though, that these represent arithmetic average, long-term premiums for stocks over treasuries.

How much will the premium change if we make different choices on historical time periods, riskfree rates and averaging approaches? To answer this question, we estimated the arithmetic and geometric risk premiums for stocks over both treasury bills and bonds over different time periods in table 4, with standard errors reported in brackets below each number:

Table 4: Historical Equity Risk Premiums (ERP) –Estimation Period, Riskfree Rate and Averaging Approach

	ERP: Stocks minus T.Bills		*ERP: Stocks minus T.Bonds*	
	Arithmetic	*Geometric*	*Arithmetic*	*Geometric*
1928-2010	7.62% (2.25%)	5.67%	6.03% (2.38%)	4.31%
1960-2010	5.83% (2.42%)	4.44%	4.13% (2.69%)	3.09%
2000-2010	1.37% (6.73%)	-0.79%	-2.26% (9.00%)	-4.11%

Note that even with only three slices of history considered, the premiums range from -4.11% to 7.62%, depending upon the choices made. If we take the earlier discussion about the “right choices” to heart, and use a long-term geometric average premium over the long-term rate as the risk premium to use in valuation and corporate finance, the equity risk premium that we would use would be 4.31%. The caveats that we would offer, though, are that this estimate comes with significant standard error and is reflective of time periods (such as 1920s and 1930s) when the U.S. equity market (and investors in it) had very different characteristics. There have been attempts to extend the historical time period to include years prior to 1926 (the start of the Ibbotson database). Goetzmann and Jorion (1999) estimate the returns on stocks and bonds between 1792 and 1925 and report an arithmetic average premium, for stocks over bonds, of 2.76% and a geometric average premium of 2.83%.[44] The caveats about data reliability and changing market characteristics that we raised in an earlier section apply to these estimates.

There is one more troublesome (or at least counter intuitive) characteristic of historical risk premiums. The geometric average equity risk premium through the end of 2007 was 4.79%, higher than the 3.88% estimated though the end of 2008; in fact, every single equity risk premium number in this table would have been much higher, if we had

[44] Jorion, Philippe and William N. Goetzmann, 1999, *Global Stock Markets in the Twentieth Century*, Journal of Finance, 54(3), 953-980.

stopped with 2007 as the last year. Adding the data for 2008, an abysmal year for stocks and a good year for bonds, lowers the premium dramatically, even over very long periods. In effect, the historical risk premium approach would lead investors to conclude, after one of worst stock market crisis in several decades, that stocks were less risky than they were before the crisis and that investors should therefore demand lower premiums.

Global Estimates

If it is difficult to estimate a reliable historical premium for the US market, it becomes doubly so when looking at markets with short, volatile and transitional histories. This is clearly true for emerging markets, where equity markets have often been in existence for only short time periods (Eastern Europe, China) or have seen substantial changes over the last few years (Latin America, India). It also true for many West European equity markets. While the economies of Germany, Italy and France can be categorized as mature, their equity markets did not share the same characteristics until recently. They tended to be dominated by a few large companies, many businesses remained private, and trading was thin except on a few stocks.

Notwithstanding these issues, services have tried to estimate historical risk premiums for non-US markets with the data that they have available. To capture some of the danger in this practice, Table 5 summarizes historical arithmetic average equity risk premiums for major non-US markets below for 1976 to 2001, and reports the standard error in each estimate:[45]

Table 5: Risk Premiums for non-US Markets: 1976- 2001

Country	*Weekly average*	*Weekly standard deviation*	*Equity Risk Premium*	*Standard error*
Canada	0.14%	5.73%	1.69%	3.89%
France	0.40%	6.59%	4.91%	4.48%
Germany	0.28%	6.01%	3.41%	4.08%
Italy	0.32%	7.64%	3.91%	5.19%
Japan	0.32%	6.69%	3.91%	4.54%
UK	0.36%	5.78%	4.41%	3.93%
India	0.34%	8.11%	4.16%	5.51%
Korea	0.51%	11.24%	6.29%	7.64%
Chile	1.19%	10.23%	15.25%	6.95%
Mexico	0.99%	12.19%	12.55%	8.28%
Brazil	0.73%	15.73%	9.12%	10.69%

[45] Salomons, R. and H. Grootveld, 2003, *The equity risk premium: Emerging vs Developed Markets,* Emerging Markets Review, v4, 121-144.

Before we attempt to come up with rationale for why the equity risk premiums vary across countries, it is worth noting the magnitude of the standard errors on the estimates, largely because the estimation period includes only 25 years. Based on these standard errors, we cannot even reject the hypothesis that the equity risk premium in each of these countries is greater than zero, let alone attach a value to that premium.

If the standard errors on these estimates make them close to useless, consider how much more noise there is in estimates of historical risk premiums for some emerging market equity markets, which often have a reliable history of ten years or less, and very large standard deviations in annual stock returns. Historical risk premiums for emerging markets may provide for interesting anecdotes, but they clearly should not be used in risk and return models.

The survivor bias

Given how widely the historical risk premium approach is used, it is surprising that the flaws in the approach have not drawn more attention. Consider first the underlying assumption that investors’ risk premiums have not changed over time and that the average risk investment (in the market portfolio) has remained stable over the period examined. We would be hard pressed to find anyone who would be willing to sustain this argument with fervor. The obvious fix for this problem, which is to use a more recent time period, runs directly into a second problem, which is the large noise associated with historical risk premium estimates. While these standard errors may be tolerable for very long time periods, they clearly are unacceptably high when shorter periods are used.

Even if there is a sufficiently long time period of history available, and investors’ risk aversion has not changed in a systematic way over that period, there is a final problem. Markets such as the United States, which have long periods of equity market history, represent "survivor markets”. In other words, assume that one had invested in the largest equity markets in the world in 1926, of which the United States was one.[46] In the period extending from 1926 to 2000, investments in many of the other equity markets would have earned much smaller premiums than the US equity market, and some of them would have resulted in investors earning little or even negative returns over the period. Thus, the survivor bias will result in historical premiums that are larger than expected

[46] Jorion, Philippe and William N. Goetzmann, 1999, *Global Stock Markets in the Twentieth Century*, Journal of Finance, 54(3), 953-980. They looked at 39 different equity markets and concluded that the US was the best performing market from 1921 to the end of the century. They estimated a geometric average premium of 3.84% across all of the equity markets that they looked at, rather than just the US and estimated that the survivor bias added 1.5% to the US equity risk premium (with arithmetic averages) and 0.9% with geometric averages.

premiums for markets like the United States, even assuming that investors are rational and factor risk into prices.

How can we mitigate the survivor bias? One solution is to look at historical risk premiums across multiple equity markets across very long time periods. In the most comprehensive attempt of this analysis, Dimson, Marsh and Staunton (2002, 2008) estimated equity returns for 17 markets and obtained both local and a global equity risk premium.[47] In their most recent update in 2011, they provide the risk premiums from 1900 to 2010 for 19 markets, with standard errors on each estimate:[48]

Table 6: Historical Risk Premiums across Equity Markets – 1900 – 2010 (in %)

	Stocks minus Short term Governments				*Stocks minus Long term Governments*			
Country	*Geometric Mean*	*Arithmetic Mean*	*Standard Error*	*Standard Deviation*	*Geometric Mean*	*Arithmetic Mean*	*Standard Error*	*Standard Deviation*
Australia	6.7%	8.3%	1.7%	17.6%	5.9%	7.8%	1.9%	19.8%
Belgium	2.9%	5.5%	2.3%	24.7%	2.5%	4.9%	2.0%	21.4%
Canada	4.2%	5.6%	1.6%	17.2%	3.7%	5.3%	1.7%	18.2%
Denmark	2.8%	4.6%	1.9%	20.5%	2.0%	3.4%	1.6%	17.2%
Finalnd	5.9%	9.5%	2.9%	30.2%	5.6%	9.2%	2.9%	30.3%
France	6.0%	8.7%	2.3%	24.5%	3.2%	5.6%	2.2%	22.9%
Germany*	5.9%	9.8%	3.0%	32.0%	5.4%	8.8%	2.7%	28.4%
Ireland	3.0%	5.3%	2.0%	21.5%	2.9%	4.9%	1.9%	19.8%
Italy	5.8%	9.8%	3.0%	32.0%	3.7%	7.2%	2.8%	29.6%
Japan	5.9%	9.0%	2.6%	27.7%	5.0%	9.1%	3.1%	32.8%
Netherlands	4.2%	6.5%	2.2%	22.8%	3.5%	5.8%	2.1%	22.2%
New Zealand	4.1%	5.7%	1.7%	18.3%	3.8%	5.4%	1.7%	18.1%
Norway	3.0%	5.9%	2.5%	26.5%	2.5%	5.5%	2.7%	28.0%
South Africa	6.2%	8.3%	2.1%	22.1%	5.5%	7.2%	1.9%	19.6%
Spain	3.2%	5.4%	2.1%	21.9%	2.3%	4.3%	2.0%	20.8%
Sweden	4.3%	6.6%	2.1%	22,1%	3.8%	6.1%	2.1%	22.3%
Switzerland	3.4%	5.1%	1.8%	18.9%	2.1%	3.6%	1.7%	17.6%
U.K.	4,3%	6.0%	1.9%	19.9%	3.9%	5.2%	1.6%	17.0%
U.S.	5.3%	7.2%	1.9%	19.8%	4.4%	6.4%	1.9%	20.5%

[47] Dimson, E.,, P Marsh and M Staunton, 2002, *Triumph of the Optimists: 101 Years of Global Investment Returns*, Princeton University Press, NJ; Dimson, E.,, P Marsh and M Staunton, 2008, The Worldwide Equity Risk Premium: a smaller puzzle, Chapter 11 in the Handbook of the Equity Risk Premium, edited by R. Mehra, Elsevier.

[48] *Credit Suisse Global Investment Returns Sourcebook,* 2011, Credit Suisse/ London Business School. Summary data is accessible at the Credit Suisse website.

World-ex U.S.	4.0%	5.9%	1.9%	19.9%	3.8%	5.0%	1.5%	15.5%
World	4.5%	5.9%	1.6%	17.1%	3.8%	5.0%	1.5%	15.5%

Note that the risk premiums, averaged across the markets, are lower than risk premiums in the United States. For instance, the geometric average risk premium for stocks over long term governments, across the non-US markets, is only 3.80% lower than the 4.40% for the US markets. The results are similar for the arithmetic average premium, with the average premium of 5.0% across markets being lower than the 6.4% for the United States. In effect, the difference in returns captures the survivorship bias, implying that using historical risk premiums based only on US data will results in numbers that are too high for the future.

Note that the noise problem persists, even with averaging across 19 markets and over 110 years. The standard error in the global equity risk premium estimate is 1.5%, suggesting that the range for the historical premium remains a large one. In an addendum, Dimson, Marsh and Staunton decompose the realized equity risk premium in each market into three components: the level of dividends, the growth in those dividends and the effects on stock price of a changing multiple for dividend (price to dividend ratio). For the United States, they attribute 1.4% of the overall premium of 5.3% (for stocks over treasury bills) to growth in real dividends and 1% to expansion in the price to dividend ratio. Of the global premium of 4.49%, 0.83% can be attributed to growth in dividends and 0.48% to increases in the price to dividend ratio.

Historical Premium Plus

If we accept the proposition that historical risk premiums are the best way of estimating future risk premiums and also come to terms with the statistical reality that we need long time periods of history to get reliable estimates, we are trapped when it comes to estimating risk premiums in most emerging markets, where historical data is either non-existent or unreliable. Furthermore, the equity risk premium that we estimate becomes the risk premium that we use for all stocks within a market, no matter what their differences are on market capitalization and growth potential; in effect, we assume that the betas we use will capture differences in risk across companies.

In this section, we consider one way out of this box, where we begin with the US historical risk premium (4.31%) or the global premium from the DMS data (3.8%) as the base premium for a mature equity market and then build additional premiums for riskier markets or classes of stock. For the first part of this section, we stay within the US equity market and consider the practice of adjusting risk premiums for company-specific characteristics, with market capitalization being the most common example. In the second part, we extend the analysis to look at emerging markets in Asia, Latin American and Eastern Europe, and take a look at the practice of estimating country risk premiums that augment the US equity risk premium. Since many of these markets have significant exposures to political and economic risk, we consider two fundamental questions in this section. The first relates to whether there should be an additional risk premium when valuing equities in these markets, because of the country risk. As we will see, the answer will depend upon whether we think country risk is diversifiable or non-diversifiable, view markets to be open or segmented and whether we believe in a one-factor or a multi-factor model. The second question relates to estimating equity risk premiums for emerging markets. Depending upon our answer to the first question, we will consider several solutions.

Small cap and other risk premiums

In computing an equity risk premium to apply to all investments in the capital asset pricing model, we are essentially assuming that betas carry the weight of measuring the risk in individual firms or assets, with riskier investments having higher betas than safer investments. Studies of the efficacy of the capital asset pricing model over the last three decades have cast some doubt on whether this is a reasonable assumption, finding that the model understates the expected returns of stocks with specific characteristics; small market cap companies and companies low price to book ratios, in particular, seem to earn much higher returns than predicted by the CAPM. It is to counter this finding that many practitioners add an additional premium to the required returns (and costs of equity) of smaller market cap companies.

The CAPM and Market Capitalization

In one of very first studies to highlight the failure of the traditional capital asset pricing model to explain returns at small market cap companies, Banz (1981) looked returns on stocks from 1936-1977 and concluded that investing in the smallest companies (the bottom 20% of NYSE firms in terms of capitalization) would have generated about 6% more, after adjusting for beta risk, than larger cap companies.[49] In the years since, there has been substantial research on both the origins and durability of the small cap premium, with mixed conclusions. First, there is evidence of a small firm premium in markets outside the United States as well. Studies find small cap premiums of about 7%

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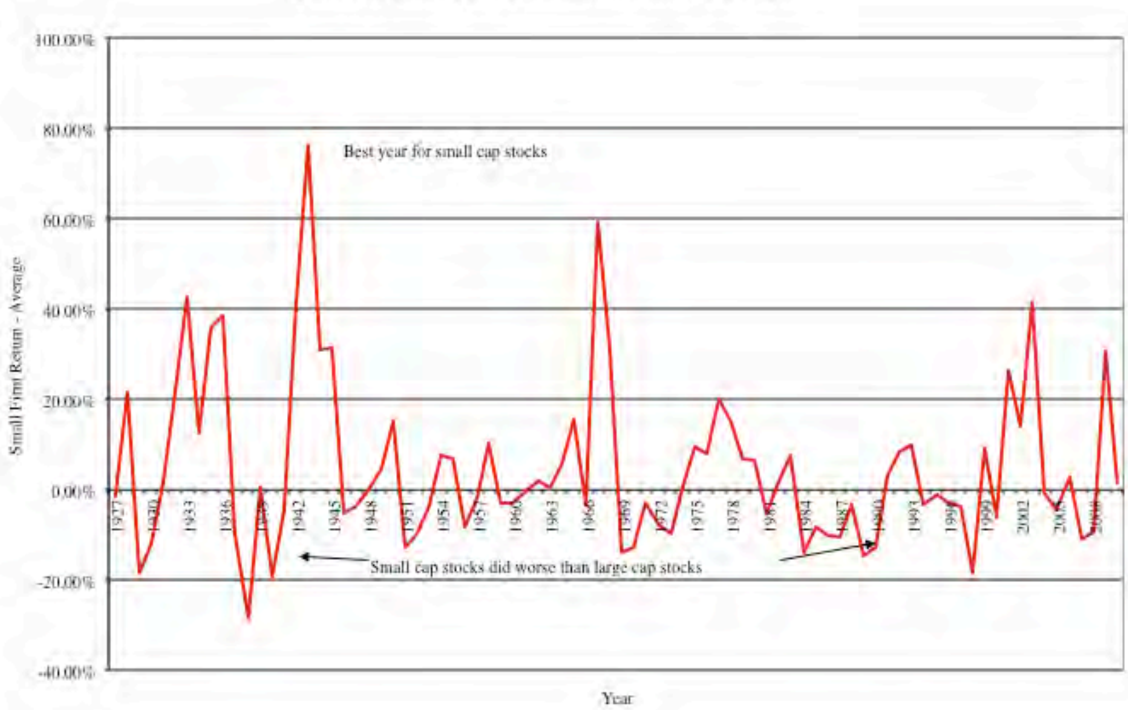
[49] Banz, R., 1981, *The Relationship between Return and Market Value of Common Stocks*, Journal of Financial Economics, v9.

from 1955 to 1984 in the United Kingdom,[50] 8.8% in France and 3% in Germany,[51] and a premium of 5.1% for Japanese stocks between 1971 and 1988.[52] Dimson, March and Staunton (2011), in their updated assessment of equity risk premiums in 19 markets, also compute small cap premiums in those markets. Of the 19 markets, small cap stocks have not outperformed the rest of the market in only Norway and Denmark; the premiums in small cap premium, over the long term, has been higher in the United States than in any of the other equity markets. Second, while the small cap premium has been persistent in US equity markets, it has also been volatile, with large cap stocks outperforming small cap stocks for extended periods. In figure 4, we look at the difference in returns between small cap (defined as bottom 10% of firms in terms of market capitalization) and all US stocks between 1927 and 2010; note that the premium was pronounced in the 1970s and disappeared for much of the 1980s.[53]

Figure 4: Small Firm Premium over time- 1927 -2010



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[50] Dimson, E. and P.R. Marsh, 1986, *Event Studies and the Size Effect: The Case of UK Press Recommendations*, Journal of Financial Economics, v17, 113-142.

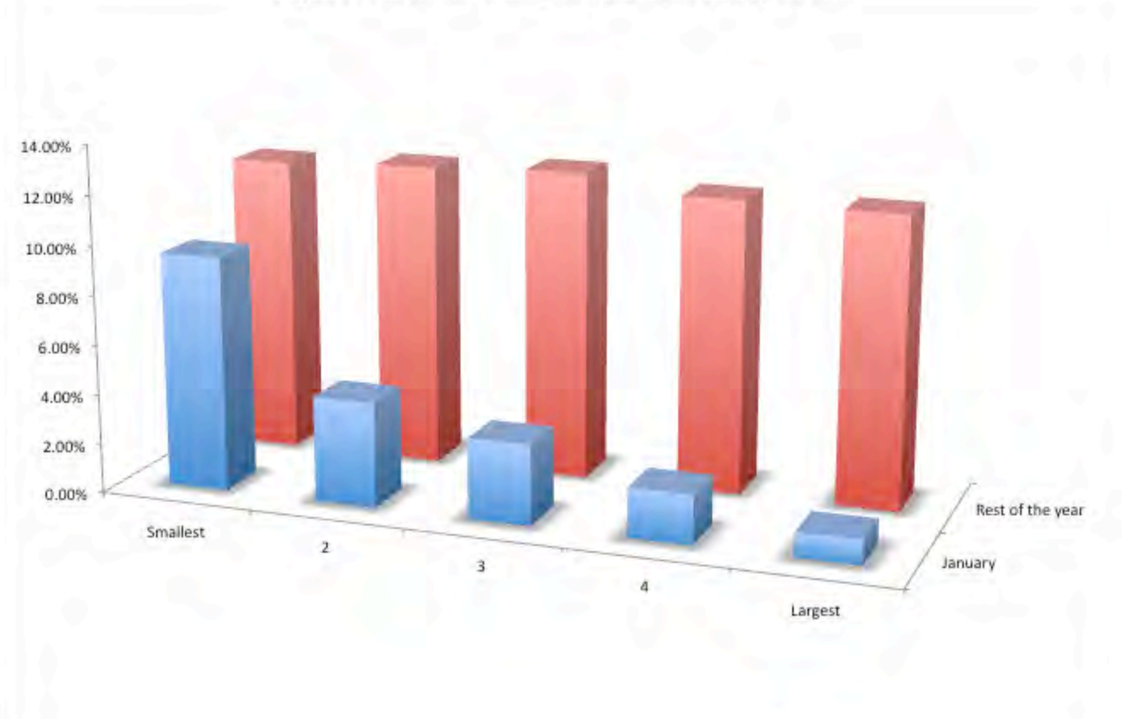
[51] Bergstrom,G.L., R.D. Frashure and J.R. Chisholm, 1991, *The Gains from international small-company diversification* in Global Portfolios: Quantiative Strategies for Maximum Performance, Edited By R.Z. Aliber and B.R. Bruce, Business One Irwin, Homewood.

[52] Chan, L.K., Y. Hamao, and J. Lakonishok, 1991, *Fundamentals and Stock Returns in Japan*, Journal of Finance. v46. 1739-1789.

[53] The raw data for this table is obtained from Professor Ken French's website at Dartmouth.

The average premium for stocks in the bottom decile, in terms of market capitalization, between 1927 and 2010 was 4.82%, but the standard error in that estimate is 2.01%. Third, much of the premium is generated in one month of the year: January. As Figure 5 shows, eliminating that month from our calculations would essentially dissipate the entire small stock premium. That would suggest that size itself is not the source of risk, since small firms in January remain small firms in the rest of the year, but that the small firm premium, if it exists, comes from some other risk that is more prevalent or virulent in January than in the rest of the year.

Figure 5: The Small Firm Effect- January vs Rest of the Year



Finally, a series of studies have argued that market capitalization, by itself, is not the reason for excess returns but that it is a proxy for other ignored risks such as illiquidity and poor information.

In summary, while the empirical evidence supports the notion that small cap stocks have earned higher returns after adjusting for beta risk than large cap stocks, it is not as conclusive, nor as clean as it was initially thought to be. The argument that there is, in fact, no small cap premium and that we have observed over time is just an artifact of history cannot be rejected out of hand.

The Small Cap Premium

If we accept the notion that there is a small cap premium, there are two ways in which we can respond to the empirical evidence that small market cap stocks seem to earn higher returns than predicted by the traditional capital asset pricing model. One is to view this as a market inefficiency that can be exploited for profit: this, in effect, would require us to load up our portfolios with small market cap stocks that would then proceed to deliver higher than expected returns over long periods. The other is to take the excess returns as evidence that betas are inadequate measures of risk and view the additional returns are compensation for the missed risk. The fact that the small cap premium has endured for as long as it has suggests that the latter is the more reasonable path to take.

If CAPM betas understate the true risk of small cap stocks, what are the solutions? The first is to try and augment the model to reflect the missing risk, but this would require being explicit about this risk. For instance, there are models that include additional factors for illiquidity and imperfect information that claim to do better than the CAPM in predicting future returns. The second and simpler solution that is adopted by many practitioners is to add a premium to the expected return (from the CAPM) of small cap stocks. To arrive at this premium, analysts look at historical data on the returns on small cap stocks and the market, adjust for beta risk, and attribute the excess return to the small cap effect. Using the data from 1926-2010, we would estimate a small cap premium of 4.82%. Duff and Phelps presents a richer set of estimates, where the premiums are computed for stocks in 25 different size classes (with size measured on eight different dimensions including market capitalization, book value and net income). Using the Fama/French data, we present excess returns for firms broken down by ten market value classes in Table 7, with the standard error for each estimate.

Table 7: Excess Returns by Market Value Class: US Stocks from 1927 – 2010

Excess Return = Return on Portfolio – Return on Market

Decile	Average	Standard Error	Maximum	Minimum
Smallest	4.82%	2.01%	76.28%	-28.42%
2	1.84%	1.15%	41.25%	-17.96%
3	1.50%	0.79%	41.98%	-13.54%
4	0.78%	0.56%	15.56%	-7.50%
5	0.06%	0.54%	11.63%	-16.05%
6	-0.14%	0.51%	15.21%	-14.01%
7	-0.64%	0.55%	7.56%	-19.50%
8	-1.66%	0.82%	10.81%	-29.73%
9	-2.32%	1.04%	21.96%	-36.30%
Largest	-4.23%	1.58%	31.35%	-65.57%

Note that the market capitalization effect shows up at both extremes – the smallest firms earn higher returns than expected whereas the largest firms earn lower returns than expected. The small firm premium is statistically significant only for the lowest and three highest size deciles.

Perils of the approach

While the small cap premium may seem like a reasonable way of dealing with the failure of the CAPM to capture the risk in smaller companies, there are significant costs to using the approach.

a. Standard Error on estimates: One of the dangers we noted with using historical risk premiums is the high standard error in our estimates. This danger is magnified when we look at sub-sets of stocks, based on market capitalization or any other characteristic, and extrapolate past returns. The standard errors on the small cap premiums that are estimated are likely to be significant, as is evidenced in table 7.

b. Small versus Large Cap: At least in its simplest form, the small cap premium adjustment requires us to divide companies into small market companies and the rest of the market, with stocks falling on one side of the line having much higher required returns (and costs of equity) than stocks falling on the other side.

c. Understanding Risk: Even in its more refined format, where the required returns are calibrated to market cap, using small cap premiums allows analysts to evade basic questions about what it is that makes smaller cap companies riskier, and whether these factors may vary across companies.

d. Small cap companies become large cap companies over time: When valuing companies, we attach high growth rates to revenues, earnings and value over time. Consequently, companies that are small market cap companies now grow to become large market cap companies over time. Consistency demands that we adjust the small cap premium as we go further into a forecast period.

e. Other risk premiums: Using a small cap premium opens the door to other premiums being used to augment expected returns. Thus, we could adjust expected returns upwards for stocks with price momentum and low price to book ratios, reflecting the excess returns that these characteristics seem to deliver, at least on paper. Doing so will deliver values that are closer to market prices, across assets, but undercuts the rationale for intrinsic valuation, i.e., finding market mistakes.

There is one final reason why we are wary about adjusting costs of equity for a small cap effect. If, as is the practice now, we add a small cap premium of 4-5% to the cost of equity of small companies, without attributing this premium to any specific risk factor, we are exposed to the risk of double counting risk. For instance, assume that the small cap premium that we have observed over the last few decades is attributable to the lower liquidity (and higher transactions costs) of trading small cap stocks. Adding that premium on to the discount rate will reduce the estimated values of small cap and private businesses. If we attach an illiquidity discount to this value, we are double counting the effect of illiquidity.

Country Risk Premiums

As both companies and investors get acclimatized to the reality of a global economy, we have also been forced to confront the consequences of globalization for equity risk premiums and hurdle rates. Should an investor putting his money in Indian stocks demand a higher risk premium for investing in equities that one investing in German stocks? Should a US consumer product company investing in Brazil demand the same hurdle rates for its Brazilian investments as it does for its US investments? In effect, should we demand one global equity risk premium that we use for investments all over the world or should we use higher equity risk premiums in some markets than in others?

Should there be a country risk premium?

Is there more risk in investing in a Malaysian or Brazilian stock than there is in investing in the United States? The answer, to most, seems to be obviously affirmative, with the solution being that we should use higher equity risk premiums when investing in riskier emerging markets. There are, however, three distinct and different arguments offered against this practice.

1. Country risk is diversifiable

In the risk and return models that have developed from conventional portfolio theory, and in particular, the capital asset pricing model, the only risk that is relevant for purposes of estimating a cost of equity is the market risk or risk that cannot be diversified away. The key question in relation to country risk then becomes whether the additional risk in an emerging market is diversifiable or non-diversifiable risk. If, in fact, the additional risk of investing in Malaysia or Brazil can be diversified away, then there should be no additional risk premium charged. If it cannot, then it makes sense to think about estimating a country risk premium.

But diversified away by whom? Equity in a publicly traded Brazilian, or Malaysian, firm can be held by hundreds or even thousands of investors, some of whom may hold only domestic stocks in their portfolio, whereas others may have more global exposure. For purposes of analyzing country risk, we look at the marginal investor – the investor most likely to be trading on the equity. If that marginal investor is globally diversified, there is at least the potential for global diversification. If the marginal investor does not have a global portfolio, the likelihood of diversifying away country risk declines substantially. Stulz (1999) made a similar point using different terminology.[54] He differentiated between segmented markets, where risk premiums can be different in each market, because investors cannot or will not invest outside their domestic markets, and open markets, where investors can invest across markets. In a segmented market, the marginal investor will be diversified only across investments in that market, whereas in an open market, the marginal investor has the opportunity (even if he or she does not take it) to invest across markets.

Even if the marginal investor is globally diversified, there is a second test that has to be met for country risk to be diversifiable. All or much of country risk should be country specific. In other words, there should be low correlation across markets. Only then will the risk be diversifiable in a globally diversified portfolio. If, on the other hand, the returns across countries have significant positive correlation, country risk has a market risk component, is not diversifiable and can command a premium. Whether returns across countries are positively correlated is an empirical question. Studies from the 1970s and 1980s suggested that the correlation was low, and this was an impetus for global diversification.[55] Partly because of the success of that sales pitch and partly because economies around the world have become increasingly intertwined over the last decade, more recent studies indicate that the correlation across markets has risen. The correlation across equity markets has been studied extensively over the last two decades and while there are differences, the overall conclusions are as follows:

1. The correlation across markets has increased over time, as both investors and firms have globalized. Yang, Tapon and Sun (2006) report correlations across eight, mostly developed markets between 1988 and 2002 and note that the correlation in the 1998-2002 time period was higher than the correlation between 1988 and 1992 in every single market; to illustrate, the correlation between the

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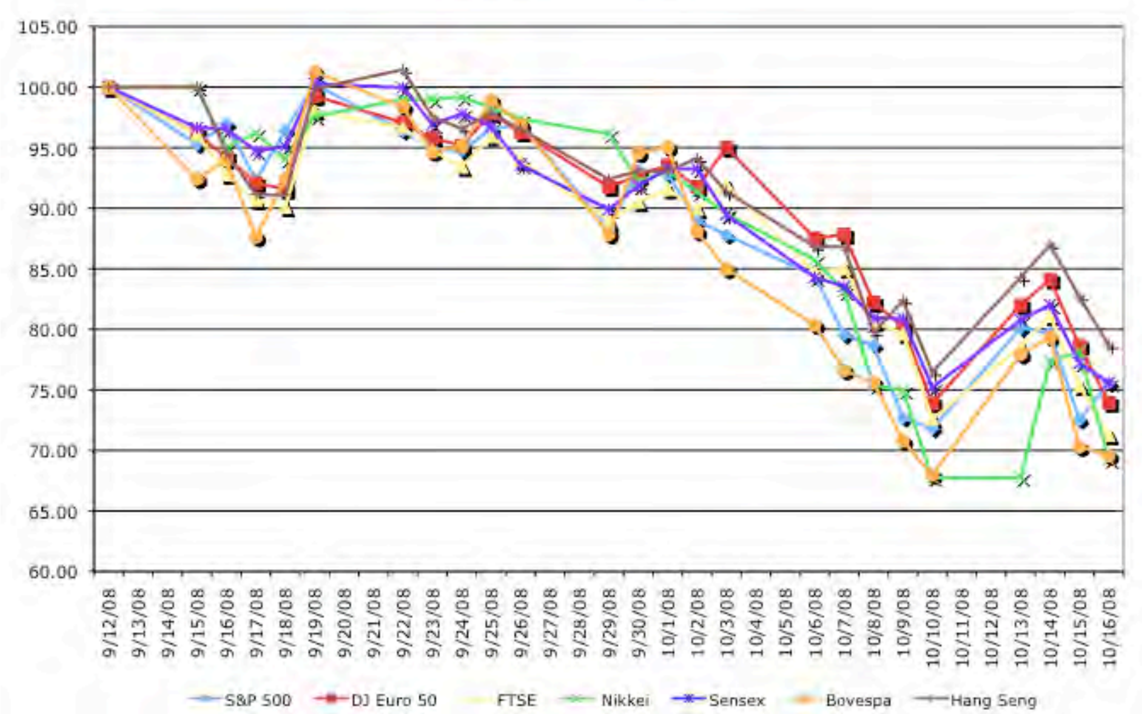
[54] Stulz, R.M., *Globalization, Corporate finance, and the Cost of Capital*, Journal of Applied Corporate Finance, v12.
[55] Levy, H. and M. Sarnat, 1970, *International Diversification of Investment Portfolios*, American Economic Review 60(4), 668-75.

Hong Kong and US markets increased from 0.48 to 0.65 and the correlation between the UK and the US markets increased from 0.63 to 0.82.[56]

2. The correlation across equity markets increases during periods of extreme stress or high volatility.[57] This is borne out by the speed with which troubles in one market, say Russia, can spread to a market with little or no obvious relationship to it, say Brazil. The contagion effect, where troubles in one market spread into others is one reason to be skeptical with arguments that companies that are in multiple emerging markets are protected because of their diversification benefits. In fact, the market crisis in the last quarter of 2008 illustrated how closely bound markets have become, as can be seen in figure 6:

Figure 6: The globalization of risk



Between September 12, 2008 and October 16, 2008, markets across the globe moved up and down together, with emerging markets showing slightly more volatility.

3. In a twist on the last point, Longin and Solnik (2001) report that it is not high volatility per se that increases correlation, but downside volatility. Put differently,

56 Yang, Li , Tapon, Francis and Sun, Yiguo, 2006, *International correlations across stock markets and industries: trends and patterns 1988-2002*, Applied Financial Economics, 16: 16, 1171-1183

57 Ball, C. and W. Torous, 2000, *Stochastic correlation across international stock markets*, Journal of Empirical Finance. V7, 373-388.

the correlation between equity markets is higher in bear markets than in bull markets.[58]

So where do I stand? I believe that while the barriers to trading across markets have dropped, investors still have a home bias in their portfolios and that markets remain partially segmented. While globally diversified investors are playing an increasing role in the pricing of equities around the world, the resulting increase in correlation across markets has resulted in a portion of country risk being non-diversifiable or market risk. It behooves us therefore to confront the question of how best to measure country risk and reflect that risk in valuation.

2. A Global Capital Asset Pricing Model

The other argument against adjusting for country risk comes from theorists and practitioners who believe that the traditional capital asset pricing model can be adapted fairly easily to a global market. In their view, all assets, no matter where they are traded, should face the same global equity risk premium, with differences in risk captured by differences in betas. In effect, they are arguing that if Malaysian stocks are riskier than US stocks, they should have higher betas and expected returns.

While the argument is reasonable, it flounders in practice, partly because betas do not seem capable of carry the weight of measuring country risk.

1. If betas are estimated against local indices, as is usually the case, the average beta within each market (Brazil, Malaysia, US or Germany) has to be one. Thus, it would be mathematically impossible for betas to capture country risk.
2. If betas are estimated against a global equity index, such as the Morgan Stanley Capital Index (MSCI), there is a possibility that betas could capture country risk but there is little evidence that they do in practice. Since the global equity indices are market weighted, it is the companies that are in developed markets that have higher betas, whereas the companies in small, very risky emerging markets report low betas. Table 8 reports the average beta estimated for the ten largest market cap companies in Brazil, India, the United States and Japan against the MSCI.

Table 8: Betas against MSCI – Large Market Cap Companies

Country	*Average Beta (against local index)*	*Average Beta (against MSCI)*
India	0.97	0.83
Brazil	0.98	0.81
United States	0.96	1.05
Japan	0.94	1.03

[58] Longin, F. and B. Solnik, 2001, *Extreme Correlation of International Equity Markets*, Journal of Finance, v56 , pg 649-675.

[a] The betas were estimated using two years of weekly returns from January 2006 to December 2007 against the most widely used local index (Sensex in India, Bovespa in Brazil, S&P 500 in the US and the Nikkei in Japan) and the MSCI using two years of weekly returns.

The emerging market companies consistently have lower betas, when estimated against global equity indices, than developed market companies. Using these betas with a global equity risk premium will lead to lower costs of equity for emerging market companies than developed market companies. While there are creative fixes that practitioners have used to get around this problem, they seem to be based on little more than the desire to end up with higher expected returns for emerging market companies.[59]

3. *Country risk is better reflected in the cash flows*

The essence of this argument is that country risk and its consequences are better reflected in the cash flows than in the discount rate. Proponents of this point of view argue that bringing in the likelihood of negative events (political chaos, nationalization and economic meltdowns) into the expected cash flows effectively risk adjusts the cashflows, thus eliminating the need for adjusting the discount rate.

This argument is alluring but it is wrong. The expected cashflows, allowing for the possibility of poor outcomes, is not risk adjusted. In fact, this is exactly how we should be calculating expected cash flows in any discounted cash flow analysis. Risk adjustment requires us to adjust the expected cash flow further for its risk, i.e. compute certainty equivalent cash flows in capital budgeting terms. To illustrate why, consider a simple example where a company is considering making the same type of investment in two countries. For simplicity, let us assume that the investment is expected to deliver $ 90, with certainty, in country 1 (a mature market); it is expected to generate $ 100 with 90% probability in country 2 (an emerging market) but there is a 10% chance that disaster will strike (and the cash flow will be $0). The expected cash flow is $90 on both investments, but only a risk neutral investor would be indifferent between the two. A risk averse investor would prefer the investment in the mature market over the emerging market investment, and would demand a premium for investing in the emerging market.

In effect, a full risk adjustment to the cash flows will require us to go through the same process that we have to use to adjust discount rates for risk. We will have to

[59] There are some practitioners who multiply the local market betas for individual companies by a beta for that market against the US. Thus, if the beta for an Indian chemical company is 0.9 and the beta for the Indian market against the US is 1.5, the global beta for the Indian company will be 1.35 (0.9*1.5). The beta for the Indian market is obtained by regressing returns, in US dollars, for the Indian market against returns on a US index (say, the S&P 500).

estimate a country risk premium, and use that risk premium to compute certainty equivalent cash flows.[60]

Estimating a Country Risk Premium

If country risk is not diversifiable, either because the marginal investor is not globally diversified or because the risk is correlated across markets, we are then left with the task of measuring country risk and considering the consequences for equity risk premiums. In this section, we will consider three approaches that can be used to estimate country risk premiums, all of which build off the historical risk premiums estimated in the last section. To approach this estimation question, let us start with the basic proposition that the risk premium in any equity market can be written as:

Equity Risk Premium = Base Premium for Mature Equity Market + Country Risk Premium

The country premium could reflect the extra risk in a specific market. This boils down our estimation to estimating two numbers – an equity risk premium for a mature equity market and the additional risk premium, if any, for country risk. To estimate a mature market equity risk premium, we can look at one of two numbers. The first is the historical risk premium that we estimated for the United States, which yielded 4.31% as the geometric average premium for stocks over treasury bonds from 1928 to 2010. If we do this, we are arguing that the US equity market is a mature market, and that there is sufficient historical data in the United States to make a reasonable estimate of the risk premium. The other is the average historical risk premium across 19 equity markets, approximately 3.8%, that was estimated by Dimson et al (see earlier reference), as a counter to the survivor bias that they saw in using the US risk premium. Consistency would then require us to use this as the equity risk premium, in every other equity market that we deem mature; the equity risk premium in January 2011 would be 4.31% (3.8%) in Germany, France and the UK, for instance. For markets that are not mature, however, we need to measure country risk and convert the measure into a country risk premium, which will augment the mature market premium.

Measuring Country Risk

There are at least three measures of country risk that we can use. The first is the sovereign rating attached to a country by ratings agencies. The second is to subscribe to services that come up with broader measures of country risk that explicitly factor in the

[60] In the simple example above, this is how it would work. Assume that we compute a country risk premium of 3% for the emerging market to reflect the risk of disaster. The certainty equivalent cash flow on the investment in that country would be $90/1.03 = $87.38.

economic, political and legal risks in individual countries. The third is go with a market-based measure such as the volatility in the country's currency or markets.

i. Sovereign Ratings

One of the simplest and most accessible measures of country risk is the rating assigned to a country's debt by a ratings agency (S&P, Moody's and Fitch, among others, all provide country ratings). These ratings measure default risk (rather than equity risk) but they are affected by many of the factors that drive equity risk – the stability of a country's currency, its budget and trade balances and political uncertainty, among other variables[61].

To get a measure of country ratings, consider five countries – Germany, Brazil, China, India and Russia. In January 2011, the Moody's ratings for the countries are summarized in table 9:

Table 9: Sovereign Ratings in January 2011 – Moody's

Country	*Foreign Currency Rating*	*Local Currency Rating*
Germany	Aaa	Aaa
Brazil	Baa3	Baa3
China	Aa3	Aa3
India	Baa3	Ba1
Russia	Baa1	Baa1
Greece	Ba1	Ba1

What do these ratings tell us? First, the local currency ratings tend to be higher (or at worst equal to) the foreign currency ratings for most countries, because a country should be in a better position to pay off debt in the local currency than in a foreign currency. India seems to be an exception to this rule, with a foreign currency rating that exceeds its local currency rating. Second, at least based on Moody's assessments in January 2011, Brazil and India are equivalent in terms of default risk, if we use the foreign currency ratings, India and Greece are the riskiest, if we draw on local currency ratings, and Germany is the safest, with China and Russia falling into the intermediate slots. Third, ratings do change over time. In fact, Brazil's rating has risen from B1 in 2001 to its current rating of Baa3, reflecting both strong economic growth and a more

[61] The process by which country ratings are obtained in explained on the S&P web site at http://www.ratings.standardpoor.com/criteria/index.htm.

diversified economy. Appendix 2 contains the current ratings – local currency and foreign currency – for the countries that are tracked by Moody's in January 2011.[62]

While ratings provide a convenient measure of country risk, there are costs associated with using them as the only measure. First, ratings agencies often lag markets when it comes to responding to changes in the underlying default risk. The ratings for India, according to Moody's, were unchanged from 2004 to 2007, though the Indian economy grew at double-digit rates over that period. Second, the ratings agency focus on default risk may obscure other risks that could still affect equity markets. For instance, rising commodity (and especially oil) prices pushed up the ratings for commodity supplying countries (like Russia), even though there was little improvement in the rest of the economy. Finally, not all countries have ratings; much of sub-Saharan Africa, for instance, is unrated.

ii. Country Risk Scores

Rather than focus on just default risk, as rating agencies do, some services have developed numerical country risk scores that take a more comprehensive view of risk. These risk scores are often estimated from the bottom-up by looking at economic fundamentals in each country. This, of course, requires significantly more information and, as a consequence, most of these scores are available only to commercial subscribers.

The Political Risk Services (PRS) group, for instance, considers political, financial and economic risk indicators to come up with a composite measure of risk (ICRG) for each country that ranks from 0 to 100, with 0 being highest risk and 100 being the lowest risk.[63] Appendix 3 includes composite country risk measures from the PRS Group for countries that they analyzed in November 2010, with comparisons to scores in earlier years.[64] Harvey (2005) examined the efficacy of these scores and found that they were correlated with costs of capital, but only for emerging market companies.

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[62] In a disquieting reaction to the turmoil of the market crisis in the last quarter of 2008, Moody's promoted the notion that Aaa countries were not all created equal and slotted these countries into three groups – resistant Aaa (the stongest), resilient Aaa (weaker but will probably survive intact) and vulnerable Aaa (likely to face additional default risk.

[63] The PRS group considers three types of risk – political risk, which accounts for 50% of the index, financial risk, which accounts for 25%, and economic risk, which accounts for the balance. While this table is dated, updated numbers are available for a hefty price. We have used the latest information in the public domain. Some university libraries have access to the updated data. While we have not updated the numbers, out of concerns about publishing proprietary data, you can get the latest PRS numbers by paying $99 on their website (http://www.prsgroup.com).

[64] Harvey, C.R., *Country Risk Components, the Cost of Capital, and Returns in Emerging Markets*, Working paper, Duke University. Available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=620710.

The Economist, the business newsmagazine, also operates a country risk assessment unit that measures risk from 0 to 100, with 0 being the least risk and 100 being the most risk. In September 2008, Table 10 the following countries were ranked as least and most risky by their measure:

Table 10: Country Risk Scores – The Economist

Economist.com rankings

Country risk

Selected countries and territories, September 2008 (except where noted)

Least risky

Rank		Score*
1	Switzerland †	12
2	Finland **	14
	Norway **	14
	Sweden ††	14
5	Canada **	17
	Denmark †	17
	Netherlands §	17
8	Germany ††	18
9	Austria **	19
	France ††	19
11	Belgium ††	20
12	Singapore	21
13	Japan **	23
14	Ireland #	24
	Britain	24
	United States †	24

Most risky

Rank		Score
120	Zimbabwe	86
119	Iraq	80
118	Sudan	76
117	Myanmar	75
116	Nicaragua	69
115	Jamaica	68
114	Kenya	66
113	Cuba	64
112	Cambodia	62
111	Côte d'Ivoire	61
	Ecuador	61
	Pakistan	61
	Venezuela	61
	Vietnam	61
106	Syria	60

*Out of 100, with higher numbers indicating more risk. Scores are based on indicators from three categories: currency risk, sovereign debt risk and banking risk.

† May 2008; ** July 2008; †† June 2008; § August 2008; # February 2008

In fact, comparing the PRS and Economist measures of country risk provides some insight into the problems with using their risk measures. The first is that the measures may be internally consistent but are not easily comparable across different services. The Economist, for instance, assigns its lowest scores to the safest countries whereas PRS assigns the highest scores to these countries. The second is that, by their very nature, a significant component of these measures have to be black boxes to prevent others from replicating them at no cost. Third, the measures are not linear and the services do not claim that they are; a country with a risk score of 60 in the Economist measure is not twice as risky as a country with a risk score of 30.

iii. Market-based Measures

To those analysts who feel that ratings agencies are either slow to respond to changes in country risk or take too narrow a view of risk, there is always the alternative of using market based measures.

¥ Bond default spread: We can compute a default spread for a country if it has bonds that are denominated in currencies such as the US dollar, Euro or Yen, where there is a riskfree rate to compare it to. On February 5, 2011, for instance, a 10-year US dollar denominated bond issued by the Brazilian government had a yield to maturity of 4.74%, giving it a default spread of 1.13% over the 10-year US treasury bond rate (3.61%), as of the same date.

¥ Credit Default Swap Spreads: In the last few years, credit default swaps (CDS) markets have developed, allowing us to obtain updated market measures of default risk in different entities. In particular, there are CDS markets for countries (governments) that yield measures of default spreads that may be more updated and precise, at least in some cases, than bond default spreads.[65] Table 11 summarizes the CDS spreads (in basis points) for countries on February 5, 2011:

Table 11: Credit Default Swap Spreads (in basis points)– February 5, 2011

Country	*CDS Spread*	*Country*	*CDS Spread*	*Country*	*CDS Spread*
Abu Dhabi	1.06%	Iceland	2.10%	Peru	1.52%
Argentina	6.62%	Indonesia	2.06%	Phillipines	1.96%
Australia	0.60%	Ireland	4.95%	Poland	1.64%
Austria	1.00%	Israel	1.62%	Portugal	4.09%
Bahrain	2.38%	Italy	1.87%	Qatar	1.04%
Belgium	1.72%	Japan	1.11%	Romania	3.05%
Brazil	1.59%	Kazakhstan	1.80%	Russia	1.78%
Bulgaria	2.70%	Lebanon	3.76%	Saudi Arabia	1.29%
Chile	1.00%	Lithuania	2.76%	Slovak Republic	0.99%
China	0.99%	Malaysia	0.99%	South Africa	1.65%
Colombia	1.55%	Mexico	1.59%	South Korea	1.17%
Croatia	2.76%	Netherlands	0.63%	Spain	2.48%
Czech Republic	0.98%	New Zealand	0.66%	Sweden	0.47%
Denmark	0.57%	Norway	0.31%	Switzerland	0.53%
Dubai	4.05%	Panama	1.34%	Thailand	1.35%
Egypt	3.58%	Peru	1.52%	Turkey	2.01%
Finland	0.52%	Philippines	1.96%	US	0.65%
France	1.11%	Poland	1.64%	Ukraine	4.88%
Germany	0.71%	Portugal	4.09%	United Kingdom	0.69%

[65] The spreads are usually stated in US dollar or Euro terms.

Greece	7.27%	Qatar	1.04%	Venezuela	11.96%
Hungary	3.23%	Romania	3.05%	Vietnam	4.24%

Source: Bloomberg
Spreads are for 10-year CDS. Italicized numbers are Euro CDS. All others are US $ CDS.

On February 5, 2011, for instance, the CDS market yielded a spread of 1.59% for the Brazilian Government, higher than the 1.13% obtained from the 10-year dollar denominated Brazilian bond.

¥ Market volatility: In portfolio theory, the standard deviation in returns is generally used as the proxy for risk. Extending that measure to emerging markets, there are some analysts who argue that the best measure of country risk is the volatility in local stock prices. Stock prices in emerging markets will be more volatile that stock prices in developed markets, and the volatility measure should be a good indicator of country risk. While the argument makes intuitive sense, the practical problem with using market volatility as a measure of risk is that it is as much a function of the underlying risk as it is a function of liquidity. Markets that are risky and illiquid often have low volatility, since you need trading to move stock prices. Consequently, using volatility measures will understate the risk of emerging markets that are illiquid and overstate the risk of liquid markets.

Market-based numbers have the benefit of constant updating and reflect the points of view of investors at any point in time. However, they also are also afflicted with all of the problems that people associate with markets – volatility, mood shifts and at times, irrationality. They tend to move far more than the other two measures – sovereign ratings and country risk scores – sometimes for good reasons and sometimes for no reason at all.

b. Estimating Country Risk Premium

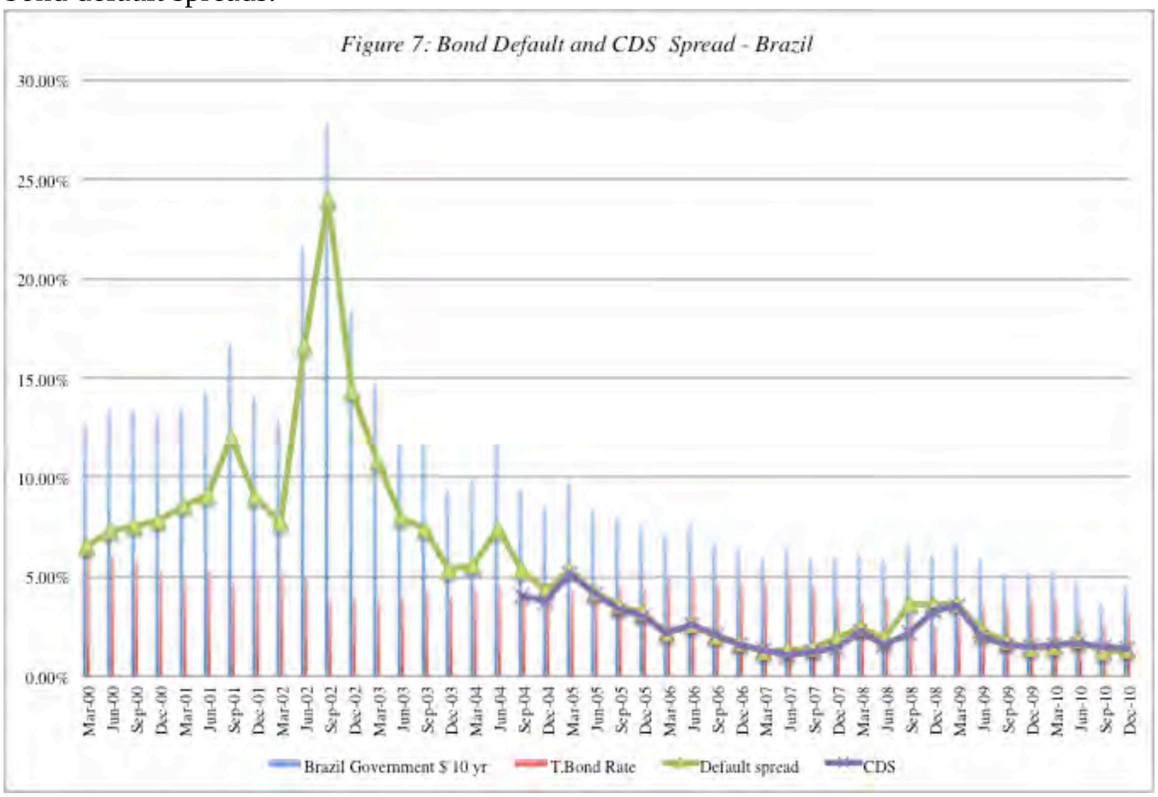
How do we link a country risk measure to a country risk premium? In this section, we will look at three approaches. The first uses default spreads, based upon country bonds or ratings, whereas the latter two use equity market volatility as an input in estimating country risk premiums.

1. Default Spreads

The simplest and most widely used proxy for the country risk premium is the default spread that investors charge for buying bonds issued by the country. This default spread can be estimated in one of three ways.

a. Current Default Spread on Sovereign Bond or CDS market: As we noted in the last section, the default spread comes from either looking at the yields on bonds issued by the country in a currency where there is a default free bond yield to which it can be compared or spreads in the CDS market.[66] With the 10-year US dollar denominated Brazilian bond that we cited as an example in the last section, the default spread would have amounted to 1.13% on February 5, 2011: the difference between the interest rate on the Brazilian bond and a treasury bond of the same maturity. The CDS market spread on the same day for the default spread was 1.59%.

<u>b. Average (Normalized) spread on bond</u>: While we can make the argument that the default spread in the dollar denominated is a reasonable measure of the default risk in Brazil, it is also a volatile measure. In figure 7, we have graphed the yields on the dollar denominated ten-year Brazilian Bond and the U.S. ten-year treasury bond and highlighted the default spread from 2000 to 2010. In the same figure, we also show the 10-year CDS spreads from 2004 to 2010;[67] the spreads have also changed over time but move with the bond default spreads.



Note that the bond default spread widened dramatically during 2002, mostly as a result of uncertainty in neighboring Argentina and concerns about the Brazilian presidential

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[66] You cannot compare interest rates across bonds in different currencies. The interest rate on a peso bond cannot be compared to the interest rate on a dollar denominated bond.

[67] Data for the sovereign CDS market is available only from the last part of 2004.

elections.[68] After the elections, the spreads decreased just as quickly and continued on a downward trend through the middle of last year. Since 2004, they have stabilized, with a downward trend; they spiked during the market crisis in the last quarter of 2008 but have settled back into pre-crisis levels. Given this volatility, a reasonable argument can be made that we should consider the average spread over a period of time rather than the default spread at the moment. If we accept this argument, the normalized default spread, using the average spreads over the last 5 years of data would be 2.03% (bond default spread) or 1.86% (CDS spread). Using this approach makes sense only if the economic fundamentals of the country have not changed significantly (for the better or worse) during the period but will yield misleading values, if there have been structural shifts in the economy. In 2008, for instance, it would have made sense to use averages over time for a country like Nigeria, where oil price movements created volatility in spreads over time, but not for countries like China and India, which saw their economies expand and mature dramatically over the period or Venezuela, where government capriciousness made operating private businesses a hazardous activity (with a concurrent tripling in default spreads).

c. Imputed or Synthetic Spread: The two approaches outlined above for estimating the default spread can be used only if the country being analyzed has bonds denominated in US dollars, Euros or another currency that has a default free rate that is easily accessible. Most emerging market countries, though, do not have government bonds denominated in another currency and some do not have a sovereign rating. For the first group (that have sovereign rating but no foreign currency government bonds), there are two solutions. If we assume that countries with the similar default risk should have the same sovereign rating, we can use the typical default spread for other countries that have the same rating as the country we are analyzing and dollar denominated or Euro denominated bonds outstanding. Thus, Bulgaria, with a Baa3 rating, would be assigned the same default spread as Brazil, which also has Baa3 rating, and dollar denominated bonds and CDS prices from which we can extract a default spread. For the second group, we are on even more tenuous grounds. Assuming that there is a country risk score from the Economist or PRS for the country, we could look for other countries that are rated and have similar scores and assign the default spreads that these countries face. For instance, we could assume that Cuba and Kenya, which have the same country risk score from the Economist, have similar country risk; this would lead us to attach Cuba's rating of Caa1

[68] The polls throughout 2002 suggested that Lula who was perceived by the market to be a leftist would beat the establishment candidate. Concerns about how he would govern roiled markets and any poll that showed him gaining would be followed by an increase in the default spread.

to Kenya (which is not rated) and to use the same default spread (based on this rating) for both countries.

In table 12, we have estimated the typical default spreads for bonds in different sovereign ratings classes in January 2011. One problem that we had in estimating the numbers for this table is that relatively few emerging markets have dollar or Euro denominated bonds outstanding. Consequently, there were some ratings classes where there was only one country with data and several ratings classes where there were none. To mitigate this problem, we used spreads from the CDS market, referenced in the earlier section. We were able to get default spreads for almost 60 countries, categorized by rating class, and we averaged the spreads across multiple countries in the same ratings class.[69] An alternative approach to estimating default spread is to assume that sovereign ratings are comparable to corporate ratings, i.e., a Ba1 rated country bond and a Ba1 rated corporate bond have equal default risk. In this case, we can use the default spreads on corporate bonds for different ratings classes. Table 12 also summarizes the typical default spreads for corporate bonds in different ratings classes in January 2011.

Table 12: Default Spreads by Sovereign Ratings Class – January 2011

Moody's Rating	*Sovereign Bonds/ CDS*	*Corporate Bonds*
Aaa	0.00%	0.50%
Aa1	0.25%	0.60%
Aa2	0.50%	0.65%
Aa3	0.70%	0.75%
A1	0.85%	0.85%
A2	1.00%	1.00%
A3	1.15%	1.10%
Baa1	1.50%	1.30%
Baa2	1.75%	1.60%
Baa3	2.00%	2.05%
Ba1	2.40%	2.90%
Ba2	2.75%	3.35%
Ba3	3.25%	3.50%
B1	4.00%	3.75%
B2	5.00%	5.00%
B3	6.00%	6.00%
Caa1	7.00%	7.75%
Caa2	8.50%	10.00%

[69] For instance, Brazil, Bulgaria and Croatia all share a Baa3 rating, and the CDS spreads as of January 2011 were 1.59%, 2.7% and 2.76% respectively. The average spread across the three countries is 2%.

Caa3	10.00%	15.00%

Note that the corporate bond spreads, at least in January 2011, were slightly larger than the sovereign spreads for the higher ratings classes, converge for the intermediate ratings and widen again at the lowest ratings. Using this approach to estimate default spreads for Brazil, with its rating of Baa3 would result in a spread of 2% (2.05%), if we use sovereign spreads (corporate spreads). These spreads are down from post-crisis levels at the end of 2008 but are still much larger than the actual spreads on Brazilian sovereign bonds or the Brazilian CDS in early 2011.

Figure 8 depicts the alternative approaches to estimating default spreads for four countries, Brazil, China, Greece and Russia, in February 2011:

Figure 8: Approaches for estimating Sovereign Default Spreads

Estimating a default spread for a country or sovereign entity

Market Based estimates

Soverign Bond spread
1. Find a bond issued by the country, denominated in US$ or Euros.
2. Compute the default spread by comparing to US treasury bond (if US $) or German Euro bond (if Euros).

CDS Market
1. Find a 10-year CDS for the country (if one exists)
2. This is your default spread.

Country	Sovereign Bond yield	Currency	Riskfree Rate	Default Spread	CDS Spread
Brazil	4.74%	US$	3.61%	1.13%	1.59%
China	NA	NA	NA	NA	0.99%
Greece	11.55%	Euros	3.30%	8.25%	7.26%
Russia	4.93%	US$	3.61%	1.32%	1.78%

Rating/Risk score based estimates
Step 1: Find a sovereign rating (local currency) for the country (on Moody's or S&P)
Step 2: Look up the default spread for that rating in the lookup table below:

Rating	*Default Spread*
Aaa	0.00%
Aa1	0.25%
Aa2	0.50%
Aa3	0.70%
A1	0.85%
A2	1.00%
A3	1.15%
Baa1	1.50%
Baa2	1.75%
Baa3	2.00%
Ba1	2.40%
Ba2	2.75%
Ba3	3.25%
B1	4.00%
B2	5.00%
B3	6.00%
Caa1	7.00%
Caa2	8.50%
Caa3	10.00%

Country	Sovereign Rating	Default Spread
Brazil	Baa3	2%
China	Aa3	0.70%
Greece	Ba1	2.40%
Russia	Baa1	1.50%

Analysts who use default spreads as measures of country risk typically add them on to both the cost of equity and debt of every company traded in that country. For instance, the cost of equity for a Brazilian company, estimated in U.S. dollars, will be 2% higher than the cost of equity of an otherwise similar U.S. company, using the January 2011 measure of the default spread, based upon the rating. In some cases, analysts add the default spread to the U.S. risk premium and multiply it by the beta. This increases the cost of equity for high beta companies and lowers them for low beta firms.[70]

2. Relative Equity Market Standard Deviations

There are some analysts who believe that the equity risk premiums of markets should reflect the differences in equity risk, as measured by the volatilities of these markets. A conventional measure of equity risk is the standard deviation in stock prices; higher standard deviations are generally associated with more risk. If you scale the standard deviation of one market against another, you obtain a measure of relative risk. For instance, the relative standard deviation for country X (against the US) would be computed as follows:

$$\text{Relative Standard Deviation}_{\text{Country X}} = \frac{\text{Standard Deviation}_{\text{Country X}}}{\text{Standard Deviation}_{\text{US}}}$$

If we assume a linear relationship between equity risk premiums and equity market standard deviations, and we assume that the risk premium for the US can be computed (using historical data, for instance) the equity risk premium for country X follows:

$$\text{Equity risk premium}_{\text{Country X}} = \text{Risk Premum}_{\text{US}} * \text{Relative Standard Deviation}_{\text{Country X}}$$

Assume, for the moment, that you are using an equity risk premium for the United States of 5.00%. The annualized standard deviation in the S&P 500 in two years preceding February 2011, using weekly returns, was 17.22%, whereas the standard deviation in the Bovespa (the Brazilian equity index) over the same period was 20.76%.[71] Using these values, the estimate of a total risk premium for Brazil would be as follows.

$$\text{Equity Risk Premium}_{\text{Brazil}} = 5.00\% * \frac{20.76\%}{17.22\%} = 6.03\%$$

The country risk premium for Brazil can be isolated as follows:

$$\text{Country Risk Premium}_{\text{Brazil}} = 6.03\% - 5.00\% = 1.03\%$$

Table 13 lists country volatility numbers for some emerging markets and the resulting total and country risk premiums for these markets, based on the assumption that the equity risk premium for the United States is 5%.

Table 13: Equity Market Volatilities and Risk Premiums (weekly returns: Feb 09-Feb 11)

Country	Standard deviation in index	Relative Volatility (to US)	Total Equity Risk Premium	Country risk premium
Argentina	27.94%	1.62	8.11%	3.11%

[70] In a companion paper, I argue for a separate measure of company exposure to country risk called lambda that is scaled around one (just like beta) that is multiplied by the country risk premium to estimate the cost of equity. See Damodaran, A., 2007, Measuring Company Risk Exposure to Country Risk, Working Paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=889388

[71] If the dependence on historical volatility is troubling, the options market can be used to get implied volatilities for both the US market (18.03%) and for the Bovespa (23.56%).

Brazil	20.76%	1.21	6.03%	1.03%
Chile	13.02%	0.76	3.78%	-1.22%
China	26.18%	1.52	7.60%	2.60%
Columbia	14.81%	0.86	4.30%	-0.70%
Croatia	23.28%	1.35	6.76%	1.76%
Czech Republic	23.74%	1.38	6.89%	1.89%
Egypt	29.67%	1.72	8.61%	3.61%
Greece	31.63%	1.84	9.18%	4.18%
Hungary	28.22%	1.64	8.19%	3.19%
Iceland	15.61%	0.91	4.53%	-0.47%
India	22.58%	1.31	6.56%	1.56%
Indonesia	23.02%	1.34	6.68%	1.68%
Ireland	25.06%	1.46	7.28%	2.28%
Israel	14.65%	0.85	4.25%	-0.75%
Kenya	15.30%	0.89	4.44%	-0.56%
Korea	15.91%	0.92	4.62%	-0.38%
Malaysia	10.94%	0.64	3.18%	-1.82%
Mexico	19.21%	1.12	5.58%	0.58%
Namibia	21.34%	1.24	6.20%	1.20%
Nigeria	28.39%	1.65	8.24%	3.24%
Pakistan	17.62%	1.02	5.12%	0.12%
Peru	24.76%	1.44	7.19%	2.19%
Philippines	19.52%	1.13	5.67%	0.67%
Poland	19.68%	1.14	5.71%	0.71%
Portugal	19.57%	1.14	5.68%	0.68%
Romania	30.31%	1.76	8.80%	3.80%
Russia	30.31%	1.76	8.80%	3.80%
Slovenia	25.15%	1.46	7.30%	2.30%
Slovakia	16.42%	0.95	4.77%	-0.23%
Spain	25.64%	1.49	7.44%	2.44%
Thailand	19.04%	1.11	5.53%	0.53%
Turkey	25.44%	1.48	7.39%	2.39%
Ukraine	41.29%	2.40	11.99%	6.99%
Venezuela	13.02%	0.76	3.78%	-1.22%
Vietnam	32.58%	1.89	9.46%	4.46%
US	17.22%		**5.00%**	

While this approach has intuitive appeal, there are problems with using standard deviations computed in markets with widely different market structures and liquidity. Since equity market volatility is affected by liquidity, with more liquid markets often showing higher volatility, this approach will understate premiums for illiquid markets and overstate the premiums for liquid markets. For instance, the standard deviations in many emerging markets is lower than the standard deviation in the S&P 500, leading to equity risk premiums for those countries that are lower than the US. Thus, we assign a total equity risk premium, with this approach, of only 3.78% for Venezuela, lower than the 5% we use in mature markets. On a relative basis, China's risk premiums, using this approach, are well above the equity risk premiums for Pakistan and Thailand, both of which are riskier markets and economies than China. The second problem is related to currencies since the standard deviations are usually measured in local currency terms; the standard deviation in the U.S. market is a dollar standard deviation, whereas the standard deviation in the Brazilian market is based on nominal Brazilian Real returns. This is a relatively simple problem to fix, though, since the standard deviations can be measured in the same currency – you could estimate the standard deviation in dollar returns for the Brazilian market.

3. Default Spreads + Relative Standard Deviations

In the first approach to computing equity risk premiums, we assumed that the default spreads (actual or implied) for the country were good measures of the additional risk we face when investing in equity in that country. In the second approach, we argued that the information in equity market volatility can be used to compute the country risk premium. In the third approach, we will meld the first two, and try to use the information in both the country default spread and the equity market volatility.

The country default spreads provide an important first step in measuring country equity risk, but still only measure the premium for default risk. Intuitively, we would expect the country equity risk premium to be larger than the country default risk spread. To address the issue of how much higher, we look at the volatility of the equity market in a country relative to the volatility of the bond market used to estimate the spread. This yields the following estimate for the country equity risk premium.

$$\text{Country Risk Premium} = \text{Country Default Spread}^* \left(\frac{\sigma_{\text{Equity}}}{\sigma_{\text{Country Bond}}} \right)$$

To illustrate, consider again the case of Brazil. As noted earlier, the default spread for Brazil in January 2011, based upon its sovereign rating, was 2.00%. Since we did not have two years of data available on the Brazilian government bond, we computed annualized standard deviations in both the equity market and the government bond, using the 100 trading days just prior to February 14, 2011. The annualized standard deviation in the Brazilian dollar denominated ten-year bond was 7.32%, well below the standard deviation in the Brazilian equity index of 17.65%. The resulting country equity risk premium for Brazil is as follows:

$$\text{Brazil's Country Risk Premium} = 2.00\%\left(\frac{17.65\%}{7.32\%}\right) = 4.82\%$$

Unlike the equity standard deviation approach, this premium is in addition to a mature market equity risk premium. Thus, assuming a 5% mature market premium, we would compute a total equity risk premium for Brazil of 9.82%:

Brazil’s Total Equity Risk Premium = 5% + 4.82% = 9.82%

Note that this country risk premium will increase if the country rating drops or if the relative volatility of the equity market increases.

Why should equity risk premiums have any relationship to country bond spreads? A simple explanation is that an investor who can make 2.00% risk premium on a dollar-denominated Brazilian government bond would not settle for a risk premium of 1.2% (in dollar terms) on Brazilian equity. Playing devil’s advocate, however, a critic could argue that the interest rate on a country bond, from which default spreads are extracted, is not really an expected return since it is based upon the promised cash flows (coupon and principal) on the bond rather than the expected cash flows. In fact, if we wanted to estimate a risk premium for bonds, we would need to estimate the expected return based upon expected cash flows, allowing for the default risk. This would result in a lower default spread and equity risk premium. Both this approach and the last one use the standard deviation in equity of a market to make a judgment about country risk premium, but they measure it relative to different bases. This approach uses the country bond as a base, whereas the previous one uses the standard deviation in the U.S. market. This approach assumes that investors are more likely to choose between Brazilian bonds and Brazilian equity, whereas the previous approach assumes that the choice is across equity markets.

There are two potential measurement problems with using this approach. The first is that the relative standard deviation of equity is a volatile number, both across countries (ranging from 4.56 for Czech Republic to 0.37 for Venezuela) and across time (Brazil’s relative volatility numbers have ranged from close to one to well above 2.5). The second is that computing the relative volatility requires us to estimate volatility in the government bond, which, in turn, presupposes that long-term government bonds not only exist but are also traded.[72] In countries where this data item is not available, we have three choices. One is to fall back on one of the other two approaches. The second is to use a proxy, say the volatility in bonds issued by a large corporation in that country; if the company has low default risk, the volatility on the corporate bond should be close to the volatility in the government bond. The third is to compute a cross sectional average of the ratio of stock market to bond market volatility across countries, where both items are available, and use that average. In 2011, for instance, there were 33 emerging markets, where both the equity market volatility and the government bond volatility numbers were available, at least for 100 trading days; the numbers are summarized in Appendix 4. The median ratio, across these markets, of equity market volatility to bond price volatility was approximately 1.88.[73] We apply this median ratio to compute country risk premiums for all the countries.

Choosing between the approaches

The three approaches to estimating country risk premiums will generally give you different estimates, with the bond default spread and relative equity standard deviation approaches generally yielding lower country risk premiums than the melded approach that uses both the country bond default spread and the equity and bond standard deviations. Table 14 summarizes the estimates of country equity and total risk premium using the three approaches for Brazil in January 2011:

Table 14: Country and Total Equity Risk Premium: Brazil in January 2011

Approach	*Mature Market Equity Premium*	*Brazil Country Risk Premium*	*Total Equity Risk Premium*
Country Bond Default Spread	5.00%	2.00%	7.00%
Relative Equity Market Standard Deviations	5.00%	1.03%	6.03%
Melded Approach (Bond default spread + Relative Standard Deviation)	5.00%	3.75%	8.75%

We believe that the larger country risk premiums that emerge from the last approach are the most realistic for the immediate future, but that country risk premiums will decline

[72] One indication that the government bond is not heavily traded is an abnormally low standard deviation on the bond yield.

[73] The ratio seems to be lowest in the markets with the highest default spreads and higher in markets with lower default spreads. The median ratio this year is higher than it has been historically. On my website, I continue to use a multiple of 1.50, reflecting the historical value for this ratio.

over time. Just as companies mature and become less risky over time, countries can mature and become less risky as well.

One way to adjust country risk premiums over time is to begin with the premium that emerges from the melded approach and to adjust this premium down towards either the country bond default spread or the country premium estimated from equity standard deviations. Thus, the equity risk premium will converge to the country bond default spread as we look at longer term expected returns. As an illustration, the country risk premium for Brazil would be 3.75% for the next year but decline over time to either the 2.00% (country default spread) or 1.03% (relative standard deviation) or perhaps even lower, depending upon your assessment of how Brazil's economy will evolve over time.

Implied Equity Premiums

The problem with any historical premium approach, even with substantial modifications, is that it is backward looking. Given that our objective is to estimate an updated, forward-looking premium, it seems foolhardy to put your faith in mean reversion and past data. In this section, we will consider three approaches for estimating equity risk premiums that are more forward looking.

1. DCF Model Based Premiums

When investors price assets, they are implicitly telling you what they require as an expected return on that asset. Thus, if an asset has expected cash flows of $15 a year in perpetuity, and an investor pays $75 for that asset, he is announcing to the world that his required rate of return on that asset is 20% (15/75). In this section, we expand on this intuition and argue that the current market prices for equity, in conjunction with expected cash flows, should yield an estimate on the equity risk premium.

A Stable Growth DDM Premium

It is easiest to illustrated implied equity premiums with a dividend discount model (DDM). In the DDM, the value of equity is the present value of expected dividends from the investment. In the special case where dividends are assumed to grow at a constant rate forever, we get the classic stable growth (Gordon) model:

$$\text{Value of equity} = \frac{\text{Expected Dividends Next Period}}{\text{(Required Return on Equity - Expected Growth Rate)}}$$

This is essentially the present value of dividends growing at a constant rate. Three of the four inputs in this model can be obtained or estimated - the current level of the market (value), the expected dividends next period and the expected growth rate in earnings and dividends in the long term. The only “unknown” is then the required return on equity; when we solve for it, we get an implied expected return on stocks. Subtracting out the riskfree rate will yield an implied equity risk premium.

To illustrate, assume that the current level of the S&P 500 Index is 900, the expected dividend yield on the index is 2% and the expected growth rate in earnings and dividends in the long term is 7%. Solving for the required return on equity yields the following:

$$900 = (.02*900) /(r - .07)$$

Solving for r,

$$r = (18+63)/900 = 9\%$$

If the current riskfree rate is 6%, this will yield a premium of 3%.

In fact, if we accept the stable growth dividend discount model as the base model for valuing equities and assume that the expected growth rate in dividends should equate to the riskfree rate in the long term, the dividend yield on equities becomes a measure of the equity risk premium:

$$\text{Value of equity} = \frac{\text{Expected Dividends Next Period}}{(\text{Required Return on Equity - Expected Growth Rate})}$$

$$\begin{aligned}\text{Dividends/ Value of Equity} &= \text{Required Return on Equity – Expected Growth rate}\\ \text{Dividend Yield} &= \text{Required Return on Equity – Riskfree rate}\\ &= \text{Equity Risk Premium}\end{aligned}$$

Rozeff (1984) made this argument[74] and empirical support has been claimed for dividend yields as predictors of future returns in many studies since.[75] Note that this simple equation will break down if (a) companies do not pay out what they can afford to in dividends, i.e., they hold back cash or (b) if earnings are expected to grow at extraordinary rates for the short term.

There is another variant of this model that can be used, where we focus on earnings instead of dividends. To make this transition, though, we have to state the expected growth rate as a function of the payout ratio and return on equity (ROE) :[76]

$$\text{Growth rate} = (1 – \text{Dividends/ Earnings}) (\text{Return on equity})$$

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[74] Rozeff, M. S. 1984. *Dividend yields are equity risk premiums*, Journal of Portfolio Management, v11, 68-75.

[75] Fama, E. F., and K. R. French. 1988. *Dividend yields and expected stock returns*. Journal of Financial Economics, v22, 3-25.

[76] This equation for sustainable growth is discussed more fully in Damodaran, A., 2002, Investment Valuation, John Wiley and Sons.

$$= (1 - \text{Payout ratio}) (\text{ROE})$$

Substituting back into the stable growth model,

$$\text{Value of equity} = \frac{\text{Expected Earnings Next Period (Payout ratio)}}{(\text{Required Return on Equity - (1-Payout ratio) (ROE)})}$$

If we assume that the return on equity (ROE) is equal to the required return on equity (cost of equity), i.e., that the firm does not earn excess returns, this equation simplifies as follows:

$$\text{Value of equity} = \frac{\text{Expected Earnings Next Period}}{\text{Required Return on Equity}}$$

In this case, the required return on equity can be written as:

$$\text{Required return on equity} = \frac{\text{Expected Earnings Next Period}}{\text{Value of Equity}}$$

In effect, the inverse of the PE ratio (also referenced as the earnings yield) becomes the required return on equity, if firms are in stable growth earning no excess returns. Subtracting out the riskfree rate should yield an implied premium:

Implied premium (EP approach) = Earnings Yield on index – Riskfree rate

In January 2011, both these approaches would have delivered very low equity risk premiums for the US market.

Dividend Yield = 1.84%

Earnings Yield = 6.65%:[77] Implied premium = 5.35% - 3.29% = 2.06%

Both approaches, though, draw on the dividend discount model and make strong assumptions about firms being in stable growth and/or long-term excess returns.

A Generalized Model: Implied Equity Risk Premium

To expand the model to fit more general specifications, we would make the following changes: Instead of looking at the actual dividends paid as the only cash flow to equity, we would consider potential dividends instead of actual dividends. In my earlier work (2002, 2006), the free cash flow to equity (FCFE), i.e, the cash flow left over after taxes, reinvestment needs and debt repayments, was offered as a measure of potential dividends.[78] Over the last decade, for instance, firms have paid out only about half their FCFE as dividends. If this poses too much of an estimation challenge, there is a simpler alternative. Firms that hold back cash build up large cash balances that they use

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[77] The earnings yield in January 2011 is estimated by dividing the aggregated earnings for the index by the index level.

[78] Damodaran, A., 2002, *Investment Valuation*, John Wiley and Sons; Damodaran, A., 2006, *Damodaran on Valuation*, John Wiley and Sons.

over time to fund stock buybacks. Adding stock buybacks to aggregate dividends paid should give us a better measure of total cash flows to equity. The model can also be expanded to allow for a high growth phase, where earnings and dividends can grow at rates that are very different (usually higher, but not always) than stable growth values. With these changes, the value of equity can be written as follows:

$$\text{Value of Equity} = \sum_{t=1}^{t=N} \frac{E(FCFE_t)}{(1+k_e)^t} + \frac{E(FCFE_{N+1})}{(k_e - g_N)\,(1+k_e)^N}$$

In this equation, there are N years of high growth, $E(FCFE_t)$ is the expected free cash flow to equity (potential dividend) in year t, k_e is the rate of return expected by equity investors and g_N is the stable growth rate (after year N). We can solve for the rate of return equity investors need, given the expected potential dividends and prices today. Subtracting out the riskfree rate should generate a more realistic equity risk premium.

In a variant of this approach, the implied equity risk premium can be computed from excess return or residual earnings models. In these models, the value of equity today can be written as the sum of capital invested in assets in place and the present value of future excess returns:[79]

$$\text{Value of Equity} = \text{Book Equity today} + \sum_{t=1}^{t=\infty} \frac{\text{Net Income}_t - k_e(\text{Book Equity}_{t-1})}{(1+k_e)^t}$$

If we can make estimates of the book equity and net income in future periods, we can then solve for the cost of equity and use that number to back into an implied equity risk premium. Claus and Thomas (2001) use this approach, in conjunction with analyst forecasts of earnings growth, to estimate implied equity risk premiums of about 3% for the market in 2000.[80]

Implied Equity Risk Premium: S&P 500

Given its long history and wide following, the S&P 500 is a logical index to use to try out the implied equity risk premium measure. In this section, we will begin by estimating implied equity risk premiums at the start of the years 2008-2011, and follow up by looking at the volatility in that estimate over time.

Implied Equity Risk Premiums: 2008-2011

On December 31, 2007, the S&P 500 Index closed at 1468.36, and the dividend yield on the index was roughly 1.89%. In addition, the consensus estimate of growth in

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[79] For more on excess return models, see Damodaran, A, 2006, *Valuation Approaches and Metrics: A Survey of the Theory and Evidence*, Working Paper, www.damodaran.com.

[80] Claus, J. and J. Thomas, 2001,'*Equity premia as low as three percent? Evidence from analysts' earnings forecasts for domestic and international stock markets*, Journal of Finance 56(5), 1629–1666.

earnings for companies in the index was approximately 5% for the next 5 years.[81] Since this is not a growth rate that can be sustained forever, we employ a two-stage valuation model, where we allow growth to continue at 5% for 5 years, and then lower the growth rate to 4.02% (the riskfree rate) after that.[82] Table 15 summarizes the expected dividends for the next 5 years of high growth, and for the first year of stable growth thereafter:

Table 15: Estimated Dividends on the S&P 500 Index – January 1, 2008

Year	*Dividends on Index*
1	29.12
2	30.57
3	32.10
4	33.71
5	35.39
6	36.81

[a]Dividends in the first year = 1.89% of 1468.36 (1.05)

If we assume that these are reasonable estimates of the expected dividends and that the index is correctly priced, the value can be written as follows:

$$1468.36 = \frac{29.12}{(1+r)} + \frac{30.57}{(1+r)^2} + \frac{32.10}{(1+r)^3} + \frac{33.71}{(1+r)^4} + \frac{35.39}{(1+r)^5} + \frac{36.81}{(r-.0402)(1+r)^5}$$

Note that the last term in the equation is the terminal value of the index, based upon the stable growth rate of 4.02%, discounted back to the present. Solving for required return in this equation yields us a value of 6.04%. Subtracting out the ten-year treasury bond rate (the riskfree rate) yields an implied equity premium of 2.02%.

The focus on dividends may be understating the premium, since the companies in the index have bought back substantial amounts of their own stock over the last few years. Table 16 summarizes dividends and stock buybacks on the index, going back to 2001.

Table 16: Dividends and Stock Buybacks on S&P 500 Index: 2001-2007

Year	*Dividend Yield*	*Stock Buyback Yield*	*Total Yield*
2001	1.37%	1.25%	2.62%
2002	1.81%	1.58%	3.39%
2003	1.61%	1.23%	2.84%
2004	1.57%	1.78%	3.35%
2005	1.79%	3.11%	4.90%
2006	1.77%	3.38%	5.15%

[81] We used the average of the analyst estimates for individual firms (bottom-up). Alternatively, we could have used the top-down estimate for the S&P 500 earnings.

[82] The treasury bond rate is the sum of expected inflation and the expected real rate. If we assume that real growth is equal to the real interest rate, the long term stable growth rate should be equal to the treasury bond rate.

2007	1.89%	4.00%	5.89%
Average total yield between 2001-2007 =			4.02%

In 2007, for instance, firms collectively returned twice as much cash in the form of buybacks than they paid out in dividends. Since buybacks are volatile over time, and 2007 may represent a high-water mark for the phenomenon, we recomputed the expected cash flows, in table 17, for the next 6 years using the average total yield (dividends + buybacks) of 4.02%, instead of the actual dividends, and the growth rates estimated earlier (5% for the next 5 years, 4.02% thereafter):

Table 17: Cashflows on S&P 500 Index

Year	*Dividends+ Buybacks on Index*
1	61.98
2	65.08
3	68.33
4	71.75
5	75.34
6	78.36

Using these cash flows to compute the expected return on stocks, we derive the following:

$$1468.36 = \frac{61.98}{(1+r)} + \frac{65.08}{(1+r)^2} + \frac{68.33}{(1+r)^3} + \frac{71.75}{(1+r)^4} + \frac{75.34}{(1+r)^5} + \frac{75.34(1.0402)}{(r-.0402)(1+r)^5}$$

Solving for the required return and the implied premium with the higher cash flows:

Required Return on Equity = 8.39%

Implied Equity Risk Premium = Required Return on Equity - Riskfree Rate

= 8.39% - 4.02% = 4.37%

This value (4.37%) would have been our estimate of the equity risk premium on January 1, 2008.

During 2008, the S&P 500 lost just over a third of its value and ended the year at 903.25 and the treasury bond rate plummeted to close at 2.21% on December 31, 2008. Firms also pulled back on stock buybacks and financial service firms in particular cut dividends during the year. The inputs to the equity risk premium computation reflect these changes:

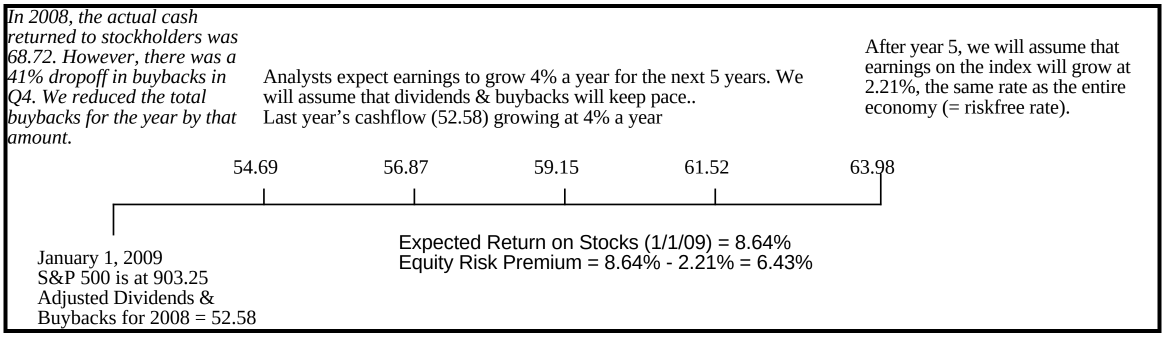
Level of the index = 903.25 (Down from 1468.36)

Treasury bond rate = 2.21% (Down from 4.02%)

Updated dividends and buybacks on the index = 52.58 (Down about 15%)

Expected growth rate = 4% for next 5 years (analyst estimates) and 2.21% thereafter (set equal to riskfree rate).

The computation is summarized below:



The resulting equation is below:

$$903.25 = \frac{54.69}{(1+r)} + \frac{56.87}{(1+r)^2} + \frac{59.15}{(1+r)^3} + \frac{61.52}{(1+r)^4} + \frac{63.98}{(1+r)^5} + \frac{63.98(1.0221)}{(r-.0221)(1+r)^5}$$

Solving for the required return and the implied premium with the higher cash flows:

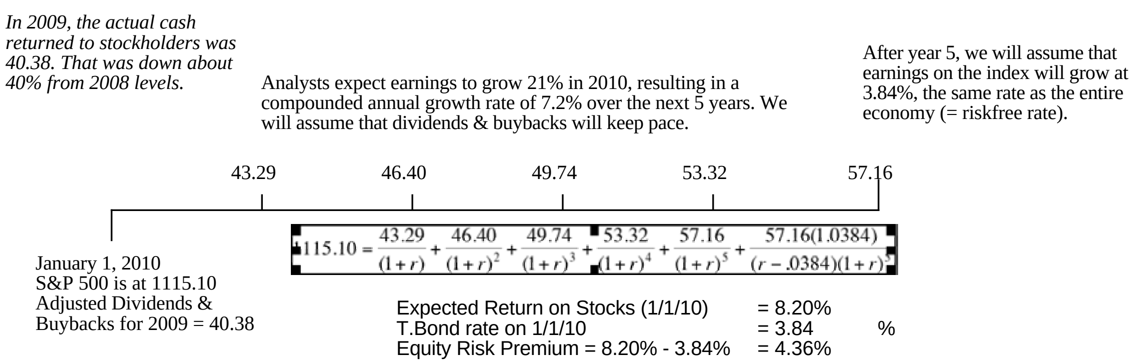
Required Return on Equity = 8.64%

Implied Equity Risk Premium = Required Return on Equity - Riskfree Rate

= 8.64% - 2.21% = 6.43%

The implied premium rose more than 2%, from 4.37% to 6.43%, over the course of the year, indicating that investors perceived more risk in equities at the end of the year, than they did at the start and were demanding a higher premium to compensate.

By January 2010, the fears of a banking crisis had subsided and the S&P 500 had recovered to 1115.10. However, a combination of dividend cuts and a decline in stock buybacks had combined to put the cash flows on the index down to 40.38 in 2009. That was partially offset by increasing optimism about an economic recovery and expected earnings growth for the next 5 years had bounced back to 7.2%.[83] The resulting equity risk premium is 4.36%:



In effect, equity risk premiums have reverted back to what they were before the 2008 crisis.

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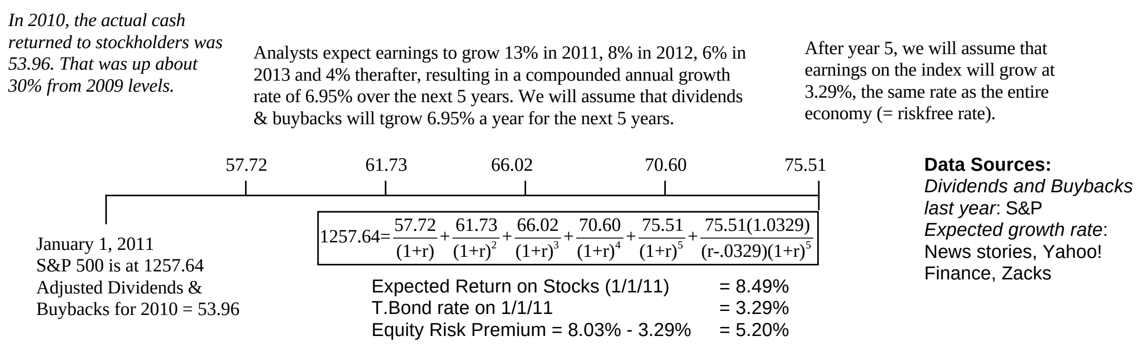
83 The expected earnings growth for just 2010 was 21%, primarily driven by earnings bouncing back to pre-crisis levels, followed by a more normal 4% earnings growth in the following years. The compounded average growth rate is $((1.21)(1.04)^4)^{1/5}-1 = .072$ or 7.2%.

Updating the numbers to January 2011, the S&P 500 had climbed to 1257.64, but cash flows on the index, in the form of dividends and buybacks, made an even more impressive comeback, increasing to 53.96 from the depressed 2009 levels. The implied equity risk premium computation is summarized below:

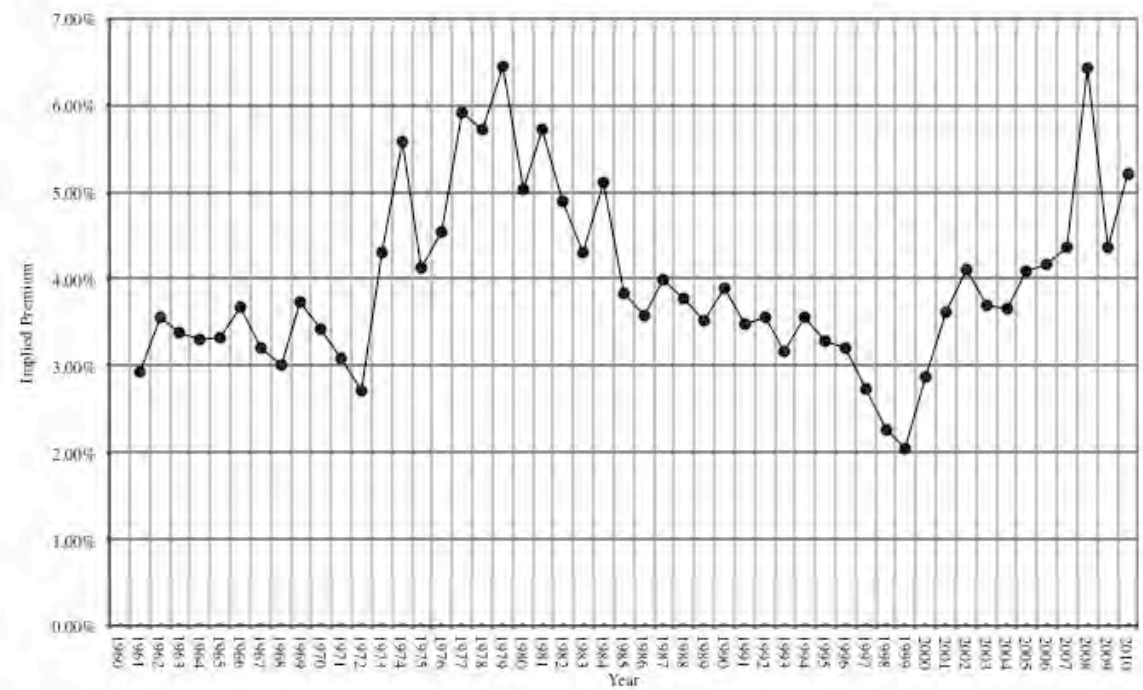


The implied equity risk premium climbed to 5.20%, with the higher cash flows more than offsetting the rise in equity prices.

Time Series Behavior for S&P 500 Implied Premium

As the inputs to the implied equity risk premium, it is quite clear that the value for the premium will change not just from day to day but from one minute to the next. In particular, movements in the index will affect the equity risk premium, with higher (lower) index values, other things remaining equal, translating into lower (higher) implied equity risk premiums. In Figure 9, we chart the implied premiums in the S&P 500 from 1960 to 2010:

Figure 9: Implied Premium for US Equity Market



In terms of mechanics, we used potential dividends (including buybacks) as cash flows, and a two-stage discounted cash flow model; the estimates for each year are in appendix 5.[84] Looking at these numbers, we would draw the following conclusions:

- The implied equity premium has generally been lower than the historical risk premium for the US equity market for most of the last few decades. To provide a contrast, we compare the implied equity risk premiums each year to the historical risk premiums for stocks over treasury bonds, using both geometric and arithmetic averages, each year from 1961 to 2010 in figure 10:

[84] We used analyst estimates of growth in earnings for the 5-year growth rate after 1980. Between 1960 and 1980, we used the historical growth rate (from the previous 5 years) as the projected growth, since analyst estimates were difficult to obtain. Prior to the late 1980s, the dividends and potential dividends were very similar, because stock buybacks were uncommon. In the last 20 years, the numbers have diverged.

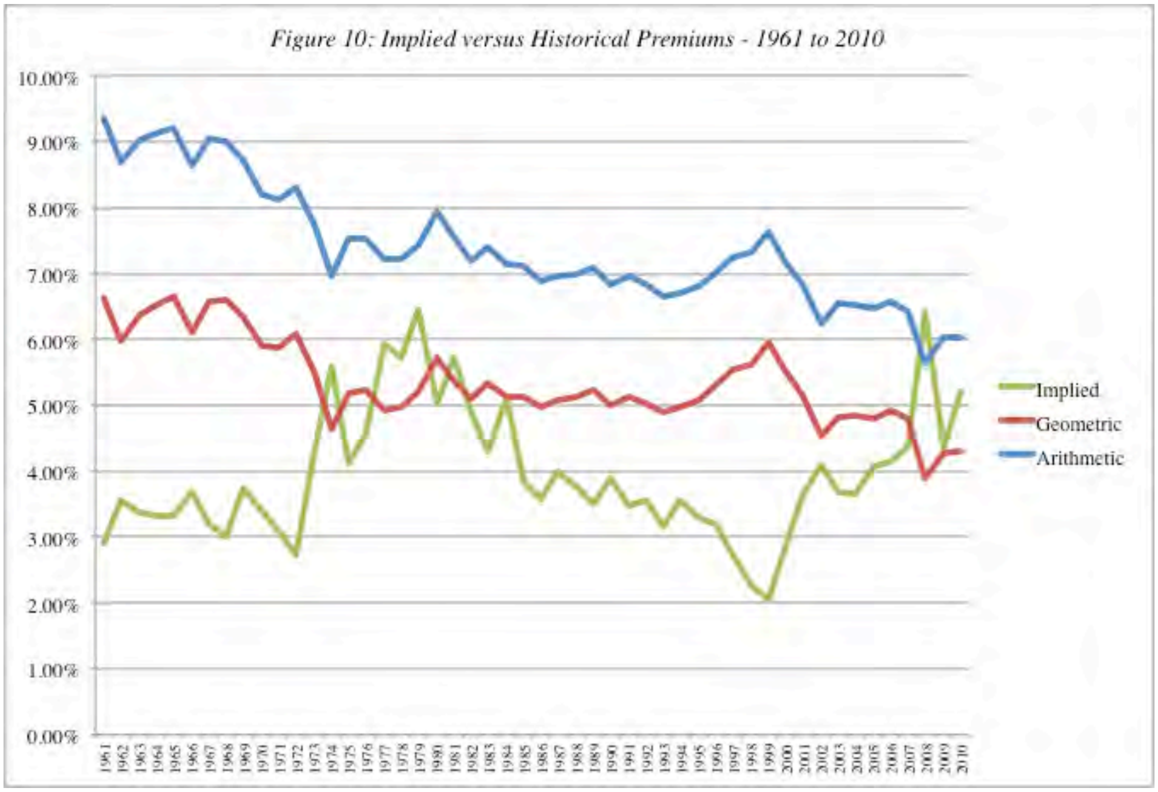


Figure 10: Implied versus Historical Premiums - 1961 to 2010

The arithmetic average premium, which is used by many practitioners, has been dramatically higher than the implied premium over almost the entire fifty-year period (with 2009 the only exception). The geometric premium does provide a more interesting mix of results, with implied premiums exceeding historical premiums in the mid-1970s and again since 2008.

¥ The implied equity premium did increase during the seventies, as inflation increased. This does have interesting implications for risk premium estimation. Instead of assuming that the risk premium is a constant, and unaffected by the level of inflation and interest rates, which is what we do with historical risk premiums, it may be more realistic to increase the risk premium if expected inflation and interest rates go up.

¥ While historical risk premiums have generally drifted down for the last few decades, there is a strong tendency towards mean reversion in implied equity premiums. Thus, the premium, which peaked at 6.5% in 1978, moved down towards the average in the 1980s. By the same token, the premium of 2% that we observed at the end of the dot-com boom in the 1990s quickly reverted back to the average, during the market correction from 2000-2003.[85] Given this tendency, it is possible that we can end up

[85] Arnott, Robert D., and Ronald Ryan, 2001, *The Death of the Risk Premium: Consequences of the 1990s*, Journal of Portfolio Management, Spring 2001. They make the same point about reduction in implied equity risk premiums that we do. According to their calculations, though, the implied equity risk premium in the late 1990s was negative.

with a far better estimate of the implied equity premium by looking at not just the current premium, but also at historical trend lines. We can use the average implied equity premium over longer periods, say ten to fifteen years. Note that we do not need as many years of data to make this estimate as we do with historical premiums, because the standard errors tend to be smaller.

¥ Finally, the crisis of 2008 was unprecedented in terms of its impact on equity risk premiums. Implied equity risk premiums rose more during the last year (2008) than in any one of the prior 50 years. Much of that change occurred in the last 15 weeks of the year and we will come back to take a closer look at that period later in the paper. However, much of that increase dissipated in 2009, as equity risk premiums returned to pre-crisis levels.

Determinants of Implied Premiums

Looking at the variation of the implied equity risk premium over time does give rise to a follow-up question: How much of the variation in the premium over time can be explained by changes in the macro economic environment? To answer this question, we considered the effect of changes in interest rates on equity risk premiums. As can be seen in figure 11, the implied equity risk premiums were highest in the 1970s, when interest rates and inflation were also high.

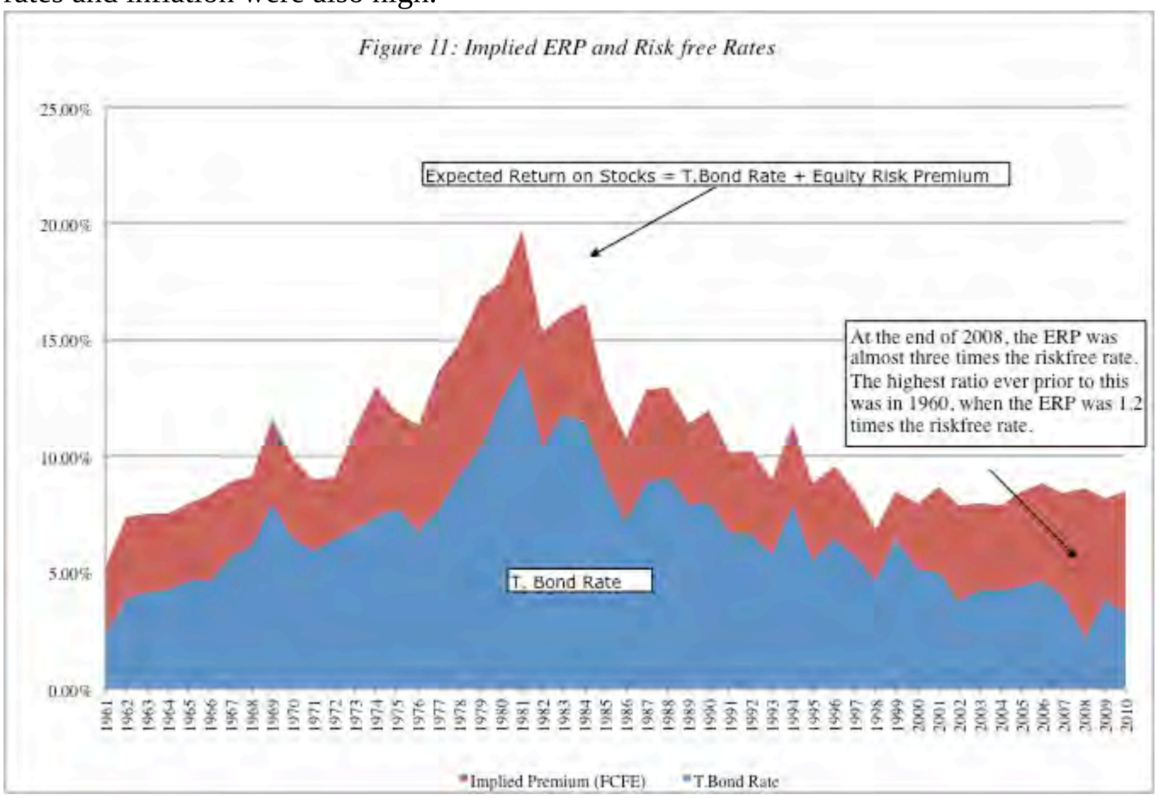


Figure 11: Implied ERP and Risk free Rates

To see if this was an aberration, we ran a regression of the implied equity risk premium against both the level of long-term rates (the treasury bond rate) and the slope of the yield curve (captured as the difference between the 10-year treasury bond rate and the 6-month T.Bill rate), with the t statistics reported in brackets below each coefficient:

Implied ERP = 2.96% + 0.149 (T.Bond Rate) + 0.01 (T.Bond – T.Bill) R^2= 14.9%
(2.86)   (0.26)

There is a strong positive relationship between the T.Bond rate and implied equity risk premiums: every 1% increase in the treasury bond rate increases the equity risk premium by 0.15%. The slope of the yield curve seems to have little impact on the implied equity risk premium. Removing the latter variable and running the regression again:

Implied ERP = 2.97% + 0.149 (T.Bond Rate) R^2=14.9%
(2.89)

This regression reinforces the view that equity risk premiums should not be constant but should be linked to the level of interest rates, at the minimum, and perhaps even to the slope of the yield curve. On February 5, 2011, for instance, when the 10-year treasury bond rate was 3.6%, the implied equity risk premium would have been computed as follows:

Implied ERP = 2.97% + 0.149 (3.60%)   = 3.51%

This would have been below the observed implied equity risk premium of about 5.21% and the average implied equity risk premium of 3.95% between 1960 and 2010.

While we have considered only interest rates in this analysis, it can be expanded to include other fundamental variables including measures of overall economic growth (such as expected growth in the GDP), exchange rates and even measures of risk aversion. Doing so may give us a way of estimating an “intrinsic’ equity risk premium, based upon macro economic conditions, that is less susceptible to market moods and perceptions.

Implied Equity Risk Premiums during a Market Crisis and Beyond

When we use historical risk premiums, we are, in effect, assuming that equity risk premiums do not change much over short periods and revert back over time to historical averages. This assumption was viewed as reasonable for mature equity markets like the United States, but was put under a severe test during the market crisis that unfolded with the fall of Lehman Brothers on September 15, and the subsequent collapse of equity markets, first in the US, and then globally.

Since implied equity risk premiums reflect the current level of the index, the 75 trading days between September 15, 2008, and December 31, 2008, offer us an unprecedented opportunity to observe how much the price charged for risk can change over short periods. In figure 12, we depict the S&P 500 on one axis and the implied equity risk premium on the other. To estimate the latter, we used the level of the index and the treasury bond rate at the end of each day and used the total dollar dividends and buybacks over the trailing 12 months to compute the cash flows for the most recent year.[86] We also updated the expected growth in earnings for the next 5 years, but that number changed only slowly over the period. For example, the total dollar dividends and buybacks on the index for the trailing 12 months of 52.58 resulted in a dividend yield of 4.20% on September 12 (when the index closed at 1252) but jumped to 4.97% on October 6, when the index closed at 1057.[87]

Figure 12: Implied Equity Risk Premium - 9/12- 12/31/08

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86 This number, unlike the index and treasury bond rate, is not updated on a daily basis. We did try to modify the number as companies in the index announced dividend suspensions or buyback modifications.

87 It is possible, and maybe even likely, that the banking crisis and resulting economic slowdown was leading some companies to reassess policies on buybacks. Alcoa, for instance, announced that it was terminating stock buybacks. However, other companies stepped up buybacks in response to lower stock prices. If the total cash return was dropping, as the market was, the implied equity risk premiums should be lower than the numbers that we have computed.

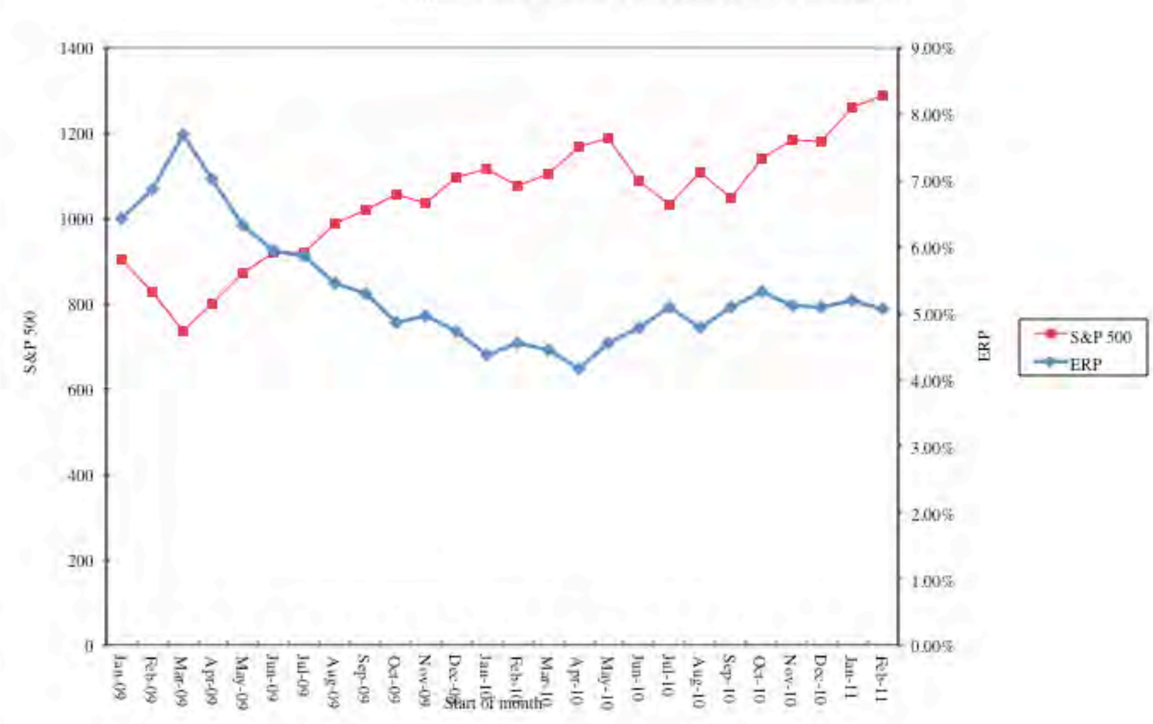
In a period of a month, the implied equity risk premium rose from 4.20% on September 12 to 6.39% at the close of trading of October 10 as the S&P moved from 1250 down to 903. Even more disconcertingly, there were wide swings in the equity risk premium within a day; in the last trading hour just on October 10, the implied equity risk premium ranged from a high of 6.6% to a low of 6.1%. Over the rest of the year, the equity risk premium gyrated, hitting a high of 8% in late November, before settling into the year-end level of 6.43%.

The volatility captured in figure 12 was not restricted to just the US equity markets. Global equity markets gyrated with and sometimes more than the US, default spreads widened considerably in corporate bond markets, commercial paper and LIBOR rates soared while the 3-month treasury bill rate dropped close to zero and the implied volatility in option markets rose to levels never seen before. Gold surged but other commodities, such as oil and grains, dropped. Not only did we discover how intertwined equity markets are around the globe but also how markets for all risky assets are tied together. We will explicitly consider these linkages as we go through the rest of the paper.

There are two ways in which we can view this volatility. One the one side, proponents of using historical averages (either of actual or implied premiums) will use the day-to-day volatility in market risk premiums to argue for the stability of historical averages. They are implicitly assuming that when the crisis passes, markets will return to the status quo. On the other hand, there will be many who point to the unprecedented jump in implied premiums over a few weeks and note the danger of sticking with a “fixed” premium. They will argue that there are sometimes structural shifts in markets, i.e. big events that change market risk premiums for long periods, and that we should be therefore be modifying the risk premiums that we use in valuation as the market changes around us. In January 2009, in the context of equity risk premiums, the first group would have argued we should ignore history (both in terms of historical returns and implied equity risk premiums) and move to equity risk premiums of 6%+ for mature markets (and higher for emerging markets whereas the second would have made a case for sticking with a historical average, which would have been much lower than 6.43%.

The months since the crisis ended have provided more support for the latter group than the former, though the evidence is not conclusive. In figure 13, we report on the monthly equity risk premiums for the S&P 500 from January 2009 through February 2011:

Figure 13: ERP and S&P 500: January 2009 - February 2011



Note that the equity risk premium has dropped from its post-crisis highs and seems to have settled into a range between 4.5-5% for much of the last year.

Rather than take the expedient position of sitting out this debate, the very act of valuing companies requires taking a stand. Though I believe that mean reversion is a powerful force, I think that the banking and financial crisis of 2008 has created a new reality, i.e., that equity risk premiums can change quickly and by large amounts even in mature equity markets. Consequently, I have forsaken my practice of staying with a fixed equity risk premium for mature markets, year after year and vary it year to year, and even on an intra-year basis, if conditions warrant. For many years prior to September 2008, I used 4% as my mature market equity risk premium when valuing companies, and assumed that mean reversion to this number (the average implied premium over time) would occur quickly and deviations from the number would be small. After the crisis, in the first half of 2009, I used equity risk premiums of 6% for mature markets in my valuations. As risk premiums came down in 2009, I moved back to using a 4.5% equity risk premium for mature markets in 2010. With the increase in implied premiums at the start of 2011, my valuations for the year will be based upon an equity risk premium of 5% for mature markets. While some may view this shifting equity risk premium as a sign of weakness, I would frame it differently. When valuing individual companies, I want my valuations to reflect my assessments of the company and not my assessments of the overall equity market. Using equity risk premiums that are very different from the implied premium will introduce a market view into individual company valuations.

Extensions of Implied Equity Risk Premium

The practice of backing out risk premiums from current prices and expected cashflows is a flexible one. It can be expanded into emerging markets to provide estimates of risk premiums that can replace the country risk premiums we developed in the last section. Within an equity market, it can be used to compute implied equity risk premiums for individual sectors or even classes of companies.

a. Other Equity Markets

The advantage of the implied premium approach is that it is market-driven and current, and does not require any historical data. Thus, it can be used to estimate implied equity premiums in any market, no matter how short its history, It is, however, bounded by whether the model used for the valuation is the right one and the availability and reliability of the inputs to that model. Earlier in this paper, we estimated country risk premiums for Brazil, using default spreads and equity market volatile. To provide a contrast, we estimated the implied equity risk premium for the Brazilian equity market in September 2009, from the following inputs.

- The index (Bovespa) was trading at 61,172 on September 30, 2009, and the dividend yield on the index over the previous 12 months was approximately 2.2%. While stock buybacks represented negligible cash flows, we did compute the FCFE for companies in the index, and the aggregate FCFE yield across the companies was 4.95%.
- Earnings in companies in the index are expected to grow 6% (in US dollar terms) over the next 5 years, and 3.45% (set equal to the treasury bond rate) thereafter.
- The riskfree rate is the US 10-year treasury bond rate of 3.45%.

The time line of cash flows is shown below:

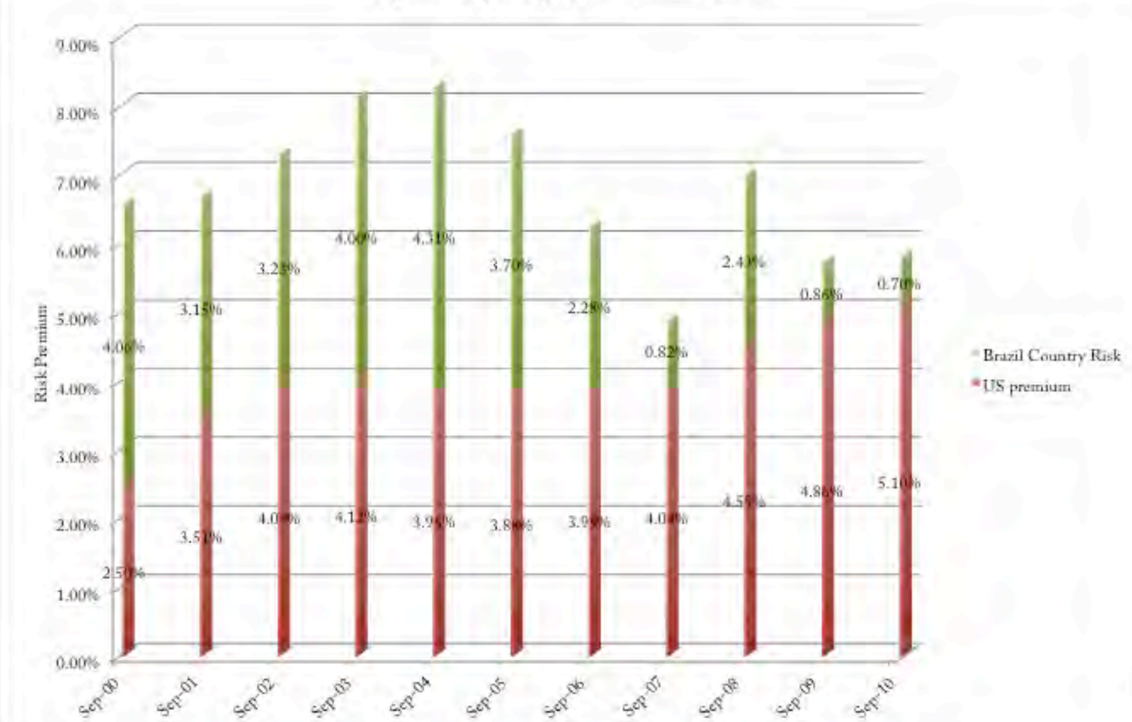
$$61,272 = \frac{3210}{(1+r)} + \frac{3,402}{(1+r)^2} + \frac{3,606}{(1+r)^3} + \frac{3,821}{(1+r)^4} + \frac{4,052}{(1+r)^5} + \frac{4,052(1.0345)}{(r-.0345)(1+r)^5}$$

These inputs yield a required return on equity of 9.17%, which when compared to the treasury bond rate of 3.45% on that day results in an implied equity premium of 5.72%.

For simplicity, we have used nominal dollar expected growth rates[88] and treasury bond rates, but this analysis could have been done entirely in the local currency.

One of the advantages of using implied equity risk premiums is that that they are more sensitive to changing market conditions. The implied equity risk premium for Brazil in September 2007, when the Bovespa was trading at 73,512 was 4.63%, lower than the premium in September 2009, which in turn was much higher than the premium prevailing in January 2011. In figure 14, we trace the changes in the implied equity risk premium in Brazil from September 2000 to September 2010 and compare them to the implied premium in US equities:

Figure 14: Implied Equity Risk Premium - Brazil



Implied equity risk premiums in Brazil declined steadily from 2003 to 2007, with the September 2007 numbers representing a historic low. They surged in September 2008, as the crisis unfolded, but have fallen back since. In fact, the Brazil portion of the implied equity risk premium has fallen to its lowest level in ten years in September 2010.

Computing and comparing implied equity risk premiums across multiple equity markets allows us to pinpoint markets that stand out, either as over priced (because their implied premiums are too low, relative to other markets) or under priced (because their

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88 The input that is most difficult to estimate for emerging markets is a long-term expected growth rate. For Brazilian stocks, I used the average consensus estimate of growth in earnings for the largest Brazilian companies which have ADRs listed on them. This estimate may be biased, as a consequence.

premiums at too high, relative to other markets). In September 2007, for instance, the implied equity risk premiums in India and China were roughly equal to or even lower than the implied premium for the United States, computed at the same time. Even an optimist on future growth these countries would be hard pressed to argue that equity markets in these markets and the United States were of equivalent risk, which would lead us to conclude that these stocks were overvalued relative to US companies.

One final note is worth making. Over the last decade, the implied equity risk premiums in the largest emerging markets – India, China and Brazil- have all declined substantially, relative to developed markets. (The graphs of implied premiums for India and China look very much like Figure 14) Though it is possible that these markets are over priced, a stronger argument that can be made that this convergence reflects the increasing maturity and stability of the underlying economies in these countries. In fact, the volatility in developed markets, especially in the last two years, suggests that globalization has put “emerging market risk” into developed markets, while creating “developed markets stability factors” (more predictable government policies, stronger legal and corporate governance systems, lower inflation and stronger currencies) in emerging markets.

Sector

Using current prices and expected future cash flows to back out implied risk premiums is not restricted to market indices. We can employ the approach to estimate the implied equity risk premium for a specific sector at a point in time. In September 2008, for instance, there was a widely held perception that investors were attaching much higher equity risk premiums to commercial bank stocks, in the aftermath of the failures of Fannie Mae, Freddie Mac, Bear Stearns and Lehman. To test this proposition, we took a look at the S&P Commercial Bank index, which was trading at 318.26 on September 12, 2008, with an expected dividend yield of 5.83% for the next 12 months. Assuming that these dividends will grow at 4% a year for the next 5 years and 3.60% (the treasury bond rate) thereafter, well below the nominal growth rate in the overall economy, we arrived at the following equation:

$$318.26 = \frac{19.30}{(1+r)} + \frac{20.07}{(1+r)^2} + \frac{20.87}{(1+r)^3} + \frac{21.71}{(1+r)^4} + \frac{22.57}{(1+r)^5} + \frac{22.57(1.036)}{(r-.036)(1+r)^5}$$

Solving for the expected return yields a value of 9.74%, which when netted out against the riskfree rate at the time (3.60%) yields an implied premium for the sector:

Implied ERP for Banking in September 2008 = 9.74% - 3.60% = 6.14%

How would we use this number? One approach would be to compare it to the average implied premium in this sector over time, with the underlying assumption that the value will revert back to the historical average for the sector. The implied equity risk premium for commercial banking stocks was close to 4% between 2005 and 2007, which would lead to the conclusion that banking stocks were undervalued in September 2008. The other is to assume that the implied equity premium for a sector is reflective of perceptions of future risk in that sector; in September 2008, there can be no denying that financial service companies faced unique risks and the market was reflecting these risks in prices. As a postscript, the implied equity risk premium for financial service firms in January 2011 reverted back to about 5%, just below the market implied premium at the time (5.20%).

A note of caution has to be added to about sector-implied premiums. Since these risk premiums consolidate both sector risk and market risk, it would be inappropriate to multiply these premiums by conventional betas, which are influenced by sector risk. Thus, multiplying the implied equity risk premium for the technology sector (which will yield a high value) by a market beta for a technology company (which will also be high for the same reason) will result in double counting risk.[89]

Firm Characteristics

Earlier in this paper, we talked about the small firm premium and how it has been estimated using historical data, resulting in backward looking estimates with substantial standard error. We could use implied premiums to arrive at more forward looking estimates, using the following steps:

1. Compute the implied equity risk premium for the overall market, using a broad index such as the S&P 500. Earlier in this paper, we estimated this as of January 2011 to be 5.20%.

2. Compute the implied equity risk premium for an index containing primarily or only small cap firms, such as the S&P 600 Small Cap Index. In January 2011, the index was trading at 419.77, with an aggregated dividend yield (including stock buybacks) of about 3.35%, with an expected growth rate in earnings of 18% for the next 5 years. Using these values, in conjunction with a riskfree rate of 3.84%, yields the following equation:

$$419.77 = \frac{15.32}{(1+r)} + \frac{19.58}{(1+r)^2} + \frac{23.10}{(1+r)^3} + \frac{27.26}{(1+r)^4} + \frac{32.17}{(1+r)^5} + \frac{32.17(1.0329)}{(r-.0329)(1+r)^5}$$

Solving for the expected return, we get:

Expected return on small cap stocks = 9.62%

Implied equity risk premium for small cap stocks = 9.62% -3.29% = 6.33%

[89] You could estimate betas for technology companies against a technology index (rather than the market index) and use these betas with the implied equity risk premium for technology companies.

3. The forward-looking estimate of the small cap premium should be the difference between the implied premium for small cap stocks (in step 2) and the implied premium for the market (in step 1). With the numbers in January 2011, the small cap premium is 1.13%, well below the historical average premium of 4.72% that we estimated in the earlier section. In fact, if small cap stocks are riskier than the rest of the market (have a beta greater than 1.22), there may be no excess returns at all from buying these stocks.[90]

This approach to estimating premiums can be extended to other variables. For instance, one of the issues that has challenged analysts in valuation is how to deal with illiquidity, with the question being how to discount the values of illiquid assets. While the conventional approach is to attach an illiquidity discount, an alternative is to adjust the discount rate upwards for illiquid assets. If we compute the implied equity risk premiums for stocks categorized by illiquidity, we may be able to come up with an appropriate adjustment. For instance, assume that the implied equity risk premium for stocks that rank in the lowest decile in terms of illiquidity, defined as turnover ratio, is 6.35%;[91] comparing this value to the implied premium for the S&P 500 of 5.20% results in an illiquidity premium of 1.15%. Adding this premium to the cost of equity for relatively illiquid investments will then discount the value of these investments for illiquidity.

2. Default Spread Based Equity Risk Premiums

While we think of corporate bonds, stocks and real estate as different asset classes, it can be argued that they are all risky assets and that they should therefore be priced consistently. Put another way, there should be a relationship across the risk premiums in these asset classes that reflect their fundamental risk differences. In the corporate bond market, the default spread, i.e, the spread between the interest rate on corporate bonds and the treasury bond rate, is used as the risk premium. In the equity market, as we have seen through this paper, historical and implied equity premiums have tussled for supremacy as the measure of the equity risk premium. In the real estate market, no mention is made of an explicit risk premium, but real estate valuations draw heavily on the "capitalization rate", which is the discount rate applied to a real estate property's earnings to arrive at an estimate of value. The use of higher (lower) capitalization rates is the equivalent of demanding a higher (lower) risk premium.

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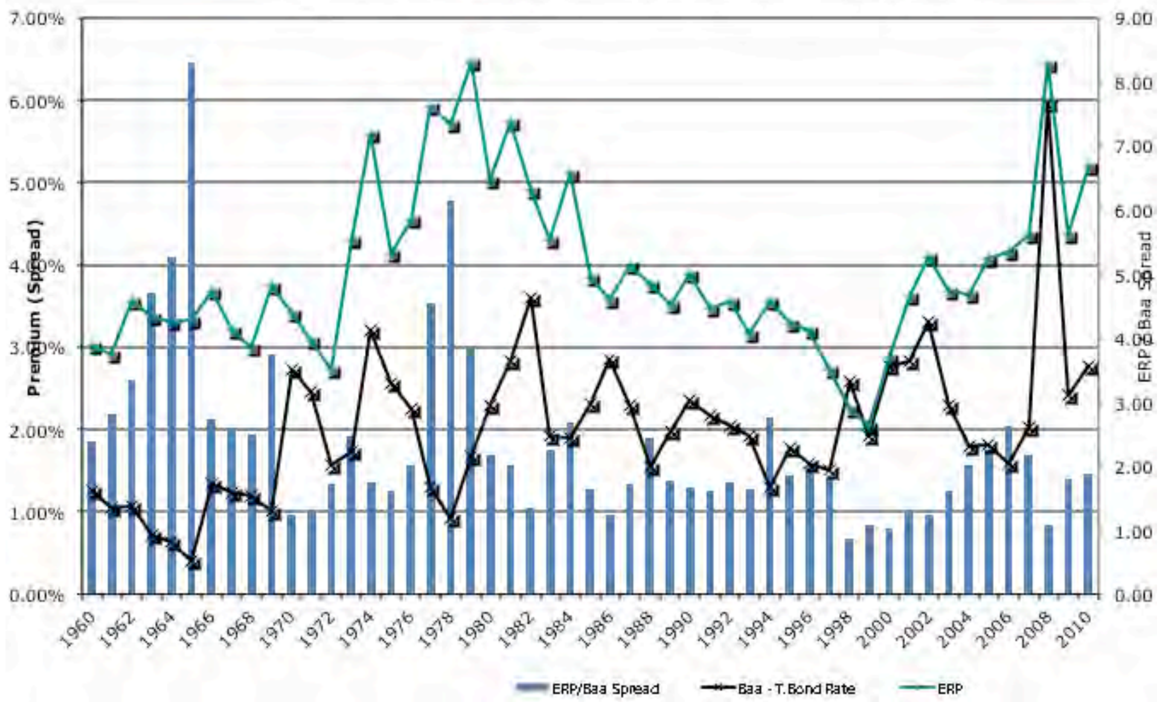
[90] To work out the imputed beta, divide the implied premium for small cap stocks (6.33%) by the implied premium for the S&P 500 (5.20%). If we assume that the latter has a beta close to 1, the beta for small cap stocks would have to be less than 1.22 (6.33/5.20) for the excess return to be positive.

[91] The turnover ratio is obtained by dividing $ trading volume in a stock by its market capitalization at that time.

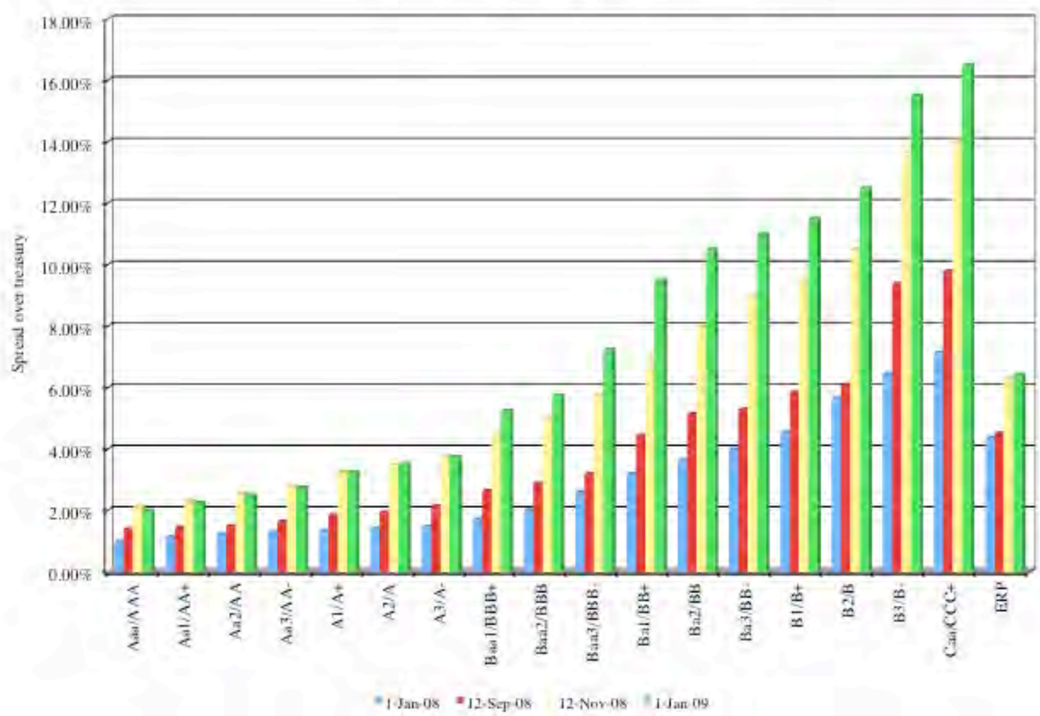
Of these three premiums, the default spread is the less complex and the most widely accessible data item. If equity risk premiums could be stated in terms of the default spread on corporate bonds, the estimation of equity risk premiums would become immeasurably simpler. For instance, assume that the default spread on Baa rated corporate bonds, relative to the ten-year treasury bond, is 2.2% and that equity risk premiums are routinely twice as high as Baa bonds, the equity risk premium would be 4.4%. Is such a rule of thumb even feasible? To answer this question, we looked at implied equity risk premiums and Baa rated corporate bond default spreads from 1960 to 2010 in Figure 15.

Figure 15: Equity Risk Premiums and Bond Default Spreads



Note that both default spreads and equity risk premiums jumped in 2008, with the former increasing more on a proportionate basis. The ratio of 1.08 (ERP/ Baa Default Spread) at the end of 2008 was close to the lowest value in the entire series, suggesting that either equity risk premiums were too low or default spreads were too high. By January 2011, both risk premiums decreased, but default spreads dropped far more than the equity risk premium and the ratio moved back to 1.88, a little lower than the median value of 2.01 (and the average of 2.36) for the entire time period. The connection between equity risk premiums and default spreads was most obvious during 2008, where changes in one often were accompanied by changes in the other. Figure 16 graphs out changes in default spreads and ERP over the tumultuous year:

Figure 16: Default Spreads on Ratings Classes



In closing, default spreads, like equity risk premiums, decreased in the first nine months of 2009. On January 1, 2011, the default spread on a Baa rated bond was back to 2.76%. Applying the median ratio of 2.01, estimated from 1960-2010 numbers, to the Baa default spread of 2.76% in January 2011 results in the following estimate of the ERP:

Default Spread on Baa bonds (over treasury) on 1/1/2011 = 2.76%

Imputed Equity Risk Premium = Default Spread * Median ratio or ERP/Spread

=2.76%* 2.01 = 5.55%

This is higher than the implied equity risk premium of 5.20% in January 2011, but there is significant variation in the ratio (of ERP to default spreads) over time, with the ratio dropping below one at the peak of the dot.com boom (when equity risk premiums dropped to 2%) and rising to as high as 2.63 at the end of 2006; the standard error in the estimate is 0.20. Whenever the ratio has deviated significantly from the average, though, there is reversion back to that median over time.

The capitalization rate in real estate, as noted earlier, is a widely used number in the valuation of real estate properties. For instance, a capitalization rate of 10%, in conjunction with an office building that generates income of $ 10 million, would result in a property value of $ 100 million ($10/.10). The difference between the capitalization ratio and the treasury bond rate can be considered a real estate market risk premium, In Figure 17, we used the capitalization rate in real estate ventures and compared the risk premiums imputed for real estate with both bond default spreads and implied equity risk premiums between 1980 and 2010.

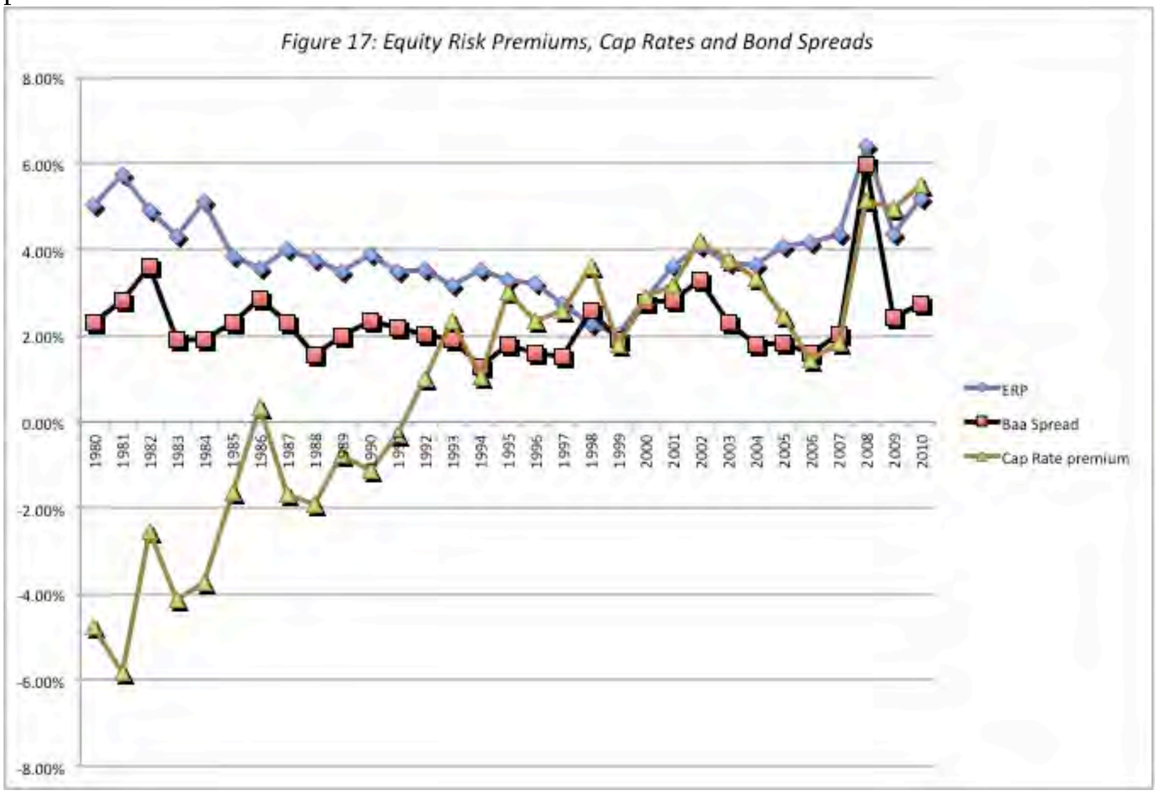


Figure 17: Equity Risk Premiums, Cap Rates and Bond Spreads

The story in this graph is the convergence of the real estate and financial asset risk premiums. In the early 1980s, the real estate market seems to be operating in a different risk/return universe than financial assets, with the cap rates being less than the treasury bond rate. For instance, the cap rate in 1980 was 8.1%, well below the treasury bond rate of 12.8%, resulting in a negative risk premium for real estate. The risk premiums across the three markets - real estate, equity and bonds - starting moving closer to each other in the late 1980s and the trend accelerated in the 1990s. We would attribute at least some of this increased co-movement to the securitization of real estate in this period. In 2008, the three markets moved almost in lock step, as risk premiums in the markets rose and prices fell. The housing bubble of 2004-2008 is manifested in the drop in the real estate equity risk premium during those years, bottoming out at less than 2% at the 2006. The correction in housing prices since has pushed the premium back up. Both equity and bond premiums have adjusted quickly to pre-crisis levels in 2009 and 2010, and real estate premiums are following, albeit at a slower pace.

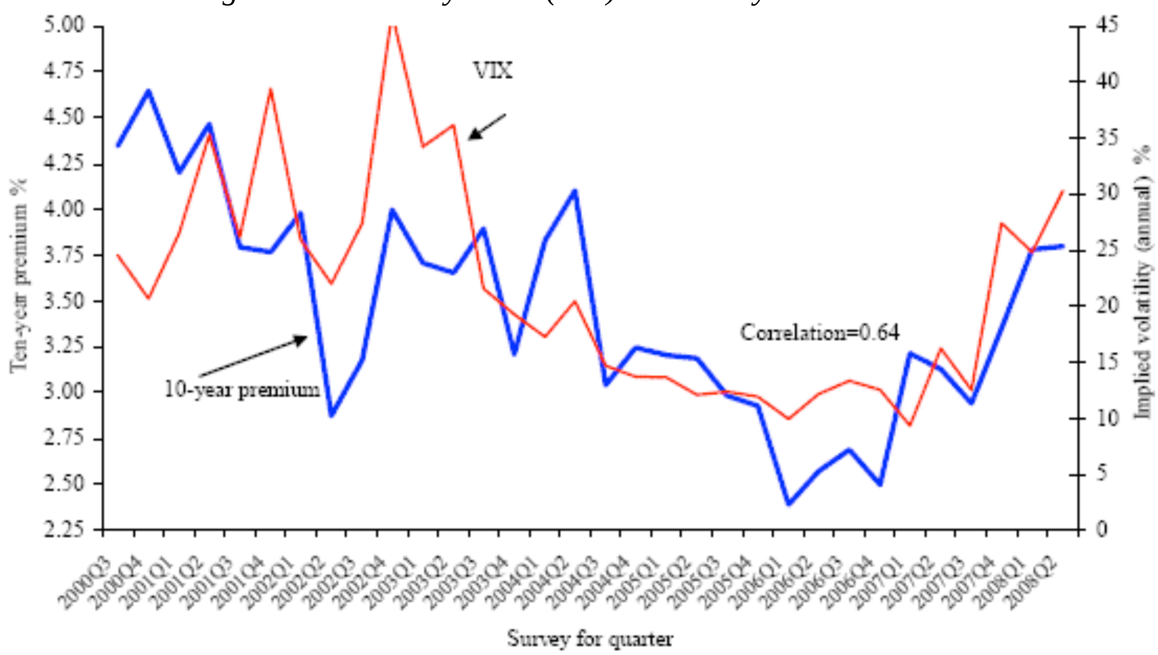
While the noise in the ratios (of ERP to default spreads and cap rates) is too high for us to develop a reliable rule of thumb, there is enough of a relationship here that we would suggest using this approach as a secondary one to test to see whether the equity risk premiums that we are using in practice make sense, given how risky assets are being priced in other markets. Thus, using an equity risk premium of 2%, when the Baa default spread is approximately at the same level strikes us as imprudent, given history. For macro strategists, there is a more activist way of using these premiums. When risk premiums in markets diverge, there is information about relative pricing. Thus, the drop in equity risk premiums in the late 1990s, as default spreads stayed stable, would have signaled that the equity markets were overvalued (relative to bonds), just as the drop in default spreads between 2004 and 2007, while equity risk premiums were stagnant, would have suggested the opposite.

Option Pricing Model based Equity Risk Premium

There is one final approach to estimating equity risk premiums that draws on information in the option market. In particular, option prices can be used to back out implied volatility in the equity market. To the extent that the equity risk premium is our way of pricing in the risk of future stock price volatility, there should be a relationship between the two.

The simplest measure of volatility from the options market is the volatility index (VIX), which is a measure of 30—day volatility constructed using the implied volatilities in traded S&P 500 index options. The CFO survey premium from Graham and Harvey that we referenced earlier in the paper found a high degree of correlation between the premiums demanded by CFOs and the VIX value (see figure 18 below):

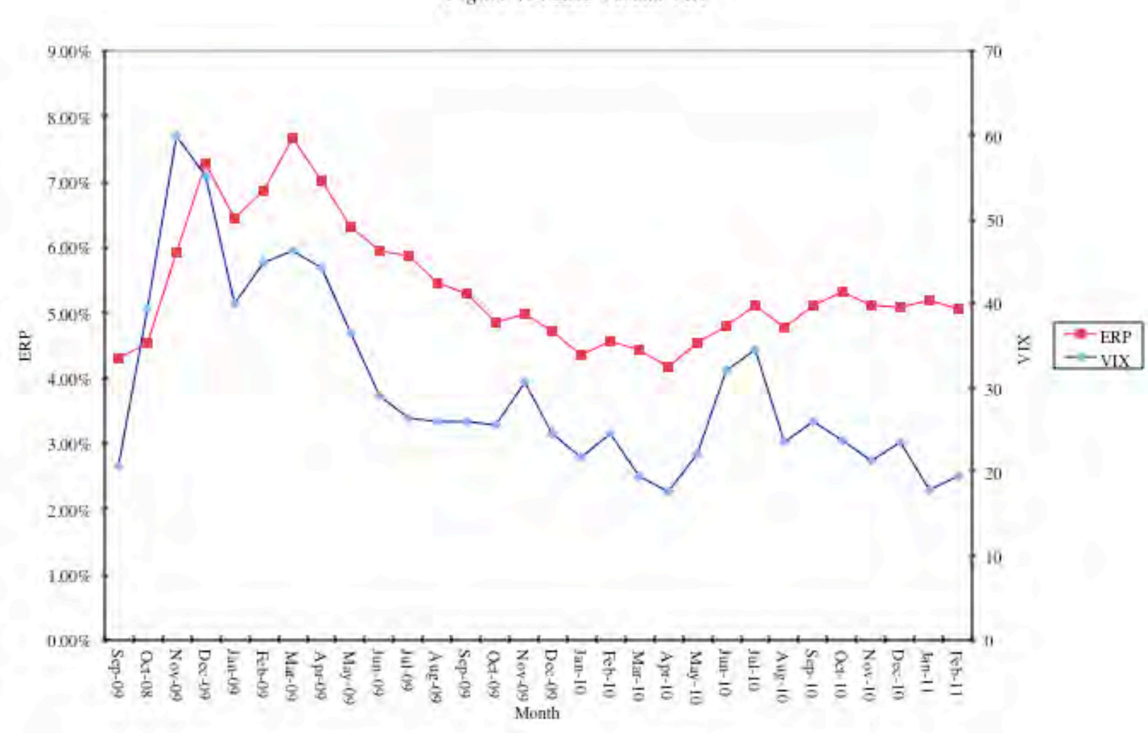
Figure 18: Volatility Index (VIX) and Survey Risk Premiums



Santa-Clara and Yan (2006) use options on the S&P 500 to estimate the ex-ante risk assessed by investors from 1996 and 2002 and back out an implied equity risk premium on that basis.[92] To estimate the ex-ante risk, they allow for both continuous and discontinuous (or jump) risk in stocks, and use the option prices to estimate the probabilities of both types of risk. They then assume that investors share a specific utility function (power utility) and back out a risk premium that would compensate for this risk. Based on their estimates, investors should have demanded an equity risk premium of 11.8% for their perceived risk and that the perceived risk was about 70% higher than the realized risk over this period.

The link between equity market volatility and the equity risk premium also became clearer during the market meltdown in the last quarter of 2008. Earlier in the paper, we noted the dramatic shifts in the equity risk premiums, especially in the last year, as the financial crisis has unfolded. In figure 19, we look at the implied equity risk premium each month from September 2008 to February 2011 and the volatility index (VIX) for the S&P 500:

Figure 19: ERP versus VIX



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[92] Santa-Clara, P. and S. Yan, 2006, *Crashes, Volatility, and the Equity Premium: Lessons from S&P 500 Options*, Review of Economics and Statistics, v92, pg 435-451.

Note that the surge in equity risk premiums between September 2008 and December 2008 coincided with a jump in the volatility index and that both numbers have declined in the years since the crisis.

Choosing an Equity Risk Premium

We have looked at three different approaches to estimating risk premiums, the survey approach, where the answer seems to depend on who you ask and what you ask them, the historical premium approach, with wildly different results depending on how you slice and dice historical data and the implied premium approach, where the final number is a function of the model you use and the assumptions you make about the future. Ultimately, thought, we have to choose a number to use in analysis and that number has consequences. In this section, we consider why the approaches give you different numbers and a pathway to use to devise which number is best for you.

Why do the approaches yield different values?

The different ways of estimating equity risk premium provide cover for equity research analysts by providing justification for almost any number they choose to use in practice. No matter what the premium used by an analyst, whether it be 3% or 12%, there is back-up evidence offered that the premium is appropriate. While this may suffice as a legal defense, it does not pass muster on common sense grounds since not all risk premiums are equally justifiable. To provide a measure of how the numbers vary, the values that we have attached to the US equity risk premium, using different approaches, in January 2011 are summarized in table 18.

Table 18: Equity Risk Premium (ERP) for the United States – January 2010

Approach Used	*ERP*	*Additional information*
Survey: CFOs	3.07%	Campbell and Harvey survey of CFOs (2010); Average estimate. Median was 2.7%.
Survey: Global Fund Managers	3.86%	Merrill Lynch (January 2011) survey of global managers
Historical - US	4.31%	Geometric average - Stocks over T.Bonds: 1928-2010
Historical – Multiple Equity Markets	3.80%	Average premium across 19 markets: Dimson, Marsh and Staunton (2011)
Current Implied premium	5.07%	From S&P 500 – February 1, 2011
Average Implied premium	3.95%	Average of implied equity risk premium: 1960-2010
Implied premium adjusted for T.Bond rate and term structure	3.51%	Using regression of implied premium on T.Bond rate

Default spread based premium	5.55%	Baa Default Spread * (ERP/ Default Spread average)

The equity risk premiums, using the different approaches, yield a range, with the lowest value being 3.07% and the highest being 5.55%. Note that the range would have been larger if we used other measures of historical risk premiums: different time periods, arithmetic instead of geometric averages. The narrow range on the estimates that we obtain is unusual, since the differences have been far wider at other points in time. In December 1999, for instance, the estimates would have ranged from 2% (the implied equity risk premium from the index) to over 6% (from surveys and historical data).

There are several reasons why the approaches yield different answers much of time and why they converge sometimes.

1. When stock prices enter an extended phase of upward (downward) movement, the historical risk premium will climb (drop) to reflect past returns. Implied premiums will tend to move in the opposite direction, since higher (lower) stock prices generally translate into lower (higher) premiums. In 1999, for instance, after the technology induced stock price boom of the 1990s, the implied premium was 2% but the historical risk premium was almost 6%.
2. Survey premiums reflect historical data more than expectations. When stocks are going up, investors tend to become more optimistic about future returns and survey premiums reflect this optimism. In fact, the evidence that human beings overweight recent history (when making judgments) and overreact to information can lead to survey premiums overshooting historical premiums in both good and bad times. In good times, survey premiums are even higher than historical premiums, which, in turn, are higher than implied premiums; in bad times, the reverse occurs.
3. When the fundamentals of a market change, either because the economy becomes more volatile or investors get more risk averse, historical risk premiums will not change but implied premiums will. Shocks to the market are likely to cause the two numbers to deviate. After the terrorist attack in September 2001, for instance, implied equity risk premiums jumped almost 0.50% but historical premiums were unchanged (at least until the next update).

In summary, we should not be surprised to see large differences in equity risk premiums as we move from one approach to another, and even within an approach, as we change estimation parameters.

Which approach is the "best" approach?

If the approaches yield different numbers for the equity risk premium, and we have to choose one of these numbers, how do we decide which one is the "best" estimate? The answer to this question will depend upon several factors:

a. Predictive Power: In corporate finance and valuation, what we ultimately care about is the equity risk premium for the future. Consequently, the approach that has the best predictive power, i.e. yields forecasts of the risk premium that are closer to realized premiums, should be given more weight. So, which of the approaches does best on this count?

Campbell and Shiller (1988) suggested that the dividend yield, a simplistic measure of the implied equity risk premium, had significant predictive power for future returns.[93] However, Goyal and Welch (2007) examined many of the measures suggested as predictors of the equity risk premium in the literature, including the dividend yield and the earnings to price ratio, and find them all wanting.[94] Using data from 1926 to 2005, they conclude that while the measures do reasonably well in sample, they perform poorly out of sample, suggesting that the relationships in the literature are either spurious or unstable. Campbell and Thompson (2008) disagree, noting that putting simple restrictions on the predictive regressions improve out of sample performance for many predictive variables.[95]

To answer this question, we looked at the implied equity risk premiums from 1960 to 2010 and considered four predictors of this premium – the historical risk premium through the end of the prior year, the implied equity risk premium at the end of the prior year, the average implied equity risk premium over the previous five years and the premium implied by the Baa default spread. Since the survey data does not go back very far, we could not test the efficacy of the survey premium. Our results are summarized in table 19:

Table 19: Predictive Power of different estimates- 1960 - 2010

Predictor	*Correlation with implied premium next year*	*Correlation with actual risk premium – next 10 years*
Current implied premium	0.700	0.427

[93] Campbell, J. Y. and R. J. Shiller. 1988, *The Dividend-Price Ratio And Expectations Of Future Dividends And Discount Factors*, Review of Financial Studies, v1(3), 195-228.

[94] Goyal, A. and I. Welch, 2007, *A Comprehensive Look at the Empirical Performance of Equity Premium Prediction*, Review of Financial Studies, v21, 1455-1508.

[95] Campbell, J.Y., and S.B. Thompson, 2008, *Predictive Excess Stock Returns Out of Sample: Can Anything Beat the Historical Average?* Review of Financial Studies, v21, 150-9-1531.

Average implied premium: Last 5 years	0.630	0.352
Historical Premium	-0.353	-0.497
Default Spread based premium	0.065	0.181

Over this period, the implied equity risk premium at the end of the prior period was the best predictor of the implied equity risk premium in the next period, whereas historical risk premiums did worst. If we extend our analysis to make forecasts of the actual return premium earned by stocks over bonds for the next 10 years, the current implied equity risk premium still yields the best forecast for the future, though default spread based premiums improve slightly as predictors. Historical risk premiums perform even worse as forecasts of actual risk premiums over the next 10 years. If predictive power were the only test, historical premiums clearly fail the test.

b. <u>Beliefs about markets</u>: Implicit in the use of each approach are assumptions about market efficiency or lack thereof. If you believe that markets are efficient in the aggregate, or at least that you cannot forecast the direction of overall market movements, the current implied equity premium is the most logical choice, since it is estimated from the current level of the index. If you believe that markets, in the aggregate, can be significantly overvalued or undervalued, the historical risk premium or the average implied equity risk premium over long periods becomes a better choice. If you have absolutely no faith in markets, survey premiums will be the choice.

c. <u>Purpose of the analysis</u>: Notwithstanding your beliefs about market efficiency, the task for which you are using equity risk premiums may determine the right risk premium to use. In acquisition valuations and equity research, for instance, you are asked to assess the value of an individual company and not take a view on the level of the overall market. This will require you to use the current implied equity risk premium, since using any other number will bring your market views into the valuation. To see why, assume that the current implied premium is 4% and you decide to use a historical premium of 6% in your company valuation. Odds are that you will find the company to be over valued, but a big reason for your conclusion is that you started off with the assumption that the market itself is over valued by about 25-30%.[96] To make your valuation market neutral, you will have to stick with the

[96] If the current implied premium is 4%, using a 6% premium on the market will reduce the value of the index by about 25-30%.

current implied premium. In corporate finance, where the equity risk premium is used to come up with a cost of capital, which in turn determines the long-term investments of the company, it may be more prudent to build in a long-term average (historical or implied) premium.

In conclusion, there is no one approach to estimating equity risk premiums that will work for all analyses. If predictive power is critical or if market neutrality is a pre-requisite, the current implied equity risk premium is the best choice. For those more skeptical about markets, the choices are broader, with the average implied equity risk premium over a long time period having the strongest predictive power. Historical risk premiums are very poor predictors of both short-term movements in implied premiums or long-term returns on stocks.

Myths about equity risk premiums

There are widely held misconceptions about equity risk premiums that we would like to dispel in this section.

1. Services "know" the risk premium: When Ibbotson and Sinquefield put together the first database of historical returns on stocks, bonds and bills in the 1970s, the data that they used was unique and not easily replicable, even for professional money managers. The niche they created, based on proprietary data, has led some to believe that Ibbotson Associates, and data services like them, have the capacity to read the historical data better than the rest of us, and therefore come up with better estimates. Now that the access to data has been democratized, and we face a much more even playing field, there is no reason to believe that any service has an advantage over any other, when it comes to historical premiums. Analysts should no longer be allowed to hide behind the defense that the equity risk premiums they use come from a reputable service and are thus beyond questioning.
2. There is no right risk premium: The flip side of the "services know it best" argument is that the data is so noisy that no one knows what the right risk premium is, and that any risk premium within a wide range is therefore defensible. As we have noted in this paper, it is indeed possible to arrive at outlandishly high or low premiums, but only if you use estimation approaches that do not hold up to scrutiny. The arithmetic average premium from 2001 to 2011 for stocks over treasury bonds of -4.11% is an equity risk premium estimate, but it is not a good one.
3. The equity risk premium does not change much over time: Equity risk premiums reflect both economic fundamentals and investor risk aversion and they do change over time, sometimes over very short intervals, as evidenced by what happened in the

last quarter of 2008. Shocks to the system – a collapse of a large company or sovereign entity or a terrorist attack – can cause premiums to shoot up overnight. A failure to recognize this reality will lead to analyses that lag reality.

4. Using the same premium is more important than using the right premium: Within many investment banks, corporations and consulting firms, the view seems to be that getting all analysts to use the same risk premium is more important than testing to see whether that premium makes sense. Thus, if all equity research analysts use 5% as the equity risk premium, the argument is that they are all being consistent. There are two problems with this argument. The first is that using a premium that is too high or low will lead to systematic errors in valuation. For instance, using a 5% risk premium across the board, when the implied premium is 4%, will lead you to find that most stocks are overvalued. . The second is that the impact of using too high a premium can vary across stocks, with growth stocks being affected more negatively than mature companies. A portfolio manager who followed the recommendations of these analysts would then be over invested in mature companies and under invested in growth companies.
5. If you adjust the cash flows for risk, there is no need for a risk premium: While statement is technically correct, adjusting cash flows for risk has to go beyond reflecting the likelihood of negative scenarios in the expected cash flow. The risk adjustment to expected cash flows to make them certainty equivalent cash flows requires us to answer exactly the same questions that we deal with when adjusting discount rates for risk.

Summary

The risk premium is a fundamental and critical component in portfolio management, corporate finance and valuation. Given its importance, it is surprising that more attention has not been paid in practical terms to estimation issues. In this paper, we began by looking at the determinants of equity risk premiums including macro economic volatility, investor risk aversion and behavioral components. We then looked at the three basic approaches used to estimate equity risk premiums – the survey approach, where investors or managers are asked to provide estimates of the equity risk premium for the future, the historical return approach, where the premium is based upon how well equities have done in the past and the implied approach, where we use future cash flows or observed bond default spreads to estimate the current equity risk premium.

The premiums we estimate can vary widely across approaches, and we considered two questions towards the end of the paper. The first is why the numbers vary across approaches and the second is how to choose the “right” number to use in analysis. For the latter question, we argued that the choice of a premium will depend upon the forecast period, whether your believe markets are efficient and whether you are required to be market neutral in your analysis.

Appendix 1: Historical Returns on Stocks, Bonds and Bills – United States

	Annual Returns on Investment in			**Realized Risk Premium**		**Arithmetic Premium**	**Geometric Premium**
Year	*Stocks*	*T.Bills*	*T.Bonds*	Stocks - Bills	Stocks - Bonds	Stocks –Bonds 1928-Year	Stocks – Bonds 1928-Year
1928	43.81%	3.08%	0.84%	40.73%	42.98%	42.98%	42.98%
1929	-8.30%	3.16%	4.20%	-11.46%	-12.50%	15.24%	12.33%
1930	-25.12%	4.55%	4.54%	-29.67%	-29.66%	0.27%	-3.60%
1931	-43.84%	2.31%	-2.56%	-46.15%	-41.28%	-10.12%	-15.42%
1932	-8.64%	1.07%	8.79%	-9.71%	-17.43%	-11.58%	-15.81%
1933	49.98%	0.96%	1.86%	49.02%	48.13%	-1.63%	-7.36%
1934	-1.19%	0.32%	7.96%	-1.51%	-9.15%	-2.70%	-7.61%
1935	46.74%	0.18%	4.47%	46.57%	42.27%	2.92%	-2.49%
1936	31.94%	0.17%	5.02%	31.77%	26.93%	5.59%	0.40%
1937	-35.34%	0.30%	1.38%	-35.64%	-36.72%	1.36%	-4.22%
1938	29.28%	0.08%	4.21%	29.21%	25.07%	3.51%	-1.87%
1939	-1.10%	0.04%	4.41%	-1.14%	-5.51%	2.76%	-2.17%
1940	-10.67%	0.03%	5.40%	-10.70%	-16.08%	1.31%	-3.30%
1941	-12.77%	0.08%	-2.02%	-12.85%	-10.75%	0.45%	-3.88%
1942	19.17%	0.34%	2.29%	18.84%	16.88%	1.54%	-2.61%
1943	25.06%	0.38%	2.49%	24.68%	22.57%	2.86%	-1.18%
1944	19.03%	0.38%	2.58%	18.65%	16.45%	3.66%	-0.21%
1945	35.82%	0.38%	3.80%	35.44%	32.02%	5.23%	1.35%
1946	-8.43%	0.38%	3.13%	-8.81%	-11.56%	4.35%	0.63%
1947	5.20%	0.57%	0.92%	4.63%	4.28%	4.35%	0.81%
1948	5.70%	1.02%	1.95%	4.68%	3.75%	4.32%	0.95%
1949	18.30%	1.10%	4.66%	17.20%	13.64%	4.74%	1.49%
1950	30.81%	1.17%	0.43%	29.63%	30.38%	5.86%	2.63%
1951	23.68%	1.48%	-0.30%	22.20%	23.97%	6.61%	3.46%
1952	18.15%	1.67%	2.27%	16.48%	15.88%	6.98%	3.94%
1953	-1.21%	1.89%	4.14%	-3.10%	-5.35%	6.51%	3.57%
1954	52.56%	0.96%	3.29%	51.60%	49.27%	8.09%	4.98%
1955	32.60%	1.66%	-1.34%	30.94%	33.93%	9.01%	5.93%
1956	7.44%	2.56%	-2.26%	4.88%	9.70%	9.04%	6.07%
1957	-10.46%	3.23%	6.80%	-13.69%	-17.25%	8.16%	5.23%
1958	43.72%	1.78%	-2.10%	41.94%	45.82%	9.38%	6.39%
1959	12.06%	3.26%	-2.65%	8.80%	14.70%	9.54%	6.66%
1960	0.34%	3.05%	11.64%	-2.71%	-11.30%	8.91%	6.11%
1961	26.64%	2.27%	2.06%	24.37%	24.58%	9.37%	6.62%
1962	-8.81%	2.78%	5.69%	-11.59%	-14.51%	8.69%	5.97%

1963	22.61%	3.11%	1.68%	19.50%	20.93%	9.03%	6.36%
1964	16.42%	3.51%	3.73%	12.91%	12.69%	9.13%	6.53%
1965	12.40%	3.90%	0.72%	8.50%	11.68%	9.20%	6.66%
1966	-9.97%	4.84%	2.91%	-14.81%	-12.88%	8.63%	6.11%
1967	23.80%	4.33%	-1.58%	19.47%	25.38%	9.05%	6.57%
1968	10.81%	5.26%	3.27%	5.55%	7.54%	9.01%	6.60%
1969	-8.24%	6.56%	-5.01%	-14.80%	-3.23%	8.72%	6.33%
1970	3.56%	6.69%	16.75%	-3.12%	-13.19%	8.21%	5.90%
1971	14.22%	4.54%	9.79%	9.68%	4.43%	8.12%	5.87%
1972	18.76%	3.95%	2.82%	14.80%	15.94%	8.30%	6.08%
1973	-14.31%	6.73%	3.66%	-21.03%	-17.97%	7.73%	5.50%
1974	-25.90%	7.78%	1.99%	-33.68%	-27.89%	6.97%	4.64%
1975	37.00%	5.99%	3.61%	31.01%	33.39%	7.52%	5.17%
1976	23.83%	4.97%	15.98%	18.86%	7.85%	7.53%	5.22%
1977	-6.98%	5.13%	1.29%	-12.11%	-8.27%	7.21%	4.93%
1978	6.51%	6.93%	-0.78%	-0.42%	7.29%	7.21%	4.97%
1979	18.52%	9.94%	0.67%	8.58%	17.85%	7.42%	5.21%
1980	31.74%	11.22%	-2.99%	20.52%	34.72%	7.93%	5.73%
1981	-4.70%	14.30%	8.20%	-19.00%	-12.90%	7.55%	5.37%
1982	20.42%	11.01%	32.81%	9.41%	-12.40%	7.18%	5.10%
1983	22.34%	8.45%	3.20%	13.89%	19.14%	7.40%	5.34%
1984	6.15%	9.61%	13.73%	-3.47%	-7.59%	7.13%	5.12%
1985	31.24%	7.49%	25.71%	23.75%	5.52%	7.11%	5.13%
1986	18.49%	6.04%	24.28%	12.46%	-5.79%	6.89%	4.97%
1987	5.81%	5.72%	-4.96%	0.09%	10.77%	6.95%	5.07%
1988	16.54%	6.45%	8.22%	10.09%	8.31%	6.98%	5.12%
1989	31.48%	8.11%	17.69%	23.37%	13.78%	7.08%	5.24%
1990	-3.06%	7.55%	6.24%	-10.61%	-9.30%	6.82%	5.00%
1991	30.23%	5.61%	15.00%	24.62%	15.23%	6.96%	5.14%
1992	7.49%	3.41%	9.36%	4.09%	-1.87%	6.82%	5.03%
1993	9.97%	2.98%	14.21%	6.98%	-4.24%	6.65%	4.90%
1994	1.33%	3.99%	-8.04%	-2.66%	9.36%	6.69%	4.97%
1995	37.20%	5.52%	23.48%	31.68%	13.71%	6.80%	5.08%
1996	23.82%	5.02%	1.43%	18.79%	22.39%	7.02%	5.32%
1997	31.86%	5.05%	9.94%	26.81%	21.92%	7.24%	5.53%
1998	28.34%	4.73%	14.92%	23.61%	13.42%	7.32%	5.63%
1999	20.89%	4.51%	-8.25%	16.38%	29.14%	7.63%	5.96%
2000	-9.03%	5.76%	16.66%	-14.79%	-25.69%	7.17%	5.51%
2001	-11.85%	3.67%	5.57%	-15.52%	-17.42%	6.84%	5.17%
2002	-21.97%	1.66%	15.12%	-23.62%	-37.08%	6.25%	4.53%

2003	28.36%	1.03%	0.38%	27.33%	27.98%	6.54%	4.82%
2004	10.74%	1.23%	4.49%	9.52%	6.25%	6.53%	4.84%
2005	4.83%	3.01%	2.87%	1.82%	1.97%	6.47%	4.80%
2006	15.61%	4.68%	1.96%	10.94%	13.65%	6.57%	4.91%
2007	5.48%	4.64%	10.21%	0.84%	-4.73%	6.42%	4.79%
2008	-36.58%	1.59%	20.10%	-38.16%	-56.68%	5.65%	3.88%
2009	25.92%	0.14%	-11.12%	25.79%	37.04%	6.03%	4.29%
2010	14.86%	0.13%	8.46%	14.73%	6.39%	6.03%	4.31%

Appendix 2: Sovereign Ratings by Country- January 2011

	Foreign Currency Rating	Local Currency Rating		Foreign Currency Rating	Local Currency Rating		Foreign Currency Rating	Local Currency Rating
Albania	B1	B1	Finland [1]	Aaa	Aaa	Norway	Aaa	Aaa
Angola	B1	B1	France [1]	Aaa	Aaa	Oman	A1	A1
Argentina	B3	B3	Georgia	Ba3	Ba3	Pakistan	B3	B3
Armenia	Ba2	Ba2	Germany [1]	Aaa	Aaa	Panama	Baa3	Baa3
Australia	Aaa	Aaa	Greece [1]	Ba1	Ba1	Papua New	B1	B1
Austria [1]	Aaa	Aaa	Guatemala	Ba1	Ba1	Paraguay	B1	B1
Azerbaijan	Ba1	Ba1	Honduras	B2	B2	Peru	Baa3	Baa3
Bahamas	A3	A3	Hong Kong	Aa1	Aa1	Philippines	Ba3	Ba3
Bahrain	A3	A3	Hungary	Baa3	Baa3	Poland	A2	A2
Bangladesh	Ba3	Ba3	Iceland	Baa3	Baa3	Portugal [1]	A1	A1
Barbados	Baa3	Baa2	India	Baa3	Ba1	Qatar	Aa2	Aa2
Belarus	B1	B1	Indonesia	Ba2	Ba2	Romania	Baa3	Baa3
Belgium [1]	Aa1	Aa1	Ireland [1]	Baa1	Baa1	Russia	Baa1	Baa1
Belize	B3	B3	Isle of Man	Aaa	Aaa	Saudi Arabia	Aa3	Aa3
Bermuda	Aa2	Aa2	Israel	A1	A1	Singapore	Aaa	Aaa
Bolivia	B1	B1	Italy [1]	Aa2	Aa2	Slovakia	A1	A1
Bosnia and Herzegovina	B2	B2	Jamaica	B3	B3	Slovenia [1]	Aa2	Aa2
Botswana	A2	A2	Japan	Aa2	Aa2	South Africa	A3	A3
Brazil	Baa3	Baa3	Jordan	Ba2	Baa3	Spain [1]	Aa1	Aa1
Bulgaria	Baa3	Baa3	Kazakhstan	Baa2	Baa2	Sri Lanka	B1	B1
Cambodia	B2	B2	Korea	A1	A1	St. Vincent &	B1	B1
Canada	Aaa	Aaa	Kuwait	Aa2	Aa2	Suriname	B1	Ba3
Cayman Islands	Aa3	Aa3	Latvia	Baa3	Baa3	Sweden	Aaa	Aaa
Chile	Aa3	Aa3	Lebanon	B1	B1	Switzerland	Aaa	Aaa
China	Aa3	Aa3	Lithuania	Baa1	Baa1	Taiwan	Aa3	Aa3
Colombia	Ba1	Baa3	Luxembourg	Aaa	Aaa	Thailand	Baa1	Baa1
Costa Rica	Baa3	Baa3	Macao	Aa3	Aa3	Trinidad and	Baa1	Baa1
Croatia	Baa3	Baa3	Malaysia	A3	A3	Tunisia	Baa2	Baa2
Cuba	Caa1	Caa1	Malta [1]	A1	A1	Turkey	Ba2	Ba2
Cyprus [1]	Aa3	Aa3	Mauritius	Baa2	Baa2	Ukraine	B2	B2
Czech Republic	A1	A1	Mexico	Baa1	Baa1	United Arab	Aa2	Aa2
Denmark	Aaa	Aaa	Moldova	B3	B3	United King	Aaa	Aaa
Dominican Republic	B1	B1	Mongolia	B1	B1	United State	Aaa	Aaa
Ecuador	Caa3	Caa3	Montenegro	Ba3	Ba3	Uruguay	Ba1	Ba1
Egypt	Ba1	Ba1	Morocco	Ba1	Ba1	Venezuela	B2	B1
El Salvador	Ba1	WR	Netherlands	Aaa	Aaa	Vietnam	B1	B1
Estonia	A1	A1	New Zealand	Aaa	Aaa			
Fiji Islands	B1	B1	Nicaragua	B3	B3			

Appendix 3: Country Risk Scores from the PRS Group – November 2010

	Nov-10	2009	2008	2007	2006		Nov-10	2009	2008	2007	2006
1. Canada	92	95	96	96	96	47. Tunisia	72	72	74	75	74
1. Hong Kong	92	91	91	92	90	53. Paraguay	71	71	69	67	68
3. Singapore	89	89	90	90	90	53. South Africa	71	72	74	77	77
3. Sweden	89	89	90	91	91	53. Zambia	71	70	72	72	71
5. Austria	88	88	88	87	87	56. China	70	70	70	70	68
5. Netherlands	88	87	89	89	89	56. Dominican Republic	70	69	72	72	75
5. Taiwan	88	83	84	85	84	56. El Salvador	70	70	69	71	71
8. Australia	87	86	86	87	86	56. Guatemala	70	70	73	73	72
8. Finland	87	87	87	87	87	56. Indonesia	70	67	69	69	70
8. Norway	87	88	88	87	86	56. Jamaica	70	68	70	71	71
8. United Arab Emirates	87	88	90	90	90	56. Kenya	70	66	67	67	68
12. Oman	86	86	87	87	86	56. Morocco	70	70	72	73	74
12. Slovakia	86	83	84	81	81	64. Honduras	69	67	69	69	72
12. Switzerland	86	86	85	87	86	64. Papua New Guinea	69	69	69	69	72
15. Botswana	83	83	85	85	85	64. Suriname	69	73	70	67	66
15. Chile	83	83	82	83	84	64. Thailand	69	69	69	70	73
15. Czech Republic	83	83	84	84	86	68. Algeria	68	69	71	73	74
15. Japan	83	83	83	85	84	68. Angola	68	68	65	67	69
15. Trinidad & Tobago	83	83	84	84	84	68. India	68	70	66	66	64
20. Belgium	82	82	85	86	85	68. Libya	68	69	70	68	68
20. Bulgaria	82	83	84	84	84	72. Colombia	67	64	65	66	67
20. New Zealand	82	83	83	81	80	72. Egypt	67	67	67	64	61
23. Germany	81	80	81	81	82	72. Ghana	67	67	69	70	73
23. Uruguay	81	77	77	77	78	72. Guyana	67	65	66	65	62
25. Ireland	80	80	80	84	82	72. Philippines	67	66	66	66	64
25. Kuwait	80	79	79	80	80	72. Vietnam	67	69	71	68	66
25. United Kingdom	80	80	86	89	89	78. Bolivia	66	66	64	62	61
28. Denmark	79	79	79	82	82	78. Sri Lanka	66	65	64	65	65
28. Malaysia	79	78	79	80	79	80. Kazakhstan	65	63	68	68	68
28. Saudi Arabia	79	76	79	78	78	80. Turkey	65	66	68	70	67
31. Israel	78	78	76	75	70	82. Côte d'Ivoire	64	61	58	58	58
31. Poland	78	80	82	80	83	82. Russia	64	64	67	68	68
31. United States	78	76	78	79	79	84. Haiti	63	62	58	62	60
34. France	77	77	79	81	80	85. Sudan	62	63	66	66	66
34. Panama	77	74	70	73	73	85. Syria	62	60	63	63	59
34. Portugal	77	77	79	81	80	87. Argentina	60	58	63	64	65
37. Brazil	75	76	76	77	76	87. Bangladesh	60	59	57	54	58
38. Costa Rica	74	74	76	73	70	87. Ukraine	60	62	67	68	66
38. Gabon	74	77	77	76	75	90. Iraq	58	56	52	48	51
38. Italy	74	77	77	78	78	91. Nigeria	57	58	58	58	58
38. Mexico	74	74	77	81	81	92. Congo DR	56	54	60	61	61
38. Romania	74	74	75	75	>76	93. Guinea	55	52	51	51	53
38. Spain	74	76	79	79	79	94. Ecuador	53	51	55	55	62
44. Azerbaijan	73	74	74	73	73	94. Pakistan	53	56	55	53	55
44. Cameroon	73	73	73	73	69	96. Iran	50	51	54	54	54
44. Hungary	73	77	76	80	79	97. Cuba	49	49	51	49	52
47. Congo	72	72	70	71	75	98. Venezuela	48	46	51	51	50
47. Greece	72	73	78	80	80	99. Zimbabwe	46	47	47	49	49
47. Nicaragua	72	69	67	66	67	100. Myanmar	43	43	45	47	44
47. Peru	72	68	69	67	67						
47. South Korea	72	73	73	73	73						

Appendix 4: Relative Equity Market Volatility and Country Risk Premiums – February 2011

Standard deviation in equity index and government bond price computed, using 100 trading days. The default spread is based on the rating for each country.

Country	*Std deviation in Equities*	*Std deviation in Bond Price*	*Relative Standard Deviation*	*Default Spread*	*Country Risk Premium*	*Country Risk Premium (based on median)*
Argentina	23.47%	15.67%	1.50	6.00%	8.99%	11.26%
Brazil	17.65%	7.32%	2.41	2.00%	4.82%	3.75%
Chile	11.13%	4.73%	2.35	0.70%	1.65%	1.31%
China	28.54%	7.94%	3.59	0.70%	2.52%	1.31%
Columbia	17.71%	6.45%	2.75	2.00%	5.49%	3.75%
Croatia	18.39%	7.08%	2.60	2.00%	5.19%	3.75%
Czech Republic	15.72%	3.45%	4.56	0.85%	3.87%	1.59%
Egypt	25.03%	13.34%	1.88	2.40%	4.50%	4.50%
Greece	26.84%	17.62%	1.52	2.40%	3.66%	4.50%
Hungary	20.46%	10.39%	1.97	2.00%	3.94%	3.75%
Iceland	15.36%	12.41%	1.24	2.00%	2.48%	3.75%
India	22.92%	4.12%	5.56	2.40%	13.35%	4.50%
Indonesia	19.89%	22.72%	0.88	2.75%	2.41%	5.16%
Ireland	18.25%	21.00%	0.87	1.50%	1.30%	2.81%
Israel	13.10%	10.15%	1.29	0.85%	1.10%	1.59%
Korea	13.61%	8.22%	1.66	0.85%	1.41%	1.59%
Malaysia	8.82%	3.38%	2.61	1.15%	3.00%	2.16%
Mexico	10.88%	8.16%	1.33	1.50%	2.00%	2.81%
Pakistan	11.76%	7.54%	1.56	6.00%	9.36%	11.26%
Peru	19.36%	5.53%	3.50	2.00%	7.00%	3.75%
Philippines	17.98%	16.80%	1.07	3.25%	3.48%	6.10%
Poland	11.41%	4.58%	2.49	1.00%	2.49%	1.88%
Portugal	15.75%	14.80%	1.06	0.85%	0.90%	1.59%
Romania	12.42%	16.97%	0.73	2.00%	1.46%	3.75%
Russia	17.40%	28.47%	0.61	1.50%	0.92%	2.81%
Slovakia	12.10%	3.27%	3.70	0.85%	3.15%	1.59%
Slovenia	10.99%	5.63%	1.95	0.50%	0.98%	0.94%
Spain	22.44%	9.83%	2.28	0.25%	0.57%	0.47%
Thailand	17.85%	32.20%	0.55	1.50%	0.83%	2.81%
Turkey	21.58%	10.85%	1.99	2.75%	5.47%	5.16%
Ukraine	19.18%	9.27%	2.07	5.00%	10.35%	9.38%
Venezuela	6.29%	16.87%	0.37	4.00%	1.49%	7.51%
Vietnam	18.38%	11.63%	1.58	4.00%	6.32%	7.51%
Average			**2.00**			
Median			**1.88**			

Appendix 5: Year-end Implied Equity Risk Premiums: 1961-2010

Year	*S&P 500*	*Earnings*	*Dividends*	*T.Bond Rate*	*Estimated Growth*	*Implied Premium*
1961	71.55	3.37	2.04	2.35%	2.41%	2.92%
1962	63.1	3.67	2.15	3.85%	4.05%	3.56%
1963	75.02	4.13	2.35	4.14%	4.96%	3.38%
1964	84.75	4.76	2.58	4.21%	5.13%	3.31%
1965	92.43	5.30	2.83	4.65%	5.46%	3.32%
1966	80.33	5.41	2.88	4.64%	4.19%	3.68%
1967	96.47	5.46	2.98	5.70%	5.25%	3.20%
1968	103.86	5.72	3.04	6.16%	5.32%	3.00%
1969	92.06	6.10	3.24	7.88%	7.55%	3.74%
1970	92.15	5.51	3.19	6.50%	4.78%	3.41%
1971	102.09	5.57	3.16	5.89%	4.57%	3.09%
1972	118.05	6.17	3.19	6.41%	5.21%	2.72%
1973	97.55	7.96	3.61	6.90%	8.30%	4.30%
1974	68.56	9.35	3.72	7.40%	6.42%	5.59%
1975	90.19	7.71	3.73	7.76%	5.99%	4.13%
1976	107.46	9.75	4.22	6.81%	8.19%	4.55%
1977	95.1	10.87	4.86	7.78%	9.52%	5.92%
1978	96.11	11.64	5.18	9.15%	8.48%	5.72%
1979	107.94	14.55	5.97	10.33%	11.70%	6.45%
1980	135.76	14.99	6.44	12.43%	11.01%	5.03%
1981	122.55	15.18	6.83	13.98%	11.42%	5.73%
1982	140.64	13.82	6.93	10.47%	7.96%	4.90%
1983	164.93	13.29	7.12	11.80%	9.09%	4.31%
1984	167.24	16.84	7.83	11.51%	11.02%	5.11%
1985	211.28	15.68	8.20	8.99%	6.75%	3.84%
1986	242.17	14.43	8.19	7.22%	6.96%	3.58%
1987	247.08	16.04	9.17	8.86%	8.58%	3.99%
1988	277.72	24.12	10.22	9.14%	7.67%	3.77%
1989	353.4	24.32	11.73	7.93%	7.46%	3.51%
1990	330.22	22.65	12.35	8.07%	7.19%	3.89%
1991	417.09	19.30	12.97	6.70%	7.81%	3.48%
1992	435.71	20.87	12.64	6.68%	9.83%	3.55%
1993	466.45	26.90	12.69	5.79%	8.00%	3.17%
1994	459.27	31.75	13.36	7.82%	7.17%	3.55%
1995	615.93	37.70	14.17	5.57%	6.50%	3.29%
1996	740.74	40.63	14.89	6.41%	7.92%	3.20%
1997	970.43	44.09	15.52	5.74%	8.00%	2.73%
1998	1229.23	44.27	16.20	4.65%	7.20%	2.26%
1999	1469.25	51.68	16.71	6.44%	12.50%	2.05%

2000	1320.28	56.13	16.27	5.11%	12.00%	2.87%
2001	1148.09	38.85	15.74	5.05%	10.30%	3.62%
2002	879.82	46.04	16.08	3.81%	8.00%	4.10%
2003	1111.91	54.69	17.88	4.25%	11.00%	3.69%
2004	1211.92	67.68	19.407	4.22%	8.50%	3.65%
2005	1248.29	76.45	22.38	4.39%	8.00%	4.08%
2006	1418.3	87.72	25.05	4.70%	12.50%	4.16%
2007	1468.36	82.54	27.73	4.02%	5.00%	4.37%
2008	903.25	65.39	28.05	2.21%	4.00%	6.43%
2009	1115.10	59.65	22.31	3.84%	7.20%	4.36%
2010	1257.64	83.66	23.12	3.29%	6.95%	5.20%

CHAPTER 8

Equity Risk Premium [1]

INTRODUCTION

The *equity risk premium* (ERP) (often interchangeably referred to as the *market risk premium)* is defined as the extra return (over the expected yield on risk-free securities) that investors expect to receive from an investment in the market portfolio of common stocks, represented by a broad-based market index (e.g., S&P 500 Index or the NYSE Index).

As Arnott comments:

For the capital markets to "work," stocks should produce higher returns than bonds. Otherwise, stockholders would not be paid for the additional risk they take for being lower down in the capital structure. This relationship should be particularly true when stocks are compared to government bonds that (ostensibly) cannot default. [2]

In a recent paper, the authors conclude that "The ERP is almost certainly the most important variable in finance." [3]

The effect of a decision that the appropriate ERP is 4% instead of 8% in the capital asset pricing model (CAPM) will generally have a greater impact on the concluded discount rate than alternative theories of the proper measure of other components, such as beta. One academic study looked at sources of error in estimating expected rates of return over time and concluded:

We find that the great majority of the error in estimating the cost of capital is found in the risk premium estimate, and relatively small errors are due to the risk measure, or beta. This suggests that analysts should improve estimation procedures for market risk premiums, which are commonly based on historical averages. [4]

In ranking what matters and what does not matter in estimating the cost of equity capital, another author categorizes the choice of the ERP as a "high impact decision," likely to make a difference of more than two percentage points and could make a difference of more than four percentage points. [5]

Driving forces behind the discussions that have evolved on ERP include:

- What returns can be expected by retirement plans from investments in publicly traded common stocks?
- What expected returns are being priced in the observed values of publicly traded common stocks?
- What is the appropriate cost of capital to use in discounting future cash flows of a company or a project to their present value equivalent?
- What is the appropriate cost of capital for ratemaking in regulated industries?

Because of the importance of the ERP estimate and the fact that we find many practitioners confused about estimating ERP, we report first on recent studies of the long-term average or *unconditional ERP*. The expected unconditional ERP answers the question: What is a reasonable range of ERP that can be expected over an entire business cycle?

Research has shown that the ERP varies over the business cycle. We use the term *conditional ERP* to mean the ERP that reflects current market conditions. The expected conditional ERP answers the question: where in the unconditional range is the current ERP?

In other chapters we present data and examples using data through December 2011.

But in Chapter 7 and in this chapter we report data through June 2013, the time we are authoring this book. We report on the risk-free rate and ERP estimates through the entire period of the financial crisis that began in 2008 (2008 Crisis) and up through June 2013.

DEFINING THE EQUITY RISK PREMIUM

The ERP (or notational RP_m) is defined as:

(Formula 8.1)

$$RP_m = R_m - R_f$$

where: RP_m = the equity risk premium
R_m = the expected return on a diversified portfolio of equity securities, most often measured as the S&P 500 Index or the NYSE Index
R_f = the rate of return expected on a risk-free (free of default risk) security

ERP is a forward-looking concept. It is an expectation as of the valuation date for which no market quotes are directly observable. ERP is a function of expected returns on a diversified portfolio of equities minus an expected yield on a risk-free security to which it is compared over a specified duration.

As we pointed out earlier, the ERP can be thought of in terms of an *unconditional* ERP (i.e., the long-term average through the business cycle) and a *conditional* ERP based on current levels of the stock market and economy relative to the long-term average. [6]

In this chapter, we are addressing returns of publicly traded stocks relative to an expected yield on a risk-free security. The ERP in conjunction with the risk-free rate, either normalized or actual, also establishes a beginning benchmark for estimating the appropriate discount rates for securities of closely held businesses.

NOMINAL OR REAL?

Both the expected return on a diversified portfolio of equity securities and the rate of return expected on a risk-free security can be stated in nominal (including expected inflation) or real terms (expected inflation removed). The most commonly used data on risk-free rates, stock returns, net cash flows, and size premia are expressed in nominal terms and if one decides to express net cash flows in real terms, for example, inputs into the discount rate must be expressed in real terms, too.

If both returns are expressed in nominal terms, the difference in essence removes the expected inflation; if both returns are expressed in real terms, inflation has been removed, but the difference in the return remains the same. Thus, the resulting ERP estimate should not be affected by inflation.

ESTIMATING THE ERP

There is no one universally accepted methodology for estimating the ERP. A wide variety of premiums are used in practice and recommended by academics and financial advisors. These differences are often due to differences in how the term ERP is estimated.

Generally, we can categorize approaches for estimating the ERP as either an *ex post* approach or an *ex ante* approach.

For example, some analysts define expected returns on common stocks in terms of averages of realized (historical) single-period returns. Some analysts define expected returns on common stocks in terms of realized multiyear compound returns. These are *ex post* approaches.

Some analysts estimate the ERP using the returns on the diversified portfolio implied by expected (future) stock prices or expected dividends. These are *ex ante* approaches.

Analysts estimate the ERP relative to expected yields on various benchmark risk-free rates including:

- 30-day U.S. government notes (T-bills)
- 10-year U.S. government bonds
- 20-year U.S. government bonds
- 30-year U.S. government bonds

From an investment return perspective, the ERP is typically defined as the expected average annual compound return on a diversified portfolio of equity securities, most often measured as the S&P 500 Index or the NYSE Index, minus the expected return on a risk-free security. [7]

If one is using *historical* risk premiums (sometimes called a "historical ERP") as an estimator of *future* risk premiums (an *ex post* approach), the geometric average of realized returns is the estimator one should use in compounding future returns to estimate future wealth.

But if one is using historical risk premiums as the estimator of the ERP for use in cost of capital models intended for discounting expected cash flows, the most widely used statistic is the arithmetic average of realized risk premiums.

Even if one is simply looking forward at prospective returns for the S&P 500 and the implied ERP (an *ex ante* approach), the arithmetic average equivalent of the implied ERP is a better statistic to use in cost of capital models intended for discounting expected cash flows.

Historical return and risk premium data is most often expressed in terms of one-year returns. But in either the *ex post* or *ex ante* approach the best statistical estimator may not be the arithmetic average of one-year returns. We explore the statistical properties of estimators in Appendix 8A.

In this chapter, we have attempted to convert varying indications of the ERP to present them measured in a consistent framework (e.g., a statistical estimator of the ERP in excess of 20-year U.S. government bonds).

***Ex Post* Approach** While an analyst can observe premiums realized over time by referring to historical data (i.e., realized risk premium approach or *ex post* approach), such realized premium data do not represent the ERP expected in those prior periods, nor do they represent the current ERP estimate. Rather, to the extent that realized premiums on the average equate to expected premiums in prior periods, such samples *may be* representative of current expectations. But to the extent that prior events that were not expected to occur caused realized returns to differ from prior expectations, such samples need to be adjusted to remove the effects of these nonrecurring events. One needs to understand which events might be considered nonrecurring and then adjust the data for them in order to improve the predictive power of the sample.

Further, *ex post* realized returns on stocks and realized risk premiums will be affected by differences between expected inflation at the time of an ERP estimate and the realized inflation subsequent to the date of the estimate. This difference will cause *ex post* stock returns and *ex post* risk premiums to differ from ERP estimates made in prior periods.

***Ex Ante* Approach** Alternatively, the analyst can derive forward-looking estimates for the ERP from forward-looking data at the time of the analysis (*ex ante* approach). [8] We can generally categorize four types of forward-looking data used in estimating the expected returns on a diversified portfolio of equities and, in turn, the ERP:

1. Data on the underlying expectations of growth in overall corporate earnings and dividends
2. Data aggregated from projections of analysts following the companies comprising the broad portfolio as to their expectations of dividends and future stock prices
3. Data on observations of risk premiums evidenced in the level of the S&P 500, corporate bond spreads (e.g., differences in yields on corporate bonds rated Baa and Aaa), or prices for credit default swaps
4. Surveys of expectations of respondents

The goal of either the *ex post* or the *ex ante* approach is to estimate the true *expected* ERP as of the valuation date.

ERP IS MEASURED RELATIVE TO A RISK-FREE RATE

Any estimate of the ERP must be made in relation to a risk-free security. That is, the ERP is measured as the difference between the expected return on a well-diversified portfolio of large company common stocks and the rate of return expected on a risk-free security. The selection of an appropriate risk-free security on which to base the ERP estimate is a function of the expected maturity for the investment to which the discount rate (rate of return) is to apply.

As we discussed in Chapter 7, the duration on the risk-free instrument should match the duration of the expected net cash flows from the investment. Recall that the generalized cost of capital relationship is (repeating Formula 6.1):

(Formula 8.1)
$$E(R_i) = R_f + RP_i$$

where:
$E(R_i)$ = expected return of asset i
R_f = risk-free rate
RP_i = risk premium for asset i

In theory, when determining the risk-free rate and the corresponding risk premium, the analyst should match the duration of the risk-free security and the risk premium with the period over which the net cash flows are expected (not over the expected period any one investor may expect to hold the investment). That is, the risk premium must be measured relative to the duration of the risk-free security, and the maturity of the risk-free security must equal the expected life of the investment.

As a shortcut, analysts often use the maturity of the risk-free instrument instead of the duration as the expected life of the investment. Often this makes little difference.

For example, if you were estimating the expected equity return on a highly liquid investment with an expected short-term maturity, a U.S. government short-term note (e.g., T-bill) may be an appropriate instrument to use in benchmarking a risk premium.

Alternatively, if you were estimating the equity return on a long-term investment, such as the valuation of a business where the value can be equated to the present value of a series of future cash flows over many years, then the yield on a long-term U.S. government bond (e.g., T-bond) may be the more appropriate instrument in benchmarking a risk premium.

Assuming that the risk premium, RP_m, is a function of a relative risk measure, β, [9] multiplied by the ERP, the analyst should be discounting expected cash flows as follows:

Period	Risk-free Rate		Risk Premium
Short-term cash flows	T-bill rate	+	$\beta \times$ (RP_m relative to T-bills)
Cash flows expected in:		+	
Year 1	1-year rate	+	$\beta \times$ (RP_m relative to 1-year T-bonds)
2	2-year rate	+	$\beta \times$ (RP_m relative to 2-year T-bonds)
3	3-year rate	+	$\beta \times$ (RP_m relative to 3-year T-bonds)
. . . and so on			
10	10-year rate	+	$\beta \times$ (RP_m relative to 10-year T-bonds)
. . . and so on			
long-term	long-term rate	+	$\beta \times$ (RP_m relative to long-term T-bonds)

This discounting process is matching the *term structure* of the cost of capital to the timing of the expected cash flows. Term structure refers to the change in discount rate as the period in which the cash flows are expected to be received changes. Some analysts will employ this type of discounting for investments where the risk of the cash flows varies dramatically period to period or for investments where the pattern of cash flows has a relatively predictable pattern (e.g., an operating oil field with expected declining cash flows as production declines). In these cases, the valuation using a term structure will improve the accuracy of the concluded present value.[10]

MEASURING THE AVERAGE PERIOD OF THE EXPECTED CASH FLOWS

Alternatively, an analyst may measure the weighted average period of expected net cash flows and use an average maturity period for the risk-free security and the ERP. One tool to measure the length of planning horizon over which cash flows are expected is the *duration* of cash flows. We introduced the concept of duration in Chapter 5, specifically Formula 5.13.

Duration is a measure of the weighted average time period over which one expects to receive cash flows. An analyst may calculate the expected duration of any stream of expected cash flows for any investment.

In practice, few analysts discount each year's expected net cash flow estimate using a matched maturity risk-free rate and ERP estimate. In valuing going-concern businesses and long-term investments made by businesses, practitioners generally use long-term U.S. government bonds as the risk-free security and use an estimate of ERP developed relative to long-term U.S. government bonds. The duration of net cash flows of a business are typically comparable to the maturity of these 10- to 30-year U.S. government bonds even if the net cash flows are projected into perpetuity (e.g., the Gordon Growth Model).

This convention both represents a realistic, simplifying assumption and is consistent with the theory of the capital asset pricing model (CAPM).[11] If (a) the expected cash flows are risky and future changes in cash flows are independent of prior changes in cash flows but (b) the risk-free rate and the ERP estimated as of the valuation date are known (even if they are not expected to be constant over time), then the risk-adjusted discount rate for discounting the risky cash flows is constant as well.

The statement "the risk-free rate and the ERP estimated as of the valuation date are known" means one can reasonably estimate an average risk-free rate and ERP matching the duration of the net cash flows using information at the valuation date. While the risk-free rate and ERP may not be considered stochastic (i.e., random) variables for the CAPM to be applicable to multiperiod valuation problems, we know that future values of the risk-free rate and the ERP are uncertain. In periods when interest rates are volatile, one needs to be particularly cautious in making multiperiod forecasts of the cost of equity capital.[12]

Most business investments have long durations and suffer from a reinvestment risk just as long-term government bonds do. As such, the use of long-term U.S. government bonds and an ERP estimated relative to such bonds more closely matches the investment horizon and risks confronting business managers in capital budgeting decisions, as well as valuators in valuation problems, than reference to T-bills.

Therefore, in the remainder of this chapter, we have translated all estimates of ERP to estimates relative to 20-year U.S. government bonds. As we discussed in Chapter 7, one may consider normalizing the risk-free rate on 20-year U.S. government bonds during a period of Federal Reserve (Fed) intervention to reduce rates on longer maturity instruments. We summarize ERP estimates below relative to the "spot" yields and normalized rates.

UNCONDITIONAL ERP

First we will examine the evidence of the unconditional ERP and then we will address issues involving the conditional ERP.

In this section, we look at estimates of the *unconditional ERP* (i.e., long-term average) using realized risk premium data (the *ex post* approach). While academics and practitioners agree that ERP is a forward-looking concept, some practitioners, including taxing authorities and regulatory bodies, use historical data to estimate the ERP under the assumption that historical data are a valid proxy for current investor expectations. They like the

appearance of accuracy, and we do emphasize the word *appearance*. There are alternative conventions available to summarize realized risk premiums. Before arriving at a conclusion regarding the accuracy of using realized risk premiums as an estimate of the ERP, an analyst must consider appropriate adjustments to the realized risk premiums, which we discuss in this chapter.

In the realized risk premium approach, the estimate of the ERP is the risk premium (realized return on stocks in excess of the risk-free rate) that investors have, on the average, realized over some historical holding period.

The underlying theory is that the past provides a reasonable indicator of how the market will behave in the future, and also that investors' expectations are influenced by the historical performance of the market.

A more direct justification for use of the realized risk premium approach is the contention that, for whatever reason, securities in the past have been priced in such a way as to earn the returns observed. By using an estimated cost of equity capital incorporating the average of realized risk premiums, you may to some extent replicate this level of pricing.

The long-term average of realized risk premiums is calculated from varying rates of returns on common stocks over shifting risk-free rates. They are generally reported annually. It is common practice to add the same long-term average realized risk premium (an *ex post* estimate of the ERP) to the market interest rate of the risk-free security throughout the following year regardless of the level of the rate on that security as of the valuation date.

This common practice implicitly assumes that during upcoming periods the difference between the expected return on common stocks and U.S. government bonds is constant. Alternatively, this common practice implicitly assumes that any decrease or increase in the ERP as of the valuation date is short-term and that the ERP is mean reverting to the long-term average of realized risk premiums rather quickly.

Let us look at an example of the consequences of this common practice. If an analyst were using the long-term average of realized risk premiums from 1926–2007 of 7.1% as his ERP estimate during 2008, that 7.1% ERP would have been added to the risk-free rate at any valuation date during 2008 regardless of the level of the risk-free rate during that year and regardless of any changes in risks in the economy.

For example, the yield on 20-year U.S. government bonds was 4.8% on October 31, 2008. But due to the increase in economic risks as the 2008 Crisis unfolded, the yield had fallen due to the flight to quality to 3.7% as of November 30, 2008. Following common practice, the 7.1% would have been added to this lower yield even though risks had increased.

But what is the "best" way of summarizing realized risk premiums over time? Should we summarize realized risk premiums as averages of one-year returns? Or should they be summarized as averages of multiple year returns (i.e., multiple year holding periods)? Should you summarize the realized risk premiums as an arithmetic average or as a geometric average?

If period returns on stocks (e.g., monthly stock returns) are not autocorrelated (e.g., this month's stock returns are not predictable based on last month's returns), and if the distribution of expected stock returns is stable through time, then the arithmetic average of historical stock returns provides an unbiased estimate of expected future stock returns and the arithmetic average of realized risk premiums provides an unbiased estimate of expected future risk premiums (the ERP).

But this is not intended to imply that the arithmetic average of returns measured over one-year periods is the best arithmetic average. In fact, estimating discount rates using an ERP based on the arithmetic average of risk premiums (as is often done) is not without controversy. In using realized risk premium data to estimate the ERP, there are disagreements as to how one should summarize the data:

- Is the arithmetic average or geometric average the more accurate method of summarizing realized return data over the sample period?
- Should returns be measured over one-year holding periods or over longer holding periods?

We discuss the disagreements in detail in Appendix 8A.

SELECTING A SAMPLE PERIOD OF *EX POST* DATA

The average realized risk premium is sensitive to the period chosen for the average. While the selection of 1926 as a starting point corresponds to the initial publishing of the forerunner to the current S&P 500 (the S&P Composite Index of 90 stocks), the choice of that date was otherwise arbitrary. Regarding the historical time period over which realized risk premiums should be calculated, Morningstar offers two observations:[13]

1. Reasons to focus on recent history:
   1. The recent past may be most relevant to an investor.
   2. Return patterns may change over time.
   3. The longer period includes "unusual events" which may not be representative of today's economy.
2. Reasons to focus on long-term history:
   1. Long-term historical returns have shown surprising stability.
   2. Short-term observations may lead to illogical forecasts.
   3. Every period has dramatic historical events and we do not know what major events lie ahead.
   4. Law of large numbers: More observations lead to a more accurate estimate.

In choosing the years one includes in the estimate, the analyst is looking for a period in which the realized returns best represent what might be expected in future periods. One might consider eliminating from the sample period a period influenced by abnormal circumstances. Or one might consider a sample period with risk characteristics more comparable to the risk characteristics confronting investors today.

BIAS IN REALIZED RISK PREMIUM DATA

Some observers have suggested that the period including the 1940s and the immediate post–World War II boom years may have exhibited unusually high average realized return premiums due to the Fed's intervention in interest rates.

The low real rates on bonds may have contributed to greater equity returns in the immediate postwar period. Since firms finance a large part of their capital investment with bonds, the *lower* real cost of obtaining such funds likely *increased* returns to shareholders. It may not be a coincidence that the greatest 30-year average equity return occurred in a period marked by very low real returns on bonds.[14]

We consider the years 1942 through 1951 particularly problematic as they reflected a period of government-imposed stability in U.S. government bond interest rates. During World War II, the U.S. Treasury (Treasury) decreed that interest rates had to be kept at artificially low levels in order to reduce government financing costs. This led to the Fed's April 1942 public commitment to maintain interest rates at prescribed levels on U.S. government debt, both long term and short term.

EXHIBIT 8.1 Realized Risk Premiums Excluding 1942–1951

Year	Realized Risk Premiums (arithmetic average)	Standard Deviation
1926–2012 all years	6.70%	20.26%
1926–2012 (excluding 1942–1951)	5.53%	20.76%

Source: Compiled from data in the *EnCorr*® database. Copyright © 2013 Morningstar, Inc. All rights reserved. Calculated (or derived) on CRSP® data; © 2013 Center for Research in Security Prices (CRSP®), University of Chicago Booth School of Business. Compiled by Duff & Phelps LLC.

With regard to short-term interest rates, the Fed agreed to make a market in 3-month T-bills at a yield of 3/8%. With regard to longer-term securities, the Fed agreed to support interest rate ceilings; for example, it agreed to support 25-year U.S. government bond prices at a level consistent with a 2.5% interest rate ceiling.[15]

After World War II, the Fed continued maintaining an interest rate ceiling due to the Treasury's pressure and, to a lesser extent, a fear of returning to the high unemployment levels of the Great Depression. The Treasury and the Fed ended the pegging of interest rates on T-bills in July 1947. But interest rate controls on long-term rates continued until postwar inflationary pressures caused the Treasury and the Fed to reach an accord announced March 4, 1951, freeing the Fed of its obligation of pegging interest rates.[16] Including this period in calculating realized returns is analogous to valuing airline stocks today by looking at prices of airline stocks when domestic airline fares were regulated.

To better understand the impact of the interest rate controls on the ERP, we examined the arithmetic average of realized risk premiums (based on one-year returns) for the period 1926–2012 as reported in the *SBBI Yearbook*[17] and the arithmetic average of realized risk premiums (based on one-year returns) for the period 1926–2012 *excluding 1942 through 1951*. Exhibit 8.1 displays these results.

Eliminating the years 1942 through 1951 from the sample reduced the realized risk premium from the published 6.70% to 5.53% for 1926–2012. One can interpret the realized risk premium data reported in the *SBBI Yearbook* as being biased high by as much as 117 basis points (1.17%). We will call this the "WWII Interest Rate Bias." We use 1.17% as the adjustment below to indicate the extent of the possible bias created by this period in the indicated ERP estimates we display.

We are not questioning the accuracy of the realized risk premiums reported in the *SBBI Yearbook*. Rather, we believe that if one were using the realized return data as a basis for forecasting ERP, demonstrated bias should be removed where possible. Removing the data from 1942–1951 from the sample allows the analyst to make the data more representative of what might be expected in future years. We believe that analysts should consider the WWII Interest Rate Bias when estimating ERP using realized risk premium data.[18]

"Market" rates subject to control are really not market rates reflective of real interest rates plus the market's expectations of inflation. This was true during the 1942–1951 period and is true as we are writing this book due to the actions of the Fed through quantitative easing.

PREDICTING FUTURE ERP

Is an ERP estimate calculated as the historical average annual difference in returns on stocks and the risk free rate (i.e., as published in the *SBBI Valuation Yearbook)* a good predictor of future performance differences between stocks and U.S. government bonds? The evidence suggests that it is not a good predictor.

Smithers concludes that the pricing and returns from equities and bonds are independently determined and thus unrelated. His study looks back over 200 years and finds that the long-term returns from equities and bonds were positively correlated in the first half of the period (between 1801 and 1906) and negatively correlated in the second half (between 1907 and 2011).[19]

To investigate this further, we first calculated the average annual realized risk premium measured as the difference between the S&P 500 Index and the income component of the 20-year U.S. government bond for each year from 1926–1992. This is often referred to as the "historical ERP." Since the historical ERP is measured as an average over time and is sensitive to the number of periods used (generally, the more, the better), the first year in which the historical ERP could be calculated using *at least 20 years of data* is the historical ERP as measured over the time period 1926–1945, which is the leftmost point of the solid black line in Exhibit 8.2. Moving to the right, the second equity risk premium point shown is the historical ERP as measured over the time period 1926–1946 (21 years), and so on. The rightmost equity risk premium point shown is the historical ERP as measured over the time period 1926–1992 (67 years).[20]

Second, as of each year from 1945–1992 for which we had a historical ERP estimate, we calculated the annual performance of stocks over the *subsequent* 20 years, and then subtracted the annual performance of the 20-year U.S. government bond over the *subsequent* 20 years (represented by the dashed black line in Exhibit 8.2). For example, from 1946–1965 the S&P had an annual performance of 13.84%, and 20-year U.S. government bonds had an annual performance of 1.61%. The difference is 12.23% (13.84% − 1.61%), which is the first point on the left of the dashed line.

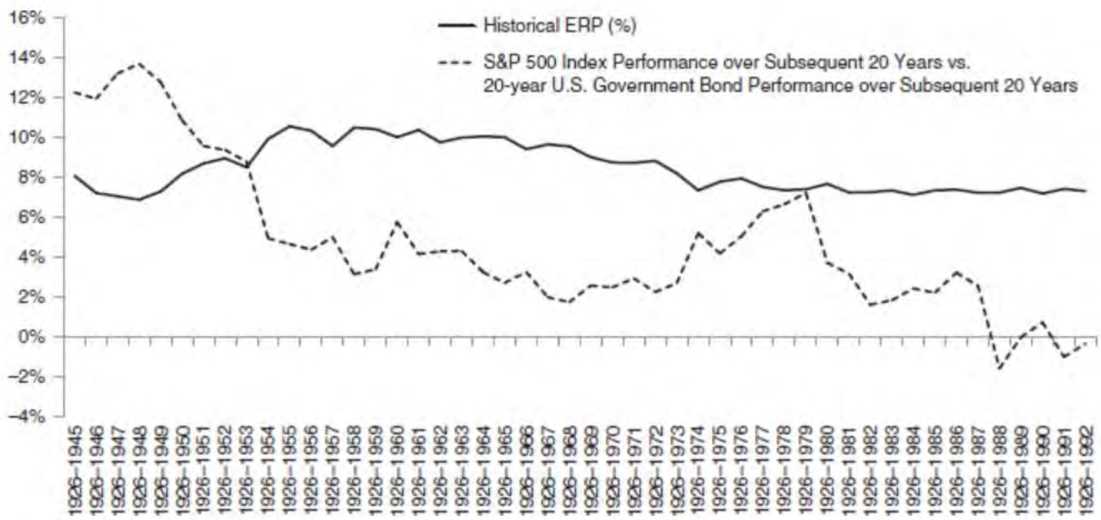

EXHIBIT 8.2 The *Historical* ERP versus *Actual* Difference in Subsequent 20-year Period in Stocks' Performance versus 20-year U.S. Government Bonds' Performance

Source: Calculated by Duff & Phelps. *Source of underlying data:* Morningstar *EnCorr* database.

The *solid* black "historical ERP" line in Exhibit 8.2 can be thought of as what would have been reported in the *SBBI Valuation Yearbook* as the historical ERP if it had been published starting in 1945, rather than in 1999. The *solid* black line (the ERP) in Exhibit 8.2 is essentially the *prediction* of how stocks would perform relative to 20-year U.S. government bonds in subsequent periods.

The *dashed* black line in Exhibit 8.2 is the *actual* performance of stocks relative to 20-year U.S. government bonds in subsequent periods. The *difference* between the solid black line and the *dashed* black line can be thought of as how accurate the historical ERP was in predicting subsequent stock performance relative to 20-year U.S. government bonds (the realized ERP).

Another perspective is provided in Exhibit 8.3. In Exhibit 8.3, the *difference* between the historical ERP (the *solid* black line in Exhibit 8.3) and the subsequent performance of stocks over 20-year U.S. government bonds (the *dashed* black line in Exhibit 8.3) is plotted.

The graph in Exhibit 8.3 suggests that since 1954 (and through the 1992 estimate) the annual historical ERP estimate of the ERP has systematically *overestimated* the subsequent 20-year performance of stocks relative to subsequent total returns on 20-year U.S. government bonds.

Even if we use long-term observations, say the unadjusted 87-year average as the ERP, the resulting statistic gives an estimate with a 95% confidence interval around the unobserved *true* ERP in the range of approximately 2.4% to 11.0%.[21] The authors of this book believe that the analyst needs to exercise professional judgment when using any statistical estimate, recognizing the events that caused the underlying data series to result in the summary statistic and make appropriate adjustments to arrive at a forward-looking ERP.

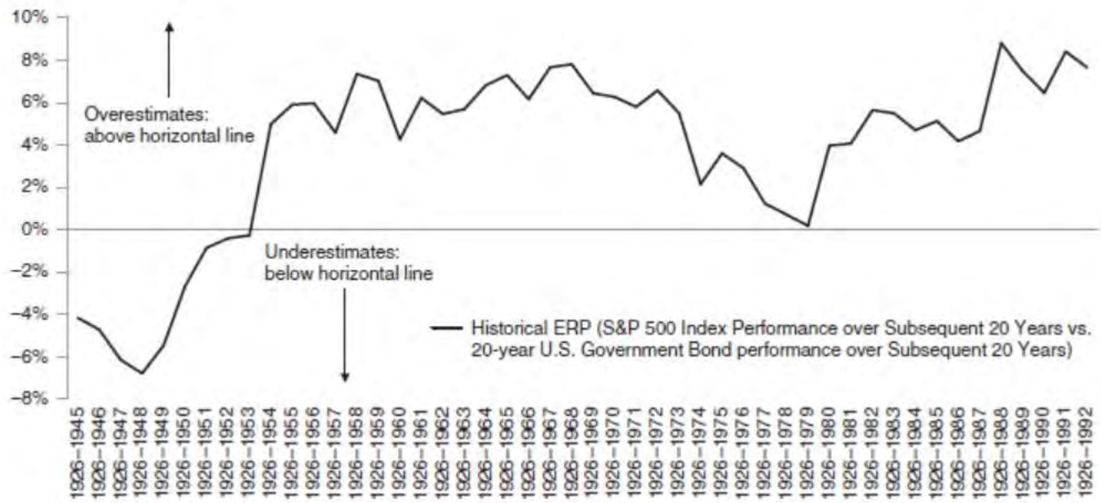

EXHIBIT 8.3 Historical ERP (subsequent 20-year performance of stocks vs. subsequent 20-year performance of 20-year U.S. government bonds) (%)

Source: Calculated by Duff & Phelps. *Source of underlying data:* Morningstar *EnCorr* database.

Equity Risk Premium: Expectations Great and Small

Richard A. Derrig* and Elisha D. Orr†

Abstract

The equity risk premium (ERP) is an essential building block of the market value of risk. In theory, the collective action of all investors results in an equilibrium expectation for the return on the market portfolio excess of the risk-free return, the ERP. The ability of the valuation actuary to choose a sensible value for the ERP, whether as a required input to capital asset pricing model valuation, or any of its descendants, is as important as choosing risk-free rates and risk relatives (betas) to the ERP for the asset at hand.

The historical realized ERP for the stock market appears to be at odds with pricing theory parameters for risk aversion. Since 1985, there has been a constant stream of research, each of which reviews theories of estimating market returns, examines historical data periods, or both. Those ERP value estimates vary *widely* from about −1% to about 9%, based on a geometric or arithmetic averaging, short or long horizons, short- or long-run expectations, unconditional or conditional distributions, domestic or international data, data periods, and real or nominal returns.

This paper examines the principal strains of the recent research on the ERP and catalogues the empirical values of the ERP implied by that research. In addition, the paper supplies several time series analyses of the standard Ibbotson Associates 1926–2002 ERP data using short Treasuries for the risk-free rate. Recommendations for ERP values to use in common actuarial valuation problems also are offered.

"What I actually think is that our prey, called the equity risk premium, is extremely elusive."
—*Stephen A. Ross (2002, p. 22)*

1. Introduction

The equity risk premium (ERP) is an essential building block of the market value of risk. In theory, the collective action of all investors results in an equilibrium expectation for the return on the market portfolio excess of the risk-free return, the ERP. The ability of the valuation actuary to choose a sensible value for the ERP—whether as a required input to capital asset pricing model (CAPM) valuation or any of its descendants[1]—is as important as choosing risk-free rates and risk relatives (betas) to the ERP for the asset at hand. Risky discount rates, asset allocation models, and project costs of capital are common actuarial uses of ERP as a benchmark rate.

The ERP should be of particular interest to actuaries. For pensions and annuities backed by bonds and stocks, the actuary needs to have an understanding of the ERP and its variability compared to fixed-horizon bonds. Variable products, including guaranteed minimum death benefits, require accurate projections of returns to ensure adequate future assets. With the latest research producing a relatively low ERP, the rationale for including equities in insurers' asset holdings is being tested.

In describing individual investment account guarantees, LaChance and Mitchell (2003) point out an underlying assumption of pension asset investing that, based only on the historical record, future equity returns will continue to outperform bonds; they clarify that those higher ex-

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[1] The multifactor arbitrage pricing theory of Ross (1976), the three-factor model of Fama and French (1992) and the recent Mamaysky (2002) five-factor model for stocks and bonds are all examples of enhanced CAPM models.

pected equity returns come with the additional higher risk of equity returns. Ralfe et al. (2003) support the risky equity view and discuss their pension experience with an all-bond portfolio. Recent projections in some literature of a zero or negative ERP challenge the assumptions underlying these views.

By reviewing some of the most recent and relevant work on the issue of the ERP, actuaries will have a better understanding of how these values were estimated, critical assumptions that allowed for such a low ERP, and the time period for the projection (see Appendix B). Actuaries can then make informed decisions for expected investment results going forward.

In 1985, Mehra and Prescott published their work on the *equity risk premium puzzle*: the fact that the historical realized ERP for the stock market from 1889–1978 appeared to be at odds with and, relative to Treasury bills, far in excess of asset pricing theory values based on investors with reasonable risk aversion parameters. Since then, there has been a constant stream of research, each of which reviews theories of estimating market returns, examines historical data periods, or both (for example, see Cochrane 1997, Cornell 1999, or Equity Risk Premium Forum 2002). Those ERP value estimates vary *widely,* from about −1% to about 9%, based on geometric or arithmetic averaging, short or long horizons, short- or long-run means, unconditional or conditional expectations, using domestic or international data, differing data periods, and real or nominal returns. Brealey and Myers (2000), in the sixth edition of their standard corporate finance textbook, believe a range of 6–8.5% for the U.S. ERP is reasonable for practical project valuation. Is that a fair estimate?

Current research on the ERP is plentiful. This paper covers a selection of mainstream articles and books that describe different approaches to estimating the *ex ante* ERP. We select examples of the research that cover the most important approaches to the ERP. We begin by describing the methodology of using historical returns to predict future estimates. We identify the many varieties of ERPs in order to alert the reader to the fact that numerical estimates of the ERP that appear different may instead be about the same under a common definition. We examine the well-known Ibbotson Associates 1926–2002 data series for stationarity, that is, time invariance of the mean ERP. We show by several statistical tests that stationarity cannot be rejected and the best estimate going forward, *ceteris paribus,* is the realized mean. This paper will examine the principal strains of the recent research on the ERP and catalogue the empirical values of the ERP implied by that research (see Appendix B).

We first discuss how the Social Security Administration derives estimates of the ERP. Then, we survey the puzzle research, that is, the literature written in response to the equity premium puzzle suggested by Mehra and Prescott (1985). We cover five major approaches from the literature. Next, we report from two surveys of "experts" on the ERP. Finally, after describing the main strains of research, we explore some of the implications for practicing actuaries.

We do not discuss the important companion problem of estimating the risk relationship of an individual company, line of insurance, or project with the overall market. Within a CAPM or Fama-French framework, the problem is estimating a market beta.[2] Actuaries should be aware, however, that simple 60-month regression betas are biased low where size or nonsynchronous trading is a substantial factor (Kaplan and Peterson 1998, Pratt 1998, p. 86). Adjustments are made to historical betas in order to remove the bias and derive more accurate estimates. Elton and Gruber (1995, p. 148) explain that by testing the relationship of beta estimates over time, empirical studies have shown that an adjustment toward the mean should be made to project future betas.

2. THE EQUITY RISK PREMIUM

Based on the definition in Brealey and Myers (2000), the ERP is the "expected additional return for making a risky investment rather than a safe one" (p. 1071). In other words, the ERP is the difference between the market return and a risk-free return. Market returns include both dividends and capital gains. Because both the historical ERP and the prospective ERP have been

[2] According to CAPM, investors are compensated only for nondiversifiable, or market, risk. The market beta becomes the measurement of the extent to which returns on an individual security co-vary with the market. The market beta times the ERP represents the nondiversifiable expected return from an individual security.

referred to simply as the ERP, the terms *ex post* and *ex ante* are used to differentiate between them but are often omitted. Table 1 shows the historical annual average returns from 1926 to 2002 for large company equities (S&P 500), Treasury bills and bonds, and their arithmetic differences using data from Ibbotson Associates (2003a,b); the entire series is shown in Appendix A.

In 1985, Mehra and Prescott introduced the idea of the ERP puzzle. The puzzling result is that the historical realized ERP for the stock market using 1889–1978 data appeared to be at odds with and, relative to Treasury bills, far in excess of asset pricing theory values based on normal parametrizations of risk aversion. When using standard frictionless return models and historical growth rates in consumption, the real risk-free rate, and the ERP, the resulting relative risk aversion parameter appears too high. By choosing a maximum relative risk aversion parameter to be 10 and using the growth in consumption, Mehra and Prescott's model produces an ERP much lower than the historical premium.[3]

Their result inspired a stream of finance literature that attempts to solve the puzzle. Two different research threads have emerged. One thread, including behavioral finance, attempts to explain the historical returns with new models and different assumptions about investors (see, e.g., Benartzi and Thaler 1995 and Mehra 2002). A second thread is from a group that provides estimates of the ERP that are derived from historical data and/or standard economic models. Some in this latter group argue that historical returns may have been higher than those that should be required in the future. In a curiously asymmetric way, there are no serious studies yet concluding that the historical results are too low to serve as *ex ante* estimates.

Although both groups have made substantial and provocative contributions, the behavioral models do not give any *ex ante* ERP estimates other than explaining and supporting the historical returns. We presume, until results show otherwise, that the behaviorists support the historical average as the *ex ante* unconditional long-run

Table 1
U.S. Equity Risk Premia 1926–2002

Annual Equity Returns and Premia versus Treasury Bills, Intermediate, and Long-Term Bonds			
Horizon	Equity Returns	Risk-Free Return	ERP
Short	12.20%	3.83%	8.37%
Intermediate	12.20	4.81	7.40
Long	12.20	5.23	6.97

Source: Authors' calculations using Ibbotson Associates (2003a, p. 38–39, 177, 238–39, 246–47).

expectation. Therefore, we focus on the latter to catalogue ERP estimates other than those based on the historical approach,[4] but we will discuss both as important strains for puzzle research.

3. ERP Types

Many different types of ERP estimates can be given, even though they are labeled by the same general term. These estimates vary widely; currently the estimates range from about 9% to a small negative. When ERP estimates are given, one should determine the type before comparing to other estimates. Here are seven important types to look for when given an ERP estimate:

- Geometric versus arithmetic averaging.
- Short versus long investment horizon.
- Short- versus long-run expectation.
- Unconditional versus conditional on some related variable.
- Domestic United States versus international market data.
- Data sources and periods.
- Real versus nominal returns.

The average market return and ERP can be stated as a geometric or arithmetic mean return. An *arithmetic mean return* is a simple average of a series of returns. The *geometric mean return* is the compound rate of return; it is a measure of the actual average performance of a portfolio over a given time period. Arithmetic returns are the same or higher than geometric returns, so it is not appropriate to make a direct comparison between an arithmetic estimate and a geometric estimate. However, those two returns can be transformed one to the other. For example, arithmetic returns

[3] Campbell, Lo, and MacKinlay (1997, pp. 307–308) performed a similar analysis and found a risk-aversion coefficient of 19, larger than the reasonable level suggested in Mehra and Prescott's paper.

[4] See Appendix C.

can be approximated from geometric returns by the formula

$$AR = GR + \frac{\sigma^2}{2}, \ \sigma^2 \text{ the variance of the (arithmetic) return process}$$

(see Welch 2000, Dimson et al. 2002, and Ibbotson and Chen 2003). Arithmetic averages of periodic returns are to be preferred when estimating next period returns since they, not geometric averages, reproduce the proper probabilities and means of expected returns.[5] ERPs can be generated by arithmetic differences (Equity − Risk Free) or by geometric differences ([(1 + Equity)/(1 + Risk Free)] − 1). Usually, the arithmetic and geometric differences produce similar estimates.[6]

A second important difference in ERP estimate types is the horizon. The *horizon* indicates the total investment or planning period under consideration. For estimation purposes, the horizon relates to the term or maturity of the risk-free instrument that is used to determine the ERP. Ibbotson Associates (2003a, p. 177) provides definitions for three different horizons. The *short-horizon* expected ERP is defined as "the large company stock total returns minus U.S. Treasury bill *total* returns." Note, the income return and total return are the same for U.S. Treasury bills. The *intermediate-horizon* expected ERP is "the large company stock total returns minus intermediate-term government bond *income* returns." Finally, the *long-horizon* expected ERP is "the large company stock total returns minus long-term government bond *income* returns." (Table 1 displays the short-horizon ERP.)

For the Ibbotson data, Treasury bills have a maturity of approximately one month, intermediate-term government bonds have a maturity around five years, and long-term government bonds have a maturity of about 20 years. Although the Ibbotson definitions may not apply to other research, we will classify ERP estimates based on these guidelines to establish some consistency among the current research. The reader should note that Ibbotson Associates recommends the income return (or the yield) when using a bond as the risk-free rate rather than the total return.[7]

A third type is the length of time of the ERP forecast. We distinguish between short-run and long-run expectations. *Short-run* expectations refer to the current ERP or, for this paper, a prediction of up to 10 years. In contrast, the *long-run* expectation is a forecast over 10 years to as many as 75 years for social security purposes. Ten years appears an appropriate breaking point based on the current literature surveyed.

The next difference is whether the ERP estimate is *unconditional* or *conditioned* on one or more related variables. In defining this type, we refer to an admonition by Constantinides (2002) of the differences in these estimates:

> "First, I draw a sharp distinction between *conditional, short-term forecasts* of the mean equity return and premium and *estimates of the unconditional mean.* I argue that the currently low conditional short-term forecasts of the return and premium do not lessen the burden on economic theory to explain the large unconditional mean equity return and premium, as measured by their sample average over the past one hundred and thirty years" (p. 1568).

Many of the estimates we catalogue below will be conditional ones, conditional on dividend yield, expected earnings, capital gains, or other assumptions about the future.

ERP estimates can also exhibit a *U.S. versus international* market type depending on the data used for estimation purposes and the ERP being estimated. Dimson et al. (2002) notes that, at the start of 2000, the U.S. equity market, while dominant, was slightly less than one-half (46.1%) of the total international market for equities, capitalized at $52.7 trillion. Table 2 shows a comparison of historical ERP values for the United States and the world. Data from the non-U.S. equity markets are clearly different from those of U.S. markets and, hence, will produce different estimates for returns

[5] For a complete discussion of the arithmetic/geometric choice, see Ibbotson Associates (2003b, pp. 71–3). See also Dimson et al. (2002, p. 35), and Brennan and Schwartz (1985).

[6] The arithmetic difference is the geometric difference multiplied by 1 + Risk Free.

[7] The reason for this is two-fold. First, when issued, the yield is the expected market return for the entire horizon of the bond. No net capital gains are expected for the market return for the entire horizon of the bond. No capital gains are expected at the default-free maturity. Second, historical annual capital gains on long-term government bonds average near zero (0.4%) over the 1926–2002 period (Ibbotson Associates 2003a, tables 6–7).

and ERP.[8] Results for the entire world equity market will, of course, be a weighted average of the U.S. and non-U.S. estimates.

The next type is the *data source and period* used for the market and ERP estimates. Whether given an historical average of the ERP or an estimate from a model using various historical data, the ERP estimate will be influenced by the length, timing, and source of the underlying data used. The time series compilations are primarily annual or monthly returns. Occasionally, daily returns are analyzed, but not for the purpose of estimating an ERP. Some researchers use as much as 200 years of history; the Ibbotson data currently uses S&P 500 returns from 1926 to the present.[9]

As an example, Siegel (2002) examined a series of real U.S. returns beginning in 1802.[10] He used three sources to obtain the data. For the first period, 1802–1870, characterized by stocks of financial organizations involved in banking and insurance, he cites Schwert (1990). The second period, 1871–1925, incorporates Cowles stock indexes compiled in Shiller (1989). The last period, beginning in 1926, uses data from the Center for Research in Security Prices (CRSP), University of Chicago Graduate School of Business; these are the same data underlying Ibbotson Associates calculations.

Goetzmann et al. (2001) constructed an NYSE data series for 1815–1925 to add to the 1926–1999 Ibbotson series. They concluded that the pre-1926 and post-1926 data periods show differences in both risk and reward characteristics. They highlighted the fact that inclusion of pre-1926 data will generally produce lower estimates of ERPs than relying exclusively on the Ibbotson post-1926 data, similar to that shown in Appendix A. Several studies that rely on pre-1926 data, catalogued in Appendix B, show the magnitudes of these lower estimates.[11] Table 3 displays Siegel's ERPs for three subperiods. He notes that subperiod III, 1926–2001, shows a larger ERP (4.7%), or a smaller real risk-free mean (2.2%), than the prior subperiods.[12]

Table 2

Worldwide Equity Risk Premia, 1900–2000
Annual Equity Risk Premium Relative to Treasury Bills

Country	Geometric Mean	Arithmetic Mean
United States	5.8%	7.7%
World	4.9	6.2

Source: Dimson et al. (2002, pp. 166–67)

Smaller subperiods will show much larger variations in equity, bill, and ERP returns. Table 4 displays the Ibbotson returns and short-horizon risk premia for subperiods as small as five years. The scatter of results is indicative of the underlying large variation (20% std dev) in annual data.

In calculating an expected equity risk premium by averaging historical data, projecting historical data using growth models, or even conducting a survey, one must determine a proxy for the "market." Common proxies for the U.S. market include the S&P 500, the NYSE index, and the NYSE, AMEX, and NASDAQ index (Ibbotson Associates 2003b, p. 92). For the purpose of this paper, we use the S&P 500 and its antecedents as the market. However, in the various research surveyed, many different market proxies were assumed. We have already discussed using international versus ERP domestic data when describing different MRP types. With international data, different proxies for other country, region, or world markets are used. For example, Dimson (2002) and Claus and Thomas (2001) use international market data.

[8] One qualitative difference can arise from the collapse of equity markets during war time.

[9] For the Ibbotson analysis of the small stock premium, the NYSE/AMEX/NASDAQ combined data are used, with the S&P 500 data falling within deciles 1 and 2 (Ibbotson Associates 2003b, pp. 66 and Chapter 7.)

[10] A more recent alternative is Wilson and Jones (2002), as cited by Dimson et al. (2002, p. 39).

[11] Using Wilson and Jones' 1871–2002 data series, time series analyses show no significant ERP difference between the 1871–1925 period and the 1926–2002 period; one cannot distinguish the old from the new. The overall average is lower with the additional 1871–1925 data, but on a statistical basis, they are not significantly different. Assuming the equivalency of the two data series for 1871–1925 (Goetzmann et al. 2001 and Wilson and Jones 2002), the risk difference found by Goetzmann et al. must be determined by a significantly different ERP in the pre-1871 data. The 1871–1913 return that is prior to personal income tax and that appears to be about 35% lower than the 1926–2002 period average of 11.8%, might simply reflect a zero valuation for income taxes in the pre-1914 returns. Adjusting the pre-1914 data for taxes would most likely make the ERP for the entire period (1871–2002) approximately equal to 7.5%, the 1926–2002 average.

[12] The low risk-free return is indicative of the "risk-free rate puzzle," the twin of the ERP puzzle. For details see Weil (1989).

Table 3
Short-Horizon Equity Risk Premium by Subperiods

	Subperiod I 1802–1870	Subperiod II 1871–1925	Subperiod III 1926–2001
Real Geometric Stock Returns	7.0%	6.6%	6.9%
Real Geometric Long-Term Governments	4.8	3.7	2.2
Equity Risk Premium	2.2	2.9	4.7

Source: Siegel (2002, pp. 13 and 15).

For domestic data, different proxies have been used over time as stock market exchanges have expanded. (For a data series that is a mixture of the NYSE exchange, NYSE, AMEX, and NASDAQ stock exchange, and the Wilshire 5000, see Dimson 2002, p. 306.) Fortunately, as shown by Ibbotson Associates (2003b), the issue of a U.S. market proxy does not have a large effect on the ERP estimate because the various indices are highly correlated. For example, the S&P 500 and the NYSE have a correlation of 0.95, the S&P 500 and NYSE/AMEX/NASDAQ 0.97, and the NYSE and NYSE/AMEX/NASDAQ 0.90 (Ibbotson Associates 2003b, p. 93, using data from October 1997–September 2002). Therefore, the equity proxy selected is one reason for slight differences in the estimates of the market risk premium.

As a final note, stock returns and risk-free rates can be stated in *nominal* or *real* terms. Nominal includes inflation; real removes inflation. The ERP should not be affected by inflation because either the stock return and risk-free rate both

Table 4
Average Short-Horizon Risk Premium over Various Time Period

Year		Common stocks Total Annual Returns	U.S. Treasury Bills Total Annual Returns	Short-Horizon Risk Premium
All Data	1926–2002	12.20%	3.83%	8.37%
50-year	1953–2002	12.50	5.33	7.17
40-year	1963–2002	11.80	6.11	5.68
30-year	1943–1972	14.55	2.54	12.02
	1973–2002	12.21	6.61	5.60
15-year	1928–1942	5.84	0.95	4.89
	1943–1957	17.14	1.20	15.94
	1958–1972	11.96	3.87	8.09
	1973–1987	11.42	8.20	3.22
	1988–2002	13.00	5.03	7.97
10-year	1933–1942	12.88	0.15	12.73
	1943–1952	17.81	0.81	17.00
	1953–1962	15.29	2.19	13.11
	1963–1972	10.55	4.61	5.94
	1973–1982	8.67	8.50	0.17
	1983–1992	16.80	6.96	9.84
	1993–2002	11.17	4.38	6.79
5-year	1928–1932	−8.25	2.55	−10.80
	1933–1937	19.82	0.22	19.60
	1938–1942	5.94	0.07	5.87
	1943–1947	15.95	0.37	15.57
	1948–1952	19.68	1.25	18.43
	1953–1957	15.79	1.97	13.82
	1958–1962	14.79	2.40	12.39
	1963–1967	13.13	3.91	9.22
	1968–1972	7.97	5.31	2.66
	1973–1977	2.55	6.19	−3.64
	1978–1982	14.78	10.81	3.97
	1983–1987	16.93	7.60	9.33
	1988–1992	16.67	6.33	10.34
	1993–1997	21.03	4.57	16.46
	1998–2002	1.31	4.18	−2.88

Source: Authors' calculations using Ibbotson Associates (2003a, p. 38–39).

Table 5
ERP Using Same Historical Data (1926–2002)

RFR Description	ERP Description	ERP Historical Return
Short nominal	Arithmetic short-horizon	8.4%
Short nominal	Geometric short-horizon	6.4
Short real	Arithmetic short-horizon	8.4
Short real	Geometric short-horizon	6.4
Intermediate nominal	Arithmetic inter-horizon	7.4
Intermediate nominal	Geometric inter-horizon	5.4
Intermediate real	Arithmetic inter-horizon	7.4
Intermediate real	Geometric inter-horizon	5.4
Long nominal	Arithmetic long-horizon	7.0
Long nominal	Geometric long-horizon	5.0
Long real	Arithmetic long-horizon	7.0
Long real	Geometric long-horizon	5.0

Source: Authors' calculations using Ibbotson Associates (2003a, p. 112).

include the effects of inflation (both stated in nominal terms) or neither have inflation (both stated in real terms). If both returns are nominal, the difference in the returns is generally assumed to remove inflation. Otherwise, both terms are real, so inflation is removed prior to finding the ERP. While numerical differences in the real and nominal approaches may exist, their magnitudes are expected to be small.

4. Equity Risk Premia 1926–2002

As an example of the importance of knowing the types of ERP estimates under consideration, Table 5 displays ERP returns that each use the same historical data, but are based on arithmetic or geometric returns and the type of horizon. The ERP estimates are quite different.[13]

5. Historical Methods

The historical methodology uses averages of past returns to forecast future returns. Different time periods may be selected, but the two most common periods arise from data provided by either Ibbotson or Siegel. The Ibbotson series begins in 1926 and is updated each year. The Siegel series begins in 1802, with the most recent compilation using returns through 2001.

Appendix A provides ERP estimates using Ibbotson data for the 1926–2002 period that we use in this paper for most illustrations. We begin with a look at the ERP history through a time series analysis of the Ibbotson data.

6. Time Series Analysis

Much of the analysis addressing the ERP puzzle relies on the annual time series of market, risk-free and risk premium returns. Two opposite views can be taken of these data. One view would have the 1926–2002 Ibbotson data or the 1802–2001 Siegel data represent one data point; that is, we have observed one path for the ERP through time from the many possible 77- or 200-year paths. This view rests upon the existence or assumption of a stochastic process with (possibly) intertemporal correlations.

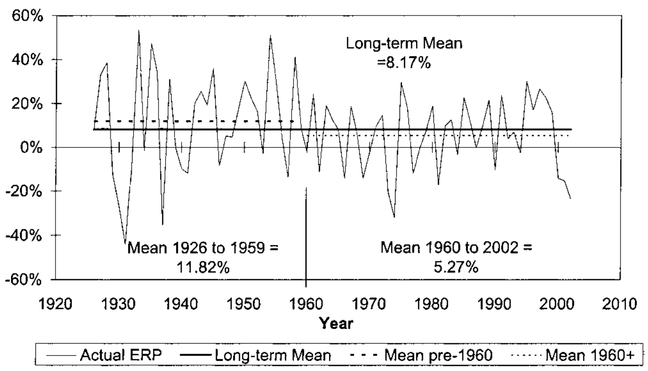
While mathematically sophisticated, this model is particularly unhelpful without some testable hint at the details of the generating stochastic process. The practical view is that the observed returns are random samples from annual distributions that are i.i.d. (independent and identically distributed) about the mean. The obvious advantage is that we have at hand 77 or 200 observations on the i.i.d. process to analyze. We adopt the latter view.

Some analyses adopt the assumption of stationarity of ERP; that is, the true mean does not change with time. Figure 1 displays the Ibbotson ERP data and highlights two subperiods, 1926–1959 and 1960–2002.[14] While the mean ERP for

[13] The nominal and real ERPs are identical in Table 5 because the ERPs are calculated as arithmetic differences, and the same value of inflation will reduce the market return and the risk-free return equally. Geometric differences would produce minimally different estimates for the same types.

[14] The ERP shown here are the geometric differences (calculated) rather than the simple arithmetic differences in Table 1; i.e., ERP = $[(1 + r_m)/(1 + r_f)] - 1$. The test results are qualitatively the same for the arithmetic differences.

Figure 1
Short-Horizon Equity Risk Premium



Source: Authors' calculations using Ibbotson Associates (2003a, p. 38–39), geometric differences.

the two subperiods appear quite different (11.82% versus 5.27%), the large variance of the process (20.24% std dev) should make them indistinguishable, statistically speaking.

7. T-Tests

The standard t-test can be used for the null hypothesis H_o : mean 1960–2002 = 8.17%, the 77-year mean.[15] The outcome of the test is shown in Table 6; the null hypothesis cannot be rejected. Another t-test can be used to test whether the subperiod means are different in the presence of unequal variances.[16] The result is similar to Table 6 and the difference of subperiod means equal to zero cannot be rejected.[17]

8. Time Trends

The supposition of stationarity of the ERP series can be supported by ANOVA regressions. The results of regressing the ERP series on time is shown in Table 7. There are no significant time trends in the Ibbotson ERP data.[18]

Table 6
T-Test under the Null Hypothesis That ERP (1960–2002) = ERP (1926–2002) = 8.17%

Sample mean 1960–2002	5.27%
Sample s.d. 1960–2002	15.83%
T-value (DF = 42)	−1.20
PR > |T|	0.2374
Confidence Interval 95%	(0.0040, 0.1014)
Confidence Interval 90%	(0.0121, 0.0933)

9. ARIMA Model

Time series analysis using the well-established Box-Jenkins approach can be used to predict future series values through the lag correlation structure (see Harvey 1990, p. 30). The SAS ARIMA procedure applied to the full 77 time series data shows:

1. No significant autocorrelation lags.
2. An identification of the series as white noise.
3. ARIMA projection of year 78 + ERP is 8.17%, the 77 year average.

All of the above single time series tests point to the reasonability of the stationarity assumption for (at least) the Ibbotson ERP 77-year series.[19]

10. Social Security Administration

In the current debate on whether to allow private accounts that may invest in equities, the Office of the Chief Actuary (OCACT) of the Social Security Administration (SSA) has selected certain assumptions to assess various proposals (Goss 2001). The relevant selection is to use 7% as the real (geometric) annual rate of return for equities (compare Table 3, subperiod III). This assumption is based on the historical return of the 20th century. SSA received further support that showed the historical return for the last 200 years is consistent with this estimate, along with the Ibbotson series beginning in 1926.

For SSA, the calculation of the ERP uses a long-run real yield on Treasury bonds as the risk-free rate. From the assumptions in the 1995 Trustees Report, the long-run real yield on Treasury bonds that the Advisory Council proposals

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[15] Standard statistical procedures in SAS 8.1 have been used for all tests.

[16] Equality of variances is rejected at the 1% level by an F test (F = 2.39, DF = 33,42).

[17] T-value 1.35, PR > |T| = 0.1850 (Cochran method).

[18] The result is confirmed by a separate Chow test on the two subperiods.

[19] The same tests applied to the Wilson and Jones 1871–2002 data series show similar results: Neither the 1871–1925 period nor the 1926–2002 period is different from the overall 1871–2002 period. The overall period and subperiods also show no trends over time.

Table 7
ERP ANOVA Regressions on Time

Period	Time Coefficient	P-Value
1926–1959	0.004	0.355
1960–2002	0.001	0.749
1926–2002	−0.001	0.443

use is 2.3%. Using a future Treasury securities real yield of 2.3% produces a geometric ERP of 4.7% over long-term Treasury securities. More recently, the Treasury securities assumption has increased to 3% (Social Security Trustees Report 1999), yielding a 4% geometric ERP over long-term Treasury securities.

At the request of the OCACT, John Campbell, Peter Diamond, and John Shoven were engaged to give their expert opinions on the assumptions Social Security made. Each economist begins with the Social Security assumptions and then explains any difference he or she feels would be more appropriate.

Campbell (2001) considered valuation ratios as a comparison to the returns from the historical approach. The current valuation ratios are at unusual levels, with a low dividend-price ratio and high price-earnings ratio. He reasoned that the prices are what have dramatically changed these ratios. Campbell presented two views as to the effect of valuation ratios in their current state. One is that valuations will remain at the current level, suggesting much lower expected returns. The second view is a correction to the ratios, resulting in less favorable returns until the ratios readjust. He decided to give some weight to both possibilities, so he lowered the geometric equity return estimate to 5–5.5% from 7%. For the risk-free rate, he used the yield on the long-term inflation-indexed bonds of 3.5% or the OCACT assumption of 3% (see discussion of current yields on Treasury Inflation Protection Securities (TIPS) in Section 16 below). Therefore, his geometric equity premium estimate was around 1.5–2.5%.

Diamond (1999, 2001) used the Gordon growth formula to calculate an estimate of the equity return. The classic Gordon dividend growth model (Brealey and Myers 2000, p. 67) follows.

$K = (D_1/P_0) + g$

K = Expected return or discount rate

P_0 = Price this period

D_1 = Expected dividend next period

g = Expected growth in dividends in perpetuity

Based on analysis, he felt that the equity return assumption of 7% for the next 75 years is not consistent with a reasonable level of stock value compared to GDP. Even when increasing the GDP growth assumption, he still did not feel that the equity return was plausible. By reasoning that the next decade of returns will be lower than normal, only then is the equity return beyond that time frame consistent with the historical return. By considering the next 75 years together, he would lower the overall projected equity return to 6–6.5%. He argued that the stock market is overvalued, and a correction is required before the long-run historical return is a reasonable projection for the future. By using the OCACT assumption of 3% for the long-term real yield on Treasury bonds, Diamond estimated a geometric ERP of about 3–3.5%.

Shoven (2001) began by explaining why the traditional Gordon growth model is not appropriate and suggested a modernized Gordon model that allows share repurchases to be included, instead of only using the dividend yield and growth rate. By assuming a long-term price-earnings ratio between its current and historical value, he came up with an estimate for the long-term real equity return of 6.125%. Using his general estimate of 6–6.5% for the equity return and the OCACT assumptions for the long-term bond yield, he projected a long-term ERP of approximately 3–3.5%.

All the SSA experts begin by accepting the long-run historical ERP analyses and then modifying that by changes in the risk-free rate or by decreases in the long-term ERP based on their own personal assessments. We now turn to the major strains in ERP puzzle research.

11. ERP PUZZLE RESEARCH

Campbell and Shiller (2001) began with the assumption of mean reversion of dividend/price and price/earnings ratios. Next, they explained the result of prior research (Campbell and Shiller 1988) that found that the dividend-price ratio predicts future prices, and historically, the price corrects the ratio when it diverts from the mean. Based on this result, they then used regressions of the dividend-price ratio and the price-smoothed-earnings ratio—"smoothed" by using 10-year averages—to predict future stock prices out 10 years. Both regressions predict large losses in stock prices for the 10-year horizon.

Although Campbell and Shiller (2001) did not rerun the regression on the dividend-price ratio to incorporate share repurchases, they pointed out that the dividend-price ratio should be upwardly adjusted, but the adjustment only moves the ratio to the lower range of the historical fluctuations (as opposed to the mean). They concluded that the valuation ratios indicate a bear market in the near future.[20] They predicted negative real stock returns for the next 10-year period. They also cautioned that, because valuation ratios have changed so much from their normal level, they may not completely revert to the historical mean, but this does not change their pessimism about the next decade of stock market returns.

Arnott and Ryan (2001) took the perspective of fiduciaries, such as pension fund managers, with an investment portfolio. They began by breaking down the historical stock returns (for the 74 years since December 1925) by analyzing dividend yields and real dividend growth. They pointed out that the historical dividend yield is much higher than the current dividend yield of about 1.2%. They argued that the changes from stock repurchases, reinvestment, and mergers and acquisitions, which affect the lower dividend yield, can be represented by a higher dividend growth rate. However, they capped real dividend or earnings growth at the level of real economic growth. They added the dividend yield and the growth in real dividends to come up with an estimate for the future equity return; the current dividend yield of 1.2% and the economic growth rate of 2% add to the 3.2% estimated real stock return. This method corresponds to the dividend growth model or earnings growth model and does not take into account changing valuation levels. They cite a TIPS yield of 4.1% for the real risk-free rate return (see Section 16). These two estimates yield a negative geometric long-horizon conditional ERP.

Arnott and Bernstein (2002) began by arguing that, in 1926, investors were not expecting the realized, historical compensation that they later received from stocks. They cited bonds' reaction to inflation, increasing valuations, survivorship bias (see Brown et al. 1992, 1995), and changes in regulation as positive events that helped investors during this period. They only used the dividend growth model to predict a future expected return for investors. They did not agree that the earnings growth model is better than the dividend growth model, both because earnings are reported using accounting methods and earnings data before 1870 are inaccurate. Even if the earnings growth model is chosen instead, they found that the earnings growth rate from 1870 only grows 0.3% faster than dividends, so their results would not change much. Because of the Modigliani-Miller theorem (Brealey and Myers 2000, p. 447; also see the discussion in Ibbotson and Chen 2003), a change in dividend policy should not change the value of the firm. Arnott and Bernstein concluded that managers benefited in the "era of 'robber baron' capitalism" (p. 66) instead of the conclusion reached by others that the dividend growth model underrepresents the value of the firm.

By holding valuations constant and using the dividend yield and real growth of dividends, Arnott and Bernstein (2002) calculated the equity return that an investor might have expected during the historical time period starting in 1802. They used an expected dividend yield of 5%, close to the historical average of 1810–2001. For the real growth of dividends, they chose the real per capita GDP growth less a reduction for entrepreneurial activity in the economy plus stock repurchases. They concluded that the net adjustment is negative, so the real GDP growth is reduced from 2.5–3% to only 1%. A fair expectation of the stock return for the historical period is close to 6.1% by adding 5% for the dividend yield and a net real GDP per capita growth of 1.1%. They used a TIPS yield of 3.7% for the real risk-free rate, which yields a geometric intermediate-horizon ERP of 2.4% as a fair expectation for investors in the past. They considered this a "normal" ERP estimate. They also opined that the current ERP is zero; that is, they expected stocks and (risk-free) bonds to return the same amounts.

[20] The stock market correction from year-end 1999 to year-end 2002 is a decrease of 37.6%, or 14.6% per year. Presumably, the "next 10 years" refers to 2000 to 2010.

Fama and French (2002) used both the dividend growth model and the earnings growth model to investigate three periods of historical returns: 1872–2000, 1872–1950, and 1951–2000. Their ultimate aim was to find an unconditional ERP. They cited that, by assuming the dividend-price ratio and the earnings-price ratio follow a mean reversion process, the result follows that the dividend growth model or earnings growth model produce approximations of the unconditional equity return. Fama and French's analysis of the earlier period of 1872–1950 shows that the historical average equity return and the estimate from the dividend growth model are about the same.

In contrast, they found that the 1951–2000 period has different estimates for returns when comparing the historical average and the growth models' estimates. The difference in the historical average and the model estimates for 1951–2000 was interpreted to be "unexpected capital gains" over this period. They found that the unadjusted growth model estimates of the ERP, 2.55% from the dividend model and 4.32% from the earnings model, fell short of the realized average excess return for 1951–2000.

Fama and French preferred estimates from growth models instead of the historical method because of the lower standard error using the dividend growth model. Fama and French provided 3.83% as the unconditional expected ERP return (referred to as the annual bias-adjusted ERP estimate) using the dividend growth model with underlying data from 1951–2000. They gave 4.78% as the unconditional expected ERP return, using the earnings growth model with data from 1951–2000. Note that using a one-month Treasury bill instead of commercial paper for the risk-free rate would increase the ERP by about 1% to nearly 6% for the 1951–2000 period.

Ibbotson and Chen (2003) examined the historical real geometric long-run market and long risk-free returns using their "building block" methodology.[21] They used the full 1926–2000 Ibbotson Associates data and considered as building blocks all of the fundamental variables of the prior researchers. Those blocks include (not all simultaneously):

- Inflation.
- Real risk-free rates (long).
- Real capital gains.
- Growth of real earnings per share.
- Growth of real dividends.
- Growth in payout ratio (dividend/earnings).
- Growth in book value.
- Growth in ROE.
- Growth in price/earnings ratio.
- Growth in real GDP/population.
- Growth in equities excess of GDP/POP.
- Reinvestment.

Their calculations show that a forecast real geometric long-run return of 9.4% is a reasonable extrapolation of the historical data underlying a realized 1926–2000 return of 10.7%, yielding a long-horizon arithmetic ERP of 6%, or a short-horizon arithmetic ERP of about 7.5%.

Ibbotson and Chen (2003) constructed six building-block methods; that is, they used combinations of historic estimates to produce an expected geometric equity return. They highlighted the importance of using both dividends and capital gains by invoking the Modigliani-Miller theorem. The methods, and their component building blocks are:

- Method 1: Inflation, real risk-free rate, realized ERP.
- Method 2: Inflation, income, capital gains and reinvestment.
- Method 3: Inflation, income, growth in price/earnings, growth in real earnings per share and reinvestment.
- Method 4: Inflation, growth rate of price/earnings, growth rate of real dividends, growth rate of payout ratio dividend yield and reinvestment.
- Method 5: Inflation, income growth rate of price/earnings, growth of real book value, ROE growth and reinvestment.
- Method 6: Inflation, income, growth in real GDP/POP, growth in equities excess GDP/POP and reinvestment.

All six methods reproduce the historical long-horizon geometric mean of 10.70% as shown in Appendix D. Since the source of most other researchers'

[21] See Appendix D for a summary of their estimates. Also see Pratt (1998) for a discussion of the building block, or build-up model, cost of capital estimation method.

lower ERP is the dividend yield, Ibbotson and Chen (2003) recast the historical results in terms of *ex ante* forecasts for the next 75 years. Their estimate of 9.37% using supply side methods 3 and 4 is approximately 130 basis points lower than the historical result. Within their methods, they also show how the substantially lower expectation of 5.44% for the long mean geometric return is calculated by omitting one or more relevant variables. Underlying these *ex ante* methods are the assumptions of stationarity of the mean ERP return and market efficiency, the absence of the assumption that the market has mispriced equities. All of their methods are aimed at producing an unconditioned estimate of the *ex ante* ERP.

As opposed to short-run, conditional estimates from Campbell and Shiller and others, Constantinides (2002) sought to estimate the unconditional ERP, more in line with the goal of Fama and French (2002) and Ibbotson and Chen (2003). He began with the premise that the unconditional ERP can be estimated from the historical average using the assumption that the ERP follows a stationary path. He suggested that most of the other research produces conditional estimates, conditioned upon beliefs about the future paths of fundamentals such as dividend growth, price-earnings ratio, and the like. While interesting in themselves, they add little to the estimation of the unconditional mean ERP.

Constantinides (2002) used the historical return and adjusted downward by the growth in the price-earnings ratio to calculate the unconditional ERP. He removed the growth in the price-earnings ratio because he was assuming no change in valuations in the unconditional state. He gave estimates using three periods. For 1872–2000, he used the historical ERP, which is 6.9%, and, after amortizing the growth in the price-dividend ratio or price-earnings ratio over a period as long as 129 years, the effect of the potential reduction was no change. Therefore, he found an unconditional arithmetic, short-horizon ERP of 6.9% using the 1872–2000 underlying data. For 1951–2000, he again started with the historical ERP, which is 8.7%, and lowered this estimate by the growth in the price-earnings ratio of 2.7% to find an unconditional arithmetic, short-horizon ERP of 6.0%. For 1926–2000, he used the historical ERP, which is 9.3%, and reduced this estimate by the growth in the price-earnings ratio of 1.3% to find an unconditional arithmetic, short-horizon ERP of 8.0%. He appealed to behavioral finance to offer explanations for such high unconditional ERP estimates.

From the perspective of giving practical investor advice, Malkiel (1999) discussed "the age of the millennium" to give some indication of what investors might expect for the future. He specifically estimated a reasonable expectation for the first few decades of the 21^{st} century. He estimated the future bond returns by giving estimates if bonds are held to maturity with corporate bonds of 6.5–7%, long-term zero-coupon Treasury bonds of about 5.25%, and TIPS with a 3.75% return.

Depending on the desired level of risk, Malkiel indicated bondholders should be more favorably compensated in the future compared to the historical returns from 1926 to 1998. Malkiel used the earnings growth model to predict future equity returns. He used the then-current dividend yield of 1.5% and an earnings growth estimate of 6.5%, yielding an 8% equity return estimate, compared with an 11% historical return. Malkiel's estimated range of the ERP is from 1% to 4.25%, depending on the risk-free instrument selected. Although his ERP is lower than the historical return, his selection of a relatively high earnings growth rate is similar to Ibbotson and Chen's (2003) forecasted models. In contrast with Ibbotson and Chen, Malkiel allowed for a changing ERP and advised investors not to rely solely on the past "age of exuberance" as a guide for the future. Malkiel pointed out the impact of changes in valuation ratios but did not attempt to predict future valuation levels.

Finally, Mehra (2002) summarized the results of the research since the ERP puzzle was posed. The essence of the puzzle is the inconsistency of the ERPs produced by descriptive and prescriptive economic models of asset pricing, on the one hand, and the historical ERPs realized in the U.S. market, on the other. Mehra and Prescott (1985) speculated that the inconsistency could arise from the inadequacy of standard models to incorporate market imperfections and transaction costs. Failure of the models to reflect reality rather than failure of the market to follow the theory seems to be Mehra's conclusion as of 2002. Mehra points to two promising threads of model-modifying research. Campbell and Cochrane (1999) incorporated economic cycles and changing risk aversion while Constantinides et al. (2002) proposed a life cycle investing modification, replacing the representative agent by segmenting investors into young, middle-aged, and older cohorts. Mehra summed up as follows:

> "Before we dismiss the premium, we not only need to have an understanding of the observed phenomena but also why the future is likely to be different. In the absence of this, we can make the following claim based on what we know. Over the long horizon the equity premium is likely to be similar to what it has been in the past and the returns to investment in equity will continue to substantially dominate those in bonds for investors with a long planning horizon" (p. 146).

12. Financial Analyst Estimates

Claus and Thomas (2001) and Harris and Marston (2001) both provided equity premium estimates using financial analysts' forecasts. However, their results were rather different. Claus and Thomas used an abnormal earnings model with data from 1985 to 1998 to calculate an ERP, as opposed to using the more common dividend growth model. Financial analysts project five-year estimates of future earnings growth rates. When using this five-year growth rate for the dividend growth rate in perpetuity in the Gordon growth model, Claus and Thomas explained that there is a potential upward bias in estimates for the ERP. Therefore, they chose to use the abnormal earnings model, instead, and only let earnings grow at the level of inflation after five years. The abnormal earnings model replaced dividends with "abnormal earnings" and discounted each flow separately instead of using a perpetuity. The average estimate that they found was 3.39% for the ERP.

Although it is generally recognized that financial analysts' estimates have an upward bias, Claus and Thomas (2001) proposed that, in the current literature, financial analysts' forecasts have underestimated short-term earnings in order for management to achieve earnings estimates in the slower economy. Claus and Thomas concluded that their findings of the ERP using data from the past 15 years were not in line with historical values.

Harris and Marston (2001) used the dividend growth model with data from 1982 to 1998. They assumed that the dividend growth rate should correspond to investor expectations. By using financial analysts' longest estimates (five years) of earnings growth in the model, they attempted to estimate these expectations. They argued that, if investors are in accord with the optimism shown in analysts' estimates, even biased estimates do not pose a drawback because these market sentiments will be reflected in actual returns. Harris and Marston found an ERP estimate of 7.14%, with fluctuations in the ERP over time. Because their estimates were close to historical returns, they contended that investors would continue to require a high ERP.

13. Survey Methods

One method to estimate the *ex ante* ERP is to find the consensus of experts. Graham and Harvey (2002) surveyed chief financial officers to determine the average cost of capital used by firms. Welch (2000, 2001) surveyed financial economists to determine the ERP that academic experts in this area would estimate.

Graham and Harvey (2002) administered surveys from the second quarter of 2000 to the third quarter of 2002. For their survey format, they showed the current 10-year bond yield and then asked CFOs to provide their estimate of the S&P 500 return for the next year and over the next 10 years. CFOs are actively involved in setting a company's individual hurdle rate[22] and, therefore, are considered knowledgeable about investors' expectations. When comparing the survey responses of the one- and 10-year returns, the one-year returns have so much volatility that the authors, Graham and Harvey, concluded that the 10-year ERP is the more important and appropriate return of the two when making financial decisions such as estimating hurdle rates and cost of capital. The average 10-year ERP estimate varied from 3% to 4.7%.

In his most current survey, Welch (2001) compiled the responses of about 500 financial economists to determine their consensus ERP. He found the average arithmetic estimate for the 30-year ERP, relative to Treasury bills, to be 5.5% and the one-year arithmetic ERP consensus to be 3.4%. Welch deduced from the average 30-year geometric equity return estimate of 9.1% that the

[22] A "hurdle" rate is a benchmark cost of capital used to evaluate projects to accept (expected returns greater than hurdle rate) or reject (expected returns less than hurdle rate). Graham and Harvey (2002) claim three-fourths of the CFOs use CAPM to estimate hurdle rates.

Table 8
Differences in Forecasts across Expertise Level

Relative Expertise	Statistic	Stock Market 30-Year Geometric	Equity Premium 30-Year Arithmetic	Equity Premium 30-Year Geometric
188 Less Involved	Mean	8.5%	4.9%	4.4%
	Median	8	5	4
	IQ Range	6–10	3–6	2–5.5
235 Average	Mean	9.2	5.8	4.8
	Median	9	5	4
	IQ Range	7.5–10	3.5–7	3–6
72 Experts	Mean	10.1	6.2	5.4
	Median	9	5.4	5
	IQ Range	8–11	4–7.5	3.4–6

Source: Welch (2001, table 5).

arithmetic equity return forecast was approximately 10%.[23]

Welch's survey question allowed participants to self-select into different categories based on their knowledge of ERP. The results indicate that the responses of the less ERP-knowledgeable participants were more pessimistic than those of the self-reported experts. The experts gave 30-year estimates that are 30–150 basis points above the estimates of the nonexpert group.

Table 8 shows that there may be a "lemming" effect, especially among economists who are not directly involved in the ERP question. Stated differently, all the academic and popular press—together with the prior 1998 Welch survey (which had an ERP consensus of about 7%)—could have conditioned the nonexpert, or the "less involved," that the expected ERP was lower than historic levels.

14. The Behavioral Approach

Benartzi and Thaler (1995) analyzed the ERP puzzle from the viewpoint of prospect theory (Kahneman and Tversky 1979). Prospect theory allows asymmetric "loss aversion"—the fact that individuals are more sensitive to potential loss than gain—as one of its central tenets (see Tversky and Kahneman 1991 and Barberis et al. 2001 for a current survey of the applications of prospect theory to finance). Once an asymmetry in risk aversion is introduced into the model of the rational representative investor or agent, the unusual risk aversion problem raised initially by Mehra and Prescott (1985) can be "explained" by parameters within this behavioral model of decision making under uncertainty.

Stated differently, given the historical ERP series, there exists a model of investor behavior that can produce those or similar results. Benartzi and Thaler (1995) combined loss aversion with "mental accounting"—the behavioral process people use to evaluate their status relative to gains and losses compared to expectations, utility, and wealth—to get "myopic loss aversion." In particular, mental accounting for a portfolio needs to take place infrequently in order to reduce the chances of observing loss versus gain. The authors concede that there is a puzzle with the standard expected utility-maximizing paradigm but that the myopic loss aversion view may resolve the puzzle. The authors' views are not free of controversy; any progress applying behavioral concepts to the ERP puzzle is sure to match the advance of behavioral economics as a whole.

The adoption of other behavioral aspects of investing also may provide support for the historical patterns of ERPs we see from 1802–2002. For example, as the true nature of risk and rewards has been uncovered by the virtual army of 20th century researchers, and as institutional investors held sway in the latter 50 years of the century, the demand for higher rewards seen in the later historical data may be a natural and rational response to the new and expanded information set. Dimson et al. (2002, figs. 4–6) displays increasing real U.S. equity returns of 6.7%, 7.4%, 8.2% and 10.2% for periods of 101, 75, 50 and 25

[23] For the Ibbotson 1926–2002 data, the arithmetic return is about 190 basis points higher than the geometric return, rather than the inferred 90 basis points. This suggests the participants' beliefs, in Welch's study, may not be internally consistent.

years, ending in 2001, consistent with this "risk-learning" view.

15. The Next 10 Years

The "next 10 years" is an issue that Campbell and Diamond discuss when reviewing Social Security's assumptions and Campbell and Shiller (2001) address, either explicitly or implicitly. Experts evaluating Social Security's proposals predicted that returns during the "next 10 years," indicating a period beginning around 2000, were likely to be below the historical return. However, a historical return was recommended as appropriate for the remaining 65 of the 75 years to be projected. The period Campbell and Shiller discussed is approximately 2000–2010. Based on the then-current state of valuation ratios, they predicted lower stock market returns over "the next 10 years."

These expert predictions, and other pessimistic low estimates, have already come to fruition as market results from 2000 through 2002.[24] The U.S. equities market has decreased 37.6% since 1999, or an annual decrease of 14.6%. Although these forecasts have proved to be accurate in the short term, for future long-run projections, the market is not at the same valuation today as it was when these conditional estimates were originally given. Therefore, actuaries should be wary of using the low long-run estimates made prior to the large market correction of 2000–2002.

16. Treasury Inflation Protection Securities

Several of the ERP researchers referred to TIPS when considering the real risk-free rates. Historically, they adjusted Treasury yields downward to a real rate by an estimate of inflation, presumably for the term of the Treasury security. The modern era data in Table 3 show a low real long-term, risk-free rate of return (2.2%). This contrasts with the initial TIPS issue yields of 3.375%.[25] Some researchers use those TIPS yields as (market) forecasts of real risk-free returns for intermediate and long-horizon, together with reduced (real) equity returns, to produce low estimates of *ex ante* ERPs. None consider the volatility of TIPS as indicative of the accuracy of their ERP estimate.

Table 9
Inflation-Indexed Treasury Securities

Maturity	Coupon Issue Rate	Yield to Maturity
1/2011	3.500	1.763
1/2012	3.375	1.831
7/2012	3.000	1.878
4/2028	3.625	2.498
4/2029	3.875	2.490
4/2032	3.375	2.408

Source: Wall Street Journal (2003)

Table 9 shows a 2003 market valuation of 10- and 30-year TIPS issued in 1998–2002. Note the large 90–180 basis point decrease in the current "real" yields from the issue yields even just a year later for some issues. While there can be several explanations for the change (revaluation of the inflation option, flight to Treasury quality, paucity of 30-year Treasuries), the use of these current "real" risk-free yields, with fixed expected returns, would raise ERPs by at least 1%.

17. Conclusion

This paper has sought to bring the essence of recent research on the ERP to practicing actuaries. The researchers covered here face the same ubiquitous problems that actuaries face daily: Do I rely on past data to forecast the future (costs, premiums, investments), or do I analyze the past and apply informed judgment as to future differences, if any, to arrive at actuarially fair forecasts? Most of the ERP estimates lower than the unconditional historical estimate have an undue reliance on recent lower dividend yields (without a recognition of capital gains[26]) and/or on data prior to 1926.

Despite a spate of research suggesting *ex ante* ERPs lower than recent realized ERPs, actuaries should be aware of the range of estimates covered here (Appendix B); be aware of the underlying

[24] The Social Security Advisory Board (2002) will revisit the 75-year rate of return assumption during 2003.

[25] TIPS were introduced by the Treasury in 1996 with the first issue in January 1997.

[26] Under the current U.S. tax code, capital gains are tax-advantaged relative to dividend income for the vast majority of equityholders (households and mutual funds are 55% of the total equityholders, according to the Federal Flow of Funds, 2002 Q3, Table L-213). Curiously, the reverse is true for property-liability insurers because of the 70% stock dividend exclusion afforded insurers.

assumptions, data, and terminology; and be aware that their independent analysis is required before adopting an estimate other than the historical average. We believe that the Ibbotson and Chen (2003) layout, reproduced here as Appendix D, offers the actuary both an understanding of the fundamental components of the historical ERP and the opportunity to change the estimates based on good judgment and supportable beliefs. We believe that reliance solely on "expert" survey averages, whether of financial analysts, academic economists, or CFOs, is fraught with risks of statistical bias in estimates of the *ex ante* ERP.

It is dangerous for actuaries to engage in simplistic analyses of historical ERPs to generate *ex ante* forecasts that differ from the realized mean.[27] The research we have catalogued in Appendix B, the common level ERPs estimated in Appendix C, and the building-block (historical) approach of Ibbotson and Chen (2003) in Appendix D all discuss important concepts related to both *ex post* and *ex ante* ERPs and cannot be ignored in reaching an informed estimate.

For example, Wendt (2002) concluded that a linear relationship with interest rates is a better predictor of future returns than is a "constant" ERP based on the average historical return. He arrived at this conclusion by estimating a regression equation relating long bond yields with 15-year geometric mean market returns starting monthly in 1960.[28] Wendt's findings are misleading. First, there was no significant relationship between short-, intermediate-, or long-term income returns over 1926–2002 (or 1960–2002) and annual ERPs, as evidenced by simple regressions using Ibbotson data.[29] Second, if the linear structural equation indeed held, there would be no need for an ERP since the (15-year) return could be predicted within small error bars. Third, there is always a negative bias introduced when geometric averages are used as dependent variables (Brennan and Schwartz 1985). Finally, the results are likely to be spurious due to the high autocorrelations of the target and independent variables; an autocorrelation correction would eliminate any significant relationship of long yields to the ERP.

Actuaries also should be aware of the variability of both the ERP and risk-free rate estimates discussed in this paper (see Tables 4 and 9). All too often, return estimates are made without noting the error bars, and that can lead to unexpected "surprises." As one example, recent research by Longstaff (2004) proposes that a 1991–2001 "flight to quality" has created a valuation premium (and lowered yields) in the entire yield curve of Treasuries. He finds a 10–16 basis point liquidity premium throughout the zero coupon Treasury yield curve. He translates that into a 10–15% pricing difference at the long end. This would imply a simple CAPM market estimate for the long horizon might be biased low.

Finally, actuaries should know that the research catalogued in Appendix B is not definitive. No simple model of ERP estimation has been universally accepted. Undoubtedly, there will be still more empirical and theoretical research into this data-rich financial topic. We await the potential advances in understanding the return process that the behavioral view may uncover.

18. POST SCRIPT: APPENDICES A–D

We provide four appendices that catalogue the ERP approaches and estimates discussed in the paper. Actuaries, in particular, should find the numerical values, and descriptions of assumptions underlying those values helpful for valuation work that adjusts for risk. Appendix A provides the annual data from 1926 through 2002 from Ibbotson Associates referred to throughout this paper. The equity risk premium shown is a simple difference of the arithmetic stock returns and the arithmetic U.S. Treasury bill total returns.

Appendix B is a compilation of articles and books related to the ERP. The puzzle research section contains the articles and books that were most related to addressing the ERP puzzle.[30] Appendix B

[27] ERPs are derived from historical or expected after-corporate-tax returns. Pre-tax returns depend uniquely on the tax schedule for the differing sources of income.

[28] Fifteen-year mean returns = 2.032 (Long Government Yield) – 0.0242, $R^2 = 0.882$.

[29] The *p*-values on the yield variables in an annual ERP/yield regression using 1926–2002 annual data are 0.1324, 0.2246, and 0.3604 for short-, intermediate-, and long-term yields, respectively, with adjusted R-square values virtually zero.

[30] Additional references are included, in the table, that were not previously discussed (see Cornell 1999, Dimson et al. 2002, Siegel 1999, Siegel 2002, and Grinold and Kroner 2002 (Barclays Global Investors).

gives each source, along with risk-free rate and ERP estimates and further details collected from each source. For example, we show the data period used, if applicable, and the projection period. We also list the general methodology used in the reference. Footnotes give additional details on the sources' intent.

Appendix C adjusts all the ERP estimates to a short-horizon, arithmetic, unconditional ERP estimate. We begin with the authors' estimates for a stock return (the risk-free rate plus the ERP estimate). Next, we make adjustments if the ERP "type" given by the author(s) is not provided in this format. For example, to adjust from a geometric to an arithmetic ERP estimate, we adjust upward by the 1926–2002 historical difference in the arithmetic large-company stocks' total return and the geometric large-company stocks' total return of 2%. Next, if the estimate is given in real instead of nominal terms, we adjust the stock return estimate upward by 3.1%, the 1926–2002 historical return for inflation.

We make an approximate adjustment to move the estimate from a conditional to unconditional estimate based on Fama and French (2002) where they make similar adjustments for the biases in a dividend or earnings growth model. For the 1951–2000 period, Fama and French use an adjustment of 1.28% for the dividend growth model and 0.46% for the earnings growth model (Table 4, p. 655). Using their adjustment method and the data provided in Fama and French's table 1, the 1872–2000 period would require a 0.82% adjustment and the 1872–1950 period would require a 0.54% adjustment using a dividend growth model. Therefore, we selected the lowest adjustment (0.46%) from the different time periods and models as a minimum adjustment from a conditional estimate to an unconditional estimate of market returns. Finally, we subtract the 1926–2002 historical U.S. Treasury bills' total return to arrive at an adjusted ERP.

These adjustments are only approximations because the various sources rely on different underlying data, but the changes in the ERP estimate should reflect the underlying concept that different "types" of ERPs cannot be directly compared and require some attempt to normalize the various estimates.

Appendix D reproduces a table from Ibbotson and Chen (2003) that breaks down historical returns using various methods discussed in their paper, including forward-looking estimates. Summarized formulas from Ibbotson and Chen's paper are also displayed.

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Appendix A
Ibbotson Market Data 1926–2002

Year	Common stocks	U.S. Treasury Bills	Arithmetic Short-Horizon	Year	Common stocks	U.S. Treasury Bills	Arithmetic Short-Horizon
	Total Annual Returns	Total Annual Returns	Equity Risk Premia		Total Annual Returns	Total Annual Returns	Equity Risk Premia
1926	11.62%	3.27%	8.35%	1966	−10.06%	4.76%	−14.82%
1927	37.49	3.12	34.37	1967	23.98	4.21	19.77
1928	43.61	3.56	40.05	1968	11.06	5.21	5.85
1929	−8.42	4.75	−13.17	1969	−8.50	6.58	−15.08
1930	−24.90	2.41	−27.31	1970	4.01	6.52	−2.51
1931	−43.34	1.07	−44.41	1971	14.31	4.39	9.92
1932	−8.19	0.96	−9.15	1972	18.98	3.84	15.14
1933	53.99	0.30	53.69	1973	−14.66	6.93	−21.59
1934	−1.44	0.16	−1.60	1974	−26.47	8.00	−34.47
1935	47.67	0.17	47.50	1975	37.20	5.80	31.40
1936	33.92	0.18	33.74	1976	23.84	5.08	18.76
1937	−35.03	0.31	−35.34	1977	−7.18	5.12	−12.30
1938	31.12	−0.02	31.14	1978	6.56	7.18	−0.62
1939	−0.41	0.02	−0.43	1979	18.44	10.38	8.06
1940	−9.78	0.00	−9.78	1980	32.42	11.24	21.18
1941	−11.59	0.06	−11.65	1981	−4.91	14.71	−19.62
1942	20.34	0.27	20.07	1982	21.41	10.54	10.87
1943	25.90	0.35	25.55	1983	22.51	8.80	13.71
1944	19.75	0.33	19.42	1984	6.27	9.85	−3.58
1945	36.44	0.33	36.11	1985	32.16	7.72	24.44
1946	−8.07	0.35	−8.42	1986	18.47	6.16	12.31
1947	5.71	0.50	5.21	1987	5.23	5.47	−0.24
1948	5.50	0.81	4.69	1988	16.81	6.35	10.46
1949	18.79	1.10	17.69	1989	31.49	8.37	23.12
1950	31.71	1.20	30.51	1990	−3.17	7.81	−10.98
1951	24.02	1.49	22.53	1991	30.55	5.60	24.95
1952	18.37	1.66	16.71	1992	7.67	3.51	4.16
1953	−0.99	1.82	−2.81	1993	9.99	2.90	7.09
1954	52.62	0.86	51.76	1994	1.31	3.90	−2.59
1955	31.56	1.57	29.99	1995	37.43	5.60	31.83
1956	6.56	2.46	4.10	1996	23.07	5.21	17.86
1957	−10.78	3.14	−13.92	1997	33.36	5.26	28.10
1958	43.36	1.54	41.82	1998	28.58	4.86	23.72
1959	11.96	2.95	9.01	1999	21.04	4.68	16.36
1960	0.47	2.66	−2.19	2000	−9.11	5.89	−15.00
1961	26.89	2.13	24.76	2001	−11.88	3.83	−15.71
1962	−8.73	2.73	−11.46	2002	−22.10	1.65	−23.75
1963	22.80	3.12	19.68				
1964	16.48	3.54	12.94	Mean	**12.20**	**3.83**	**8.37**
1965	12.45	3.93	8.52	Std dev	**20.49**	**3.15**	**20.78**

Source: Authors' calculations using Ibbotson Associates (2003a, pp. 38–39).

Appendix B
Compilation of Equity Risk Premium Estimates

Source	Risk-free-rate	ERP Estimate	Real Risk-Free Rate	Nominal Risk-Free Rate	Geometric	Arithmetic	Long Horizon	Short Horizon	Short-Run Expectation	Short-Run Expectation	Conditional	Unconditional
Historical												
Ibbotson Associates	3.8%[7]	8.4%[31]		X		X		X		X		X
Social Security												
Office of the Chief Actuary[1]	2.3%, 3%[8]	4.7%, 4%[32]	X		X		X			X		X
John Campbell[2]	3–3.5%[9]	1.5–2.5%, 3–4%[33]	X		X	X	X	X		X	X	
Peter Diamond	2.2%[10]	<4.8%[34]	X		X		X			X	X	
Peter Diamond[3]	3%[11]	3–3.5%[35]	X		X		X			X	X	
John Shoven[4]	3%, 3.5%[12]	3–3.5%[36]	X		X		X			X	X	
Puzzle Research												
Robert Arnott and Peter Bernstein	3.7%[13]	2.4%[37]	X		X		X			X	X	
Robert Arnott and Ronald Ryan	4.1%[14]	−0.9%[38]	X		X		X			X	X	
John Campbell and Robert Shiller	N/A	Negative[39]	X		?		?		X		X	
James Claus and Jacob Thomas	7.64%[15]	3.39% or less[40]		X		X	X			X	X	
George Constantinides	2%[16]	6.9%[41]	X			X		X		X		X
Bradford Cornell	5.6%, 3.8%[17]	3.5–5.5%, 5–7%[42]		X		X	X	X		X	X	
Dimson, Marsh, & Staunton	1.0%[18]	5.4%[43]	X			X		X		X	X	
Eugene Fama and Kenneth French	3.24%[19]	3.83% & 4.78%[44]	X			X		X		X		X
Robert Harris and Felicia Marston	8.53%[20]	7.14%[45]		X		X	X		X		X	
Roger Ibbotson and Peng Chen	2.05%[21]	4% and 6%[46]	X		X	X	X			X		X
Jeremy Siegel	4%[22]	−0.9% to −0.3%[47]	X		X		X			X	X	
Jeremy Siegel	3.5%[23]	2–3%[48]	X		X		X			?	X	
Surveys												
John Graham and Campbell Harvey	Δ by survey[24]	3–4.7%[49]		X		?	X		X		X	
Ivo Welch	N/A[25]	7%[50]		X		X		X		X	X	
Ivo Welch[5]	5%[26]	5–5.5%[51]		X		X		X		X	X	
Misc.												
Barclays Global Investors	5%[27]	2.5%, 3.25%[52]		X	X		X		X		X	
Richard Brealey and Stewart Myers	N/A[28]	6–8.5%[53]		X		X		X		X		X
Burton Malkiel	5.25%[29]	2.75%[54]		X	X		X			X	X	
Richard Wendt[6]	5.5%[30]	3.3%[55]		X		X	X			X	X	

Notes: Long-run expectation considered to be a forecast of more than 10 years. Short-run expectation considered to be a forecast of 10 years or less.

Footnotes:
[1]Social Security Administration.
[2]Presented to the Social Security Advisory Board.
[3]Presented to the Social Security Advisory Board. Update of 1999 article.
[4]Presented to the Social Security Advisory Board.
[5]Update to Welch (2000).
[6]Newsletter of the Investment Section of the Society of Actuaries.
[7]Arithmetic mean of U.S. Treasury bills annual total returns from 1926–2002.
[8]2.3% long-run real yield on Treasury bonds, used for Advisory Council proposals; 3% long-term real yield on Treasury bonds; used in 1999 Social Security Trustees Report.
[9]Estimate for safe real-interest rates in the future based on yield of long-term inflation-indexed Treasury securities of 3.5% and short-term real-interest rates recently averaging about 3%.
[10]Real long-term bond yield using 75-year historical average.
[11]Real yield on long-term Treasuries (assumption by OCACT).
[12]3% is the OCACT assumption; 3.5% is the real return on long-run (30-year) inflation-indexed Treasury securities.
[13]Long-term expected real geometric bond return (10-year-horizon).
[14]The yield on U.S. government inflation-indexed bonds (starting bond real yield in January 2000).
[15]Average 10-year government T-bond yield between 1985 and 1998 (yield of 11.43% in 1985 to 5.64% in 1998). The mean 30-year risk-free rate for each year of the U.S. sample period is 31 basis points higher than the mean 10-year risk-free rate.
[16]Rolled-over real arithmetic return of three-month Treasury bills and certificates.
[17]Historical 20-year Treasury bond return of 5.6%. Yield on 20-year Treasury bonds in 1998 was approximately 6%. Historical one-month Treasury bill return of 3.8%. Yield on one-month Treasury bills in 1998 was approximately 4%.
[18]U.S. historical arithmetic real Treasury bill return over 1900–2000 period. 0.9% geometric Treasury bill return.

Appendix B (continued)

Source	Risk-free Rate	ERP Estimate	Data Period	Methodology
Historical				
Ibbotson Associates	3.8%[7]	8.4%[31]	1926–2002	Historical
Social Security				
Office of the Chief Actuary[1]	2.3%, 3%[8]	4.7%, 4%[32]	1900–1995, Projecting out 75 years	Historical
John Campbell[2]	3–3.5%[9]	1.5–2.5%, 3–4%[33]	Projecting out 75 years	Historical & ratios (div/price & earn gr)
Peter Diamond	2.2%[10]	<4.8%[34]	Last 200 yrs for eq/75 for bonds, Proj 75 yrs	Fundamentals: div yld, GDP gr
Peter Diamond[3]	3%[11]	3–3.5%[35]	Projecting out 75 years	Fundamentals: div/price
John Shoven[4]	3%, 3.5%[12]	3–3.5%[36]	Projecting out 75 years	Fundamentals: P/E, GDP gr
Puzzle Research				
Robert Arnott and Peter Bernstein	3.7%[13]	2.4%[37]	1802 to 2001, normal	Fundamentals: div yld & gr
Robert Arnott and Ronald Ryan	4.1%[14]	−0.9%[38]	Past 74 years, 74 year projection[56]	Fundamentals: div yld & gr
John Campbell and Robert Shiller	N/A	Negative[39]	1871 to 2000, 10-year projection	Ratios: P/E and div/price
James Claus and Jacob Thomas	7.64%[15]	3.39% or less[40]	1985–1998, long-term	Abnormal earnings model
George Constantinides	2%[16]	6.9%[41]	1872 to 2000, long-term	Hist. and Fund.: price/div & P/E
Bradford Cornell	5.6%, 3.8%[17]	3.5–5.5%, 5–7%[42]	1926–1997, long-run forward-looking	Weighing theoretical and empirical evidence
Dimson, Marsh, & Staunton	1%[18]	5.4%[43]	1900–2000, prospective	Adj hist ret, var of Gordon gr model
Eugene Fama and Kenneth French	3.24%[19]	3.83% & 4.78%[44]	Estimate for 1951–2000, long-term	Fundamentals: dividends and earnings
Robert Harris and Felicia Marston	8.53%[20]	7.14%[45]	1982–1998, expectational	Fin analysts' est, div gr model
Roger Ibbotson and Peng Chen	2.05%[21]	4% and 6%[46]	1926–2000, long-term	Historical and supply side approaches
Jeremy Siegel	4%[22]	−0.9% to −0.3%[47]	1871 to 1998, forward-looking	Fundamentals: P/E, div yld, div gr
Jeremy Siegel	3.5%[23]	2–3%[48]	1802–2001, forward-looking	Earnings yield
Surveys				
John Graham and Campbell Harvey	Δ by survey[24]	3–4.7%[49]	2Q 2000 through 3Q 2002, 1 & 10-year projections	Survey of CFO's
Ivo Welch	N/A[25]	7%[50]	30-year forecast, surveys in 97/98 & 99	Survey of financial economists
Ivo Welch[5]	5%[26]	5–5.5%[51]	30-year forecast, survey around August 2001	Survey of financial economists
Misc.				
Barclays Global Investors	5%[27]	2.5%, 3.25%[52]	Long-run (10-year) expected return	Fundamentals: inc, earn gr, & repricing
Richard Brealey and Stewart Myers	N/A[28]	6–8.5%[53]	1926–1997	Predominantly historical
Burton Malkiel	5.25%[29]	2.75%[54]	1926 to 1997, estimate millennium[57]	Fundamentals: div yld, earn gr
Richard Wendt[6]	5.5%[30]	3.3%[55]	1960–2000, estimate for 2001–2015 period	Linear regression model

Footnotes:

[19]Average real return on six-month commercial paper (proxy for risk-free interest rate). Substituting the one-month Treasury bill rate for the six-month commercial paper rate causes estimates of the annual equity premium for 1951–2000 to rise by about 1%.

[20]Average yield to maturity on long-term U.S. government bonds, 1982–1998.

[21]Real, geometric risk-free rate. Geometric risk-free rate with inflation (nominal) 5.13%. Nominal yield equivalent to historical geometric long-term government bond income return for 1926–2000.

[22]The 10- and 30-year TIPS bond yielded 4% in August 1999.

[23]Return on inflation-indexed securities.

[24]Current 10-year Treasury bond yield. Survey administered from June 6, 2000 to June 4, 2002. The rate on the 10-year Treasury bond changes in each survey. For example, in the Dec. 1, 2000 survey, the current annual yield on the 10-year Treasury bond was 5.5%. For the June 6, 2001 survey, the current annual yield on the 10-year Treasury bond was 5.3%.

[25]Arithmetic per-annum average return on rolled-over 30-day T-bills.

[26]Average forecast of arithmetic risk-free rate of about 5% by deducting ERP from market return.

[27]Current nominal 10-year bond yield.

[28]Return on Treasury bills. Treasury bills yield of about 5% in mid-1998. Average historical return on Treasury bills 3.8%.

[29]Good quality corporate bonds will earn approximately 6.5–7%. Long-term zero-coupon Treasury bonds will earn about 5.25%. Long-term TIPS will earn a real return of 3.75%.

[30]1/1/01 long T-bond yield; uses initial bond yields in predictive model.

[31]Arithmetic short-horizon expected ERP. Arithmetic intermediate-horizon expected ERP 7.4%. Arithmetic long-horizon expected ERP 7.0%. Geometric short-horizon expected ERP 6.4%.

[32]Geometric equity premium over long-term Treasury securities. OCACT assumes a constant geometric real 7% stock return.

Appendix C
Estimating a Short-Horizon Arithmetic Unconditional Equity Risk Premium

Source	Risk-free Rate	ERP Estimate	Stock Return Estimate	Geometric to Arithmetic	Real to Nominal	Conditional to Unconditional[60]	Fixed Short-Horizon RFR	Short-Horizon Arithmetic Unconditional ERP Estimate
	I	II	III	IV	V	VI	VII	VIII
Historical								
Ibbotson Associates	3.8%[7]	8.4%[31]	12.2%	0.0%	0.0%	0.00%	3.8%	8.4%
Social Security								
Office of the Chief Actuary[1]	2.3%, 3%[8]	4.7%, 4%[32]	7.0%	2%	3.1%	0.00%	3.8%	8.3%
John Campbell[2]	3–3.5%[9]	1.5–2.5%, 3–4%[33]	6.0%–7.5%	0.0%	3.1%	0.46%	3.8%	5.8%–7.3%
Peter Diamond	2.2%[10]	<4.8%[34]	<7.0%	2%	3.1%	0.46%	3.8%	<8.8%
Peter Diamond[3]	3%[11]	3–3.5%[35]	6.0–6.5%	2%	3.1%	0.46%	3.8%	7.8%–8.3%
John Shoven[4]	3%, 3.5%[12]	3–3.5%[36]	6.0–7.0%	2%	3.1%	0.46%	3.8%	7.8%–8.8%
Puzzle Research								
Robert Arnott and Peter Bernstein	3.7%[13]	2.4%[37]	6.1%	2%	3.1%	0.46%	3.8%	7.9%
Robert Arnott and Ronald Ryan	4.1%[14]	−0.9%[38]	3.2%	2%	3.1%	0.46%	3.8%	5%
John Campbell and Robert Shiller	N/A	Negative[39]	Negative	N/A	N/A	N/A	N/A	N/A
James Claus and Jacob Thomas	7.64%[15]	3.39% or less[40]	11.03%	0.0%	0.0%	0.46%	3.8%	7.69%
George Constantinides	2%[16]	6.9%[41]	8.9%	0.0%	3.1%	0.00%	3.8%	8.2%
Bradford Cornell	5.6%, 3.8%[17]	3.5–5.5%, 5–7%[42]	8.8–10.8%	0.0%	0.0%	0.46%	3.8%	5.5–7.5%
Dimson, Marsh, & Staunton	1.0%[18]	5.4%[43]	6.4%[58]	0.0%	3.1%	0.46%	3.8%	6.2%[61]
Eugene Fama and Kenneth French	3.24%[19]	3.83% & 4.78%[44]	7.07–8.02%	0.0%	3.1%	0.00%	3.8%	6.37–7.32%
Robert Harris and Felicia Marston	8.53%[20]	7.14%[45]	12.34%[59]	0.0%	0.0%	0.46%	3.8%	9.00%
Roger Ibbotson and Peng Chen	2.05%[21]	4% and 6%[46]	8.05%	0.0%	3.1%	0.00%	3.8%	7.35%
Jeremy Siegel	4%[22]	−0.9% to −0.3%[47]	3.1–3.7%	2%	3.1%	0.46%	3.8%	4.9–5.5%
Jeremy Siegel	3.5%[23]	2–3%[48]	5.5–6.5%	2%	3.1%	0.46%	3.8%	7.3–8.3%
Surveys								
John Graham and Campbell Harvey	Δ by survey[24]	3–4.7%[49]	8.3–10.2%	N/A	0.0%	0.46%	3.8%	5–6.9%
Ivo Welch	N/A[25]	7%[50]	N/A	0.0%	0.0%	0.46%	0.0%	7.5%
Ivo Welch[5]	5%[26]	5–5.5%[51]	10.0–10.5%	0.0%	0.0%	0.46%	3.8%	6.7–7.2%
Misc.								
Barclays Global Investors	5%[27]	2.5%, 3.25%[52]	7.5%, 8.25%	2%	0.0%	0.46%	3.8%	6.16–6.91%
Richard Brealey and Stewart Myers	N/A[28]	6–8.5%[53]	N/A	0.0%	0.0%	0.00%	0.0%	6.0–8.5%
Burton Malkiel	5.25%[29]	2.75%[54]	8.0%	2%	0.0%	0.46%	3.8%	6.7%
Richard Wendt[6]	5.5%[30]	3.3%[55]	8.8%	0.0%	0.0%	0.46%	3.8%	5.5%

Column formulas: III = I + II; VIII = III + IV + V + VI − VII
Source for adjustments: Ibbotson Associates (2003a, table 2-1 p. 33); Fama and French (2002)—see footnote 60.

Footnotes (continued from Appendix B):
[33]Long-run average equity premium of 1.5–2.5% in geometric terms and 3–4% in arithmetic terms.
[34]Lower return over the next decade, followed by a geometric, real 7% stock return for remaining 65 years or lower rate of return for entire 75-year period (obscures pattern of returns).
[35]Most likely poor return over the next decade followed by a return to historic yields. Working from OCACT stock return assumption, he gives a single rate of return on equities for projection purposes of 6–6.5% (geometric, real).
[36]Geometric real stock return over the geometric real return on long-term government bonds.
[37]Expected geometric return over long-term government bonds. Their current risk premium is approximately zero, and their recommended expectation for the future real return for both stocks and bonds is 2–4%. The "normal" level of the risk premium is modest (2.4% or quite possibly less).
[38]Geometric real returns on stocks are likely to be in the 3–4% range for the foreseeable future (10–20 years).
[39]Substantial declines in real stock prices, and real stock returns below zero, over the next 10 years (2001–2010).
[40]The equity premium for each year between 1985 and 1998 in the United States. Similar results for five other markets.
[41]Unconditional, arithmetic mean aggregate equity premium over the 1872–2000 period. Over the period 1951 to 2000, the adjusted estimate of the unconditional mean premium is 6%. The corresponding estimate over the 1926 to 2000 period is 8%. Sharp distinction between conditional, short-term forecasts of the mean equity return and premium and estimates of the unconditional mean.
[42]Long-run arithmetic future ERP of 3.5–5.5% over Treasury bonds and 5–7% over Treasury bills. Compares estimates to historical returns of 7.4% for bond premium and 9.2% for bill premium.
[43]5.4% U.S. arithmetic expected future ERP relative to bills; 4% World (16 countries) arithmetic expected future ERP relative to bills; 4.1% U.S. geometric expected future ERP relative to bills; 3% World (16 countries) geometric expected future ERP relative to bills.
[44]3.83% unconditional expected annual simple equity premium return (referred to as the annual-bias adjusted estimate of the annual equity premium) using dividend growth model; 4.78% unconditional expected annual simple equity premium return (referred to as the annual-bias adjusted estimate of the annual equity premium) using earnings growth model. Compares these results against historical real equity risk premium of 7.43% for 1951–2000.
[45]Average expectational risk premium. Because of the possible bias of analysts' optimism, the estimates are interpreted as "upper bounds" for the market premium. The average expectational risk premium is approximately equal to the arithmetic (7.5%) long-term differential between returns on stocks and long-term government bonds.

Appendix D
Historical and Forecasted Equity Returns, Ibbotson and Chen (2003) Models (%)

Method/ Model	Sum	Inflation	Real Risk-Free Rate	Equity Risk Premium	Real Capital Gain	g (Real EPS)	g (Real Div)	−g (Pay-out Ratio)	g (BV)	g (ROE)	g (P/E)	g (Real GDP/ POP)	g (FS-GDP/ POP)	Income Return	Re-investment + Interaction	Additional Growth	Forecast Earnings Growth
Column #	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII
Historical																	
Method 1	10.70	3.08	2.05	5.24											0.33		
Method 2	10.70	3.08			3.02									4.28	0.32		
Method 3	10.70	3.08				1.75					1.25			4.28	0.34		
Method 4	10.70	3.08					1.23	0.51			1.25			4.28	0.35		
Method 5	10.70	3.08							1.46	0.31	1.25			4.28	0.31		
Method 6	10.70	3.08										2.04	0.96	4.28	0.32		
Forecast with Historical Dividend Yield																	
Model 3F	9.37	3.08				1.75								4.28	0.26		
Model 3F (ERP)	9.37	3.08	2.05	3.97											0.27		
Forecast with Current Dividend Yield																	
Model 4F	5.44	3.08					1.23							1.10[a]	0.03		
Model 4F (ERP)	5.44	3.08	2.05	0.24											0.07		
Model $4F_2$	9.37	3.08					1.23	0.51						2.05[b]	0.21	2.28	
Model $4F_2$ (FG)	9.37	3.08												1.10[a]	0.21		4.98

Source: The data and format was made available by Ibbotson and Chen and is reprinted with permission from Ibbotson Associates. Corresponds to Ibbotson and Chen (2003, table 2); column numbers have been added.
[1]2000 dividend yield.
[2]Assuming the historical average dividend-payout ratio, the 2000 dividend yield is adjusted up 0.95 percentage points.

Footnotes: (continued from Appendix B and C)
[46]4% geometric (real) and 6% arithmetic (real). Forward-looking long-horizon sustainable ERP.
[47]Using the dividend discount model, the forward-looking real long-term geometric return on equity is 3.3%. Based on the earnings yield, the forward-looking real long-term geometric return on equity is between 3.1% and 3.7%.
[48]Future geometric equity premium. Future real return on equities of about 6%.
[49]The 10-year premium. The one-year risk premium averages between 0.4% and 5.2%, depending on the quarter surveyed.
[50]Arithmetic 30-year forecast relative to short-term bills; 10-year same estimate. Second survey 6.8% for 30- and 10-year estimate. One-year horizon between 0.5% and 1.5% lower. Geometric 30-year forecast around 5.2% (50% responded to this question).
[51]Arithmetic 30-year equity premium (relative to short-term T-bills). Geometric about 50 basis points below arithmetic. Arithmetic one-year equity premium 3–3.5%.
[52]2.5% current (conditional) geometric equity risk premium. 3.25% long-run, geometric normal or equilibrium equity risk premium.
[53]Extra arithmetic return versus Treasury bills. “Brealey and Myers have no official position on the exact market risk premium, but we believe a range of 6−8.5% is reasonable for the United States. We are most comfortable with figures towards the upper end of the range.”
[54]The projected geometric (nominal) total return for the S&P 500 is 8% per year.
[55]Arithmetic mean 15-year horizon.
[56]74 years since December 1925 and 74 years starting January 2000.
[57]Estimate the early decades of the 21st century.
[58]World estimate of 5%.
[59]Long risk-free of 5.2% plus 7.14%.
[60]For the 1951–2000 period, Fama and French (2002) adjust the conditional dividend growth model estimate upwards by 1.28% for an unconditional estimate, and they make a 0.46% upwards adjustment to the earnings growth model. We select the smaller of the two as an approximate minimum adjustment. For the longer period of 1872–2000, a comparable adjustment would be 0.82% for the dividend growth model and 0.54% for the 1872–1950 period using a dividend growth model. Earnings growth rates are shown by Fama and French only for the 1951–2000 period.
[61]World estimate of 4.8%.

Appendix D (continued)

Explanation of Ibbotson/Chen Table 2 Exhibit Using Column Numbers to Represent Formula

	Formula*	Description of Method
Historical		
Method 1	I = (1 + II)*(1 + III)*(1 + IV) − 1	Building Blocks Method: inflation, real risk-free rate, and ERP.
Method 2	I = [(1 + II)*(1 + V) − 1] + XIV + XV	Capital Gain and Income Method: inflation, real capital gain, and income return.
Method 3	I = [(1 + II)*(1 + VI)*(1 + XI) − 1] + XIV + XV	Earnings Model: inflation, growth in earnings per share, growth in price to earnings ratio, and income return.
Method 4	I = [(1 + II)*(1 + XI)*(1 + VII)/(1 − VIII) − 1] + XIV + XV	Dividends Model: inflation, growth rate of price earnings ratio, growth rate of the dollar amount of dividends after inflation, growth rate of payout ratio, and dividend yield (income return).
Method 5	I = [(1 + II)*(1 + XI)*(1 + IX)*(1 + X) − 1] + XIV + XV	Return on Book Equity Model: inflation, growth rate of price earnings ratio, growth rate of book value, growth rate of ROE, and income return.
Method 6	I = [(1 + II)*(1 + XII)*(1 + XIII) − 1] + XIV + XV	GDP Per Capita Model: inflation, real growth rate of the overall economic productivity (GDP per capita), increase of the equity market relative to the overall economic productivity, and income return.
Forecast with Historical Dividend Yield		
Model 3F	I = [(1 + II)*(1 + VI) − 1] + XIV + XV	Forward-Looking Earnings Model: inflation, growth in real earnings per share, and income return.
Model 3F (ERP)	IV = (1 + I)/[(1 + II)*(1 + III)]− 1	Using Model 3F result to calculate ERP.
Forecast with Current Dividend Yield		
Model 4F	I = [(1 + II)*(1 + VII) − 1] + XIV + XV	Forward-Looking Dividends Model: inflation, growth in real dividend, and dividend yield (income return); also referred to as Gordon model.
Model 4F (ERP)	IV = (1 + I)/[(1 + II)*(1 + III)] − 1	Using Model 4F result to calculate ERP.
Model $4F_2$	I = [(1 + II)*(1 + VII)*(1 + VIII) − 1] + XIV + XV + XVI	Attempt to reconcile Model 4F and Model 3F.
Model $4F_2$ (FG)	XVII = [(1 + I)/(1 + II) − 1] − XIV − XV	Using Method $4F_2$ result to calculate forecasted earnings.

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Discussions on this paper can be submitted until July 1, 2004. The authors reserve the right to reply to any discussion. Please see the Submission Guidelines for Authors on the inside back cover for instructions on the submission of discussions.

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The Equity Premium: Stock and Bond Returns Since 1802

Jeremy J. Siegel

Over the period from 1802 through 1990, equity has provided returns superior to those on fixed income investments, gold or commodities. Most strikingly, the real rate of return on equity held remarkably constant over this period, while the real return on fixed income assets declined dramatically. Over the subperiods 1802–70, 1871–1925 and 1926–90, the real compound annual returns on equity were 5.7, 6.6 and 6.4 per cent, but the real returns on short-term government bonds dropped from 5.1 to 3.1 and, finally, 0.5 per cent.

The magnitude of the excess return on equity, especially during this century, appears excessive relative to the behavior of other macroeconomic variables. In the future, the real return on fixed income assets may be closer to the historical norm of 3 to 4 per cent. While stock returns will probably continue to dominate bond returns, they will not do so by nearly as wide a margin as they have over the past 65 years.

Since 1926, the compound real value-weighted return on all stocks listed on the New York Stock Exchange has averaged 6.4 per cent per year, while the real return on Treasury bills has averaged only 0.5 per cent.[1] This means that the purchasing power of a given sum of money invested (and reinvested) in stocks from 1926 to 1990 would have increased over 50 times, while reinvestment in bills would have increased one's real wealth by about one-third. Using these historical returns, it would take 139 years of investing in Treasury bills to double one's real wealth while it would take only 11 years of stock investment. Money managers often use these figures persuasively to convince investors that, over long periods of time, equity has no match as a wealth builder.

The return on stocks in excess of the return on short-term bonds is called the **equity premium.** Because stocks are generally riskier than fixed income investments, it is to be expected that the return on stocks would exceed that on bonds. However, in 1985 Rajnish Mehra and Edward Prescott demonstrated that stocks, despite their risk, appear to offer investors *excessive* returns, while bonds offer puzzlingly low returns.[2] The excessive return on equity is termed the "equity premium puzzle." Investors would have to be extraordinarily risk-averse, given the documented growth and variability of the economy, to accept such low returns on bonds while equity offered such superior returns. Such extreme risk-aversion appears to be inconsistent with data that reveal investor choice under uncertainty.

Many theories have been offered to explain the equity premium puzzle.[3] The data that Mehra and Prescott analyzed covered a sufficiently long period of time and were derived from well documented sources. Thus no one questioned the validity of their return data.

I extended the time period analyzed by Mehra and Prescott back to 1802, while updating the returns on stocks and bonds to 1990. My analysis demonstrates that the returns from bonds during most of the 19th century and after 1980 were far higher than in the period analyzed by Mehra and Prescott. The equity premium is not nearly as large when viewed over this extended time span as it is in the post-1926 period. These data suggest that the excess return of stocks over bonds may be significantly smaller in the future than it has been over the past 65 years.

Long-Term Asset Returns

William Schwert has developed historical stock price series dating back to 1802; there are also some fragmentary data on stock returns dating to 1789.[4] In order to analyze asset returns since 1802, I divided the data into three subperiods. The first period, running from 1802 through 1870, contains stocks of financial firms and, later, railroads. The second period, running from 1871 through 1925, comprises the period studied by the Cowles Foundation.[5] The last subperiod, from 1926 to the present, coincides with the development of the S&P 500 stock index and contains the most comprehensive data on stock prices and other economic variables.[6] I use the Schwert data for the first subperiod and a capitalization-weighted index of all NYSE stocks

Glossary

▶***Equity Premium:***
The expected return (dividends plus capital gains) on equity in excess of the return on safe assets such as government bonds.

▶***Total Return Index:***
An index that measures the increase in wealth generated by assuming that *all* cash flows and capital gains are reinvested in the same asset or class of assets.

▶***Capital Appreciation Index:***
An index that measures the increase in wealth assuming that just the capital gain, and not any income generated, is reinvested in the asset (or class of assets).

▶***Geometric Return:***
Compound return, or the nth root of the n single-year returns.

▶***Synthetic Short-Term Government Series:***
A series of what short-term, risk-free interest rates would be, based on removing the default premium on similar risky assets. Computed in the absence of actual government interest rates.

for the second and third subperiods.

The early stock indexes were not as comprehensive as those constructed today. From 1802 to 1820, the stock index consisted of an equally weighted portfolio of stocks of several banks in Boston, New York and Philadelphia. An insurance company was added later, and in 1834 the portfolio became heavily weighted toward railroad stocks. The Cowles index consisted of all stocks listed on the New York Stock Exchange and recorded, for the first time, dividend payments. The Cowles index is spliced to modern indexes, which calculate averages for all classes of common stock.

Stock Returns

Figure A displays what one dollar invested in various asset classes in 1802 would have accumulated to by the end of 1990. These series are referred to as **total return indexes,** because they assume that all cash flows, including interest and dividends as well as any capital gains, are continually reinvested in the relevant asset. Total return indexes differ from standard stock market indexes such as the S&P 500, which do not include the reinvestment of cash flows. These standard indexes are called **capital appreciation indexes.**[7]

Figure A indicates that, in terms of total return, stocks have dominated all other asset classes since 1802. Over the entire period, equities achieved a compound annual nominal rate of return of 7.6 per cent per year; at this rate, the nominal value of equity approximately doubles every 9.5 years. Figure A also demonstrates that nominal stock returns have also increased over time. The average compound rate of return on stocks was 5.8 per cent from 1802 through 1870, 7.2 per cent from 1871 through 1925 and 9.8 per cent from 1926 through 1990.[8] Table I gives the stock returns in each subperiod.

The average nominal *arithmetic* (or mean) return on stocks is 9.0 per cent per year over the entire period. Although this can be interpreted as the expected return on stocks over a 12-month period, it cannot be converted into a compound annual rate of return over periods longer than one year. Because of the mathematical properties of return calculations, the compound rate of return to a buy-and-hold strategy is measured by the **geometric**, rather than the arithmetic, return.[9]

The power of compound returns is clearly evident in the stock market. One dollar invested in 1802, with all dividends reinvested, would have accumulated to nearly $1 million by the end of 1990. Hypothetically, this means that $3 million, invested and reinvested over these past 188 years, would have grown to the incredible sum of $3 trillion—nearly equal to the entire capitalization of the U.S. stock market in 1990!

Figure A Total Nominal Return Indexes, Before Taxes, 1802 – 1990

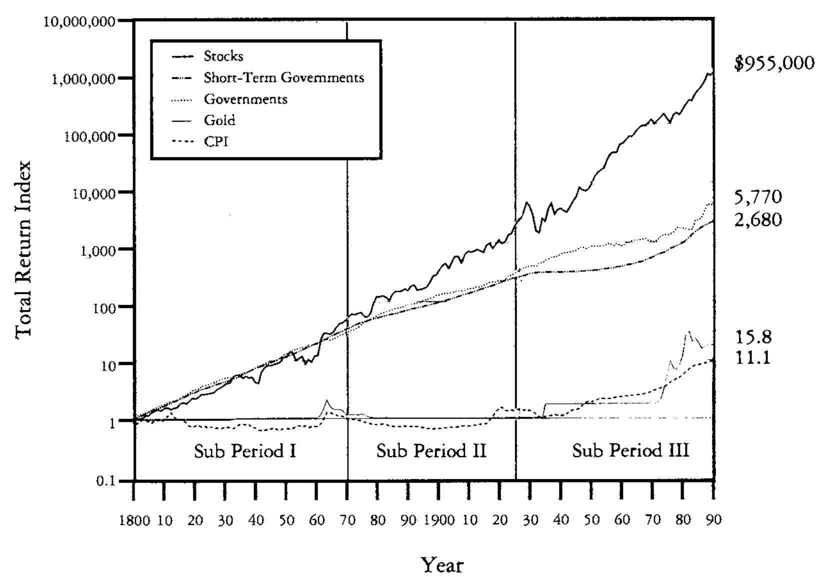


Table I Stock Market Returns (standard deviations in parentheses)*

Period	*Total Nominal Return (%)* A	*Total Nominal Return (%)* G	*Total Real Return (%)* A	*Total Real Return (%)* G	*Nominal Capital Appreciation (%)* A	*Nominal Capital Appreciation (%)* G	*Real Capital Appreciation (%)* A	*Real Capital Appreciation (%)* G	*Dividend Income (%) A*	*Average Tax Rate (%) A*	*Total Real After-Tax Return (%)* A	*Total Real After-Tax Return (%)* G
1802–1990	9.0	7.6	7.8	6.2	4.0	2.5	2.8	1.2	5.0	6.8	7.3	5.8
	(17.8)		(18.4)		(17.6)		(18.1)		(1.0)		(18.1)	
1871–1990	10.3	8.6	8.3	6.5	5.3	3.6	3.3	1.6	5.0	10.8	7.6	5.9
	(18.9)		(19.3)		(18.6)		(19.0)		(1.3)		(18.9)	
1802–1870	6.8	5.8	6.9	5.7	1.8	0.7	1.9	0.6	5.0	0.0	6.9	5.7
	(15.4)		(16.6)		(15.4)		(16.5)		(0.0)		(16.6)	
1871–1925	8.4	7.2	7.9	6.6	3.1	1.9	2.7	1.3	5.2	0.7	7.9	6.6
	(15.6)		(16.6)		(15.9)		(16.9)		(1.1)		(16.6)	
1926–1990	11.9	9.8	8.6	6.4	7.1	5.0	3.9	1.8	4.8	19.3	7.4	5.3
	(21.1)		(21.2)		(20.4)		(20.5)		(1.4)		(20.7)	
1946–1990	12.0	11.1	7.4	6.2	7.4	6.5	3.0	1.9	4.6	24.4	6.0	4.9
	(14.6)		(15.6)		(13.8)		(14.8)		(1.4)		(14.8)	
1966–1981	7.3	6.2	0.4	−0.7	3.1	2.1	−3.5	−4.6	4.2	26.4	−0.9	−1.8
	(15.1)		(14.3)		(14.3)		(13.8)		(1.3)		(13.5)	
1966–1990	10.7	9.6	4.6	3.5	6.3	5.3	0.6	−0.6	4.3	25.9	3.3	2.2
	(15.1)		(15.2)		(14.4)		(14.6)		(1.2)		(14.3)	
1982–1990	16.7	15.9	12.3	11.4	12.1	11.3	7.9	7.0	4.6	25.1	10.5	9.8
	(13.1)		(13.5)		(12.7)		(13.0)		(1.0)		(12.7)	

*A = arithmetic mean; G = geometric mean.

Three million 1802 dollars—equivalent to about $35 million in today's purchasing power—was a large—but certainly not overwhelming—sum of money to the industrialists and landholders of the early 19th century.[10]

Long-Term Bonds

In comparing past with future bond returns, it is important to choose securities whose risk characteristics match closely. There was an active market for long-term U.S. government bonds over most of the 19th century except for the years 1835 through 1841, when prior budget surpluses eliminated all federal government debt outstanding. Sidney Homer presented a series of long-term government yields in his classic work, *A History of Interest Rates*.[11] Long-term government bond issues were not numerous during the 19th century; maturities generally ranged from three to 20 years, although some bonds had no fixed duration.[12] Figure B displays the interest rates on long-term U.S. government bonds, joining the Homer series with the Ibbotson and Sinquefield series, which begins in 1926.[13]

Despite the good data on federal government bond yields, there are persuasive reasons why high-grade municipal bonds may be more representative of high-quality bonds during much of the 19th and early 20th centuries. Some of the municipal bonds is-

Figure B Long-Term Interest Rates, 1800 – 1990

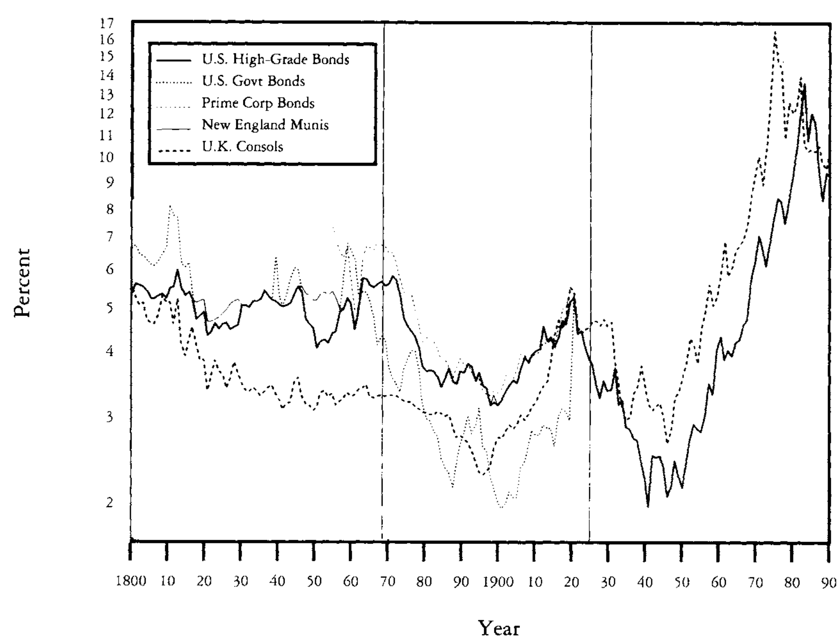


Table II Fixed Income Returns (standard deviations in parentheses)*

	Long-Term Governments							Short-Term Governments				
		Nominal Return (%)		Real Return (%)		Real After-Tax Return (%)		Rate (%)	Real Return (%)		Real After-Tax Return (%)	
Period	Coupon (%) A	A	G	A	G	A	G	A	A	G	A	G
1802–1990	4.7	4.8	4.7	3.7	3.4	3.2	2.9	4.3	3.1	2.9	2.8	2.6
	(1.8)	(5.4)		(8.5)		(8.4)		(2.2)	(6.2)		(6.3)	
1871–1990	4.5	4.7	4.5	2.8	2.5	2.1	1.8	3.7	1.8	1.7	1.4	1.2
	(2.3)	(6.5)		(8.5)		(8.3)		(2.5)	(4.7)		(4.8)	
1802–1870	4.9	5.1	5.0	5.2	4.9	5.1	4.8	5.2	5.4	5.1	5.4	5.1
	(0.4)	(2.7)		(8.3)		(8.2)		(1.1)	(7.6)		(7.6)	
1871–1925	4.0	4.5	4.4	4.0	3.8	3.9	3.7	3.8	3.3	3.1	3.2	3.1
	(0.6)	(2.9)		(6.3)		(6.3)		(0.9)	(4.8)		(4.8)	
1926–1990	5.0	4.9	4.6	1.8	1.4	0.6	0.2	3.7	0.6	0.5	−0.2	−0.3
	(2.9)	(8.4)		(9.9)		(9.4)		(3.4)	(4.3)		(4.2)	
1946–1990	5.9	4.9	4.5	0.5	−0.1	−1.1	−1.6	4.9	0.4	0.3	−0.8	−0.9
	(3.1)	(9.6)		(10.5)		(9.5)		(3.3)	(3.6)		(3.3)	
1966–1981	7.2	2.8	2.5	−3.9	−4.2	−5.6	−5.9	6.9	−0.1	−0.2	−1.9	−1.9
	(1.8)	(6.9)		(7.9)		(7.5)		(2.9)	(2.0)		(2.0)	
1966–1990	8.2	7.4	6.8	1.6	0.9	−0.7	−1.3	7.2	1.3	1.2	−0.5	−0.6
	(2.2)	(11.5)		(12.5)		(11.3)		(2.5)	(2.7)		(2.5)	
1982–1990	10.0	15.7	14.9	11.3	10.5	7.9	7.3	7.9	3.7	3.7	1.8	1.8
	(1.8)	(13.2)		(13.3)		(11.7)		(1.6)	(1.8)		(1.4)	

* A = arithmetic mean; G = geometric mean.

sued during the early 19th century, particularly those of the Commonwealth of Massachusetts and the City of Boston, were considered of higher quality than those of the federal government and thus traded at lower yields.[14] Risk of default on federal government bonds increased during both the War of 1812 and the Civil War, hence yields on federal debt rose above the yields on comparable high-grade municipals.[15] Furthermore, these high-grade municipals promised to pay interest and principal only in gold, thereby avoiding the "bimetal" option, which gave the federal government the right to redeem the principal in either gold or silver. This option may have biased the yields on federal government bonds upward.[16]

There is another reason why municipal bond yields should sometimes be substituted for federal government bonds. From the Civil War to 1920, the yields on federal government bonds were biased downward because banks were permitted to issue circulating bank notes against government bonds held as reserves. These rights, called "circulation privileges," motivated banks to bid the prices of federal bonds up above the prices of comparable high-grade securities. The effect of this bias is evident in Figure B. In 1920, circulation privileges were abolished, and the yield on federal government bonds jumped to the level of high-grade municipals.[17]

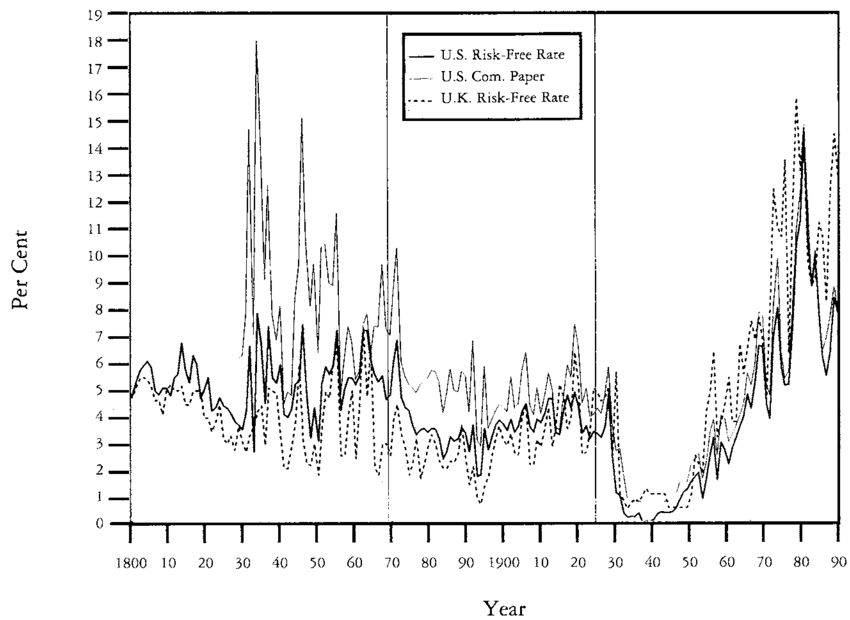
To avoid the noted problems with federal government bond yields, I constructed a high-grade series that uses the minimum yield on Treasury bonds and high-grade municipal bond yields from 1800 to 1865 and high-grade municipal yields from 1865 to 1917. This is the high-grade bond series depicted in Figure A. Table II summarizes the statistics.

Short-Term Bonds

Treasury bills, or short-term governments, did not exist before 1920. Data on commercial paper rates dating back to the 1830s are available from Macaulay, but during the 19th century commercial paper was subject to a high and variable risk premium, as Figure C shows.[18] These premiums often developed during or just prior to liquidity and financial crises (marked by NBER-designated recessions). There were also defaults on this paper, but there is insufficient information to correct the yield series for these defaults. Despite the obvious shortcomings of the data, there are few other short-term rates available for the early 19th century, and those that are available cover very short periods.

To remedy this deficiency, I constructed a **synthetic short-term government series** that removes the risk premium on commercial paper.[19] I did so by using the relation between short and long-term interest rates that prevailed in Britain during the 19th century, where the yields for long and short-term bonds were more representative of high-grade securities. The construction of the U.S. series assumes that the term structure of high-grade interest

Figure C Short-Term Interest Rates, 1800 – 1990



rates was the same over concurrent five-year periods in the U.S. and in the U.K. Figure C shows the short-term, risk-free series, along with other available short-term rates.

It is clear from Figure A that the total return indexes for fixed income assets fall far short of that for equity. With reinvestment of coupons, an initial investment of $1 in long-term bonds in 1802 would have yielded $5,770 in 1990; the same investment in risk-free, short-term assets would have yielded $2,680. Both these returns are less than 1 per cent of the sum accumulated in stocks over the entire period.

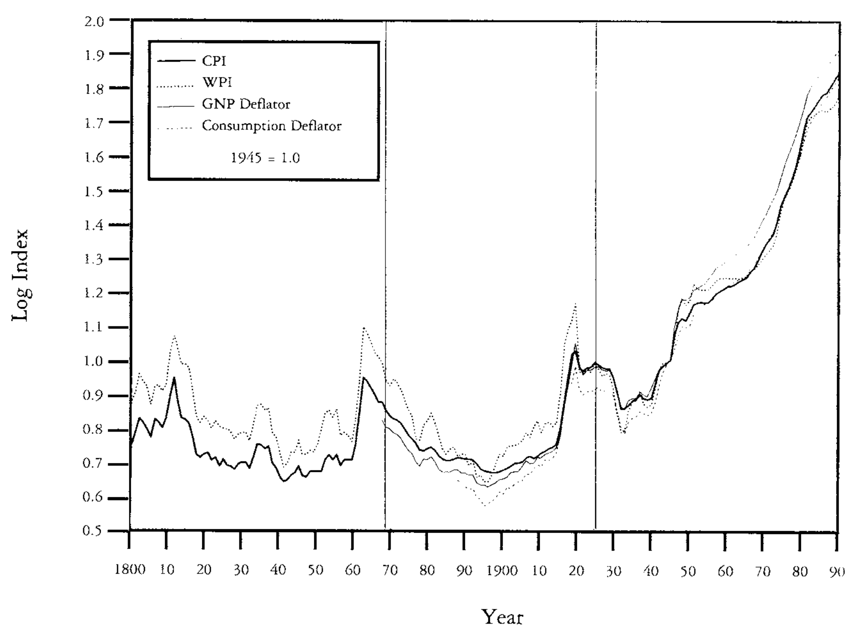
Gold and Commodities

The gold series represents the value of gold measured at the market price. Until the mid-1960s, this price was controlled by the government; furthermore, U.S. citizens were not allowed to hold gold in monetary form between 1933 and 1970. Gold has nonetheless been a key asset in world monetary history and many investors still consider it an important hedge asset. One dollar of gold bullion purchased in 1802 would have been worth $15.80 by the end of 1990.

The Consumer Price Index (CPI), provided for comparison, represents the value of a basket of widely diversified goods that could be stored costlessly, with no depreciation.[20] Consumer prices increased about 11-fold from 1802 to 1990, almost all of the appreciation coming in the last subperiod. Table III summarizes the returns for gold and commodities over the various time periods.

Note that, by the end of the first subperiod, 1802–70, the accumulations in government bonds, bills and stocks were virtually identical. It is in the second and especially the third subperiods that stocks clearly dominated fixed income assets. The return on gold is clearly dominated by bonds and stocks over the entire period, but its appreciation did surpass bonds (but not stocks) over the past 65 years.

Figure D Price Indexes, 1800 – 1990



The Price Level and Asset Returns

The behavior of price levels is critical to any interpretation of asset price movements over time. Figure D displays various U.S. price indexes. They all tell the same story. Before World War II, the price level displayed no over-

Table III Economic Variables (standard deviations in parentheses)*

	Prices							*Output*				*S&P 500 (per share)*			
	CPI (%)		*WPI (%)*		*GNP Deflator (%)*		*Gold (%)*	*Real GNP (%)*		*Industrial Production (%)*		*Real Earnings (%)*		*Real Dividends (%)*	
Period	*A*	*G*	*A*	*G*	*A*	*G*	*A*	*A*	*G*	*A*	*G*	*A*	*G*	*A*	*G*
1802–1990	1.5	1.3	1.4	1.0	—	—	2.3	—	—	—	—	—	—	—	—
	(6.1)		(9.0)				(14.8)								
1871–1990	2.1	2.0	2.0	1.6	2.3	2.2	3.3	3.5	3.3	5.5	4.0	6.0	3.0	3.9	3.1
	(5.0)		(8.1)		(5.3)		(17.7)	(5.6)		(17.7)		(25.7)		(12.8)	
1802–1870	0.4	0.1	0.4	−0.1	—	—	0.5	—	—	—	—	—	—	—	—
	(7.5)		(10.3)				(7.0)								
1871–1925	0.7	0.6	0.7	0.2	0.9	0.7	−0.2	3.8	3.7	5.6	4.1	6.5	2.1	2.5	1.6
	(5.1)		(9.6)		(5.5)		(1.2)	(4.9)		(18.2)		(31.9)		(13.4)	
1926–1990	3.2	3.1	3.1	2.9	3.5	3.4	6.2	3.2	3.0	5.4	4.0	5.6	3.7	5.2	4.4
	(4.7)		(6.4)		(4.7)		(23.6)	(6.1)		(17.4)		(19.1)		(12.1)	
1946–1990	4.6	4.5	4.3	4.1	4.9	4.9	7.4	2.6	2.5	3.7	3.5	7.1	6.1	6.4	6.2
	(3.9)		(5.3)		(4.0)		(26.5)	(4.3)		(6.1)		(14.9)		(5.9)	
1966–1981	7.0	7.0	6.8	6.7	6.6	6.6	22.0	2.8	2.8	3.4	3.3	7.6	7.0	5.8	5.7
	(3.3)		(4.2)		(2.1)		(39.2)	(2.3)		(5.1)		(10.8)		(4.5)	
1966–1990	6.0	5.9	5.2	5.2	5.6	5.6	13.4	2.8	2.8	3.2	3.1	4.7	3.9	5.4	5.3
	(3.1)		(4.1)		(2.2)		(34.4)	(2.3)		(4.9)		(12.7)		(3.7)	
1982–1990	4.0	4.0	2.5	2.5	3.9	3.9	−2.0	2.8	2.8	2.8	2.7	−0.4	−1.4	4.6	4.6
	(1.2)		(2.1)		(1.0)		(13.4)	(2.4)		(4.6)		(14.3)		(1.6)	

* A = arithmetic mean; G = geometric mean.

all trend. Since the war, the price level has increased steadily. Prices accelerated until the 1980s, when the rate of inflation slowed. The CPI in 1990 was nearly seven times its 1945 value. Over the entire period, prices increased at an average compound annual rate of 1.3 per cent. Inflation averaged 0.1 per cent per year in the first subperiod and 0.6 and 3.1 per cent in the second and third subperiods. Table III gives the statistics.

Over long periods of time, increases in the price level are strongly associated with increases in the money supply. Throughout the 19th and the early part of the 20th centuries, the money stock was closely tied to the amount of gold held by the Treasury and central bank. The abandonment of the gold standard, a process that started in 1933 but gained momentum in the post-World War II period, reduced constraints on the monetary authority's issuance of money. Chronic inflation, which cannot occur under a gold standard, became the norm in the postwar period.

Figure E depicts total *real* return indexes—total (nominal) return indexes deflated by the price level. Because of inflation, real returns are much more modest than nominal returns, especially in the final subperiod. One dollar invested in equities in 1802 would have accumulated to $86,100 of constant purchasing power, or real dollars, by 1990.

Figure E Total Real Return Indexes, Before Taxes, 1802 – 1990

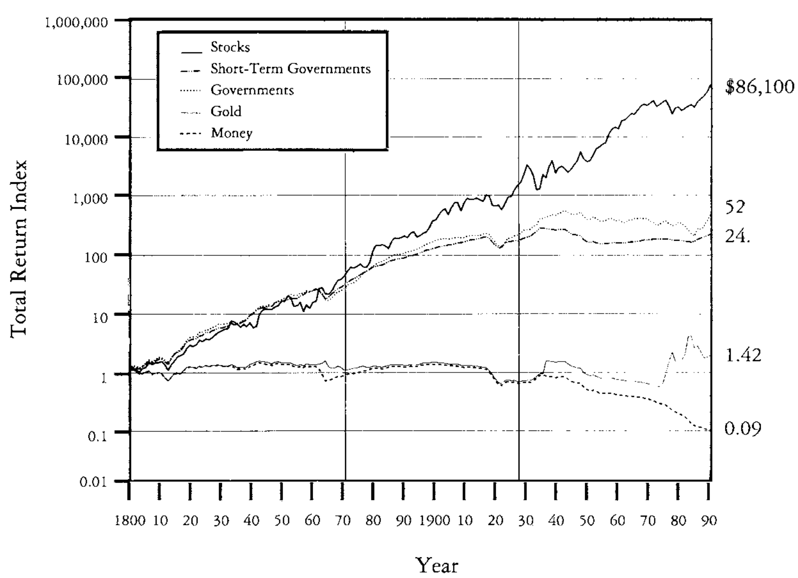
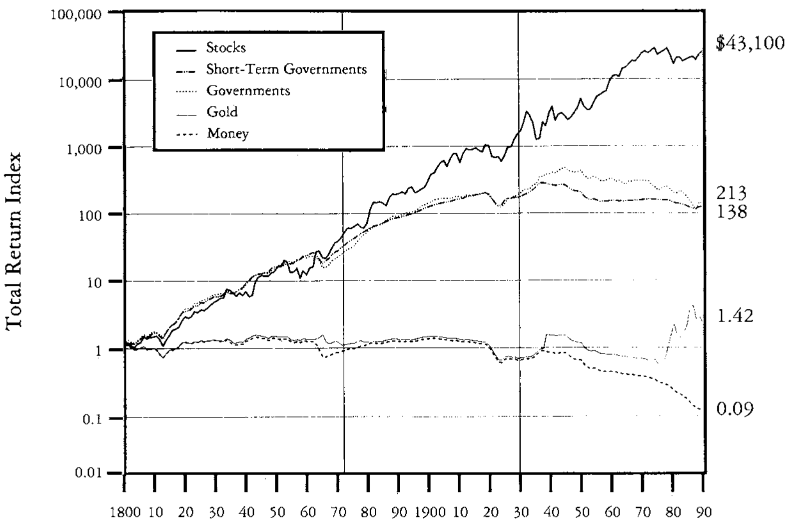


Figure F Total Real Return Indexes, After Taxes, 1802 – 1990



Over the same period, one dollar would have accumulated to $520 in real dollars if invested in long-term governments, to $242 in real dollars if invested in short-term governments, and to only $1.42 if invested in gold. A dollar of hoarded currency, which pays no return and whose value is eroded by inflation, would have left an investor with only 9 cents of purchasing power in 1990.[21]

Taxes and Returns

Figure F displays the total return index corrected for both federal taxes and inflation. Average federal income tax rates were taken from studies by Robert Barro and Chaipat Sahasakul and are reported in Table I.[22] Because no state or local taxes are considered, tax rates before 1913, when the federal income tax was instituted, are set at zero. It is assumed that dividends and interest income are taxed at the average marginal tax rate prevailing in the year they were earned and that capital gains are taxed (and losses remitted) at one-fifth the prevailing average marginal tax rate.[23] The reduced tax rate on capital gains arises primarily from the deferment of taxes on gains accrued but not realized and secondarily from the lower tax rate on realized gains.

Because a significant part of the returns on equity has been earned through capital gains, while virtually all the returns on bonds are in the form of taxable interest, the returns on equity are taxed at a lower effective rate than those on fixed income securities. In the third subperiod, 1926–90, when taxes became significant, the compound after-tax real return on stocks is reduced by 1.1 percentage points, to 5.3 per cent; the after-tax real return on short-term bonds is reduced by 0.8 percentage points, to −0.3 per cent, while the return on long-term government bonds falls 1.2 percentage points, to 0.2 per cent.

These results indicate that, on an after-tax basis, investors rolling over long-term bonds in the third subperiod have barely kept up with inflation, while those rolling over short-term bonds have fallen behind inflation. In fact, investors in short-term bonds have earned *no* after-tax real return from 1900 through 1990. Over the same period, the after-tax real return index for equities increased 90-fold!

Trends in Returns

Figure G displays 30-year centered moving averages of compound real rates of return on stocks, short and long-term government bonds.[24] One of the

Figure G Real Returns on Stocks and Bonds, 1806 – 1900
(30-year centered geometric moving average)

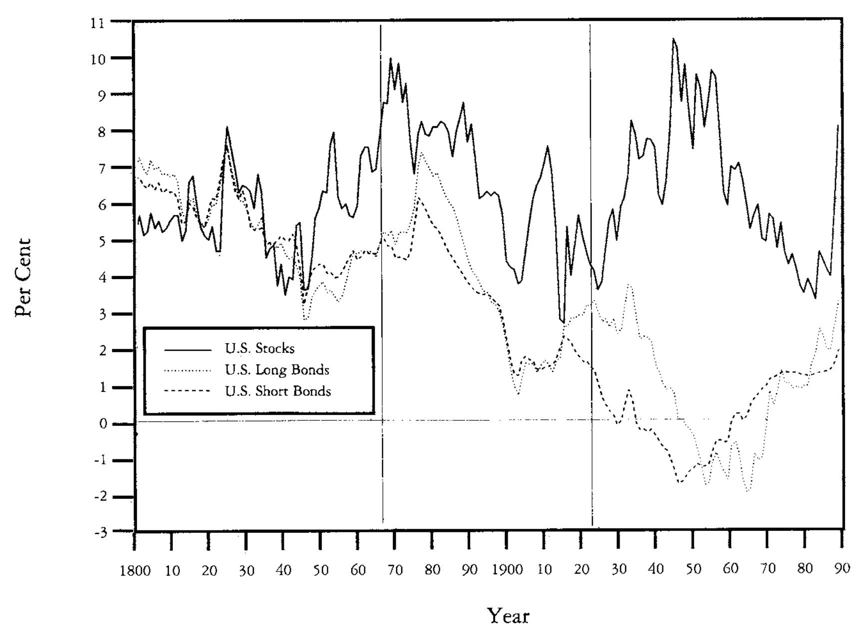


Table IV Holding-Period Returns on Stocks, Long Bonds and Short Bonds

Holding Period	*Time*	*Stock Return > Long Bond (%)*	*Stock Return > Short Bond (%)*	*Long Bond > Short Bond (%)*
	1802–1870	49.3	49.3	34.8
	1871–1925	56.4	60.0	65.5
1 Year	1926–1990	67.7	69.2	86.2
	1802–1990	57.7	59.3	61.4
	1871–1990	62.5	64.7	76.5
	1802–1870	52.9	48.5	44.1
	1871–1925	58.2	61.8	56.4
2 Years	1926–1990	75.4	69.2	60.0
	1802–1990	62.2	59.6	53.2
	1871–1990	67.5	65.8	58.3
	1802–1870	47.7	49.2	43.1
	1871–1925	67.3	67.3	60.0
5 Years	1926–1990	78.5	80.0	61.5
	1802–1990	64.3	65.4	54.6
	1871–1990	73.3	74.2	60.8
	1802–1870	46.7	43.3	46.7
	1871–1925	83.6	83.6	60.0
10 Years	1926–1990	83.1	83.1	56.9
	1802–1990	71.1	70.0	54.4
	1871–1990	83.3	83.3	58.3
	1802–1870	54.0	60.0	46.0
	1871–1925	94.5	100.0	52.7
20 Years	1926–1990	95.4	98.5	64.6
	1802–1990	82.9	87.6	55.3
	1871–1990	95.0	99.2	59.2
	1802–1870	55.0	52.5	40.0
	1871–1925	100.0	100.0	60.0
30 Years	1926–1990	100.0	100.0	63.1
	1802–1990	88.8	88.1	56.3
	1871–1990	100.0	100.0	61.7

striking aspects of these data is the relative constancy of the real returns on equity across all the subperiods. In the first subperiod, the average geometric real return on equity is 5.7 per cent; it is 6.6 per cent in the second subperiod and 6.4 per cent in the third.[25] These figures imply that, although inflation increased substantially in the third subperiod, the nominal return on equity increased by an almost identical amount, so the return after inflation remained essentially unchanged. To the extent that stocks are claims on *real* assets, they might be expected to be good hedges against inflation over the long run.[26]

As noted, the average real compound rate of return on stocks over the entire period has been 6.2 per cent. Over every 30-year period from 1802 through 1990, there have been only two when the compound real annual rate of return on stocks fell below 3.5 per cent, and those occurred in the depths of the Depression, in 1931 and 1932. The periods of the highest real returns on stock ended in the early 1960s, when the real compound annual return exceeded 10 per cent.

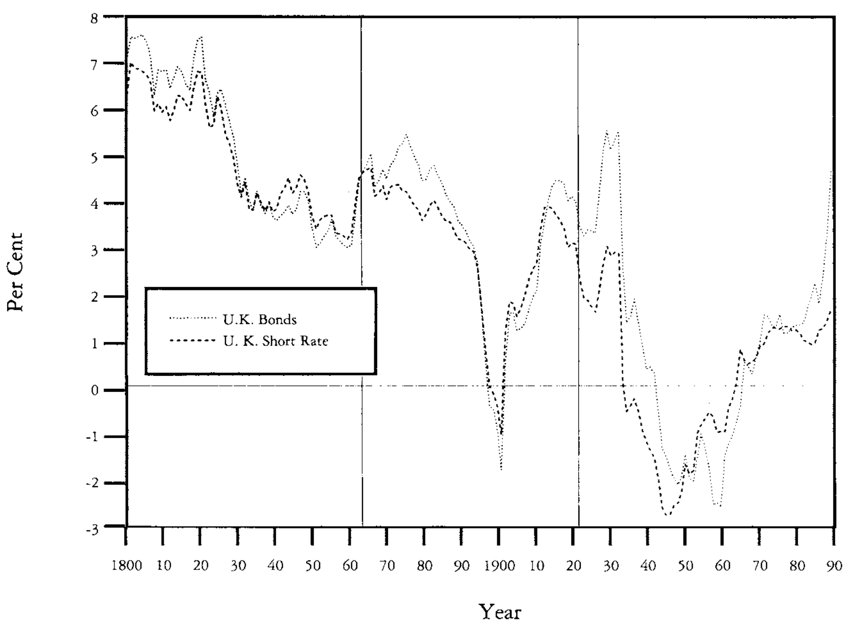
The most striking pattern in Figure G is the decline in the average real return on fixed income assets. In all 30-year periods beginning with 1888, the year that Mehra and Prescott began their analysis, the real rate of return on short-term government securities has exceeded 2 per cent in only three periods, ending in the Depression years 1932–34. Since the late 19th century, the real return on bonds and bills over any 30-year horizon has almost never matched the average return of 4.5 to 5 per cent reached during the first 70 years of our sample period. Since 1878, the real return on long-term bonds has never reached 4 per cent over any 30-year period; it exceeded 3 per cent in only six years. One has to go back to the 1831–61 period to find any 30-year period where the return on either long or short-term bonds exceeded that on equities. The dominance of stocks over fixed income securities, so evident from Figures A, E and F, is borne out by examining long-term holding-period returns.

Table IV compares the compound returns on stocks, long and short-term bonds. Over the entire period, stocks outperformed short-term bonds 57.7 per cent of the time on a year-to-year basis but 88.8 per cent of the time over 30-year horizons. Since 1871, over horizons of 20 years or longer, stocks have underperformed short-term assets only once and have outperformed long-term bonds 95 per cent of the time. Even with holding periods as short as five years, stocks have outperformed long and short-term bonds by a four-to-one margin since 1926 and a three-to-one margin since 1872. In contrast, in 1802–71, stocks outperformed short or long-term bonds only about one-half the time over any holding period.

Trends in the U.K.

In the 19th century, as London emerged as the world's financial center, capital markets in Great Britain were far more developed than in the U.S. The British consol, depicted in Figure B, is a security that pays interest only; it was first floated in 1729. The consol has long been used by economists to construct a continuous and homogeneous long-term interest rate series stretching over 250 years. British short-term in-

Figure H Real Returns on U.K. Bonds, 1806 – 1900
(30-year moving average)



terest rates are represented, with some exceptions, by the open-market rate at which high-quality commercial paper is discounted.[27] Figure H shows the 30-year average real returns on U.K. short and long-term bonds.

There is remarkable similarity in the yield trends in the U.K. and the U.S. The sharp decline in the real yields on fixed income securities in the U.S. was closely mirrored in the U.K. Statistical tests cannot reject the hypothesis that the return process was identical for both long and short-term real interest rates in the U.S. and the U.K. over the entire period.

Explanations of Trends

Although the data demonstrate that returns on equities have compensated investors for increased inflation over the postwar period, the returns on fixed income securities have not. One possible explanation is that lenders did not anticipate inflation during much of the period.

One could argue that a large part of the increase in the price level since World War II, especially since 1970, was unanticipated, hence bondholders did not have a chance to adjust their required returns. The progressive abandonment of the gold standard only slowly reduced investors' convictions about the stability of the long-run price level.

Unanticipated inflation certainly lowered the real return on long-term bonds. Buyers of such instruments in the 1960s and early 1970s could scarcely have imagined the double-digit inflation that followed. But unanticipated inflation is less important for short-term bonds. The inflationary process, although increasingly subject to long-term uncertainty, has been quite persistent and inertial in the short run. Short-term investors thus have a better opportunity to capture the inflation premium in the rate of interest as they roll over their investments. Short-term bonds should therefore provide better protection against unanticipated inflation than longer-term bonds. Of course, this protection is not perfect; unanticipated inflation may account for up to one percentage point of the decline in the real yield on short-term bonds over the sample period.[28]

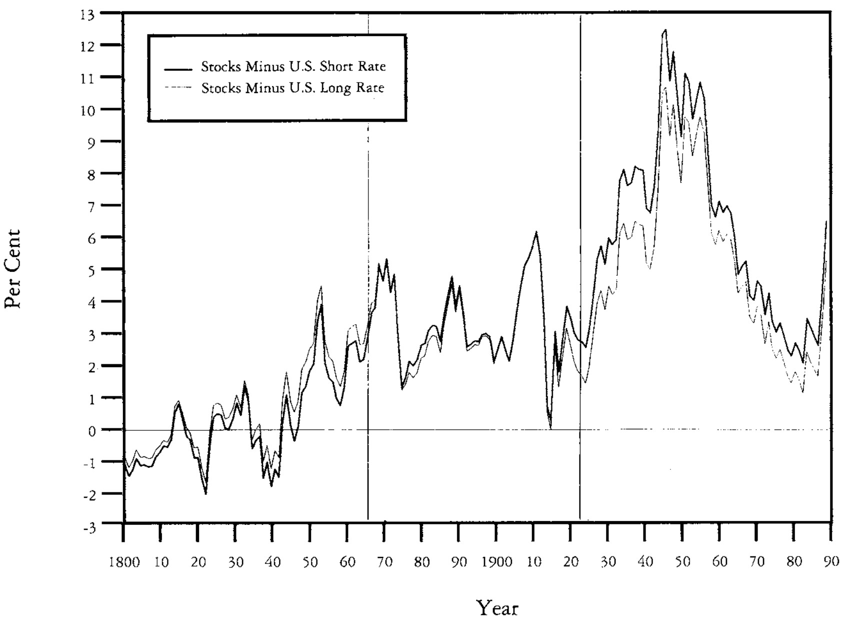
Other Factors

Other factors influence the real rate of interest. Slower or more variable economic growth, for example, will generally lower the real rate investors demand to hold fixed income assets. Slower growth may have depressed real yields over short periods of time, including the 1970s, when real returns on short-term Treasury bills were negative. Economic growth in general, however, has been as high in the 20th as in the 19th century.

There is no evidence that the economy has become more volatile. In fact, Table III suggests that the real economy has actually been more stable since World War II, but real rates have been very low in this period. Intuition would suggest that the yield differential between risky assets such as stocks and less risky assets such as bonds would be smaller, the less risky the economy. If the real return on stocks has remained constant (and this is what the data suggest), then the real return on fixed income should have risen. The decline in the real yields on bonds suggests that changing variability of the real economy can not adequately explain the decline in real returns.

Perhaps the low real interest rates during much of this century can be explained by a combination of historical and institutional factors. The 1929–32 stock market crash and the Depression left a legacy of fear; most investors clung to government securities and insured deposits, driving their yields down. Redistribution policies undertaken by the government subsequent to the Depression may also have lowered real rates by shifting wealth to more risk-averse segments of the population. Furthermore, during World War II and the early postwar years, interest rates were kept low by the Federal Reserve. Because of its inflationary conse-

Figure I Equity Risk Premium, 1806 – 1900
(30-year centered geometric moving average)



quences, this policy was abandoned in 1951, but interest rate controls, particularly on deposits, lasted much longer.

Finally, one cannot ignore the development of the capital markets, which transformed a highly segmented market for short-term instruments in the 19th century into one of the world's most liquid markets in this century.

The Equity Premium

The decline in the real return on fixed income investments has meant that the advantage of holding equities, which have experienced a remarkably steady real return, has increased over time. The equity premium, plotted in Figure I, has trended up over the last 200 years and was particularly high in the middle of this century. The premium, computed from real geometric returns, averaged 0.6 per cent in the first subperiod, 3.5 per cent in the second, and 5.9 per cent in the third.

The primary source of this equity premium has been the fall in the real return on bonds, *not* the rise in the return on equity. Nonetheless, it is not unreasonable to believe that the low real rates on bonds may, on occasion, have fueled higher equity returns, because the costs of obtaining leverage were so low. The highest 30-year average equity return occurred in 1931–61, a period that also experienced very low real returns on bonds.

One might take an even broader view of the superior returns on equity. Certainly investors in 1802 (or even 1872) did not universally expect the United States to become the greatest economic power in the next century. This was not the case in many other countries. What if one had owned stock in Japanese or German firms before World War II? Or consider Argentina, which, at the turn of the century, was one of the great economic powers. In some sense, the returns on U.S. stocks might not be representative of the broader international context.[29]

Conclusions

The high real interest rates in the 19th century may have reflected the possibility that the U.S. would default on its bonds or abandon the gold standard. Since the inflation shocks of the 1970s, fear of outright default has been replaced by an inflationary premium in nominal interest rates. Future inflation may be caused by growing U.S. government deficits or by inflationary policies pursued by the Federal Reserve in response to political pressures or economic crises.

The last 10 years represent only about 5 per cent of the total time examined in this study, but the period since 1980 contains the highest real long-term bond returns during any consecutive 10-year period since 1884 and the highest real short-term bond returns since the 19th century (excepting the sharp deflationary periods of the Depression). It is not unreasonable to assume that the current higher real rates will turn out to be more characteristic of future returns than the unusually low real rates of the earlier part of this century. If they do, then the advantage of holding equities over bonds will shrink from the levels reached over the past several generations. The holders of fixed income investments should enjoy enhanced real returns in the future. Equities, however, still appear to be the best route to long-term wealth accumulation.[30]

Footnotes

1. *The average compound real return on the S&P 500 has been 6.7 per cent over the same period. Very small stocks (bottom quartile of capitalization) have performed better, averaging 8.2 per cent compound real return since 1926.*
2. *R. Mehra and E. Prescott, "The Equity Premium: A Puzzle,"* Journal of Monetary Economics *15 (1985), pp. 145–61. The time period covered by Mehra and Prescott was 1889–1978. The returns on stocks and bonds were very similar to the returns since 1926.*
3. *Some rely on non-standard preference functions; see, for example, G. M. Constantinides, "Habit Formation: A Resolution of the Equity Premium Puzzle,"* Journal of Political Economy *98:3 (1990), pp. 519–* *A. Abel, "Asset Prices under*

Habit Formation and Catching up with the Joneses," American Economic Review 2:80 (1990), pp. 38–43; S. Benninga and A. Protopapadakis, "Time Preference and the 'Equity Premium Puzzle'," Journal of Monetary Economics, January 1990; and P. Weil, "The Equity Premium Puzzle and the Risk-free Rate Puzzle," Journal of Monetary Economics, November 1989. Others rely on individual stocks and segmented asset holdings; N. G. Mankiw, "The Equity Premium and the Concentration of Aggregate Shocks," Journal of Financial Economics 17 (1986), pp. 211–19 and N. G. Mankiw and S. P. Zeldes, "The Consumption of Stockholders and Non-Stockholders," Journal of Financial Economics 29 (1991), pp. 97–112. See A. Abel, "The Equity Premium Puzzle," Federal Reserve Bank of Philadelphia Business Review, September-October 1991, for a summary.

G. William Schwert, "Indexes of United States Stock Prices from 1802 to 1987," Journal of Business 63:3 (1990), pp. 399–426. R. Ibbotson and G. Brinson (Investment Markets: Gaining the Performance Advantage (New York: McGraw Hill, 1987), p. 73) report that the Foundation for the Study of Cycles, in Pittsburgh, has published data from an internal stock index entitled "Historical Record: Stock Prices 1789–Present," Data Bulletin 1975–1. However, attempts to obtain documentation for this series have not been successful.

5. A. Cowles, Common Stock Indexes, 1871–1937 (Bloomington, IN: Principia Press, 1938).
6. In the 1970s and 1980s, Roger Ibbotson and Rex Sinquefield analyzed data on inflation, stock and bond returns since 1926 (see Stocks, Bonds, Bills, and Inflation, 1991 Yearbook (Chicago: Ibbotson Associates, 1991)). Several authors (see for example J. W. Wilson and C. P. Jones, "A Comparison of Annual Common Stock Returns: 1871–1925 with 1926–85," Journal of Business, April 1987, and "Stock, Bonds, Paper, and Inflation, 1870–1985," Journal of Portfolio Management, Fall 1987) have extended much of the data back to 1872.
7. Standard stock indexes do, however, reflect increases in the value of shares resulting from reinvestment of retained earnings and changes in the capitalization of expected earnings.
8. The data from the Foundation for the Study of Cycles (found in Ibbotson and Brinson, Ivestment Markets, op. cit.) show a compound return of 7.95 per cent from 1802 through 1870 and 7.92 per cent from 1789 through 1870.
9. The geometric, or compound, return is the nth root of the one-year returns; it is always less than the average or mean arithmetic return, except when all yearly returns are equal. The geometric return can be approximated by the arithmetic mean minus one-half the variance of the individual yearly returns.
10. S. Blodget, Jr. (A Statistical Manual for the United States of America, 1806 ed., p. 68) estimated that wealth in the U.S. was $2.45 billion in 1802. Total wealth today is estimated at nearly $15 trillion, of which about $4 trillion is in the stock market.
11. S. Homer, A History of Interest Rates (New Brunswick, NJ: Rutgers University Press, 1963).
12. The first federal government debt was the Hamilton refunding 6s of 1790, "redeemable at the pleasure of the government at 100 in an amount not exceeding 2% a year."
13. Ibbotson and Sinquefield, Stocks, Bonds, Bills, op. cit.
14. See Homer (A History, op. cit., pp. 296 and 301) and J. G. Martin (Boston Stock Market, 1871) for a description of these municipals. The lower yield for municipals was not due to any tax advantage, because tax considerations did not emerge until the early 20th century.
15. The Greenback period, when the government issued notes not redeemable in specie, provides a fascinating episode in monetary theory. For further discussion, R. Roll, "Interest Rates and Price Expectations During the Civil War," Journal of Economic History, June 1972.
16. For a discussion of the issues involved in the bimetal standard and the potential distortion in yields see P. M. Garber, "Nominal Contracts in a Bimetallic Standard," American Economic Review, December 1986.
17. The magnitude of this distortion can be seen by examining the yields in 1917–20 on government bonds issued with and without circulation privileges (see Homer, A History, op. cit., Table 46). The yield differential between bonds with and without circulation privileges ranged from 50 to 100 basis points.
18. F. R. Macaulay (The Movements of Interest Rates, Bond Yields, and Stock Prices in the United States since 1856 (New York: National Bureau of Economic Research, 1938)) reported rates for choice 60 to 90-day commercial paper after 1856, while data from 1831 through 1856 were collected from E. B. Bigelow (The Tariff Question . . ., (Boston, 1862)), which covers "Street rates on First class paper in Boston and New York, at the beginning, middle, and end of the month." The paper floated in Boston is said to be of three to six months in duration. See Macaulay, p. A341, for a more detailed discussion of these sources.
19. For details of the construction of U.S. short-term rate series, see J. J. Siegel, "The Real Rates of Interest from 1800–1900: A Study of the U.S. and U.K.," Journal of Monetary Economics, forthcoming.
20. The CPI includes services that cannot be stored. Since World War II, commodity prices have risen slower and service prices faster than the CPI. When futures markets exist, investors can buy futures, putting up margin in interest-bearing Treasury bills. This may result in returns higher than the CPI.
21. An investor would actually have done far better hoarding paper money than gold bullion. The first U.S. currency, a one dollar U.S. note issued in 1862, now catalogues for $1000 in uncirculated condition, while earlier colonial paper goes for even more. Of course, gold coins have also increased in value far more than bullion.
22. R. J. Barro and C. Sahasakul, "Measuring the Average Marginal Tax Rate from the Individual Income Tax," Journal of Business 56 (1982), pp. 419–52 and "Average Marginal Tax Rates from Social Security and the Individual Income Tax," Journal of Business 59 (1986), pp. 555–66.
23. This adjustment is consistent with research done by A. Protopapadakis, "Some Indirect Evidence on Effective Capital Gains Tax Rates," Journal of Business 56 (1982), pp. 127–38.
24. The averaging period is progressively shortened to 15 years at the end points of these series.
25. If the stock data from the Foundation for the Study of Cycles (see footnote 4) are considered, the real compound annual return in equity from 1802 to 1870 is 6.8 per cent.
26. In the short run, stocks have proved poor hedges against inflation. This is particularly true if inflation is induced by supply shocks, which

Footnotes concluded on page 46.

12. *The more sophisticated method that has been developed on Wall Street to measure option cost can also be applied to the holding-period return. A project is now under way at the Wharton School to develop this methodology.*
13. *H. P. Wallace ("The Total Return Calculation for Mortgage Pass-Throughs," in F. J. Fabozzi, ed.,* The Handbook of Mortgage-Backed Securities *(Chicago: Probus, 1985)) refers to the four components of the wealth increase shown in Equation (3) as the market value return, principal payment return, interest return and reinvestment return, respectively. The first two components, however, defy any analytically useful interpretation. The market value return component combines the change in price and the change in balance, whereas we want to know the impact of the price change alone. Furthermore, showing the return of principal as a component of return is misleading, because most of the principal repaid during any period was in fact part of the investor's wealth at the beginning. The only part that was not is the recovery of the discount—the difference between the market value of the security and its face value at the beginning of the period. After this article was drafted, Andrew Carron provided me with some unpublished tabulations that indicate that the First Boston Corporation breaks down holding-period yields in a way very similar to that developed here.*
14. *The best way to do this is by multiplying the total holding-period return by the ratio of the dollar value of the components to the total dollar increase in wealth. This is no more than an approximation, however. The annual equivalent holding-period return is not the sum of the annual equivalents of the components because the price change component is realized only at the end of the period, while the other components are received during the period.*
15. *I thank Andrew S. Carron, Allan Redstone and Kenneth R. Scott for their helpful suggestions.*

Siegel *footnotes concluded from page 38.*

affect the productivity of capital. See E. F. Fama, "Stock Returns, Real Activity, Inflation and Money," The American Economic Review, *September 1981.*

27. *These series can be found in Homer (*A History, op. cit., *Table 23). He describes the paper as of "nonuniform maturity of a few months" before 1855 and thereafter "three month bills." These series are based on data compiled by the NBER from British Parliamentary papers and from various editions of* The Economist *(1858–1900). Details are contained in Siegel, "The Real Rate of Interest,"* op. cit.
28. *This has been suggested to me by some preliminary work done by Charles Calomaris.*
29. *Of course, even on a worldwide basis, who might have expected the triumph of capitalism and market-oriented economies 100 or even 50 years ago? We may be living in the golden age of capitalism, the fortunes of which may decline in the next 100 years (or sooner)!*
30. *I thank Peter Scherer and Ashish Shah for their research assistance.*

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The Equity Premium: Consistent with GDP Growth and Portfolio Insurance

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Abstract

We find that the long-term equity premium is consistent with both GDP growth and portfolio insurance. We use a supply-side growth model and demonstrate that the arithmetic average stock market return and the returns on corporate assets and debt depend on GDP per capita growth. The implied equity premium matches the U.S. historical average over 1926–2001. Separately, we find that the equity premium tracks the value of a put option on the S&P 500. Our theory predicts a smaller equity premium in the future, assuming that the recent regime shifts in dividend policies, interest rates, and tax rates are permanent.

Keywords: equity premium, GDP growth, T bills, downside risk, portfolio insurance

JEL Classifications: G10, G12

1. Introduction

The equity premium, typically defined as the difference between the S&P 500 return and a risk-free return, is a critical input in portfolio allocation decisions as well

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as in capital budgeting decisions. It is also at the heart of the ongoing policy debate about whether a portion of the social security trust fund should be invested in the equity market or not. Consequently, it is crucial for finance professionals to be able to accurately gauge the size of the premium and to understand the factors that may change its value.

In their seminal paper, Mehra and Prescott (1985) show that the standard economic growth model is unable to explain the historical difference between the average stock return on a broad index versus risk-free bonds in the United States. This has become known as the equity premium puzzle. Although the fact that equity returns are higher than short-term bond yields makes intuitive sense, the puzzle is that standard risk measures cannot explain the size of the historical difference in returns. Many attempts at modifying the standard model fall short of fully explaining the size of the premium (Kocherlakota, 1996; Campbell, 2003; Mehra, 2003). Although a few successful models have been proposed, the current asset pricing literature does not agree on a solution to the equity premium puzzle as well as other asset pricing anomalies.[1]

Empirical approaches to the study of the equity premium, although not articulating a full explanation of the puzzle, do offer alternative pathways in the quest for a solution to this important puzzle. Asness (2000) draws a link between the size of the expected premium and differences in the volatility of stocks versus bonds for horizon periods of 20 years. However, his analysis does not account for the size of the average premium over the full historical record.[2] Ibbotson and Chen (2003) use a building-block approach to estimate the long-term stock market return, and relate some of the market return components to gross domestic product (GDP) growth. However, they do not establish a firm theoretical basis for relating the *equity premium* directly either to GDP growth or to risk.

In this article, we show theoretically and empirically that in the long run, the equity premium is directly related to GDP growth and is consistent with downside risk avoidance. Thus, we establish that the historical average value of the equity premium is fully accounted for by risk and growth-based explanations. These results in turn

[1] In two recent articles, McGrattan and Prescott (2000, 2001) claim to finally put the puzzle to rest. In their 2000 article, they show that the high ratio of market value of equity to gross national product at the beginning of the year 2000 is rationally based when computing the value of corporate tangible and intangible capital assets. In the subsequent 2001 article, they show that during the post-war period, the large rise in equity values is as predicted by the theory, once the historical change in the taxation of dividends and the increase in holdings in tax-deferred accounts are accounted for. However, McGrattan and Prescott (2001) focus on explaining recent equity returns and do not explain the historical difference between stock and risk-free returns.

[2] Asness (2000) uses the dividend and earnings yield as proxies for expected returns. Although the approximations may well be valid, there is evidence that bonds may be more risky than stocks for horizons of 20 years or longer when looking at ex post return volatility, as shown by Siegel (2002).

enable us to accurately gauge the size of the historical premium and to predict changes in the premium given extrapolated recent trends.[3]

First, we use a supply-side growth model and develop the macroeconomic equivalent of the standard sustainable growth formula found in corporate finance textbooks to determine the long-run average return on stocks. The average stock return depends on GDP per capita growth and the earnings retention ratio as well as a premium reflecting systematic risk, which is linked to detrended earnings[4] and market-to-book volatilities and the response of dividend and share repurchase policies to these factors.

We then establish a relationship between GDP growth and the required returns on corporate assets (RRCA) and debt. Based on an empirical analysis at the aggregate corporate level, we obtain a value for the return on debt identical to the historical average of the three-month T bill over the period 1926–2001. Although this result is surprising, it is to some extent, an artifact of Flow of Funds data that exhibits a survivor bias, in the sense that it excludes defaulted or bankrupt companies over time. This result implies that in the long run, survivor-biased corporate debt will be risk-free as the economy grows at a constant rate, where the risk-free rate is determined by the three-month T bill, absent any term structure effects.

Our first key conclusion is that, in the long run, the size of the premium (as expressed by the difference between the average stock return and the three-month T bill) is a function of GDP growth and other financial parameters such as marginal income tax rates. We empirically match the historical value of the S&P 500 arithmetic average over 1926–2001, and the historical equity premium value of 8.1%.

Our second key result is that the equity premium is also consistent with a compensation for risk, when viewed in the context of a short-term portfolio insurance motive. We use an option-based approach and show that the equity premium is closely approximated by a put option premium on a $1 real investment in the market index when a long-term investor wishes to insure against year-to-year market volatility, by using the average yearly S&P 500 volatility over 1926–2001.

Recent research argues that the actual equity premium is much smaller than indicated by historical long-term averages (Siegel, 1999; Jagannathan, McGrattan, and Scherbina, 2000; Fama and French, 2002; De Santis, 2004). In contrast, our result is that the *observed* level of the long-run equity premium at 8.1% is fully consistent with the observed steady-state GDP growth and consistent with risk explanations as well, and thus it may constitute a legitimate input in capital budgeting and investment analyses.

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[3] It is important to emphasize that we do not claim to resolve the equity premium puzzle here, because the puzzle is really about the failure of the standard asset pricing model. However, it is also a fact that *no other class of models* has been so far put forth to show the consistency of macroeconomic growth rates, risk, and other behavioral variables with the size of the premium, which is what we attempt to do here.

[4] Earnings are scaled (or detrended) by book value of equity. In other words, we examine return on equity (ROE) volatility.

Nonetheless, if one believes that the 1990s changes in dividend yields, income taxes, and interest rates represent permanent regime shifts, our portfolio insurance model does lead to a *lower* premium value consistent with the literature, when using parameter values from that period.

2. Long-term stock market return and GDP per capita growth

Our first approach is to tackle the equity premium puzzle using a supply-side growth model. Because the equity premium is typically measured by appealing to arithmetic historical average returns, which are sample estimates for unconditional expected returns, it is reasonable to focus on unconditional expectations (Fama and French, 2002; Ibbotson and Chen, 2003). We appeal to the natural properties of the economy's long-run steady-state growth path to derive our key relationship between the equity premium and GDP growth.

In the long run, Kaldor's (1961) stylized facts show that the U.S. economy has been characterized by a constant nominal (and real) GDP growth rate that equals the growth rate of capital, with a stable factor income distribution (labor versus capital). In a stochastic framework, this amounts to saying that these year-to-year growth rates are stationary stochastic processes.

We establish a link between macroeconomic and finance variables by positing that in the long run, the unconditional expected growth of the economy's corporate capital stock must equal the unconditional expected growth in book value of a broad stock index.[5] The change in the index's book value of equity is driven by clean surplus accounting. We also postulate that the financial environment satisfies Modigliani and Miller's (1958) proposition and that the optimal capital structure is achieved for the whole economy.

Let us develop our notations. Let K_t denote the capital stock, B_t denote the book value of a broad equity index, V_t is the market value of the index, and e_t represents total earnings for the index; all at the beginning of period t. Let the variable $R_{t+1} = e_{t+1}/B_t$ denote the ex post ROE at the end of period t. A portion b_{t+1} of earnings is paid out as dividends. Let the ex post rate of net stock issues at the end of period t be denoted by $g_{s,t+1}$. Ex post, the growth in *total* book value of equity is given by the following surplus equation:

$$\frac{B_{t+1}}{B_t} = 1 + (1 - b_{t+1}) \times R_{t+1} + \frac{g_{s,t+1}}{(1 + g_{s,t+1})} \times \frac{V_t}{B_t}. \tag{1}$$

[5] It is worth noting that our approach differs from the consumption-based capital asset pricing model (CCAPM). In our model, agents' optimizing behavior is in the background, and key behavioral parameters are considered exogenous. In addition, the typical solution of a CCAPM is a pricing kernel that involves agents' conditional expectations.

Equation (1) states that the growth of book value for the equity index (S&P 500) comes from two sources: the first term on the right-hand side represents internal reinvestment. The second term is the increment from issuing net new equity at a price equal to the current market price adjusted for the increase in supply of shares (price divided by the factor $(1 + g_{s,t+1})$).[6] As mentioned, our key assumption is that the expected growth of equity book value of a broad equity index (S&P 500) equals the expected growth in total capital assets at the economy level:

$$\mathrm{E}\left(\frac{K_{t+1}}{K_t}\right) = \mathrm{E}\left(\frac{B_{t+1}}{B_t}\right), \tag{2}$$

where $E(\cdot)$ denotes the unconditional expectation operator. We assume unconditional expectations satisfy the following[7]:

(i) The expected market-to-book ratio $\mathrm{E}(\frac{V_t}{B_t}) = 1$.
(ii) The expected ROE equals the long-run average return on stocks μ.
(iii) The expected long-run growth rate of population n and net new shares g_s are both constant.
(iv) The expected growth rate of capital equals the long-run average growth rate of GDP denoted by g.
(v) The expected long-run payout ratio is the long-run average ratio b.

Using Equation (2) and condition (iv) we trivially get

$$\mathrm{E}\left(\frac{B_{t+1}}{B_t}\right) = 1 + g. \tag{3}$$

Taking unconditional expectations of both sides of Equation (1), then substituting Equation (1) into (3), by using the rest of the conditions above, then Equation (3) becomes

$$\begin{aligned} 1 + g = 1 + (1 - b)\mu + \mathrm{E}\left(\frac{g_{s,t+1}}{(1 + g_{s,t+1})}\right) \\ - \mathrm{COV}(b_{t+1}, R_{t+1}) + \mathrm{COV}\left(\frac{g_{s,t+1}}{(1 + g_{s,t+1})}, \frac{V_t}{B_t}\right). \end{aligned} \tag{3'}$$

[6] Using the current price adjusted ex post is more accurate than using *next* period's price becanse our adjustment precisely corrects for the price pressure due to share growth, without adding the noise of new market information incorporated in next period's price. This particular adjustment works when stock demand elasticities are close to 1. Shleifer (1986) provides evidence of unitary stock demaud elasticity for the S&P 500.

[7] These conditions are minimal for the stock market to be in a stationary equilibrium. Condition (i) comes from the residual accounting literature (e.g., Ohlson, 1995) since companies that grow at the same rate as the economy have zero residual earnings growth and thus market value must converge to book value on average. Condition (ii) in fact follows from condition (i). Philips (1999) documents that condition (ii) seems to hold siuce the average S&P 500 ROE has been very close to the average stock return over the last 30 years. Conditions (iii), (iv), and (v) state that these variables follow stationary stochastic processes.

Strengthening assumption (iii) we posit that in the stationary equilibrium net new share growth g_s equates population growth n.[8] Let $g_y = g - n$ denote the GDP per capita growth rate. Rearranging (3′), and using the approximation $E(\frac{g_{s,t+1}}{(1+g_{s,t+1})}) \approx n$, we get

$$\mu = \frac{g_y + \mathrm{COV}(b_{t+1}, R_{t+1}) - \mathrm{COV}\left(\frac{g_{s,t+1}}{(1+g_{s,t+1})}, \frac{V_t}{B_t}\right)}{1-b}. \tag{4}$$

Equation (4) is the central result of this section. It shows that the long-run nominal stock return is a direct function of the GDP per capita growth rate. This return also depends on the retention ratio $(1 - b)$ and the difference between two covariances: (1) the covariance between dividend payout and the index ROE and (2) the covariance between market-to-book ratio and the normalized growth rate of shares next period.[9] Thus, the long-run nominal stock return equals the long-run expected growth rate of GDP per capita plus a risk premium term (the difference of covariances), divided by the percentage of new earnings retained.

Because the retention ratio $(1 - b)$ and steady-state growth rate g_y are determined in the background by optimal consumption-investment decisions, Equation (4) simply establishes that the long-run equity return is a function of these choices. It is important to note that expression (4) is the macroeconomic equivalent to the long-term sustainable growth formula found in standard corporate finance textbooks (e.g., Brealey, Myers, and Marcus, 1999).[10] The difference with the standard formula is that ours applies to the corporate sector as a whole.

Furthermore, the sustainable growth rate is determined by the long-run GDP per capita growth rate and what essentially constitutes an added systematic risk premium.

[8] In the long run, aggregate stock wealth cannot grow faster than GDP, to rule out permanent bubbles. The same must be true on a per capita basis, given that the distribution of wealth is stable in the steady state. On one hand, the supply of net new shares has to match at least the growth of new investors. On the other hand, a growth of shares in excess of population growth would depress earnings-per-share and thus dividends and capital gains. This would depress stock prices permanently. Corporations would then have an incentive to repurchase shares. Using the Federal Flow of Funds, over the period 1946–2002, the growth in total stock market value was 8.40%, whereas it was 7.20% for the S&P 500 over the same period. Since the S&P 500 was a relatively constant fraction of the overall market value (about 60%), and the index is on a per-share basis, it is evident that the difference of 1.2% represents net share growth, about equal to long-term population growth. Loderer, Cooney, and Van Dunen (1991) show that stock prices are reduced on average by 1% around announcements of secondary equity offerings over a period covering 1969–1982. This effect is consistent again with the fact that in the long run net new share growth happens at the rate of average population growth.

[9] These two expressions play a similar role as that played by the covariance between consumption growth and equity returns in the standard consumption-based capital asset pricing, which reflects both the riskiness of growth as well as the intertemporal optimal consumption choices in light of expected returns (e.g., Hansen and Singleton, 1983). It is also worth noting that in these models the covariance expression treats consumption growth essentially as an *exogenous* variable.

[10] Our result agrees with Arnott and Bernstein (2002), who find that the stock market return is directly related to per capita GDP growth.

When the first covariance $\mathrm{COV}(b_{t+1}, R_{t+1})$ is large, this means that companies pay out a greater fraction of earnings when their ROE is high (procyclical), which exacerbates the volatility of cash flows and thus price volatility. On the other hand, when the second covariance $\mathrm{COV}(\frac{g_{s,t+1}}{(1+g_{s,t+1})}, \frac{V_t}{B_t})$ is large, greater stock issuance is associated with periods of high market-to-book ratios (procyclical). In that case, greater stock issuance will bring the market-to-book ratio back down, and vice versa in periods of low valuation. Thus, price volatility is dampened.

Our model essentially predicts that stock markets with *countercyclical* aggregate dividend payouts and *procyclical* new shares growth overall will experience a *reduction* in the impact of market risk and therefore a lower long-term stock market return. For example, during periods of large *downside* earnings volatility and low valuation, firms can reduce their investors' exposure to systematic risk in two ways. One method is to smooth out the dividend stream by temporarily paying *higher* dividends. Another possibility is to boost earnings *per share* by issuing fewer shares or even by buying back existing shares. Any such outcome is the result of optimizing behavior, which depends on the aggregated preference parameters of the particular economy.[11]

The arithmetic average yearly population growth rate is $n = 1.19\%$[12] and is assumed equal to the growth rate of shares g_s. Using yearly data, the arithmetic average nominal growth rate of GDP per capita over the 1926–2001 period is $g_y \cong g - n = 6.65\% - 1.19\% = 5.46\%$, and the average S&P 500 dividend payout is 55.5%. Our estimate for the covariance between dividend payout and ROE is -0.51%. Strikingly, this value is identical to the value of the sample covariance between the market-to-book ratio and the subsequent period (normalized) shares growth rate, over 1925–2001.[13] This means that over the period, both dividend payouts and net new share issuance

[11] The result in Equation (4) implies that, even though dividend payout policy is constant, the stock market return will be different for two economies with widely different business cycles and growth risks. The second covariance term will raise the stock market return for the higher risk economy, when that covariance is *negative*. That is, when the growth of shares is principally driven by steady financing needs of the corporations making up the index. In that instance, a low price-to-book environment necessitates higher growth of shares to meet a given financing need, although the need may be smaller during a contraction than during an expansion phase.

[12] This rate corresponds to the growth rate of the total U.S. population (source: Bureau of the Census) over the period.

[13] We construct a measure of book value for the S&P 500 by using data from Robert Shiller's Web site www.irrationalexuberance.com. We assume that the book value of the index in 1871 was equal to its market value. Year-to-year, we add retained earnings to the previous year's book value. Our computation of the ROE is theu done from year-end 1926 until 2001. The market-book ratio for the S&P 500 is assumed similar to that of the aggregate corporate sector. The data are from the Federal Flow of Funds over the period 1952–2001. The missing market-to-book values for 1926–1951 are reconstructed by back-trending corporate market and book values, using regressions of the log of these variables on linear time trends over 1952–2001. Again, because the S&P 500 was a relatively constant fraction of the overall market value (about 60%), an index for the number of stock shares in the S&P 500 is constructed by dividing the market value of corporate equity by the value of S&P 500 index.

have been *countercyclical* in the United States, thereby creating coupling effects that offset the risk premium. Hence, we get

$$\mu = \frac{5.46\%}{(1 - 55.5\%)} = 12.27\%.$$

This final value is nearly identical to the arithmetic average nominal stock return value of 12.2% estimated for example by Siegel (2002) for the period 1926–2001. Hence, we have derived an exact analytical relationship linking the average real stock return and long-term GDP per capita growth. Examining Equation (5), we observe that the smaller the retention ratio is, the greater the stock return is for a *given GDP per capita growth rate.*[14]

3. The return on corporate assets and return on debt

Whereas the first piece of the equity premium puzzle was the return on the stock market, the second piece is the return on debt. In this section, we focus on deriving the average return on corporate debt for the economy. As an intermediate step, we examine the economy's RRCA from the investors' standpoint. The RRCA is the discount rate that makes the present value of expected future after-tax cash flows accruing to creditors and equity holders equal to the market value of the corporate asset base in the economy.[15]

Again, we predict that in the long run, the expected growth of the capital stock at the economy level equals the growth in book value for the S&P 500. Furthermore, the corporate debt-equity ratio also must be constant in the steady state given an environment a la Modigliani and Miller (1958). Future cash flows are given by after personal income tax T_t, expected corporate dividends D_t, and net interest payments IP_t on outstanding corporate debt.[16] Assuming market efficiency, the market value of all corporate assets must equal the present value of all expected future cash flows net of taxes that accrue to creditors and shareholders at the economy level. Formally, this is expressed as:

[14] If all earnings are reinvested ($b = 0$), so that no dividends or share repurchases occur and growth is financed internally, the best return that investors could expect to earn is GDP per capita growth. This suggests that leverage may enhance stock returns by allowing firms to maintain asset and earnings growth and still boost stock returns through dividends and repurchases.

[15] Fama and French (1999) compute an internal rate of return (IRR) based on operating and investment cash flows. Our approach is grounded in the steady-state analysis of the economy. In that context, the fraction of dividend plus net interest payments over the market value of corporate assets should be constant, whereas its components may not be constant. In fact, this fraction of total payments has been relatively coustant over the period examined, whereas the relative size of interest payments compared with dividends has increased.

[16] Cash flows are in nominal terms. This current model does uot incorporate capital gains taxes because dividend cash flows and interest are assumed paid forever. The tax rate, T_t, is an average marginal tax rate that blends dividend income and interest income tax rates.

$$\text{MV corp assets}_0 = \mathrm{E}\sum_{t=1}^{\infty}\frac{(1-T_t)\times(D_t+\mathrm{IP}_t)}{\Pi_{j=1}^{j=t}\left(1+\mathrm{RRCA}_j\right)}, \tag{5}$$

where $E(\cdot)$ again stands for the unconditional expectation operator. We assume that in every period j, the corresponding discount rate RRCA_j is constant and equal to the long-term average RRCA given by

$$\mathrm{RRCA} = \mu\times(1-L)+r_D\times L. \tag{6}$$

The long-term nominal stock return is again denoted by μ. The variable r_D stands for the nominal return on corporate debt/bonds, and L stands for the fraction of the investor's portfolio invested in debt or alternatively corporate leverage. We hypothesize that in the long run, the sum of expected dividends plus interest payments to investors is a constant fraction λ of GDP, as they cannot *together* grow faster than GDP. Again, let g stand for the nominal long-term average GDP growth rate. Given an average marginal tax rate of T, the above-mentioned Equation (5) becomes

$$\text{MV corp assets}_0 = \sum_{t=1}^{\infty}\frac{\lambda(1-T)\times\mathrm{GDP}_0\times(1+g)^t}{(1+\mathrm{RRCA})^t} = \frac{\lambda(1-T)\times\mathrm{GDP}_0}{(\mathrm{RRCA}-g)}. \tag{7}$$

Equation (7) is the steady-state version of Equation (5). The result in Equation (7) indeed is the standard growing perpetuity formula applied to the entire asset base of the corporate sector. Thus, the RRCA is also given by

$$\mathrm{RRCA} = g+\lambda(1-T)\times\frac{\mathrm{GDP}_0}{\text{MV corp assets}_0}. \tag{8}$$

Finally, combining Equations (6) and (8), we get an expression for the debt return as

$$r_D = \frac{g+\lambda(1-T)\times\dfrac{\mathrm{GDP}_0}{\text{MV corp assets}_0}-\mu\times(1-L)}{L}. \tag{9}$$

We use Flow of Funds data and National Income and Product Accounts data from the Bureau of Economic Analysis, for the nonfinancial corporate sector over the period 1954–2001. The variables used are net interest payments, dividend payments, total debt, market value of equity, and book value of equity. Average marginal tax rates on dividend and interest income are obtained from Estrella and Fuhrer (1983) for the period 1954–1979 and from the National Bureau of Economic Research TAXSIM model for the period 1980–1999.[17] Because our marginal income tax data are limited to 1954–1999, we extrapolate the 1999 tax rates for the years 2000 and 2001.

[17] Even though there is a difference in methods between the two approaches, we do not believe that these differences affect our conclusions in any significant way.

Table 1

Estimated parameter values for return on corporate assets and debt formulas

g	g_y	b	T	L	λ	$\frac{GDP_0}{MV\ corp\ assets_0}$	μ
6.65%	5.46%	55.5%	35%	38.05%	3.27%	112%	12.27%

To determine leverage, we use book value of equity. This approach is supported by the evidence of stability of book leverage over the period 1951–1996 documented by Fama and French (1999). The average value for the book leverage ratio over our period is 38.05%; the average value for the ratio of the net total payments to investors over total market value of assets (before taxes) $\lambda\, GDP_0/MVcorp\ assets_0$ equals 3.67%. The average blended marginal (dividend plus interest) income tax rate is 35%. Table 1 summarizes the main parameters for the model.

From these parameters and Equation (9), we obtain a value for the *real* RRCA of 5.89%, based on a long-term GDP nominal growth rate of 6.65% and inflation rate of 3.14%. This result is nearly identical to Fama and French's (1999) estimate of 5.95% over the period 1950–1996. Finally, using Equation (10) our estimate for the nominal return on debt is 3.74%, which is close to the real T-bill arithmetic historical average of 3.93% for 1926–2001.[18]

This result is surprising. It suggests that the overall corporate debt may be considered risk-free in the long run! However, we must recognize that the Flow of Funds corporate debt data have a survivor bias. The corporate debt data do not retroactively correct for defaulted debt, and thus the Flow of Funds reports interest payments that typically begin to shrink earlier than the reported principal does, which biases computed rates downward.[19]

4. Growth and the long-run equity premium

Finally, we derive the difference between the return on corporate equity versus corporate bonds. Let us define $\Delta COV = COV(b_{t+1}, R_{t+1}) - COV(\frac{g_{s,t+1}}{(1+g_{s,t+1})}, \frac{V_t}{B_t})$. Based on Equations (4) and (9), the difference in returns is given by the following formula:

[18] Fama and French (1999) discuss the use of simple versus compounded returns as discount rates. They argue that under certain conditions the expected one period simple return is the appropriate discount rate. Otherwise, a more appropriate method is to use a weighted average of simple and compound returns.

[19] This leads to an understatement of the actual long-term return on debt that should probably include a default premium. Thus, the growth of actual issued volume of debt should exceed GDP growth by an amount equal to the average corporate default rate. Note also that any inflation risk and interest rate risk are already embedded in the T-bill rate. Fnrthermore, because we are examining *arithmetic* average returns, capturing one-year investment horizons, the inflation and interest rate risks may bear a smaller effect than for debt yields representing multiyear horizons. It turns out that using market-valne-based average historical leverage instead of book-value leverage ratio lowers our estimate of the return on debt even more because the value of the leverage ratio is 34.23% over 1954–2001.

$$\mu - r_D = \frac{1}{L}\left[\frac{gb - n + \Delta\mathrm{COV}}{(1-b)} - \lambda(\mathrm{I} - T) \times \frac{\mathrm{GDP}_0}{\mathrm{MV\ corp\ assets}_0}\right]. \tag{10}$$

The difference depends positively on the rate of growth of GDP, on the blended marginal income tax rate T and on systematic risk, and negatively on leverage and the net growth of shares. The fact that the difference between stocks and corporate bonds seems related to GDP growth is sensible if we note that a bond is a claim to a fixed income stream, whereas a stock is a claim to both growing dividends and earnings streams.

In section 3, we show that the return on corporate debt r_D nearly equals the risk-free rate in the long run. This result implies that Equation (10) characterizes the equity premium as well.[20] Over the period of 1926–2001, and after combining our prior estimates for the long-term return on debt and the return on stocks, we obtain a value for the premium of equity over the three-month T bill equal to 8.3%, which closely matches the historical estimate of 8.1% over the examined period.

5. Portfolio insurance and the equity premium

The literature on the equity premium has so far shown scanty evidence of the link between the premium and risk. Asness (2000) attempts to empirically reconcile the premium with measures of the difference in risk between bonds and stocks and achieves some relative success for rolling market periods of 20 years, but falls short of explaining the premium over the full historical record.

In this section, we show that option pricing can help us derive a measure for the equity premium that is directly related to observed historical stock return volatility. In fact, we show that the long-run equity premium is closely related to an investor's objective of averting downside risk.

Consider an investor adopting the following long-term strategy: every year, invest \$1 in a stock index and buy a put option on the index (with a real \$1 strike), sell the stock at the end of the year. This is an instance of seeking portfolio insurance by using a protective put (Merton, Scholes, and Gladstein, 1982). The yearly maximum loss is limited to the loss of the put premium. In the long run, the expected stock return must be the arithmetic average of the index return. We postulate that yearly market volatility is expected to equal the annual volatility given by a long-term horizon estimate. In that case, the put option price remains constant. We also posit that the index pays a known dividend.

Formally, let $\tilde{\mu}$ be the arithmetic average *real* stock return, let $\tilde{r}$ be the arithmetic average *real* risk-free rate, q is the real after-tax dividend yield, and c and p are the respective option prices for the European call and put. Our goal is to find the value of this put option. Assume that the current index price is \$1 and the strike price is

[20] Again, if it were not for the survivor bias in the Flow of Funds corporate debt data, we should expect that corporate debt returns would incorporate a default premium.

\$1 (real), and using compounded rates of returns, the put-call parity formula for a dividend paying stock (Hull, 2003) leads to express the put price as

$$p = c + e^{-\tilde{r}} - e^{-q}. \tag{11}$$

Following Rubinstein (1984), we define the *real* risk-neutral expected *future* value of the put-call relationship as follows[21]:

$$\mathrm{E}(p) = \mathrm{E}(c) + 1 - e^{\tilde{\mu}-q}. \tag{12}$$

Given that the expected capital gains rate is greater than zero, the expected value for the put option must be zero, because it is expected to be out-of-the-money. Therefore, we get

$$\mathrm{E}(c) = e^{\tilde{\mu}-q} - 1. \tag{13}$$

Thus, the real expected future value of the call option equals the real expected capital gains rate.[22] We postulate that the present value of the expected future call value discounted at the risk-free rate is a good approximation for the current call value, that is[23]

$$c \cong e^{-\tilde{r}}\mathrm{E}(c). \tag{14}$$

Using Equations (13) and (14), and plugging the resulting call price into (11), we obtain

$$e^{q} p \cong e^{\tilde{\mu}-\tilde{r}} - 1. \tag{15}$$

Hence, the equity premium can be expressed as

$$\tilde{\mu} - \tilde{r} \cong \mathrm{Ln}(1 + e^{q} p). \tag{16}$$

Thus, the risk premium approximately equals the value of a European put option on a stock index compounded at the dividend yield rate (using the average annual standard deviation of prices). Applying Black and Scholes' (1973) approach, we can evaluate the price of such a put option. It is well known that the resulting value is independent of the expected stock return and investor preferences.[24] Assume that the strike price and the current stock price are both equal to \$1 and that the option's

[21] We are applying Rubinstein's (1984) approach to real (deflated) values of expected call and put prices. Rubinstein also defines these expectations for a horizon h as a fraction of one year and for volatility estimates that may differ for individuals compared with the overall market. Here we posit that h is arbitrarily close to 1 and that individual estimates are arbitrarily close to the market volatility.

[22] It is interesting to note that this same result can be derived using Black and Scholes' (1973) call option approach to corporate equity. In that case, we would have to assume that stocks are initially purchased using zero-coupon debt and that the minimum *real* required return on debt is zero.

[23] Using parameter values introduced later, we find that the Black-Scholes current call price equals 6.56%, whereas our estimate is 6.50%.

[24] This approach is subject to the standard criticism of the normality assumption of the stock market return distribution (e.g., Fama 1965).

maturity is one year. The standard formula for an option on a dividend paying stock index (with taxes) is given by Scholes (1976).[25] According to our strategy, an investor sells his/her stock at the end of each year. We posit that he/she is taxed at the marginal ordinary income tax rate and that this tax rate equals the dividend income marginal tax rate T. Hence, the formula is

$$p = e^{-\bar{r}}N(-d_2) - e^{-q}N(-d_1) \tag{17}$$

with

$$d_1 = \frac{\bar{r} - q + \sigma^2/2}{\sigma}$$

$$d_2 = d_1 - \sigma$$

$$q = (1 - T) \times \text{dividend yield.}$$

Thus, using the relationship between the put option and the equity premium expressed in Equation (16) and the put pricing Equation (17), we obtain an independent estimate of the premium. We apply formula (17) with the following parameters: the dividend tax rate corresponds to the average marginal rate over 1954–1999 (with 1999 values used for the years 2000 and 2001). The value for the tax rate is 40%.[26] The standard deviation of stock index returns is a historical estimate using continuously compounded annual *real* total S&P 500 returns over 1926–2001. We adjust total returns according to Hull (2003), by removing the effect of dividends on stock volatility to account for the risky portion of stock prices. The value of the standard deviation σ. is estimated at 18.87%.

Our estimate of the inflation-adjusted pretax average S&P 500 dividend yield is 4.20% over the same period. The value for the real risk-free rate corresponds to the T-bill arithmetic average real rate of 0.76% over that period as well. We then arrive at a value for the put option premium p of 8.29%, and a value for the risk premium of 8.16%, which is nearly identical to our prior estimate for the risk premium.

Note that the insurance strategy presented above does not fully guarantee a risk-free return on a *yearly* basis. To achieve that goal, the investor could for example sell a call option in addition to owning a protective put. However, over a long-term investment horizon, stocks are on average as "riskless" as bonds, in the sense that they deliver an average return that is more and more certain with longer horizons, based on real long-term GDP per capita growth. The difference between riskless securities and stocks is that riskless securities are a perfect hedge against short-term market downside risk, whereas stocks obviously are not. Our result shows that the long-run equity premium reflects a portfolio insurance motive since there would otherwise be an opportunity for a riskless long-term arbitrage, in the sense that put-call parity would be violated on average.

[25] Scholes (1976) prices a European call option. A put option can be priced using the put-call parity formula.

[26] The estimates for 1954–1979 are from Estrella and Fuhrer (1983) and for 1980–1999 from the NBER TAXSIM model.

Our result demonstrates that the risk-free rate and the long-term stock return are jointly defined in relation to the premium on a put option. Our analysis of the return to corporate assets above, when combined with the result of this section, leads us to offer a new view of the debt versus stock trade-off, in which bondholders and stockholders mutually benefit from co-financing corporate assets at the macroeconomic level. Stockholders will benefit from leveraging assets since they can boost equity returns via receiving higher dividends all the while maintaining constant asset and earnings growth rates.

In this new view, it is useful to consider that an investor following our portfolio insurance strategy is a debt holder. Debt holders by choosing to hold debt instead of equity settle to earn a lower long-term return (than equity holders), because they choose to *fully* insure against the loss of their principal in the short run. Thus, in equilibrium, agents will be indifferent between holding debt or equity, because insuring one's principal is costly. Debt holders are in effect "paying" a portfolio insurance premium to stockholders, and thus end up with a return equal to the risk-free rate on average.

This argument has an interesting implication regarding the traditional view of compensation for risk. The standard CAPM uses a "bottom-up" approach to the equity premium: the equity premium is *added* to the risk-free rate to compensate stockholders for the extra risk borne by them. Our logic of portfolio insurance presents a top-down view of the premium: the premium is *subtracted* from the long-term equity return to obtain the risk-free rate, because insurance is a cost.[27] This logic obviously does not violate the spirit of CAPM.

6. A shrinking equity premium?

Jagannathan, McGrattan, and Scherbina (2000) and Fama and French (2002) argue that ex post returns are a distorted view of expected returns and that a lower equity premium should be used compared with the historical average.

Table 2 shows that for various time horizons, our portfolio insurance model predicts an overall decline in the equity premium before the market crash of 2000 with a minimum premium value around 3.5%, and an increase back to about 5% for periods ending in 2004.[28] These estimates are in line with the above-cited literature. The observed decline in the premium compared to the 1926–2001 average of 8.1%, seems to originate from declining trends in dividend yields, marginal dividend income

[27] In the limit case of 100% debt-financing, corporate debt holders would require the same return as "equity" holders (or T-bill return plus risk premium). However, to avoid short-term principal losses, debt-holders would have to use our portfolio insurance strategy and sacrifice the premium. The recent risiug corporate trend of using leverage to pay dividends may cause an increase in the equity premium, since the premium is an increasing function of the dividend yield, for a given level of the risk-free rate and independent of leverage risk.

[28] Parameter values are annualized monthly averages, except for dividend taxes (yearly averages) and except for the periods starting in 1970, where the real T bill is averaged yearly. S&P 500 standard deviations are annualized and based on monthly continuously compounded real returns.

Table 2

Estimates of the equity premium using the portfolio insurance model. 1970–2004

	Beg. year	Div. yield	Div. tax rate	SD mkt. return	Real T bill	Est. premium
Period	1970	3.62%	36.48%	12.61%	1.38%	5.38%
Ending	1982	3.21%	29.08%	11.68%	3.26%	4.08%
December	1990	2.46%	27.84%	10.51%	2.25%	3.87%
1999	1995	1.78%	29.06%	10.90%	2.89%	3.49%
Period	1970	3.32%	35.23%	12.69%	1.17%	5.44%
Ending	1982	2.83%	29.11%	12.31%	2.63%	4.49%
December	1990	2.15%	28.13%	12.03%	1.62%	4.65%
2004	1995	1.68%	29.18%	13.25%	1.67%	4.91%

tax rates, and stock market volatility along with a rise in the *average* real T-bill returns since the 1980s.

Because our model works as a predictor of long-term premia, the results shown in Table 2 are only applicable if we assume that these recent trends in dividend yields, marginal tax rates, and interest rates represent permanent regime shifts. This latter view may coincide with the Federal Reserve (Fed) recent monetary policy trend, since the Fed appears committed to keep inflation rates *and* discount rates low (although the slide of T-bill rates in the 1–2% range is also responsible for larger premia in periods ending in 2004). Regarding tax policy, marginal dividend and capital gains tax rates have reached their lowest levels in history, and hiking rates backup is a virtual political impossibility. On the other hand, dividend policy seems to have shifted toward lower payouts over the 1990s (Fama and French, 2001). However, investors can easily decide to reverse the trend if they perceive that capital gains are exposed to greater downside risk.[29]

One reason why our premium estimates seem to rise slightly (controlling for the slide in T-bill rates) for horizons ending in 2004 compared with 2000 is that market volatility did rise after the market crash of 2000. This effect is accentuated for short horizon periods (15 years or less). To smooth out the effect of the 2000 market crash, an intermediate range of about 20 years may be more appropriate. Table 2 then shows that for horizons starting in 1982 the premium can be estimated in the 4–4.5% range.

7. Conclusion

We show that the long-run equity premium is theoretically and empirically consistent with GDP growth and a portfolio insurance motive. We derive the long-run ex

[29] Another potential issue is that share repurchases may counter the effect of lower dividend yields. Grullon and Michaely (2002) report that since the mid 1980s, large established U.S. firms did not increase dividends as much as they could have, but rather chose to buy back shares. Thus, in all likelihood, lower expected dividend yields have beeu associated with greater expected capital gains. In that instance, our portfolio insurance model makes the provision in Equation (13) that the expected future value of the S&P 500 call option fully reflects these capital gains expectations and thus the equity premium embodies these trend expectations as well.

ante equity return and long-run corporate debt and asset returns using a supply-side growth model. We arrive at a macroeconomic generalization of the standard sustainable growth formula used in corporate finance textbooks to determine the long-run average return on stocks.

The long-term average stock return depends on GDP per capita growth, the earnings retention rate, and a premium linked to detrended earnings volatility and market-to-book volatility and the response of dividend and share repurchase policies to these factors. Our model accurately replicates the arithmetic average historical returns for the S&P 500. Our first conclusion is that the equity premium defined as the difference between the S&P 500 stock return and three-month T bill is consistent with observed GDP growth and other financial parameters such as marginal income tax rates.

Our result also hinges on the fact that the Flow of Funds data on corporate debt and S&P data on the equity side have an inherent survivor bias. Interestingly, our analysis entails that the corporate debt of *surviving* firms exhibits a long-term average return that is essentially risk free. In actuality, because investors typically invest in bond portfolios that experience failure rates, a default premium should be added to our estimate.

Our second key result is that the equity premium is consistent with a short-term portfolio insurance motive. We show that the equity premium is closely approximated by a put option premium on a *real* $1 investment in the market index when a long-term investor wishes to insure against *year-to-year* market volatility, by using the average yearly S&P 500 volatility over 1926–2001. This result led us to a new view of corporate asset financing where investors, pursuing a short-term insurance motive, are indifferent between long-run equity returns and the comparatively lower rate on short-term Treasury bonds. Debt holders looking to insure their principal essentially forego long-run equity returns by "paying" an insurance premium equal to the equity premium.

Siegel (1999), Jagannathan, McGrattan, and Scherbina (2000), Fama and French (2002), and De Santis (2004) all claim that ex post returns are a distorted view of expected returns and that a lower equity premium is justified compared with the historical average. Our results suggest that using an 8.1% premium in valuation formulas and capital budgeting problems may be appropriate, since the observed level of the long-run equity premium is fully consistent with the observed steady-state GDP growth and consistent with risk explanations as well. However, if one believes that the recent 1990s trends in dividend yields, interest rates, taxes and inflation represent permanent regime shifts, our model can be parameterized to yield a 3.5% equity premium in line, for example, with Fama and French's (2002) estimate.

Future research will examine the determinants of the equity premium's countercyclical behavior in the short-to-medium term. In that respect, using European options on the S&P 500 seems to be a promising avenue to characterize the equity premium.

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PUBLIC UTILITY COMMISSION
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Value Line (VL) Review
of U.S. Gas Utilities

Exhibits in Furtherance
of Testimony in Support of Partial Stipulation

July 11, 2019

Some stocks in *Value Line's* Natural Gas Utility Industry have held up fairly well over the early months of 2019. We think those price movements stem partially from decent near-term earnings prospects, aided by such factors as new rates and a growing customer base. Investors have also been drawn to these shares' appealing, stable dividends, which have provided a measure of much-needed stability during these uncertain times.

How's The Weather?

Weather is a factor that affects the demand for natural gas, especially from small commercial businesses and consumers. Not surprisingly, earnings for utilities are vulnerable to seasonal temperature patterns, with consumption normally at its peak during the winter heating months. Unseasonably warm or cold weather can cause substantial volatility in quarterly operating results. But some companies strive to counteract this exposure through temperature-adjusted rate mechanisms, which are available in a number of states. Therefore, investors interested in utilities with more-stable profits from one year to the next are advised to look for companies that are able to hedge this risk.

Nonregulated Units

Some of the companies in our group have devoted substantial resources to the nonregulated arena, including pipelines and energy marketing & trading, and we believe that trend will persist in the future. Indeed, these businesses offer opportunities for utilities to diversify their revenue streams. What's more, the fact that nonregulated segments can provide potential upside to earnings per share is notable, since the return on equity is established by the regulatory state commissions (generally in the 10%-12% range) on the regulated divisions. The Tax Cuts and Jobs Act has had a positive impact there, too.

Attractive Payouts

The primary feature of utility equities is their dividend income, which tends to be well covered by corporate profits. (It's worth mentioning that the Financial Strength ratings for half of the 10 companies in our category are A, and the lowest is a respectable B+.) At the time of this industry report, the average yield for the group was 2.6%, compared to the *Value Line* median of 2.2%. Standouts include *South Jersey Industries*, *Northwest Natural Holding Company*, *Spire Inc.*, and *NiSource Inc.* When the financial markets experience volatility, solid dividend yields act like an anchor, so to speak.

Prospects Out To 2022-2024

We are optimistic, in general, about the sector's operating performance over the long term. Natural gas should remain an abundant resource in the United States, brought about partially by new technologies, so a shortage does not appear probable anytime soon. Too, there are limited alternatives for the services the companies in this category offer. What's more, it's a challenge for new entrants in the market, given such factors as the size of existing competitors and the substantial initial capital outlays that are required. Finally, the country's population (presently numbering more than 325 million) ought to remain on a steady, upward trajectory, which augurs well for future demand for utility services.

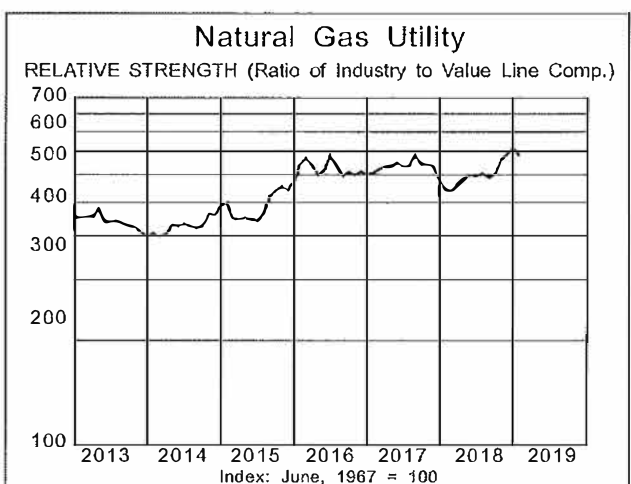
INDUSTRY TIMELINESS: 34 (of 97)

Nevertheless, there are some risks to consider. For one thing, companies are subject to state and local regulatory authorities. That being the case, there are no guarantees that petitions for rate increases will be accepted or that certain favorable provisions (which include temperature-adjusted rate mechanisms) will continue indefinitely. To further complicate matters, a slowdown in the economy may prompt customers to conserve gas and push up bad-debt expense. Finally, operational difficulties created by leaks and other accidents could result in significant financial losses. Notably, last September, *NiSource Inc.* was affected by an overpressurized gas line that caused some fires and explosions in the Greater Lawrence area outside Boston, Massachusetts, killing one person, injuring others, and destroying homes. During 2018, it recorded losses of $757 million for third-party claims plus $266 million for other incident-related expenses. Given uncertainty surrounding future liabilities, we believe that additional charges will be incurred, though management argues that there's sufficient capital available to cover any costs.

Conclusion

At the time of this writing, only *UGI Corp.* was ranked favorably for Timeliness. But that's not surprising, given that historical price movements of this typically defensive sector have tended to be steady. Still, these stocks ought to draw the attention of income-oriented investors with a conservative bent, since these good-yielding issues boast high marks for Price Stability and the majority are ranked 1 (Highest) or 2 (Above Average) for Safety. It's important to keep in mind that companies possessing more-established nonregulated operations might offer a higher potential for returns, but earnings could be more volatile than for firms with a greater focus on the more stable utility segment. As always, our subscribers are advised to carefully examine the following reports before committing funds.

Frederick L. Harris, III



ATMOS ENERGY CORP. NYSE-ATO

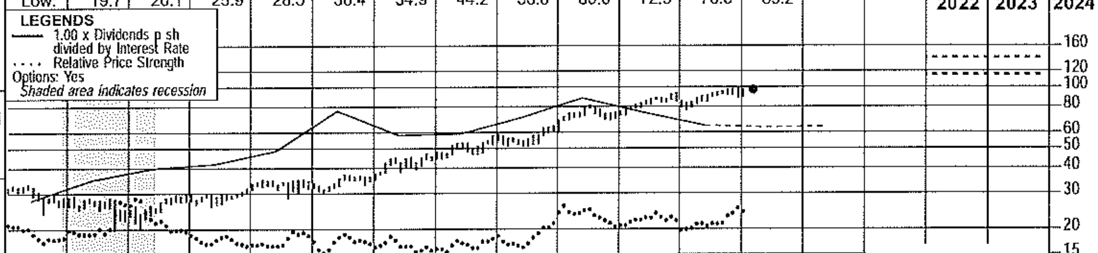
RECENT PRICE 97.30 | P/E RATIO 23.2 (Trailing: 24.3; Median: 16.0) | RELATIVE P/E RATIO 1.34 | DIV'D YLD 2.2% | VALUE LINE

TIMELINESS 3 Lowered 11/30/18
SAFETY 1 Raised 6/6/14
TECHNICAL 2 Lowered 2/1/19
BETA .60 (1.00 = Market)

High:	29.3	30.3	32.0	35.6	37.3	47.4	58.2	64.8	82.0	93.6	100.8	98.4
Low:	19.7	20.1	25.9	28.5	30.4	34.9	44.2	50.8	60.0	72.5	76.5	89.2

Target Price Range 2022 | 2023 | 2024

LEGENDS
— 1.00 x Dividends p sh divided by Interest Rate
.... Relative Price Strength
Options: Yes
Shaded area indicates recession



2022-24 PROJECTIONS

	Price	Gain	Ann'l Total Return
High	140	(+45%)	11%
Low	115	(+20%)	7%

Insider Decisions

	A	M	J	J	A	S	O	N	D
to Buy	0	0	0	0	0	0	0	0	0
Options	2	7	1	2	1	0	2	8	0
to Sell	0	0	0	0	1	0	0	0	0

Institutional Decisions

	1Q2018	2Q2018	3Q2018
to Buy	181	201	185
to Sell	192	162	175
Hld's(000)	81917	83010	82454

Percent shares traded: 24 / 16 / 8

% TOT. RETURN 1/19

	THIS STOCK	VL ARITH.* INDEX
1 yr.	20.4	-4.5
3 yr.	50.9	46.9
5 yr.	130.7	40.8

Atmos Energy's history dates back to 1906 in the Texas Panhandle. Over the years, through various mergers, it became part of Pioneer Corporation, and, in 1981, Pioneer named its gas distribution division Energas. In 1983, Pioneer organized Energas as a separate subsidiary and distributed the outstanding shares of Energas to Pioneer shareholders. Energas changed its name to Atmos in 1988. Atmos acquired Trans Louisiana Gas in 1986, Western Kentucky Gas Utility in 1987, Greeley Gas in 1993, United Cities Gas in 1997, and others.

2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	© VALUE LINE PUB. LLC	22-24
53.69	53.12	48.15	38.10	42.88	49.22	40.82	32.23	26.01	28.00	*26.65*	*26.70*	Revenues per sh A	*37.95*
4.29	4.64	4.72	4.76	5.14	5.42	5.81	6.19	6.62	7.24	*7.35*	*7.70*	"Cash Flow" per sh	*9.20*
1.97	2.16	2.26	2.10	2.50	2.96	3.09	3.38	3.60	4.00	*4.20*	*4.45*	Earnings per sh AB	*5.60*
1.32	1.34	1.36	1.38	1.40	1.48	1.56	1.68	1.80	1.94	*2.10*	*2.24*	Div'ds Decl'd per sh C■	*2.70*
5.51	6.02	6.90	8.12	9.32	8.32	9.61	10.46	10.72	13.19	*14.15*	*14.40*	Cap'l Spending per sh	*13.80*
23.52	24.16	24.98	26.14	28.47	30.74	31.48	33.32	36.74	42.87	*46.55*	*46.35*	Book Value per sh	*56.05*
92.55	90.16	90.30	90.24	90.64	100.39	101.48	103.93	106.10	111.27	*120.00*	*125.00*	Common Shs Outst'g D	*145.00*
12.5	13.2	14.4	15.9	15.9	16.1	17.5	20.8	22.0	21.7	*Bold figures are*		Avg Ann'l P/E Ratio	*23.0*
.83	.84	.90	1.01	.89	.85	.88	1.09	1.11	1.17	*Value Line*		Relative P/E Ratio	*1.30*
5.3%	4.7%	4.2%	4.1%	3.5%	3.1%	2.9%	2.4%	2.3%	2.2%	*estimates*		Avg Ann'l Div'd Yield	*2.1%*
4969.1	4789.7	4347.6	3438.5	3886.3	4940.9	4142.1	3349.9	2759.7	3115.5	*3200*	*3340*	Revenues ($mill) A	*5500*
179.7	201.2	199.3	192.2	230.7	289.8	315.1	350.1	382.7	444.3	*490*	*545*	Net Profit ($mill)	*815*
34.4%	38.5%	36.4%	33.8%	38.2%	39.2%	38.3%	36.4%	36.6%	27.0%	*22.5%*	*22.5%*	Income Tax Rate	*24.0%*
3.6%	4.2%	4.6%	5.6%	5.9%	5.9%	7.6%	10.5%	13.9%	14.3%	*15.3%*	*16.3%*	Net Profit Margin	*14.8%*
49.9%	45.4%	49.4%	45.3%	48.8%	44.3%	43.5%	38.7%	44.0%	34.3%	*36.5%*	*37.0%*	Long-Term Debt Ratio	*35.0%*
50.1%	54.6%	50.6%	54.7%	51.2%	55.7%	56.5%	61.3%	56.0%	65.7%	*63.5%*	*63.0%*	Common Equity Ratio	*65.0%*
4346.2	3987.9	4461.5	4315.5	5036.1	5542.2	5650.2	5651.8	6965.7	7263.6	*8800*	*9200*	Total Capital ($mill)	*12500*
4439.1	4793.1	5147.9	5475.6	6030.7	6725.9	7430.6	8280.5	9259.2	10371	*11300*	*12400*	Net Plant ($mill)	*15800*
5.9%	6.9%	6.1%	6.1%	5.9%	6.4%	6.6%	7.2%	6.4%	6.9%	*6.5%*	*7.0%*	Return on Total Cap'l	*7.5%*
8.3%	9.2%	8.8%	8.1%	8.9%	9.4%	9.9%	10.1%	9.8%	9.3%	*9.0%*	*9.5%*	Return on Shr. Equity	*10.0%*
8.3%	9.2%	8.8%	8.1%	8.9%	9.4%	9.9%	10.1%	9.8%	9.3%	*9.0%*	*9.5%*	Return on Com Equity	*10.0%*
2.7%	3.5%	3.3%	2.8%	4.0%	4.7%	4.9%	5.1%	4.9%	4.8%	*4.5%*	*4.5%*	Retained to Com Eq	*5.0%*
68%	62%	62%	65%	56%	50%	51%	50%	50%	48%	*51%*	*51%*	All Div'ds to Net Prof	*48%*

CAPITAL STRUCTURE as of 12/31/18
Total Debt $3659.8 mill. **Due in 5 Yrs** $1150.0 mill.
LT Debt $3084.8 mill. **LT Interest** $180.0 mill.
(LT interest earned: 6.7x; total interest coverage: 6.7x)
Leases, Uncapitalized Annual rentals $17.7 mill.
Pfd Stock None
Pension Assets-9/18 $531.7 mill. **Oblig.** $504.7 mill.
Common Stock 116,897,373 shs. as of 1/30/19
MARKET CAP: $11.4 billion (Large Cap)

CURRENT POSITION ($MILL.)	2017	2018	12/31/18
Cash Assets	26.4	13.8	218.2
Other	513.2	465.1	694.5
Current Assets	539.6	478.9	912.7
Accts Payable	233.0	217.3	301.7
Debt Due	447.7	1150.8	575.0
Other	332.7	547.0	578.8
Current Liab.	1013.4	1915.1	1455.5
Fix. Chg. Cov.	805%	926%	920%

ANNUAL RATES of change (per sh)	Past 10 Yrs.	Past 5 Yrs.	Est'd '16-'18 to '22-'24
Revenues	-9.0%	-8.0%	5.0%
"Cash Flow"	5.0%	6.5%	5.5%
Earnings	6.5%	10.0%	7.5%
Dividends	3.5%	5.5%	7.0%
Book Value	5.5%	7.0%	7.0%

Fiscal Year Ends	QUARTERLY REVENUES ($ mill.) A Dec.31	Mar.31	Jun.30	Sep.30	Full Fiscal Year
2016	906.2	1132.3	632.9	678.5	3349.9
2017	780.2	988.2	526.5	464.8	2759.7
2018	889.2	1219.4	562.2	444.7	3115.5
2019	877.8	*1260*	*605*	*457.2*	*3200*
2020	*930*	*1285*	*625*	*500*	*3340*

Fiscal Year Ends	EARNINGS PER SHARE A B E Dec.31	Mar.31	Jun.30	Sep.30	Full Fiscal Year
2016	1.00	1.38	.69	.33	3.38
2017	1.08	1.52	.67	.34	3.60
2018	1.40	1.57	.64	.41	4.00
2019	1.38	*1.64*	*.71*	*.47*	*4.20*
2020	*1.48*	*1.70*	*.77*	*.50*	*4.45*

Cal-endar	QUARTERLY DIVIDENDS PAID C■ Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2015	.39	.39	.39	.42	1.59
2016	.42	.42	.42	.45	1.71
2017	.45	.45	.45	.485	1.84
2018	.485	.485	.485	.525	1.98
2019	.525				

BUSINESS: Atmos Energy Corporation is engaged primarily in the distribution and sale of natural gas to over three million customers through six regulated natural gas utility oparations: Louisiana Division, West Texas Division, Mid-Tex Division, Mississippi Division, Colorado-Kansas Division, and Kentucky/Mid-States Division. Gas sales breakdown for fiscal 2018: 66%, residential; 28%, commercial; 5%, industrial; and 1% other. The company sold Atmos Energy Marketing, 1/17. Officers and directors own approximately 1.4% of common stock (12/18 Proxy). Presidant and Chief Executive Officer: Michael E. Haefner. Inc.: Texas. Address: Three Lincoln Centre, Suite 1800, 5430 LBJ Freeway, Dallas, Texas 75240. Telephone: 972-934-9227. Internet: www.atmosenergy.com.

Despite the slow start, Atmos Energy stands to post higher share net for fiscal 2019 as a whole. (The year ends on September 30th.) This should be brought about largely by the natural gas distribution unit, assuming that the weather helps, which ought to boost consumption levels. (The first two quarters tend to be the strongest for the company because they include the key heating season months of October through March.) Furthermore, results of the pipeline & storage division should benefit partly from increased rates from the Gas Reliability Infrastructure Program filings approved in December, 2017 and May, 2018. At this juncture, it seems that the bottom line will advance around 5%, to $4.20 a share, relative to the previous year's tally of $4.00. Turning to fiscal 2020, we believe that share net will rise at a similar percentage rate, to $4.45, as operating margins widen further.

The Financial Strength rating is healthy, at A+. When the first quarter concluded, cash and equivalents were approximately $218 million. Furthermore, long-term debt sat at a manageable 36% of total capital, and short-term obligations did not appear to present a major stumbling block. Too, $1.8 billion of common stock and/or debt securities remained available for issuance under a shelf registration statement. Finally, Atmos can access a $1.5 billion commercial paper program plus three revolving credit facilities aggregating $1.5 billion. All told, it seems capable of satisfying working capital, capital spending, and other cash requirements for quite a while. What's more, acquisitions are plausible, although they are not incorporated into our figures because of many factors.

The stock has some good characteristics. Among them is the 1 (Highest) Safety rank. Consider, too, the top score for Price Stability and lower-than-market Beta coefficient.

But the dividend yield is not exciting, stacked against those of other equities in *Value Line's* Natural Gas Utility universe. Still, we anticipate further steady hikes in the well-covered payout over the 3- to 5-year period. Right now, the Timeliness rank resides at 3 (Average).

Frederick L. Harris, III *March 1, 2019*

(A) Fiscal year ends Sept. 30th. (B) Diluted shrs. Excl. nonrec. items: '09, 12¢; '10, 5¢; '11, (1¢); '18, $1.43. Excludes discontinued operations: '11, 10¢; '12, 27¢; '13, 14¢; '17, 13¢. Next egs. rpt. due early May.
(C) Dividends historically paid in early March, June, Sept., and Dec. ■ Div. reinvestment plan. Direct stock purchase plan avail.
(D) In millions.
(E) Qtrs may not add due to change in shrs outstanding.

Company's Financial Strength	A+
Stock's Price Stability	100
Price Growth Persistence	80
Earnings Predictability	100

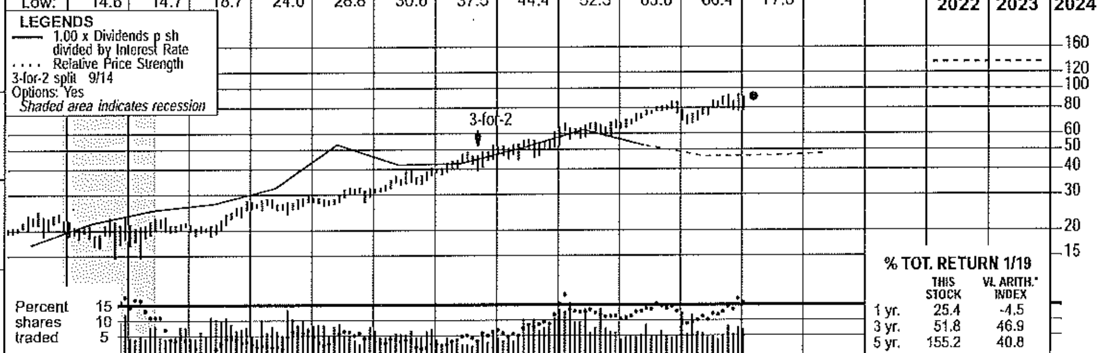
CHESAPEAKE UTIL. NYSE-CPK

RECENT PRICE 91.13 | P/E RATIO 27.4 (Trailing: 29.5; Median: 16.0) | RELATIVE P/E RATIO 1.58 | DIV'D YLD 1.7% | VALUE LINE

TIMELINESS 3 Lowered 11/23/18
SAFETY 2 New 6/5/15
TECHNICAL 2 Lowered 2/8/19
BETA .70 (1.00 = Market)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
High:	23.2	23.3	28.1	29.7	32.6	40.8	52.7	61.1	70.0	86.4	93.4	91.5
Low:	14.6	14.7	18.7	24.0	26.6	30.6	37.5	44.4	52.3	63.0	66.4	77.6

Target Price Range 2022 | 2023 | 2024



2022-24 PROJECTIONS

	Price	Gain	Ann'l Total Return
High	135	(+50%)	12%
Low	100	(+10%)	4%

Insider Decisions

	A	M	J	J	A	S	O	N	D
to Buy	0	0	0	0	0	0	0	0	1
Options	0	9	1	0	0	0	0	0	0
to Sell	1	0	1	1	0	0	0	1	0

Institutional Decisions

	1Q2018	2Q2018	3Q2018
to Buy	86	74	66
to Sell	66	94	87
Hld's(000)	10472	10445	10589

% TOT. RETURN 1/19

	THIS STOCK	VL ARITH.* INDEX
1 yr.	25.4	-4.5
3 yr.	51.8	46.9
5 yr.	155.2	40.8

2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	© VALUE LINE PUB. LLC	22-24
19.11	20.70	26.02	23.05	25.41	28.46	19.07	29.93	29.13	27.26	30.73	34.19	30.07	30.60	37.79	**41.45**	**44.55**	**47.80**	Revenues per sh	**63.75**
2.42	2.26	2.35	2.18	2.52	2.50	2.15	3.50	3.69	3.95	4.35	4.73	5.05	5.16	5.42	**6.15**	**6.55**	**6.95**	"Cash Flow" per sh	**9.00**
1.17	1.09	1.18	1.15	1.29	1.39	1.43	1.82	1.91	1.99	2.26	2.47	2.68	2.86	2.68	**3.10**	**3.35**	**3.60**	Earnings per sh A	**5.00**
.73	.75	.76	.77	.78	.81	.83	.87	.91	.96	1.01	1.07	1.12	1.19	1.26	1.39	**1.54**	**1.68**	Div'ds Decl'd per sh B■	**2.15**
1.39	2.07	3.74	4.87	3.08	3.00	1.89	3.18	3.28	5.00	6.72	6.66	9.47	10.42	10.73	**13.80**	**9.55**	**10.30**	Cap'l Spending per sh	**11.80**
8.59	9.07	9.60	11.08	11.76	12.02	14.89	15.84	16.78	17.82	19.28	20.59	23.45	27.36	29.75	**31.80**	**34.95**	**38.35**	Book Value per sh	**49.00**
8.49	8.60	8.82	10.03	10.17	10.24	14.09	14.29	14.35	14.40	14.46	14.59	15.27	16.30	16.34	**17.00**	**17.50**	**18.00**	Common Shs Outst'g C	**20.00**
12.7	15.0	16.8	17.9	16.7	14.2	14.2	12.2	14.2	14.8	15.6	17.7	19.1	21.8	27.8	**25.5**	*Bold figures are*	*Value Line*	Avg Ann'l P/E Ratio	**23.5**
.72	.79	.89	.97	.89	.85	.95	.76	.89	.94	.88	.93	.96	1.14	1.40	**1.38**	*estimates*		Relative P/E Ratio	**1.30**
4.9%	4.6%	3.8%	3.8%	3.6%	4.1%	4.1%	3.9%	3.4%	3.3%	2.9%	2.4%	2.2%	1.9%	1.7%	1.8%			Avg Ann'l Div'd Yield	**1.8%**

CAPITAL STRUCTURE as of 9/30/18
Total Debt $519.5 mill. Due in 5 Yrs $325.0 mill.
LT Debt $241.6 mill. LT Interest $11.0 mill.
(LT interest earned: 6.7x; total interest coverage: 6.7x) (32% of Cap'l)
Leases, Uncapitalized Annual rentals $2.7 mill.
Pfd Stock None
Pension Assets-12/17 $57.7 mill. Oblig. $76.1 mill.
Common Stock 16,378,545 shs. as of 10/31/18

MARKET CAP: $1.5 billion (Mid Cap)

2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		22-24
268.8	427.5	418.0	392.5	444.3	498.8	459.2	498.9	617.6	**705**	**780**	**860**	Revenues ($mill)	**1275**
15.9	26.1	27.6	28.9	32.8	36.1	40.2	44.7	43.8	**55.0**	**60.0**	**65.0**	Net Profit ($mill)	**100**
41.8%	39.7%	39.4%	40.1%	40.2%	39.9%	39.5%	38.8%	39.5%	**27.5%**	**27.5%**	**27.5%**	Income Tax Rate	**27.5%**
5.9%	6.1%	6.6%	7.4%	7.4%	7.2%	8.8%	9.0%	7.1%	**7.8%**	**7.7%**	**7.6%**	Net Profit Margin	**7.8%**
32.0%	28.4%	31.4%	28.4%	29.7%	34.5%	29.4%	23.5%	28.9%	**32.0%**	**32.0%**	**32.0%**	Long-Term Debt Ratio	**30.0%**
68.0%	71.6%	68.6%	71.6%	70.3%	65.5%	70.6%	76.5%	71.1%	**68.0%**	**68.0%**	**68.0%**	Common Equity Ratio	**70.0%**
308.6	315.9	351.1	358.5	396.4	458.8	507.5	583.0	683.7	**795**	**900**	**1015**	Total Capital ($mill)	**1400**
436.4	462.8	487.7	541.8	631.2	689.8	855.0	986.7	1126.0	**1300**	**1415**	**1575**	Net Plant ($mill)	**2000**
6.1%	9.1%	8.9%	8.8%	8.8%	8.5%	8.9%	8.6%	7.3%	**8.0%**	**7.5%**	**7.5%**	Return on Total Cap'l	**8.0%**
7.6%	11.5%	11.5%	11.2%	11.8%	12.0%	11.2%	10.0%	9.0%	**10.0%**	**10.0%**	**9.5%**	Return on Shr. Equity	**10.0%**
7.6%	11.5%	11.5%	11.2%	11.8%	12.0%	11.2%	10.0%	9.0%	**10.0%**	**10.0%**	**9.5%**	Return on Com Equity	**10.0%**
3.8%	6.6%	6.6%	6.4%	7.1%	7.4%	6.8%	6.1%	4.9%	**6.0%**	**5.5%**	**5.0%**	Retained to Com Eq	**6.0%**
50%	42%	42%	43%	40%	38%	40%	39%	45%	**43%**	**45%**	**47%**	All Div'ds to Net Prof	**43%**

CURRENT POSITION ($MILL.)	2016	2017	9/30/18
Cash Assets	4.2	5.6	6.2
Other	137.0	173.0	122.8
Current Assets	141.2	178.6	129.0
Accts Payable	56.9	74.7	60.2
Debt Due	222.0	260.4	277.9
Other	55.2	77.9	89.0
Current Liab.	334.1	413.0	427.1
Fix. Chg. Cov.	859%	749%	830%

ANNUAL RATES of change (per sh)	Past 10 Yrs.	Past 5 Yrs.	Est'd '15-'17 to '22-'24
Revenues	3.0%	2.5%	*10.0%*
"Cash Flow"	8.5%	7.0%	*8.0%*
Earnings	8.5%	7.5%	*9.0%*
Dividends	4.5%	5.5%	*9.0%*
Book Value	9.5%	10.0%	*9.0%*

Cal-endar	QUARTERLY REVENUES ($ mill.) Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2016	146.3	102.3	108.3	142.0	498.9
2017	185.2	125.1	126.9	180.4	617.6
2018	239.4	136.7	140.3	*188.6*	*705*
2019	*265*	*155*	*160*	*200*	*780*
2020	*285*	*175*	*180*	*220*	*860*

Cal-endar	EARNINGS PER SHARE A Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2016	1.33	.52	.29	.73	2.86
2017	1.17	.37	.42	.72	2.68
2018	1.64	.39	.34	*.73*	*3.10*
2019	*1.68*	*.47*	*.45*	*.75*	*3.35*
2020	*1.75*	*.53*	*.51*	*.81*	*3.60*

Cal-endar	QUARTERLY DIVIDENDS PAID B■ Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2015	.27	.27	.288	.288	1.12
2016	.288	.288	.305	.305	1.19
2017	.305	.305	.325	.325	1.26
2018	.325	.325	.37	.37	1.39
2019	.37				

BUSINESS: Chesapeake Utilities Corporation consists of two units: Regulated Enargy and Unregulated Enargy. The Regulated Energy segment (50% of 2017 revenues) distributes natural gas in Delaware, Maryland, and Florida; distributes electricity in Florida; and transmits natural gas on the Delmarva Peninsula and in Florida. The Unregulated Energy operation (50% of 2017 revenues) wholesales and distributes propane; markets natural gas; and provides other unregulated energy services, including midstream services in Ohio. Officers and directors own 4.2% of common stock; T. Rowe Price, 12.3%; BlackRock, 6.2% (4/18 Proxy). CEO: Jalfry M. Householder. Inc.: Delaware. Address: 909 Silver Lake Boulevard, Dover, DE 19904. Tel.: (302) 734-6799. Internet: www.chpk.com.

A new CEO was appointed at Chesapeake Utilities Corp. Michael McMasters retired, effective January 1st, following a generally successful eight-year tenure, marked by steady earnings growth and an increase in market capitalization from $395 million to $1.4 billion. His successor, Jeffry Householder, has held some high-level positions (including president of the Florida business unit) since joining the Delaware-headquartered company in 2010. So, given Mr. Householder's good credentials, plus the fact that it appears the transition process progressed rather smoothly, we believe the energy provider is in capable hands.

Elsewhere, there's been activity on the acquisition front. CPK bought certain propane operating assets of R.F. Ohl Fuel Oil Inc., serving more than 2,500 residential and commercial customers in Carbon, Northampton, Schuylkill, and other Pennsylvania counties. As a consequence, the company now has more than 6,000 customers throughout this state. Moreover, it purchased Marlin CNG Services, a premier supplier of mobile compressed natural gas utility and pipeline solutions, with a focus on the Gulf Coast region. The move extends Chesapeake's service offerings to a variety of new customers, and allows for flexibility in meeting the needs of local distribution and transmission companies. Terms of the aforementioned deals were not available to the public, but we don't believe they placed a considerable financial burden on Chesapeake. Acquisitions ought to continue to play an important role in management's business strategy, although numerous uncertainties prevent us from incorporating future ones into our figures.

Lately, the stock has been trading not very far from its all-time high. We believe that movement can be traced, to some degree, to investor optimism surrounding the company's earnings prospects in 2019. Other factors to bear in mind include the 2 (Above Average) Safety rank and below-market Beta coefficient.

But the dividend yield is not spectacular. That's compared to those of other equities in *Value Line's* Natural Gas Utility Industry. Meanwhile, the Timeliness rank resides at 3 (Average).

Frederick L. Harris, III *March 1, 2019*

(A) Diluted shrs. Excludes nonrecurring items: '08, d7¢; '15, 6¢; '17, 87¢. Excludes discontinued operations: '03, d9¢; '04, d1¢. Next earnings report due early May.
(B) Dividends historically paid in early January, April, July, and October. ■ Dividend reinvestment plan. Direct stock purchase plan available.
(C) In millions, adjusted for split.

Company's Financial Strength	B++
Stock's Price Stability	75
Price Growth Persistence	90
Earnings Predictability	90

NEW JERSEY RES. NYSE-NJR

RECENT PRICE **46.99** | P/E RATIO **23.5** (Trailing: 26.1; Median: 16.0) | RELATIVE P/E RATIO **1.36** | DIV'D YLD **2.5%** | VALUE LINE

TIMELINESS **3** Lowered 8/17/18

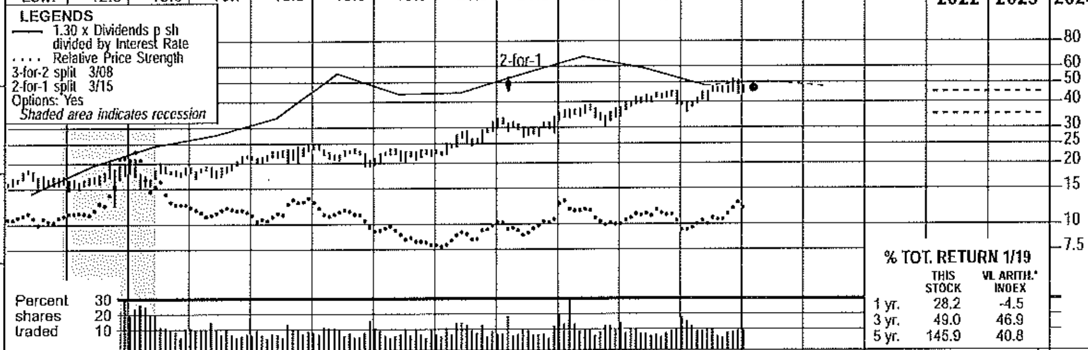
SAFETY **1** Raised 9/15/06

TECHNICAL **2** Lowered 3/1/19

BETA .70 (1.00 = Market)

High:	20.6	21.2	22.0	25.2	25.1	23.8	32.1	34.1	38.9	45.4	51.8	48.6
Low:	12.3	15.0	16.7	19.8	19.3	19.5	21.9	26.8	30.5	33.7	35.6	43.9

LEGENDS
— 1.30 x Dividends p sh divided by Interest Rate
.... Relative Price Strength
3-for-2 split 3/08
2-for-1 split 3/15
Options: Yes
Shaded area indicates recession



2022-24 PROJECTIONS

	Price	Gain	Ann'l Total Return
High	45	(-5%)	2%
Low	35	(-25%)	-4%

Insider Decisions

	A	M	J	J	A	S	O	N	D
to Buy	0	0	0	0	0	0	0	0	0
Options	1	1	1	1	1	0	3	5	7
to Sell	0	0	0	0	0	0	0	1	0

Institutional Decisions

	1Q2018	2Q2018	3Q2018
to Buy	126	141	121
to Sell	115	102	111
Hld's(000)	57945	58664	58525

% TOT. RETURN 1/19

	THIS STOCK	VL ARITH.* INDEX
1 yr.	28.2	-4.5
3 yr.	49.0	46.9
5 yr.	145.9	40.8

2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	© VALUE LINE PUB. LLC	22-24
31.14	30.44	38.10	39.81	36.31	45.37	31.17	32.05	36.30	27.08	38.38	44.40	32.09	21.90	26.28	33.24	*30.70*	*31.50*	Revenues per sh A	*34.15*
1.19	1.25	1.31	1.37	1.22	1.81	1.58	1.63	1.70	1.86	1.93	2.73	2.52	2.46	2.68	3.74	*3.05*	*3.15*	"Cash Flow" per sh	*3.60*
.79	.85	.88	.93	.78	1.35	1.20	1.23	1.29	1.36	1.37	2.08	1.78	1.61	1.73	2.74	*2.00*	*2.05*	Earnings per sh B	*2.40*
.41	.43	.45	.48	.51	.56	.62	.68	.72	.77	.81	.86	.93	.98	1.04	1.11	*1.17*	*1.21*	Div'ds Decl'd per sh C■	*1.33*
.57	.72	.64	.64	.73	.86	.90	1.05	1.13	1.26	1.33	1.52	3.76	4.15	3.80	4.39	*2.20*	*2.25*	Cap'l Spending per sh	*2.30*
5.13	5.62	5.30	7.50	7.75	8.64	8.29	8.81	9.36	9.80	10.65	11.48	12.99	13.58	14.33	16.18	*17.05*	*18.05*	Book Value per sh D	*21.40*
81.70	83.22	82.64	82.88	83.22	84.12	83.17	82.35	82.89	83.05	83.32	84.20	85.19	85.88	86.32	87.69	*88.00*	*88.25*	Common Shs Outst'g E	*89.00*
14.0	15.3	16.8	16.1	21.6	12.3	14.9	15.0	16.8	16.8	16.0	11.7	16.6	21.3	22.4	15.5	*Bold figures are*		Avg Ann'l P/E Ratio	*17.0*
.80	.81	.89	.87	1.15	.74	.99	.95	1.05	1.07	.90	.62	.84	1.12	1.13	.85	*Value Line*		Relative P/E Ratio	*.95*
3.7%	3.3%	3.1%	3.2%	3.0%	3.3%	3.5%	3.7%	3.3%	3.4%	3.7%	3.5%	3.1%	2.9%	2.7%	2.7%	*estimates*		Avg Ann'l Div'd Yield	*2.5%*

CAPITAL STRUCTURE as of 12/31/18
Total Debt $1681.3 mill. **Due in 5 Yrs** $370.4 mill.
LT Debt $1184.8 mill. **LT Interest** $46.3 mill.
Incl. $35.9 mill. capitalized leases.
(LT interest earned: 5.0x; total interest coverage: 5.0x)
Pension Assets-9/18 $357.4 mill. **Oblig.** $495.4 mill.

Pfd Stock None

Common Stock 88,772,393 shs.
as of 2/1/19
MARKET CAP: $4.2 billion (Mid Cap)

2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		22-24
2592.5	2639.3	3009.2	2248.9	3198.1	3738.1	2734.0	1880.9	2268.6	2915.1	*2700*	*2780*	Revenues ($mill) A	*3040*
101.0	101.8	106.5	112.4	113.7	176.9	153.7	138.1	149.4	240.5	*175*	*180*	Net Profit ($mill)	*215*
27.1%	41.4%	30.2%	7.1%	25.4%	30.2%	26.3%	15.5%	17.2%	NMF	*15.0%*	*15.0%*	Income Tax Rate	*15.0%*
3.9%	3.9%	3.5%	5.0%	3.6%	4.7%	5.6%	7.3%	6.6%	8.3%	*6.6%*	*6.6%*	Net Profit Margin	*7.0%*
39.8%	37.2%	35.5%	39.2%	36.6%	38.2%	43.2%	47.7%	44.6%	45.4%	*44.5%*	*43.5%*	Long-Term Debt Ratio	*40.5%*
60.2%	62.8%	64.5%	60.8%	63.4%	61.8%	56.8%	52.3%	55.4%	54.6%	*55.5%*	*56.5%*	Common Equity Ratio	*59.5%*
1144.8	1154.4	1203.1	1339.0	1400.3	1564.4	1950.6	2230.1	2233.7	2599.6	*2705*	*2820*	Total Capital ($mill)	*3200*
1064.4	1135.7	1295.9	1484.9	1643.1	1884.1	2128.3	2407.7	2609.7	2651.1	*2705*	*2760*	Net Plant ($mill)	*2925*
9.7%	9.7%	9.7%	9.2%	9.0%	12.1%	8.6%	6.9%	7.7%	10.2%	*7.5%*	*7.5%*	Return on Total Cap'l	*7.5%*
14.6%	14.0%	13.7%	13.8%	12.8%	18.3%	13.9%	11.8%	12.1%	17.1%	*11.5%*	*11.5%*	Return on Shr. Equity	*11.0%*
14.6%	14.0%	13.7%	13.8%	12.8%	18.3%	13.9%	11.8%	12.1%	17.1%	*11.5%*	*11.5%*	Return on Com Equity	*11.0%*
7.2%	6.7%	6.2%	6.2%	5.2%	11.0%	7.0%	4.8%	5.0%	10.3%	*5.0%*	*4.5%*	Retained to Com Eq	*5.0%*
50%	52%	55%	55%	59%	40%	50%	60%	59%	40%	*58%*	*59%*	All Div'ds to Net Prof	*56%*

CURRENT POSITION ($MILL.)	2017	2018	12/31/18
Cash Assets	2.2	1.5	7.7
Other	577.2	768.6	1042.2
Current Assets	579.4	770.1	1049.9
Accts Payable	280.6	373.5	372.2
Debt Due	431.4	275.5	496.5
Other	90.9	101.9	130.2
Current Liab.	802.9	750.9	998.9
Fix. Chg. Cov.	543%	545%	550%

ANNUAL RATES of change (per sh)	Past 10 Yrs.	Past 5 Yrs.	Est'd '16-'18 to '22-'24
Revenues	-3.5%	-3.5%	*4.0%*
"Cash Flow"	7.0%	8.0%	*3.5%*
Earnings	7.0%	5.5%	*2.5%*
Dividends	7.5%	6.5%	*4.0%*
Book Value	7.0%	8.0%	*6.5%*

Fiscal Year Ends	QUARTERLY REVENUES ($ mill.) A Dec.31	Mar.31	Jun.30	Sep.30	Full Fiscal Year
2016	444.3	574.2	393.2	469.2	1880.9
2017	541.1	733.5	457.5	536.5	2268.6
2018	705.3	1019.0	543.4	647.3	2915.1
2019	811.8	*785*	*520*	*583.2*	*2700*
2020	*830*	*805*	*540*	*605*	*2780*

Fiscal Year Ends	EARNINGS PER SHARE A B Dec.31	Mar.31	Jun.30	Sep.30	Full Fiscal Year
2016	.58	.91	.13	d.02	1.61
2017	.47	1.21	.20	d.14	1.73
2018	1.56	1.62	d.09	d.33	2.74
2019	.61	*1.19*	*.25*	*d.05*	*2.00*
2020	*.62*	*1.20*	*.26*	*d.03*	*2.05*

Cal-endar	QUARTERLY DIVIDENDS PAID C■ Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2015	.23	.23	.23	.24	.93
2016	.24	.24	.24	.255	.98
2017	.255	.255	.255	.273	1.04
2018	.273	.273	.273	.2925	1.11
2019	.2925				

BUSINESS: New Jersey Resources Corp. is a holding company providing retail/wholesale energy svcs. to customers in NJ, and in states from the Gulf Coast to New England, and Canada. New Jersey Natural Gas had 538,700 cust. at 9/30/18. Fiscal 2018 volume: 266 bill. cu. ft. (17% interruptible, 17% res., 9% commercial & elec. utility, 40% capacity release programs). N.J. Natural Energy subsidiary provides unregulated retail/wholesale natural gas and related energy svcs. 2018 dep. rate: 2.7%. Has 1,068 empls. Off./dir. own 1.3% of common; BlackRock, 13.2%; Vanguard, 9.7% (12/18 Proxy). Chairman, CEO & President: Laurence M. Downes. Incorporated: New Jersey. Address: 1415 Wyckoff Road, Wall, NJ 07719. Telephone: 732-938-1480. Web: www.njresources.com.

Shares of New Jersey Resources have declined modestly since our November review. To that end, the equity's price receded about 6.5% over that period. This likely reflects the company posting mixed December-period financial results.

The company is off to a difficult start this year. First-quarter revenues ticked higher by about 15%, to $811.8 million, thanks to a double-digit spike in nonutility volumes, partially offset by an almost 5% drop in utility revenues. This slowdown in the utility business was highlighted by a 9.4% drop in overall system throughput, to 210.8 bcf. Meanwhile, on the profitability front, operating expenses fell about 10 basis points, when viewed as a percentage of the top line. After accounting for a significant drop in the large tax benefit that buoyed the year-ago bottom line ($57.6 million or $0.66 per share), the company's first-quarter earnings fell more than 60%, to $0.61 a share. That said, this was relatively in line with our call of $0.65.

We look for year-over-year comparisons to remain challenged in fiscal 2019 (ends September 30th). Increased storage withdrawals and elevated volatility with regard to natural gas prices allowed NJR to realize a greater benefit from natural gas spreads last year. It is unlikely that simliar conditions will persist in 2019. As a result, we look for a modest 7.5% downturn in revenues, to $2.7 billion. At the same time, the absence of tax reform benefits will likely weigh on the NJNG, Midstream, Energy Services, and the Clean Energy ventures divisions' net financial earnings in the current year. Therefore, we look for NJR's bottom line to decline about 27%, to $2.00 a share. This falls nicely inside management's recently reiterated guidance range of $1.95-$2.05 a share.

A return to more-normalized growth patterns ought to present itself in 2020. We have introduced our top- and bottom-line estimates at $2.78 billion and $2.05 a share, respectively. These steady results should reflect 28,000-30,000 new customer meters at the New Jersey Natural Gas regulated utility segment through 2021.

All told, these neutrally ranked shares do not stand out at this juncture.

Bryan J. Fong *March 1, 2019*

(A) Fiscal year ends Sept. 30th.
(B) Diluted earnings. Qtly egs may not sum to total due to change in shares outstanding. Next earnings report due early May.
(C) Dividends historically paid in early Jan., April, July, and October. ■ Dividend reinvestment plan available.
(D) Includes regulatory assets in 2018: $368.6 million, $4.20/share.
(E) In millions, adjusted for splits.

Company's Financial Strength	A+
Stock's Price Stability	80
Price Growth Persistence	60
Earnings Predictability	50

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NISOURCE INC. NYSE-NI

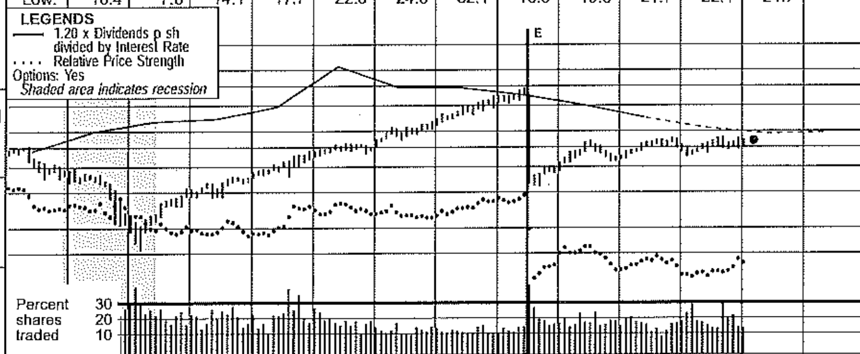
RECENT PRICE 26.94 | P/E RATIO 20.3 (Trailing: 32.9 / Median: 20.0) | RELATIVE P/E RATIO 1.17 | DIV'D YLD 3.0% | VALUE LINE

TIMELINESS 2 Raised 3/1/19
SAFETY 3 New 9/4/15
TECHNICAL 2 Raised 1/25/19
BETA .55 (1.00 = Market)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
High:	19.8	15.8	18.0	24.0	26.2	33.5	44.9	49.2	26.9	27.8	28.1	27.3
Low:	10.4	7.8	14.1	17.7	22.3	24.8	32.1	16.0	19.0	21.7	22.4	24.7

Target Price Range 2022 | 2023 | 2024

LEGENDS
— 1.20 x Dividends p sh divided by Interest Rate
.... Relative Price Strength
Options: Yes
Shaded area indicates recession



2022-24 PROJECTIONS

	Price	Gain	Ann'l Total Return
High	35	(+30%)	10%
Low	25	(-5%)	2%

Insider Decisions

	A	M	J	J	A	S	O	N	D
to Buy	0	2	0	0	0	0	0	0	0
Options	0	9	0	0	0	1	0	0	0
to Sell	0	1	0	0	2	0	0	1	0

Institutional Decisions

	1Q2018	2Q2018	3Q2018
to Buy	193	214	237
to Sell	223	185	184
Hld's(000)	301424	329159	336574

Percent shares traded 30 20 10

% TOT. RETURN 1/19

	THIS STOCK	VL ARITH.* INDEX
1 yr.	14.1	-4.5
3 yr.	41.8	46.9
5 yr.	-8.3	40.8

2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	© VALUE LINE PUB. LLC	22-24
23.78	24.63	28.97	27.37	28.96	32.36	24.02	22.99	21.33	16.31	18.04	20.47	14.58	13.90	14.46	13.74	*14.80*	*15.95*	Revenues per sh	*19.15*
3.47	3.47	3.14	3.18	3.20	3.32	2.96	3.19	2.98	3.13	3.41	3.60	2.27	2.71	2.07	2.85	*3.00*	*3.15*	"Cash Flow" per sh	*3.65*
1.59	1.62	1.08	1.14	1.14	1.34	.84	1.06	1.05	1.37	1.57	1.67	.63	1.00	.39	1.30	*1.35*	*1.40*	Earnings per sh A	*1.80*
1.10	.92	.92	.92	.92	.92	.92	.92	.92	.94	.98	1.02	.83	.64	.70	.78	*.80*	*.86*	Div'd Decl'd per sh B ■	*1.20*
2.19	1.91	2.17	2.33	2.88	3.54	2.81	2.88	3.99	4.83	5.99	6.42	4.26	4.57	5.03	*4.85*	*5.25*	*5.70*	Cap'l Spending per sh	*6.30*
16.81	17.69	18.09	18.32	18.52	17.24	17.54	17.63	17.71	17.90	18.77	19.54	12.04	12.60	12.82	15.44	*16.75*	*17.25*	Book Value per sh C	*19.65*
262.63	270.63	272.62	273.65	274.18	274.26	276.79	279.30	282.18	310.28	313.68	316.04	319.11	323.16	337.02	372.36	*371.00*	*370.00*	Common Shs Outst'g D	*350.00*
12.2	13.0	21.4	19.2	18.8	12.1	14.3	15.3	19.4	17.9	18.9	22.7	37.3	23.2	NMF	19.5	*Bold figures are*		Avg Ann'l P/E Ratio	*16.0*
.70	.69	1.14	1.04	1.00	.73	.95	.97	1.22	1.14	1.06	1.19	1.88	1.22	NMF	1.15	*Value Line*		Relative P/E Ratio	*.90*
5.7%	4.4%	4.0%	4.2%	4.3%	5.7%	7.6%	5.7%	4.5%	3.8%	3.3%	2.7%	3.5%	2.8%	2.8%	3.1%	*estimates*		Avg Ann'l Div'd Yield	*4.2%*

2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		22-24
6649.4	6422.0	6019.1	5061.2	5657.3	6470.6	4651.8	4492.5	4874.6	5114.5	*5500*	*5900*	Revenues ($mill)	*6700*
231.2	294.6	303.8	410.6	490.9	530.7	198.6	328.1	128.6	463.3	*490*	*515*	Net Profit ($mill)	*630*
41.8%	32.4%	35.0%	34.4%	34.8%	36.9%	41.6%	35.7%	71.0%	22.3%	*21.0%*	*21.0%*	Income Tax Rate	*21.0%*
--	--	--	--	--	--	--	--	2.9%	2.0%	*2.0%*	*2.0%*	AFUDC % to Net Profit	*2.0%*
55.1%	54.7%	55.6%	55.1%	56.3%	56.9%	60.7%	59.8%	63.5%	55.0%	*55.0%*	*55.0%*	Long-Term Debt Ratio	*55.0%*
44.9%	45.3%	44.4%	44.9%	43.7%	43.1%	39.3%	40.2%	36.5%	45.0%	*45.0%*	*45.0%*	Common Equity Ratio	*45.0%*
10819	10859	11264	12373	13480	14331	9792.0	10129	11832	12856	*13800*	*14215*	Total Capital ($mill)	*15210*
10592	11097	11800	12916	14365	16017	12112	13068	14360	15542	*15900*	*16500*	Net Plant ($mill)	*17000*
4.0%	4.5%	4.4%	5.0%	5.2%	5.3%	4.0%	5.0%	2.6%	5.0%	*5.0%*	*5.5%*	Return on Total Cap'l	*5.5%*
4.8%	6.0%	6.1%	7.4%	8.3%	8.6%	5.2%	8.1%	3.0%	8.0%	*8.0%*	*8.0%*	Return on Shr. Equity	*9.0%*
4.8%	6.0%	6.1%	7.4%	8.3%	8.6%	5.2%	8.1%	3.0%	8.0%	*8.0%*	*8.0%*	Return on Com Equity	*9.0%*
NMF	.8%	.9%	2.5%	3.1%	3.4%	NMF	3.0%	NMF	3.2%	*3.2%*	*3.0%*	Retained to Com Eq	*3.0%*
110%	87%	85%	67%	62%	61%	NMF	63%	NMF	63%	*61%*	*62%*	All Div'ds to Net Prof	*67%*

CAPITAL STRUCTURE as of 12/31/18
Total Debt $9132.6 mill. Due in 5 Yrs $2434.8 mill.
LT Debt $7105.4 mill. LT Interest $350 mill.
(Interest cov. earned: 2.2x) (55% of Cap'l)

Leases, Uncapitalized Annual rentals $49.1 mill.
Pension Assets-12/18 $2.1 bill. Oblig. $2.0 bill.

Pfd Stock $880 mill. Pfd Div'd $11.6 mill.

Common Stock 372,494,365 shs.
as of 2/12/19
MARKET CAP: $10.0 billion (Large Cap)

CURRENT POSITION ($MILL.)	2016	2017	12/31/18
Cash Assets	26.4	29.0	112.8
Other	1735.7	1734.3	1942.6
Current Assets	1762.1	1763.3	2055.4
Accts Payable	539.4	625.6	883.8
Debt Due	1851.1	1490.0	2027.2
Other	1061.7	1062.8	1125.8
Current Liab.	3452.2	3178.4	4036.8
Fix. Chg. Cov.	245%	259%	246%

ANNUAL RATES of change (per sh)	Past 10 Yrs.	Past 5 Yrs.	Est'd '15-'17 to '22-'24
Revenues	-6.5%	-6.5%	4.0%
"Cash Flow"	-3.0%	-5.5%	6.5%
Earnings	-5.0%	-10.5%	15.0%
Dividends	-2.5%	-5.0%	7.5%
Book Value	-4.0%	-7.0%	5.0%

Cal-endar	QUARTERLY REVENUES ($ mill.) Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2016	1436.6	897.6	861.3	1297.0	4492.5
2017	1598.6	990.7	917.0	1368.3	4874.6
2018	1750.8	1007.0	895.0	1461.7	5114.5
2019	*1850*	*1055*	*950*	*1645*	*5500*
2020	*1975*	*1125*	*1000*	*1800*	*5900*

Cal-endar	EARNINGS PER SHARE A Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2016	.58	.09	.07	.27	1.01
2017	.65	d.14	.04	d.16	.39
2018	.77	.07	.10	.38	1.30
2019	*.70*	*.15*	*.10*	*.40*	*1.35*
2020	*.75*	*.15*	*.10*	*.40*	*1.40*

Cal-endar	QUARTERLY DIVIDENDS PAID B ■ Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2015	.26	.26	.155	.155	.83
2016	.155	.155	.165	.165	.64
2017	.175	.175	.175	.175	.70
2018	.195	.195	.195	.195	.78
2019	.200				

BUSINESS: NiSource Inc. is a holding company for Northern Indiana Public Service Company (NIPSCO), which supplies electricity and gas to the northern third of Indiana. Customers: 461,000 electric in Indiana, 3.4 million gas in Indiana, Ohio, Pennsylvania, Kentucky, Virginia, Maryland, Massachusetts through its Columbia subsidiaries. Revenue breakdown, 2017: electrical, 36%; gas, 63%; other, less than 1%. Generating sources, 2017: coal, 65.2%; purchased & other, 34.8%. 2017 reported depreciation rates: 3.4% electric, 2.1% gas. Has 8,175 employees. Chairmen: Richard L. Thompson. President & Chief Executive Officer: Joseph Hamrock. Incorporated: Indiana. Address: 801 East 86th Ave., Merrillville, Indiana 46410. Tel.: 877-647-5990. Internet: www.nisource.com.

NiSource ended the fourth quarter on a decent note. The top line advanced in the neighborhood of 7%, to $1.46 billion. Meanwhile, its adjusted bottom line climbed 15% on an apples-to-apples basis, to $0.38 per share. These year-over-year gains were due to healthy revenue growth in its residential and commercial Gas Distribution operations. For the full year, the top line and nonGAAP share net came in at $5.11 billion and $1.30, respectively.

The company is looking into renewable energy sources. NIPSCO, a subsidiary of NiSource, announced its plans to transition to low-cost energy resources, with the addition of three new Indiana-based wind farms. The company intends to be coal free by 2028 and is working to replace its existing system with a mix of wind, solar, and battery storage technology. This switch to renewables is estimated to save $4 billion in costs over the long run and is in line with NI's ongoing efforts to lower emission levels while producing electricity.

NiSource's share earnings will likely rise to $1.35 in 2019. We say this because the company is spending generously on upgrading its infrastructure and technology. Usually, most of its capital expenditures start to reap benefits within 12 months of investment. Nevertheless, financing costs related to the Great Lawrence restoration and expenses associated with the implementation of safety management system ought to take a sizable bite out of 2019 profits. On the bright side, new rates filed during 2018 should boost the top line and translate into an uptick in near-term share profits.

We are introducing our estimates for 2020. Keeping in mind the aforementioned factors, we think NiSource is well poised for growth. We estimate its top and bottom lines will grow 7% and 4%, to $5.9 billion and $1.40 per share, respectively.

The company raised the quarterly dividend by 2.5%, to $0.20 a share. Meanwhile, shares of NiSource are ranked 2 (Above Average) for Timeliness. This issue is trading within our 2022-2024 Target Price Range, limiting its long-term upside potential. We remain wary of its above-average debt levels. The stock's dividend yield is modest, by utility standards.

Emma Jalees *March 1, 2019*

(A) Dil. EPS. Excl. nonrec. gains (losses): '05, (4¢); gains (losses) on disc. ops.: '05, 10¢; '06, (11¢); '07, 3¢; '08, ($1.14); '15, (30¢); '18, ($1.48). Next egs. report due late May. Qtl'y egs. may not sum to total due to rounding.
(B) Div'ds historically paid in mid-Feb., May, Aug., Nov. ■ Div'd reinv. avail.
(C) Incl. intang in '17: $1922.4 million, $5.70/sh.
(D) In mill.
(E) Spun off Columbia Pipeline Group (7/15)

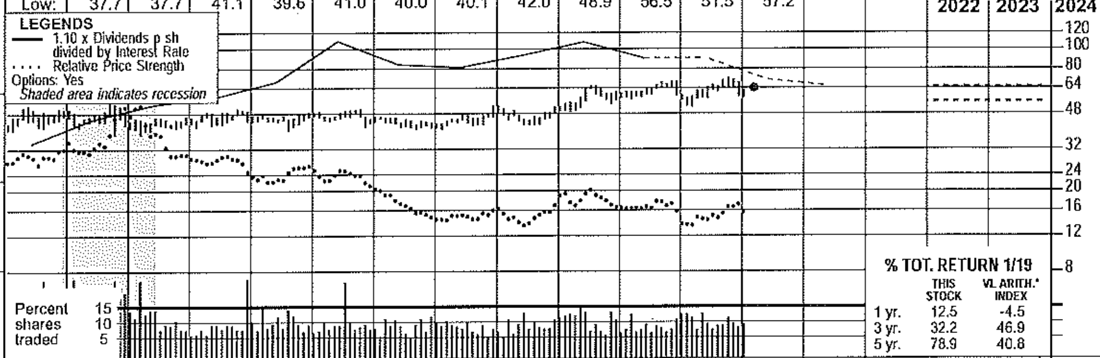
Company's Financial Strength	B+
Stock's Price Stability	95
Price Growth Persistence	NMF
Earnings Predictability	45

N.W. NATURAL NYSE-NWN

RECENT PRICE 64.18 | P/E RATIO 26.1 (Trailing: NMF; Median: 20.0) | RELATIVE P/E RATIO 1.51 | DIV'D YLD 3.0% | VALUE LINE

TIMELINESS 3 Raised 11/9/18
SAFETY 1 Raised 3/18/05
TECHNICAL 3 Lowered 3/1/19
BETA .65 (1.00 = Market)

High:	55.2	46.5	50.9	49.0	50.8	46.6	52.6	52.3	66.2	69.5	71.8	64.5
Low:	37.7	37.7	41.1	39.6	41.0	40.0	40.1	42.0	48.9	56.5	51.5	57.2



2022-24 PROJECTIONS

	Price	Gain	Ann'l Total Return
High	65	(Nil)	4%
Low	55	(-15%)	Nil

Insider Decisions

	A	M	J	J	A	S	O	N	D
to Buy	0	0	0	0	0	0	0	0	0
Options	0	4	0	0	4	0	0	0	1
to Sell	0	0	0	0	5	0	0	0	1

Institutional Decisions

	1Q2018	2Q2018	3Q2018
to Buy	94	89	78
to Sell	106	79	95
Hld's(000)	19492	19840	19034

% TOT. RETURN 1/19

	THIS STOCK	VL ARITH.* INDEX
1 yr.	12.5	-4.5
3 yr.	32.2	46.9
5 yr.	78.9	40.8

2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	© VALUE LINE PUB. LLC	22-24
23.57	25.69	33.01	37.20	39.13	39.16	38.17	30.56	31.72	27.14	28.02	27.64	26.39	23.61	26.52	25.40	27.65	28.50	Revenues per sh	28.45
3.85	3.92	4.34	4.76	5.41	5.31	5.20	5.18	5.00	4.94	5.04	5.05	4.91	4.93	1.04	4.75	5.25	5.45	"Cash Flow" per sh	6.35
1.76	1.86	2.11	2.35	2.76	2.57	2.83	2.73	2.39	2.22	2.24	2.16	1.96	2.12	d1.94	2.20	2.45	2.60	Earnings per sh A	3.50
1.27	1.30	1.32	1.39	1.44	1.52	1.60	1.68	1.75	1.79	1.83	1.85	1.86	1.87	1.88	1.89	1.93	1.07	Div'ds Decl'd per sh B■	2.20
4.90	5.52	3.48	3.56	4.48	3.92	5.09	9.35	3.76	4.91	5.13	4.40	4.37	4.87	7.43	6.80	6.65	6.65	Cap'l Spending per sh	6.25
19.52	20.64	21.28	22.01	22.52	23.71	24.88	26.08	26.70	27.23	27.77	28.12	28.47	29.71	25.85	26.30	27.30	28.20	Book Value per sh D	29.40
25.94	27.55	27.58	27.24	26.41	26.50	26.53	26.58	26.76	26.92	27.08	27.28	27.43	28.63	28.74	29.50	30.00	30.50	Common Shs Outst'g C	32.00
15.8	16.7	17.0	15.9	16.7	18.1	15.2	17.0	19.0	21.1	19.4	20.7	23.7	26.9	26.9	28.2	Bold figures are		Avg Ann'l P/E Ratio	17.0
.90	.88	.91	.86	.89	1.09	1.01	1.08	1.19	1.34	1.09	1.09	1.19	1.41	1.41	1.51	Value Line		Relative P/E Ratio	.95
4.6%	4.2%	3.7%	3.7%	3.1%	3.3%	3.7%	3.6%	3.9%	3.8%	4.2%	4.1%	4.0%	3.3%	3.0%	3.0%	estimates		Avg Ann'l Div'd Yield	3.7%

CAPITAL STRUCTURE as of 9/30/18
Total Debt $910.1 mill. **Due in 5 Yrs** $360.0 mill.
LT Debt $724.7 mill. **LT Interest** $40.0 mill.

(Total interest coverage: 3.2x)

Pension Assets-12/17 $287.9 mill. **Oblig.** $486.3 mill.

Pfd Stock None

Common Stock 28,844,682 shares as of 10/26/18

MARKET CAP $1.9 billion (Mid Cap)

2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		22-24
1012.7	812.1	848.8	730.6	758.5	754.0	723.8	676.0	762.2	750	830	870	Revenues ($mill)	910
75.1	72.7	63.9	59.9	60.5	58.7	53.7	58.9	d55.6	65.0	80.0	85.0	Net Profit ($mill)	90.0
38.3%	40.5%	40.4%	42.4%	40.8%	41.5%	40.0%	40.9%	40.9%	21.0%	21.0%	21.0%	Income Tax Rate	21.0%
7.4%	8.9%	7.5%	8.2%	8.0%	7.8%	7.4%	8.7%	NMF	8.6%	8.8%	9.1%	Net Profit Margin	12.3%
47.7%	46.1%	47.3%	48.5%	47.6%	44.8%	42.5%	44.4%	47.9%	47.5%	47.0%	47.0%	Long-Term Debt Ratio	46.5%
52.3%	53.9%	52.7%	51.5%	52.4%	55.2%	57.5%	55.6%	52.1%	52.5%	53.0%	53.0%	Common Equity Ratio	53.5%
1261.8	1284.8	1356.2	1424.7	1433.6	1389.0	1357.7	1529.8	1426.0	1485	1550	1615	Total Capital ($mill)	1750
1670.1	1854.2	1893.9	1973.6	2062.9	2121.6	2182.7	2260.9	2255.0	2345	2440	2640	Net Plant ($mill)	2745
7.3%	7.0%	6.2%	5.7%	5.8%	5.8%	5.5%	5.1%	NMF	5.5%	6.0%	6.0%	Return on Total Cap'l	7.5%
11.4%	10.5%	8.9%	8.2%	8.1%	7.6%	6.9%	6.9%	NMF	8.5%	9.0%	9.0%	Return on Shr. Equity	12.0%
11.4%	10.5%	8.9%	8.2%	8.1%	7.6%	6.9%	6.9%	NMF	8.5%	9.0%	9.0%	Return on Com Equity	12.0%
5.0%	4.0%	2.4%	1.6%	1.5%	1.1%	.6%	.9%	NMF	1.0%	2.0%	2.0%	Retained to Com Eq	4.5%
56%	61%	73%	80%	81%	85%	92%	87%	NMF	86%	79%	76%	All Div'ds to Net Prof	63%

CURRENT POSITION ($MILL.)	2016	2017	9/30/18
Cash Assets	3.5	3.5	30.0
Other	284.6	266.4	188.2
Current Assets	288.1	269.9	218.2
Accts Payable	85.7	112.3	80.1
Debt Due	93.3	150.9	185.4
Other	95.5	118.7	117.4
Current Liab.	274.5	381.9	382.9
Fix. Chg. Cov.	390%	362%	320%

ANNUAL RATES of change (per sh)	Past 10 Yrs.	Past 5 Yrs.	Est'd '15-'17 to '22-'24
Revenues	-3.5%	-3.0%	1.5%
"Cash Flow"	-3.0%	-6.5%	8.5%
Earnings	-11.5%	-22.0%	25.5%
Dividends	3.0%	1.5%	2.5%
Book Value	2.5%	1.0%	.5%

Cal-endar	QUARTERLY REVENUES ($ mill.) Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2016	255.6	99.2	87.7	233.5	676.0
2017	297.3	136.3	88.2	240.4	762.2
2018	264.7	124.6	91.2	269.5	750
2019	300	130	120	280	830
2020	310	140	130	290	870

Cal-endar	EARNINGS PER SHARE A Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2016	1.33	.07	d.29	1.01	2.12
2017	1.40	.10	d.30	d3.14	d1.94
2018	1.44	d.01	d.39	1.16	2.20
2019	1.50	.10	d.30	1.15	2.45
2020	1.55	.10	d.25	1.20	2.60

Cal-endar	QUARTERLY DIVIDENDS PAID B■ Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2015	.465	.465	.465	.4675	1.86
2016	.4675	.4675	.4675	.470	1.87
2017	.470	.470	.470	.4725	1.88
2018	.4725	.4725	.4725	.475	1.89
2019	.475				

BUSINESS: Northwest Natural Holding Co. distributes natural gas to 1000 communities, 735,000 customers, in Oregon (89% of customers) and in southwest Washington state. Principal cities served: Portland and Eugene, OR; Vancouver, WA. Service area population: 3.7 mill. (77% in OR). Company buys gas supply from Canadian and U.S. producers; has transportation rights on Northwest Pipeline system. Owns local underground storage. Rev. breakdown: residential, 38%; commercial, 22%; industrial, gas transportation, 40%. Employs 1,146. BlackRock Inc. owns 13.1% of shares; officers and directors, 1.2% (4/18 proxy). CEO: David H. Anderson. Inc.: Oregon. Address: 220 NW 2nd Ave., Portland, OR 97209. Tel.: 503-226-4211. Int.: www.nwnatural.com.

Northwest Natural Holding likely had decent fourth-quarter results. The top line benefited from the addition of several water utility operations, while seasonably cooler weather probably caused much higher natural gas throughput. However, maintenance expense was likely greater, and interest costs probably rose alongside the debt load. Still, a much-lower tax rate year over year was likely, especially considering the large one-time liability last year associated with U.S. tax reform. Overall, we think earnings rose to $1.16 per share in the quarter.

The construction of the North Mist Storage facility should be completed by the end of the quarter. Though this was originally expected to be in service by the end of the winter, management now thinks operations will start by March 31st. This project will provide no-notice natural gas delivery to Portland General Electric and will help to boost earnings.

The company has filed for a new rate case in the Washington coverage area. It asked for a 12.6% rate hike in its first filing in over a decade. An outcome will be decided by the Washington Utilities and Transport Commission, and is slated to occur by December of this year. Though the company will probably receive a rate hike, we think it will not receive the full 12.6% for which it is asking. All told, earnings will likely reach $2.45 per share in 2019, $2.60 in 2020, and $3.50 by the 2022-2024 period.

The dividend is a priority. The yield is not that exciting for a utility, although the distribution is well covered by earnings. However, the payout will probably grow at a much slower pace than others in the industry over the coming years. There is a chance the pace will accelerate thanks to the Mist capital project.

Shares of Northwest Natural Holding are neutrally ranked for Timeliness. NWN holds our highest Safety rank (1) and a good score for Price Stability, but the shares appear to be fully valued on a price-to-earnings basis. In addition, the equity is trading above the high end of our long-term Target Price Range. Though this equity may hold some appeal to income-seekers, we think waiting for a price dip is prudent.

John E. Seibert III *March 1, 2019*

(A) Diluted earnings per share. Excludes nonrecurring items: '06, ($0.06); '08, ($0.03); '09, 6¢; May not sum due to rounding. Next earnings report due in early May.

(B) Dividends historically paid in mid-February, May, August, and November.
■ Dividend reinvestment plan available.
(C) In millions.

(D) Includes intangibles. In 2017: $356.6 million, $12.40/share.

Company's Financial Strength	A
Stock's Price Stability	95
Price Growth Persistence	20
Earnings Predictability	10

ONE GAS, INC. NYSE-OGS

RECENT PRICE 84.14 | P/E RATIO 24.7 (Trailing: 25.1 Median: NMF) | RELATIVE P/E RATIO 1.43 | DIV'D YLD 2.4% | VALUE LINE

TIMELINESS 3 Lowered 8/31/18

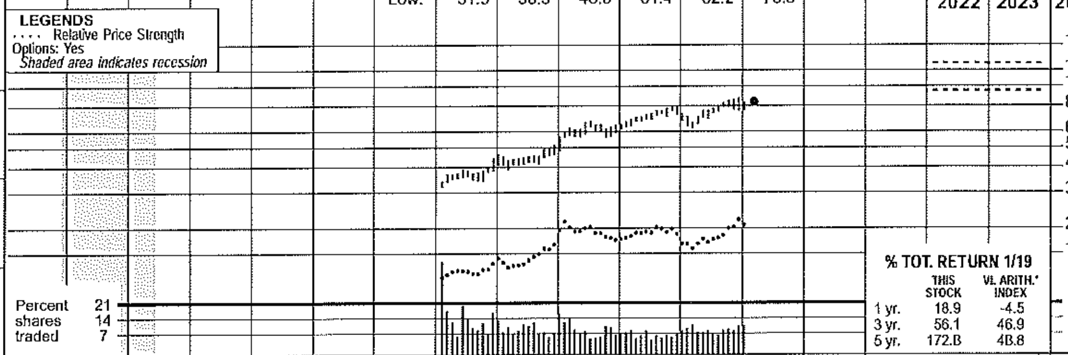
SAFETY 2 New 6/2/17

TECHNICAL 1 Raised 1/18/19

BETA .65 (1.00 = Market)

	2014	2015	2016	2017	2018	2019
High:	44.3	51.8	67.4	79.5	87.8	84.7
Low:	31.9	38.9	48.0	61.4	62.2	75.8

LEGENDS
.... Relative Price Strength
Options: Yes
Shaded area indicates recession



2022-24 PROJECTIONS

	Price	Gain	Ann'l Total Return
High	130	(+55%)	13%
Low	95	(+15%)	6%

Insider Decisions

	A	M	J	J	A	S	O	N	D
to Buy	0	1	0	0	0	1	0	0	0
Options	0	3	0	0	2	0	0	0	0
to Sell	0	0	0	0	0	0	0	0	0

Institutional Decisions

	1Q2018	2Q2018	3Q2018
to Buy	115	133	129
to Sell	160	123	134
Hld's(000)	38929	39130	39573

% TOT. RETURN 1/19

	THIS STOCK	VL ARITH.* INDEX
1 yr.	18.9	-4.5
3 yr.	56.1	46.9
5 yr.	172.B	4B.8

The shares of ONE Gas, Inc. began trading "regular-way" on the New York Stock Exchange on February 3, 2014. That happened as a result of the separation of ONEOK's natural gas distribution operation. Regarding the details of the spinoff, on January 31, 2014, ONEOK distributed one share of OGS common stock for every four shares of ONEOK common stock held by ONEOK shareholders of record as of the close of business on January 21. It should be mentioned that ONEOK did not retain any ownership interest in the new company.

2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	© VALUE LINE PUB. LLC	22-24
--	--	--	--	--	34.92	29.62	27.30	29.43	**31.10**	**32.35**	**33.75**	Revenues per sh	**40.00**
--	--	--	--	--	4.52	4.82	5.43	5.96	**6.35**	**6.90**	**7.30**	"Cash Flow" per sh	**9.00**
--	--	--	--	--	2.07	2.24	2.65	3.02	3.25	**3.45**	**3.70**	Earnings per sh A	**4.75**
--	--	--	--	--	.84	1.20	1.40	1.68	1.84	**2.00**	**2.16**	Div'ds Decl'd per sh B■	**2.65**
--	--	--	--	--	5.70	5.63	5.91	6.81	**7.50**	**8.50**	**8.70**	Cap'l Spending per sh	**8.90**
--	--	--	--	--	34.45	35.24	36.12	37.47	**38.85**	**41.05**	**42.75**	Book Value per sh	**47.90**
--	--	--	--	--	52.08	52.26	52.28	52.31	**52.50**	**53.00**	**53.50**	Common Shs Outst'g C	**55.00**
--	--	--	--	--	17.8	19.8	22.7	23.5	23.1	*Bold figures are*		Avg Ann'l P/E Ratio	**24.0**
--	--	--	--	--	.94	1.00	1.19	1.18	1.25	*Value Line*		Relative P/E Ratio	**1.35**
--	--	--	--	--	2.3%	2.7%	2.3%	2.4%	2.5%	*estimates*		Avg Ann'l Div'd Yield	**2.4%**
--	--	--	--	--	1818.9	1547.7	1427.2	1539.6	1633.7	**1715**	**1805**	Revenues ($mill)	**2200**
--	--	--	--	--	109.8	119.0	140.1	159.9	172.2	**185**	**200**	Net Profit ($mill)	**260**
--	--	--	--	--	38.4%	38.0%	37.8%	36.4%	23.7%	**23.5%**	**23.5%**	Income Tax Rate	**23.5%**
--	--	--	--	--	6.0%	7.7%	9.8%	10.4%	10.5%	**10.8%**	**11.1%**	Net Profit Margin	**11.8%**
--	--	--	--	--	40.1%	39.5%	38.7%	37.8%	**38.5%**	**38.0%**	**38.0%**	Long-Term Debt Ratio	**38.0%**
--	--	--	--	--	59.9%	60.5%	61.3%	62.2%	**61.5%**	**62.0%**	**62.0%**	Common Equity Ratio	**62.0%**
--	--	--	--	--	2995.3	3042.9	3080.7	3153.5	**3330**	**3510**	**3690**	Total Capital ($mill)	**4250**
--	--	--	--	--	3293.7	3511.9	3731.6	4007.6	**4285**	**4500**	**4700**	Net Plant ($mill)	**5400**
--	--	--	--	--	4.4%	4.7%	5.2%	5.8%	**6.5%**	**6.5%**	**6.5%**	Return on Total Cap'l	**7.5%**
--	--	--	--	--	6.1%	6.5%	7.4%	8.2%	**8.5%**	**8.5%**	**8.5%**	Return on Shr. Equity	**10.0%**
--	--	--	--	--	6.1%	6.5%	7.4%	8.2%	**8.5%**	**8.5%**	**8.5%**	Return on Com Equity	**10.0%**
--	--	--	--	--	3.7%	3.1%	3.5%	3.7%	**3.5%**	**3.5%**	**3.5%**	Retained to Com Eq	**4.5%**
--	--	--	--	--	40%	53%	52%	55%	**56%**	**57%**	**58%**	All Div'ds to Net Prof	**56%**

CAPITAL STRUCTURE as of 9/30/18
Total Debt $1469.9 mill. **Due in 5 Yrs** $655.0 mill.
LT Debt $893.9 mill. **LT Interest** $70.0 mill.
(LT interest earned: 6.5x; total interest coverage: 6.5x)
Leases, Uncapitalized Annual rentals $4.7 mill.
Pfd Stock None
Pension Assets-12/17 $884.8 mill.
Oblig. $993.9 mill.
Common Stock 52,526,346 shs.
as of 10/23/18
MARKET CAP: $4.4 billion (Mid Cap)

CURRENT POSITION ($MILL.)	2016	2017	9/30/18
Cash Assets	14.7	14.4	12.4
Other	554.2	574.6	362.1
Current Assets	568.9	589.0	374.5
Accts Payable	132.0	143.7	68.3
Debt Due	145.0	357.2	576.0
Other	166.9	172.4	191.7
Current Liab.	443.9	673.3	836.0
Fix. Chg. Cov.	685%	774%	700%

ANNUAL RATES of change (per sh)	Past 10 Yrs.	Past 5 Yrs.	Est'd '15-'17 to '22-'24
Revenues	--	--	5.0%
"Cash Flow"	--	--	7.5%
Earnings	--	--	9.0%
Dividends	--	--	9.5%
Book Value	--	--	4.0%

Calendar	QUARTERLY REVENUES ($ mill.) Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2016	508.4	245.9	232.2	440.7	1427.2
2017	550.4	279.7	247.1	462.4	1539.6
2018	638.5	292.5	238.3	464.4	1633.7
2019	*670*	*310*	*265*	*470*	*1715*
2020	*700*	*330*	*290*	*485*	*1805*

Calendar	EARNINGS PER SHARE A Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2016	1.22	.38	.25	.80	2.65
2017	1.34	.39	.36	.93	3.02
2018	1.72	.39	.31	.84	3.25
2019	*1.78*	*.43*	*.36*	*.88*	*3.45*
2020	*1.87*	*.48*	*.42*	*.93*	*3.70*

Calendar	QUARTERLY DIVIDENDS PAID B■ Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2015	.30	.30	.30	.30	1.20
2016	.35	.35	.35	.35	1.40
2017	.42	.42	.42	.42	1.68
2018	.46	.46	.46	.46	1.84
2019	.50				

BUSINESS: ONE Gas, Inc. provides natural gas distribution services to over two million customers. It has three divisions: Oklahoma Natural Gas, Kansas Gas Service, and Texas Gas Service. The company purchased 137 Bcf of natural gas supply in 2017, compared to 134 Bcf in 2016. Total volumes delivered by customer (fiscal 2017): transportation, 61%; residential, 29%; commercial & industrial, 9%; wholesale & public authority, 1%. BlackRock owns approximately 10.9% of common stock; The Vanguerd Group, 9.3%; T. Rowe Prica Associates, 8.7%; officers and directors, less than 1% (4/18 Proxy). CEO: Pierce H. Norton II. Incorporated: Oklahoma. Address: 15 East Fifth Street, Tulsa, Oklahoma 74103. Telephone: 918-947-7000. Internet: www.onegas.com.

Higher earnings appear plausible for ONE Gas in 2019. This should stem partially from the benefit of new rates. Another positive is a relatively low income tax rate. Weather-normalization mechanisms ought to help, as well. Depreciation & amortization expense stands to climb some, although that ought to reflect necessary capital investments. Right now, we believe that the bottom line will increase around 6%, to $3.45 a share, compared to the 2018 figure of $3.25. Assuming additional expansion of operating margins, 2020 share net may advance 7% or so, to $3.70.

This year's capital spending budget is anticipated to be around $450 million. That would be roughly 14% above the 2018 level of approximately $394.5 million. Around 70% of the expenditures are slated for system integrity and pipeline replacement projects. The company's balance sheet seems quite adequate to make those initiatives possible. Notably, management looks for that figure to lie between $450 million and $500 million annually during the 2019-2023 period, with about the same percentage of funds allocated to where they are currently.

The quarterly common stock dividend was just raised 8.7%, to $0.50 a share. That was made possible, no doubt, by ONE Gas' solid financial position. Furthermore, our 3- to 5-year projections indicate that additional steady increases in the distribution will take place. The payout ratio during that span ought to be in the neighborhood of 55%, which is reasonable. Nevertheless, the dividend yield is not spectacular, when stacked against those of other companies in our Natural Gas Utility category.

These shares have enjoyed a good runup in price since they started trading on the NYSE in 2014. That's in tandem with the healthy profit growth ONE Gas has experienced over that time frame. Note, also, the 2 (Above Average) Safety rank and relatively high score for Price Stability.

For now, though, long-term capital appreciation potential is subpar, versus the *Value Line* median. The stock is only an Average (3) selection for Timeliness, too.

Frederick L. Harris, III *March 1, 2019*

(A) Diluted EPS. Excludes nonrecurring gain: 2017, $0.06. Next earnings report due early May. Quarterly EPS for 2018 don't add up due to rounding.

(B) Dividends historically paid in early March, June, Sept., and Dec. ■ Dividend reinvestment plan. Direct stock purchase plan.
(C) In millions.

Company's Financial Strength	A
Stock's Price Stability	90
Price Growth Persistence	100
Earnings Predictability	NMF

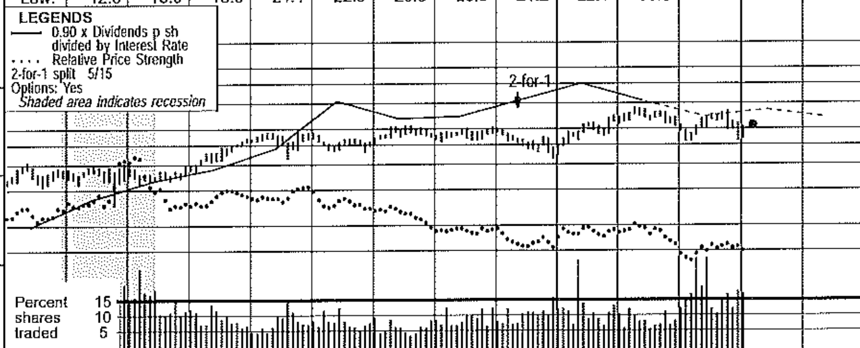
SOUTH JERSEY INDS. NYSE-SJI

RECENT PRICE 31.29 | P/E RATIO 20.9 (Trailing: 18.2; Median: 18.0) | RELATIVE P/E RATIO 1.21 | DIV'D YLD 3.8% | VALUE LINE

TIMELINESS 3 Lowered 7/20/18
SAFETY 2 Lowered 1/4/91
TECHNICAL 3 Raised 2/15/19
BETA .85 (1.00 = Market)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
High:	20.3	20.4	27.1	29.0	29.0	31.1	30.6	30.4	34.8	38.4	36.7	31.4
Low:	12.6	16.0	18.6	21.4	22.9	25.3	25.9	21.2	22.1	30.8	26.0	26.6

LEGENDS
—— 0.90 x Dividends p sh divided by Interest Rate
.... Relative Price Strength
2-for-1 split 5/15
Options: Yes
Shaded area indicates recession



Target Price Range 2022 | 2023 | 2024

2022-24 PROJECTIONS

	Price	Gain	Ann'l Total Return
High	45	(+45%)	13%
Low	35	(+10%)	7%

Insider Decisions

	A	M	J	J	A	S	O	N	D
to Buy	0	1	0	0	1	0	0	1	2
Options	0	0	4	0	0	0	0	0	0
to Sell	0	0	0	0	0	0	0	0	0

Institutional Decisions

	1Q2018	2Q2018	3Q2018
to Buy	113	147	99
to Sell	95	79	124
Hld's(000)	59747	72803	71247

Percent shares traded 15 10 5

% TOT. RETURN 1/19

	THIS STOCK	VL ARITH.* INDEX
1 yr.	4.9	-4.5
3 yr.	32.9	46.9
5 yr.	33.6	40.8

2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	© VALUE LINE PUB. LLC	22-24
13.17	14.75	15.89	15.88	16.15	16.18	14.19	15.48	13.71	11.16	11.18	12.98	13.52	13.04	15.63	*16.65*	*17.50*	*18.50*	Revenues per sh	*21.45*
1.12	1.22	1.25	1.75	1.60	1.74	1.86	2.10	2.23	2.34	2.48	2.67	2.42	2.67	2.79	*2.60*	*2.70*	*3.00*	"Cash Flow" per sh	*3.85*
.68	.79	.86	1.23	1.05	1.14	1.19	1.35	1.45	1.52	1.52	1.57	1.44	1.34	1.23	*1.62*	*1.70*	*1.90*	Earnings per sh A	*2.50*
.39	.41	.43	.46	.51	.56	.61	.68	.75	.83	.90	.96	1.02	1.06	1.10	1.13	*1.20*	*1.25*	Div'ds Decl'd per sh B ■	*1.40*
1.18	1.34	1.60	1.26	.94	1.04	1.83	2.79	3.20	4.01	4.84	5.01	4.87	3.50	3.43	*2.85*	*3.10*	*3.35*	Cap'l Spending per sh	*4.90*
5.63	6.20	6.75	7.55	8.12	8.67	9.12	9.54	10.33	11.63	12.64	13.65	14.62	16.22	14.99	*15.15*	*16.40*	*17.40*	Book Value per sh C	*20.40*
52.92	55.52	57.96	58.65	59.22	59.46	59.59	59.75	60.43	63.31	65.43	68.33	70.97	79.48	79.55	*87.00*	*90.00*	*92.00*	Common Shs Outst'g D	*98.00*
13.3	14.1	16.6	11.9	17.2	15.9	15.0	16.8	18.4	16.9	18.9	18.0	17.9	21.7	27.9	*19.3*	*Bold figures are*		Avg Ann'l P/E Ratio	*16.0*
.76	.74	.88	.64	.91	.96	1.00	1.07	1.15	1.08	1.06	.95	.90	1.14	1.40	*1.04*	*Value Line*		Relative P/E Ratio	*.90*
4.3%	3.7%	3.0%	3.2%	2.8%	3.1%	3.4%	3.0%	2.8%	3.2%	3.1%	3.4%	3.9%	3.6%	3.2%	3.6%	*estimates*		Avg Ann'l Div'd Yield	*3.5%*

CAPITAL STRUCTURE as of 9/30/18
Total Debt $3185.1 mill. Due in 5 Yrs $685 mill.
LT Debt $1281.0 mill. LT Interest $40.0 mill.

Leases, Uncapitalized Annual rentals $.7 mill.
Pension Assets-12/17 $216.1 mill. Oblig. $316.3 mill.

Pfd Stock None

Common Stock 85,506,217 shs. as of 11/1/18

MARKET CAP: $2.7 billion (Mid Cap)

2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		22-24
845.4	925.1	828.6	706.3	731.4	887.0	959.6	1036.5	1243.1	*1450*	*1575*	*1700*	Revenues ($mill)	*2100*
71.3	81.0	87.0	93.3	97.1	104.0	99.0	102.8	98.1	*140*	*150*	*170*	Net Profit ($mill)	*240*
23.0%	15.2%	22.4%	10.8%	--	--	5.9%	42.0%	42.0%	*21.0%*	*21.0%*	*21.0%*	Income Tax Rate	*21.0%*
8.4%	8.8%	10.5%	13.2%	13.3%	11.7%	10.3%	9.9%	7.9%	*9.7%*	*9.5%*	*10.0%*	Net Profit Margin	*11.4%*
36.5%	37.4%	40.5%	45.0%	45.1%	48.0%	49.2%	38.5%	48.5%	*50.0%*	*49.0%*	*49.0%*	Long-Term Debt Ratio	*49.5%*
63.5%	62.6%	59.5%	55.0%	54.9%	52.0%	50.8%	61.5%	51.5%	*50.0%*	*51.0%*	*51.0%*	Common Equity Ratio	*50.5%*
856.4	910.1	1048.3	1337.6	1507.4	1791.9	2043.9	2097.2	2315.4	*2645*	*2900*	*3150*	Total Capital ($mill)	*3950*
1073.1	1193.3	1352.4	1578.0	1859.1	2134.1	2448.1	2623.8	2700.2	*3650*	*4000*	*4300*	Net Plant ($mill)	*5000*
9.0%	9.5%	8.9%	7.4%	6.8%	6.4%	5.4%	5.4%	5.1%	*6.0%*	*6.0%*	*6.0%*	Return on Total Cap'l	*7.0%*
13.1%	14.2%	13.9%	12.7%	11.7%	11.2%	9.5%	8.0%	8.2%	*10.5%*	*10.0%*	*10.5%*	Return on Shr. Equity	*12.0%*
13.1%	14.2%	13.9%	12.7%	11.7%	11.2%	9.5%	8.0%	8.2%	*10.5%*	*10.0%*	*10.5%*	Return on Com Equity	*12.0%*
6.4%	7.1%	6.7%	5.8%	4.8%	4.3%	2.8%	1.6%	.9%	*3.0%*	*3.0%*	*3.5%*	Retained to Com Eq	*5.0%*
51%	50%	52%	55%	59%	61%	71%	80%	89%	*71%*	*72%*	*68%*	All Div'ds to Net Prof	*57%*

CURRENT POSITION ($MILL.)	2016	2017	9/30/18
Cash Assets	18.3	7.8	3.3
Other	455.0	431.2	734.0
Current Assets	473.3	439.0	737.3
Accts Payable	243.7	284.9	383.5
Debt Due	528.0	410.2	1904.1
Other	180.9	188.0	183.6
Current Liab.	952.6	883.1	2471.2
Fix. Chg. Cov.	602%	177%	162%

ANNUAL RATES of change (per sh)	Past 10 Yrs.	Past 5 Yrs.	Est'd '15-'17 to '22-'24
Revenues	-1.5%	1.0%	*6.0%*
"Cash Flow"	5.5%	3.5%	*5.5%*
Earnings	2.5%	-1.5%	*9.5%*
Dividends	8.5%	7.0%	*4.0%*
Book Value	7.5%	8.0%	*4.0%*

Cal-endar	QUARTERLY REVENUES ($ mill.) Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2016	333.0	154.4	219.1	330.0	1036.5
2017	425.8	244.4	227.1	345.8	1243.1
2018	521.9	227.3	302.5	*398.3*	*1450*
2019	*560*	*280*	*310*	*425*	*1575*
2020	*595*	*305*	*340*	*460*	*1700*

Cal-endar	EARNINGS PER SHARE A Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2016	.75	.12	.05	.42	1.34
2017	.72	.06	d.05	.50	1.23
2018	1.26	.07	d.11	*.40*	*1.62*
2019	*1.05*	*.10*	*d.05*	*.60*	*1.70*
2020	*1.15*	*.12*	*d.04*	*.67*	*1.90*

Cal-endar	QUARTERLY DIVIDENDS PAID B ■ Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2015	--	.251	.251	.515	1.02
2016	--	.264	.264	.536	1.06
2017	--	.273	.273	.553	1.10
2018	--	.280	.280	.567	1.13
2019					

BUSINESS: South Jersey Industries, Inc. is a holding company. Distributes natural gas to approx. 681,000 customers in New Jersey and Maryland. Gas revenue mix '17: residential, 44%; commercial, 21%; cogeneration and electric generation, 14%; industrial, 21%. Nonutility operations include: South Jersey Energy, South Jersey Resources Group, South Jersey Exploration, Marina Energy, South Jersey Energy Service Plus, and SJI Midstream. Has about 760 employees. Off./dir. own less than 1% of common; BlackRock, Inc., 12.8%; The Vanguard Group, Inc., 9.8% (3/18 proxy). Pres. & CEO: Michael J. Renna. Chairman: Walter M. Higgins III. Incorporated: NJ. Address: 1 South Jersey Plaza, Folsom, NJ 08037. Telephone: 609-561-9000. Internet: www.sjindustries.com.

Shares of South Jersey Industries have rebounded nicely in price since late December, in conjunction with a recovery in the broader equity market. The company reported a strong top-line advance for the third quarter, and healthy sales gains likely continued in the December period. However, operating expenses have also risen significantly of late, and we expect a decline in earnings for the term. Still, share net for full-year 2018 likely compared quite favorably with the prior-year level, thanks to a strong comparison in the March period. South Jersey was set to report results for the fourth quarter as this Issue went to press.

The company has completed the sale of gas assets to UGI Energy Services. South Jersey has now divested all of its retail gas assets. This move reflects the company's strategy to exit noncore and nonregulated markets and emphasize high-quality, regulated earnings growth. The company is reshaping its nonutility operations to emphasize wholesale marketing and fuel management.

Prospects appear to be relatively favorable for the years ahead. Utility South Jersey Gas will likely continue to fare well. This business ought to further benefit from customer additions and investment in regulated assets. The acquisitions of Elizabethtown Gas and Elkton Gas should also support growth here. Elizabethtown Gas has filed a proposal with the New Jersey Board of Public Utilities seeking authorization for a $518 million, five-year infrastructure replacement program to enhance the safety and reliability of its system. On the nonutility side, we expect good results from the company's wholesale marketing and fuel management activities.

This issue is ranked to track the broader market averages for the coming six to 12 months. Looking further out, this good-quality stock offers decent, but not outstanding, risk-adjusted total return potential. This is helped by the equity's healthy dividend yield, and we envision solid growth in revenues and earnings here out to early next decade. South Jersey Industries earns good marks for Safety, Financial Strength, and Price Stability. Volatility is subdued, as well.

Michael Napoli, CFA *March 1, 2019*

(A) Based on economic egs. from 2007. GAAP EPS: '08, $1.29; '09, $0.97; '10, $1.11; '11, $1.49; '12, $1.49; '13, $1.28; '14, $1.46; '15, $1.52; '16, $1.56; '17, ($0.04). Excl. nonrecur. gain (loss): '08, $0.16; '09, ($0.22); '10, ($0.24); '11, $0.04; '12, ($0.03); '13, ($0.24); '14, ($0.11); '15, $0.08; '16, $0.22; '17, ($1.27). Next egs. rpt. early May. (B) Div'ds paid early April, July, Oct., and late Dec. ■ Div. reinvest. plan avail. (C) Incl. reg. assets. In 2017: $469.2 mill., $5.90 per shr. (D) In mill., adj. for split.

Company's Financial Strength	A
Stock's Price Stability	80
Price Growth Persistence	20
Earnings Predictability	65

SOUTHWEST GAS NYSE-SWX

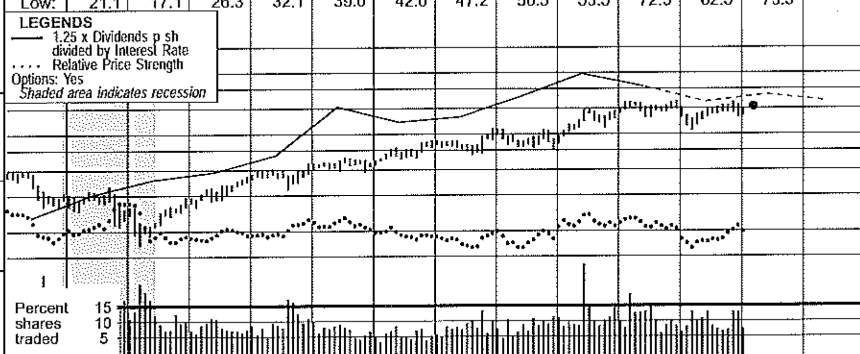
RECENT PRICE 82.16 | P/E RATIO 19.9 (Trailing: 21.1 Median: 17.0) | RELATIVE P/E RATIO 1.15 | DIV'D YLD 2.7% | VALUE LINE

TIMELINESS 3 Lowered 3/1/19
SAFETY 3 Lowered 1/4/91
TECHNICAL 1 Raised 1/25/19
BETA .70 (1.00 = Market)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
High:	33.3	29.5	37.3	43.2	46.1	56.0	64.2	63.7	79.6	86.9	86.0	82.9
Low:	21.1	17.1	26.3	32.1	39.0	42.0	47.2	50.5	53.5	72.3	62.5	73.3

Target Price Range 2022 | 2023 | 2024

LEGENDS
—— 1.25 x Dividends p sh divided by Interest Rate
.... Relative Price Strength
Options: Yes
Shaded area indicates recession



2022-24 PROJECTIONS

	Price	Gain	Ann'l Total Return
High	110	(+35%)	10%
Low	75	(-10%)	1%

Insider Decisions

	A	M	J	J	A	S	O	N	D
to Buy	0	1	0	0	0	0	0	0	0
Options	0	0	0	0	0	0	0	0	17
to Sell	0	2	1	0	1	2	0	0	0

Institutional Decisions

	1Q2018	2Q2018	3Q2018
to Buy	127	135	122
to Sell	116	119	126
Hld's(000)	39279	40920	40794

Percent shares traded 15 10 5

% TOT. RETURN 1/19

	THIS STOCK	VL ARITH.* INDEX
1 yr.	9.4	-4.5
3 yr.	43.7	46.9
5 yr.	66.3	40.8

2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	© VALUE LINE PUB. LLC	22-24
35.96	40.14	43.59	48.47	50.28	48.53	42.00	40.18	41.07	41.77	42.08	45.61	52.00	51.82	53.00	54.85	56.50	58.65	Revenues per sh	65.50
5.11	5.57	5.20	5.97	6.21	5.76	6.16	6.46	6.81	7.73	8.24	8.47	8.62	9.29	8.83	8.50	9.05	9.80	"Cash Flow" per sh	12.75
1.13	1.66	1.25	1.98	1.95	1.39	1.94	2.27	2.43	2.86	3.11	3.01	2.92	3.18	3.62	3.95	4.20	4.50	Earnings per sh A	5.75
.82	.82	.82	.82	.86	.90	.95	1.00	1.06	1.18	1.32	1.46	1.62	1.80	1.98	2.08	2.18	2.30	Div'ds Decl'd per sh B■†	2.60
7.03	8.23	7.49	8.27	7.96	6.79	4.81	4.73	8.29	8.57	7.86	8.53	10.30	11.15	12.97	13.80	14.35	15.00	Cap'l Spending per sh	17.25
18.42	19.18	19.10	21.58	22.98	23.49	24.44	25.62	26.66	28.35	30.47	31.95	33.61	35.03	37.74	42.40	44.90	47.75	Book Value per sh	53.90
34.23	36.79	39.33	41.77	42.81	44.19	45.09	45.56	45.96	46.15	46.36	46.52	47.38	47.48	48.09	52.50	54.00	55.00	Common Shs Outst'g C	58.00
19.2	14.3	20.6	15.9	17.3	20.3	12.2	14.0	15.7	15.0	15.8	17.9	19.4	21.6	22.2	19.2	Bold figures are		Avg Ann'l P/E Ratio	16.0
1.09	.76	1.10	.86	.92	1.22	.81	.89	.98	.95	.89	.94	.98	1.13	1.12	1.04	Value Line		Relative P/E Ratio	.90
3.8%	3.5%	3.2%	2.6%	2.6%	3.2%	4.0%	3.2%	2.8%	2.8%	2.7%	2.7%	2.9%	2.6%	2.5%	2.7%	estimates		Avg Ann'l Div'd Yield	2.8%

2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		22-24
1893.8	1830.4	1887.2	1927.8	1950.8	2121.7	2463.6	2460.5	2548.8	2880	3050	3225	Revenues ($mill)	3800
87.5	103.9	112.3	133.3	145.3	141.1	138.3	152.0	173.8	195	210	230	Net Profit ($mill)	290
34.0%	34.7%	36.2%	36.2%	35.0%	35.7%	36.4%	33.9%	32.8%	21.0%	21.0%	21.0%	Income Tax Rate	21.0%
4.6%	5.7%	6.0%	6.9%	7.4%	6.7%	5.6%	6.2%	6.8%	6.8%	6.9%	7.1%	Net Profit Margin	7.6%
53.5%	49.1%	43.2%	49.2%	49.4%	52.4%	49.3%	48.2%	49.8%	49.0%	48.5%	48.5%	Long-Term Debt Ratio	47.5%
46.5%	50.9%	56.8%	50.8%	50.6%	47.6%	50.7%	51.8%	50.2%	51.0%	51.5%	51.5%	Common Equity Ratio	52.5%
2371.4	2291.7	2155.9	2576.9	2793.7	3123.9	3143.5	3213.5	3613.3	4375	4725	5075	Total Capital ($mill)	5975
3034.5	3072.4	3218.9	3343.8	3486.1	3658.4	3891.1	4132.0	4523.7	4950	5300	5650	Net Plant ($mill)	6600
5.4%	6.1%	6.4%	6.4%	6.3%	5.7%	5.5%	5.8%	5.8%	5.5%	5.5%	5.5%	Return on Total Cap'l	6.0%
7.9%	8.9%	9.2%	10.2%	10.3%	9.5%	8.7%	9.1%	9.6%	9.0%	8.5%	9.0%	Return on Shr. Equity	9.5%
7.9%	8.9%	9.2%	10.2%	10.3%	9.5%	8.7%	9.1%	9.6%	9.0%	8.5%	9.0%	Return on Com Equity	9.5%
4.1%	5.1%	5.3%	6.1%	6.1%	5.0%	4.0%	4.1%	4.5%	4.0%	4.0%	4.0%	Retained to Com Eq	4.5%
48%	43%	43%	40%	41%	47%	54%	55%	53%	56%	56%	55%	All Div'ds to Net Prof	52%

CAPITAL STRUCTURE as of 9/30/18
Total Debt $2188.5 mill. Due in 5 Yrs $850 mill.
LT Debt $2123.6 mill. LT Interest $88.0 mill.
(Total interest coverage: 4.0x) (52% of Cap'l)
Leases, Uncapitalized Annual rentals $9.0 mill.
Pension Assets-12/17 $926.3 mill. Oblig. $1278.8 mill.

Pfd Stock None

Common Stock 49,431,933 shs.
as of 10/31/18

MARKET CAP: $4.1 billion (Mid Cap)

CURRENT POSITION ($MILL.)	2016	2017	9/30/18
Cash Assets	28.1	43.6	69.2
Other	505.2	613.4	652.0
Current Assets	533.3	657.0	721.2
Accts Payable	184.7	228.3	172.2
Debt Due	50.1	239.8	64.9
Other	393.6	347.8	475.6
Current Liab.	628.4	815.9	712.7
Fix. Chg. Cov.	401%	415%	389%

ANNUAL RATES of change (per sh)	Past 10 Yrs.	Past 5 Yrs.	Est'd '15-'17 to '22-'24
Revenues	1.0%	5.0%	3.5%
"Cash Flow"	4.5%	5.0%	5.0%
Earnings	6.5%	5.0%	8.5%
Dividends	8.0%	11.0%	5.5%
Book Value	5.5%	5.5%	6.0%

Cal-endar	QUARTERLY REVENUES ($ mill.) Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2016	731.2	547.8	540.0	641.5	2460.5
2017	654.7	560.5	593.2	740.4	2548.8
2018	754.3	670.9	668.1	786.7	2880
2019	780	700	730	840	3050
2020	810	740	790	885	3225

Cal-endar	EARNINGS PER SHARE A D Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2016	1.58	.19	.05	1.36	3.18
2017	1.45	.37	.21	1.58	3.62
2018	1.63	.44	.25	1.63	3.95
2019	1.70	.52	.28	1.70	4.20
2020	1.80	.58	.32	1.80	4.50

Cal-endar	QUARTERLY DIVIDENDS PAID B■† Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2015	.365	.405	.405	.405	1.58
2016	.405	.450	.450	.450	1.76
2017	.450	.495	.495	.495	1.94
2018	.495	.520	.520	.520	2.06
2019					

BUSINESS: Southwest Gas Holdings, Inc. is the parent holding company of Southwest Gas and Centuri Construction Group. Southwest Gas is a regulated gas distributor serving about 2.0 million customers in sections of Arizona, Nevada, and California. Centuri provides construction services. 2017 margin mix: residential and small commercial, 85%; large commercial and industrial, 3%; transportation, 12%. Total throughput: 2.1 billion therms. Has 7,771 employees. Off. & dir. own 1.0% of common stock; BlackRock Inc., 11.4%; The Vanguard Group, Inc., 9.2% (3/18 Proxy). Chairman: Michael J. Melarkey. President & CEO: John P. Hester. Inc.: CA. Addr.: 5241 Spring Mountain Road, Las Vegas, Nevada 89193. Telephone: 702-876-7237. Internet: www.swgas.com.

Southwest Gas probably finished 2018 on a solid note. We expect a healthy top-line advance and a somewhat more modest share-net improvement for the December quarter. Performance has been particularly strong at the infrastructure services operation in recent times. Results have been mixed lately at the natural gas utility. Fairly modest top-line growth here has been more than offset by higher expenses. The company was set to announce results for the fourth quarter the week after this Issue went to press.

Subsidiary Centuri Construction Group has acquired an 80% interest in Linetec Services, LLC for $299 million. It will have the option to purchase the remaining interest in increments over the next five years. Linetec is a premier provider of recurring maintenance, refurbishment, upgrade, and installation services for electrical transmission and distribution infrastructure throughout the Gulf Coast and Mid-Atlantic regions. This move strengthens Centuri's position as a leading provider of utility infrastructure services in North America. It expands Centuri's geographic reach and enhances its electrical distribution and transmission capabilities. The addition may prove modestly accretive to earnings, but we'll wait for clear signs before raising our estimates.

The company has completed a public offering of common stock. The offering of 3,100,000 shares was priced at $75.50 per share, for gross proceeds of $234 million. The offering was intended to partly finance the aforementioned acquisition of Linetec Services.

These shares are just an average selection for year-ahead relative price performance. Subscribers with a long-time horizon can probably also find better choices elsewhere at this juncture. We do expect healthy bottom-line growth for the company over the pull to early next decade. But this appears to be largely reflected in the recent quotation, and long-term appreciation potential is nothing to write home about. Moreover, the dividend yield does not stand out for a utility. In the plus column, Southwest Gas earns good marks for Price Stability, Growth Persistence, and Earnings Predictability. Volatility is subdued, as well.

Michael Napoli, CFA — *March 1, 2019*

(A) Diluted earnings. Excl. nonrec. gains (losses): '02, (10¢); '05, (11¢); '06, 7¢. Next egs. report due early May. (B) Dividends historically paid early March, June, September, and December. ■† Div'd reinvestment and stock purchase plan avail. (C) In millions. (D) Totals may not sum due to rounding.

Company's Financial Strength	B++
Stock's Price Stability	80
Price Growth Persistence	80
Earnings Predictability	90

SPIRE INC. NYSE-SR

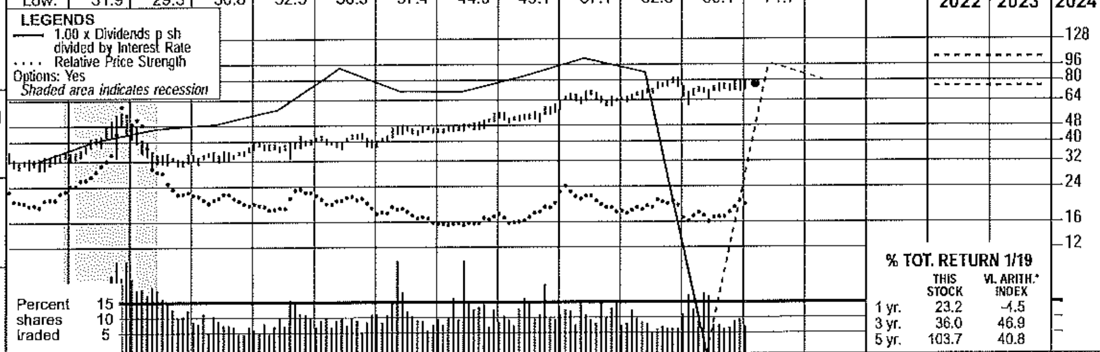
RECENT PRICE 76.86 | P/E RATIO 20.5 (Trailing: 22.9, Median: 17.0) | RELATIVE P/E RATIO 1.18 | DIV'D YLD 3.1% | VALUE LINE

TIMELINESS 3 Lowered 11/30/18
SAFETY 2 Raised 6/20/03
TECHNICAL 1 Raised 2/22/19
BETA .65 (1.00 = Market)

High:	55.8	48.3	37.8	42.8	44.0	48.5	55.2	61.0	71.2	82.9	81.1	79.5
Low:	31.9	29.3	30.8	32.9	36.5	37.4	44.0	49.1	57.1	62.3	60.1	71.7

Target Price Range 2022 | 2023 | 2024

LEGENDS
— 1.00 x Dividends p sh divided by Interest Rate
.... Relative Price Strength
Options: Yes
Shaded area indicates recession



2022-24 PROJECTIONS

	Price	Gain	Ann'l Total Return
High	105	(+35%)	11%
Low	75	(Nil)	3%

Insider Decisions

	A	M	J	J	A	S	O	N	D
to Buy	0	0	0	0	0	0	0	0	0
Options	0	0	0	0	0	0	0	5	5
to Sell	0	0	0	0	0	0	0	0	0

Institutional Decisions

	1Q2018	2Q2018	3Q2018
to Buy	124	145	119
to Sell	112	101	124
Hld's(000)	39753	42179	42187

Percent shares traded 15 10 5

% TOT. RETURN 1/19

	THIS STOCK	VL ARITH.* INDEX
1 yr.	23.2	-4.5
3 yr.	36.0	46.9
5 yr.	103.7	40.8

2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	© VALUE LINE PUB. LLC	22-24
54.95	59.59	75.43	93.51	93.40	100.44	85.49	77.83	71.48	49.90	31.10	37.68	45.59	33.68	36.07	38.78	*38.45*	*41.50*	Revenues per sh A	*54.55*
3.15	2.79	2.98	3.81	3.87	4.22	4.56	4.11	4.62	4.58	3.12	3.87	6.15	6.16	6.54	7.55	*7.10*	*7.35*	"Cash Flow" per sh	*9.55*
1.82	1.82	1.90	2.37	2.31	2.64	2.92	2.43	2.86	2.79	2.02	2.35	3.16	3.24	3.43	4.33	*3.75*	*3.85*	Earnings per sh A B	*5.00*
1.34	1.35	1.37	1.40	1.45	1.49	1.53	1.57	1.61	1.66	1.70	1.76	1.84	1.96	2.10	2.25	*2.37*	*2.46*	Div'ds Decl'd per sh C■	*2.67*
2.67	2.45	2.84	2.97	2.72	2.57	2.36	2.56	3.02	4.83	4.00	3.96	6.68	6.42	9.08	9.86	*10.95*	*11.70*	Cap'l Spending per sh	*12.75*
15.65	16.96	17.31	18.85	19.79	22.12	23.32	24.02	25.56	26.67	32.00	34.93	36.30	38.73	41.26	44.51	*44.70*	*45.30*	Book Value per sh D	*47.80*
19.11	20.98	21.17	21.36	21.65	21.99	22.17	22.29	22.43	22.55	32.70	43.18	43.36	45.65	48.26	50.67	*52.00*	*53.00*	Common Shs Outst'g E	*55.00*
13.6	15.7	16.2	13.6	14.2	14.3	13.4	13.7	13.0	14.5	21.3	19.8	16.5	19.6	19.8	16.7	*Bold figures are*		Avg Ann'l P/E Ratio	*18.0*
.78	.83	.86	.73	.75	.86	.89	.87	.82	.92	1.20	1.04	.83	1.03	1.00	.89	*Value Line*		Relative P/E Ratio	*1.00*
5.4%	4.7%	4.4%	4.3%	4.4%	3.9%	3.9%	4.7%	4.3%	4.1%	4.0%	3.8%	3.5%	3.1%	3.1%	3.1%	*estimates*		Avg Ann'l Div'd Yield	*3.0%*
						1895.2	1735.0	1603.3	1125.5	1017.0	1627.2	1976.4	1537.3	1740.7	1965.0	*2000*	*2200*	Revenues ($mill) A	*3000*
						64.3	54.0	63.8	62.6	52.8	84.6	136.9	144.2	161.6	214.2	*190*	*200*	Net Profit ($mill)	*275*
						33.6%	33.4%	31.4%	29.6%	25.0%	27.6%	31.2%	32.5%	32.4%	32.4%	*23.5%*	*24.0%*	Income Tax Rate	*24.0%*
						3.4%	3.1%	4.0%	5.6%	5.2%	5.2%	6.9%	9.4%	9.3%	10.9%	*9.5%*	*9.1%*	Net Profit Margin	*9.2%*
						42.9%	40.5%	38.9%	36.1%	46.6%	55.1%	53.0%	50.9%	50.0%	45.7%	*46.0%*	*45.0%*	Long-Term Debt Ratio	*43.0%*
						57.1%	59.5%	61.1%	63.9%	53.4%	44.9%	47.0%	49.1%	50.0%	54.3%	*54.0%*	*55.0%*	Common Equity Ratio	*57.0%*
						906.3	899.9	937.7	941.0	1959.0	3359.4	3345.1	3601.9	3986.3	4155.5	*4310*	*4380*	Total Capital ($mill)	*4600*
						855.9	884.1	928.7	1019.3	1776.6	2759.7	2941.2	3300.9	3665.2	3970.5	*4170*	*4300*	Net Plant ($mill)	*4825*
						8.7%	7.4%	8.1%	7.9%	3.3%	3.1%	5.1%	4.9%	5.0%	6.3%	*5.5%*	*6.0%*	Return on Total Cap'l	*7.5%*
						12.4%	10.1%	11.1%	10.4%	5.0%	5.6%	8.7%	8.2%	8.1%	9.5%	*8.0%*	*8.5%*	Return on Shr. Equity	*10.6%*
						12.4%	10.1%	11.1%	10.4%	5.0%	5.6%	8.7%	8.2%	8.1%	9.5%	*8.0%*	*8.5%*	Return on Com Equity	*10.5%*
						5.9%	3.6%	4.9%	4.3%	1.0%	1.5%	3.7%	3.3%	3.3%	4.7%	*3.0%*	*3.0%*	Retained to Com Eq	*5.0%*
						53%	64%	56%	59%	81%	73%	58%	59%	60%	51%	*63%*	*64%*	All Div'ds to Net Prof	*53%*

CAPITAL STRUCTURE as of 9/30/18
Total Debt $2629.1 mill. **Due in 5 Yrs** $540.0 mill.
LT Debt $1900.1 mill. **LT Interest** $80.0 mill.
(Total interest coverage: 2.8x)

Leases, Uncapitalized Annual rentals $9.7 mill.
Pension Assets-9/18 $499.2 mill.
Oblig. $664.6 mill.
Pfd Stock None
Common Stock 50,676,192 shs.
as of 11/12/18

MARKET CAP: $3.9 billion (Mid Cap)

CURRENT POSITION ($MILL.)	2016	2017	9/30/18
Cash Assets	5.2	7.4	4.4
Other	564.4	718.1	655.2
Current Assets	569.6	725.5	659.6
Accts Payable	210.9	257.1	290.1
Debt Due	648.7	577.3	729.1
Other	301.7	263.5	302.5
Current Liab.	1161.3	1097.9	1321.7
Fix. Chg. Cov.	366%	361%	284%

ANNUAL RATES of change (per sh)	Past 10 Yrs.	Past 5 Yrs.	Est'd '16-'18 to '22-'24
Revenues	-9.5%	-6.5%	7.0%
"Cash Flow"	5.5%	10.5%	6.0%
Earnings	4.0%	7.5%	5.5%
Dividends	4.0%	5.0%	4.0%
Book Value	7.5%	8.0%	2.5%

Fiscal Year Ends	QUARTERLY REVENUES ($ mill.)A Dec.31	Mar.31	Jun.30	Sep.30	Full Fiscal Year
2016	399.4	609.3	249.3	279.3	1537.3
2017	495.1	663.4	323.5	258.7	1740.7
2018	561.8	813.4	350.6	239.2	1965.0
2019	602.0	*750*	*350*	*298*	*2000*
2020	*650*	*825*	*385*	*340*	*2200*

Fiscal Year Ends	EARNINGS PER SHARE A B F Dec.31	Mar.31	Jun.30	Sep.30	Full Fiscal Year
2016	1.08	2.31	.24	d.31	3.24
2017	.99	2.36	.45	d.28	3.43
2018	2.39	2.03	.52	d.51	4.33
2019	1.32	*2.50*	*.50*	*d.57*	*3.75*
2020	*1.35*	*2.55*	*.50*	*d.55*	*3.85*

Cal-endar	QUARTERLY DIVIDENDS PAID C■ Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2015	.46	.46	.46	.46	1.84
2016	.49	.49	.49	.49	1.96
2017	.525	.525	.525	.525	2.10
2018	.5625	.5625	.5625	.5625	2.25
2019	.5925				

BUSINESS: Spire Inc., formerly known as the Laclede Group, Inc., is a holding company for natural gas utilities, which distributes natural gas across Missouri, including the cities of St. Louis and Kansas City. Has roughly 1.7 million customers. Acquired Missouri Gas 9/13, Alabama Gas Co 9/14. Utility therms sold and transported in fiscal 2017: 3.0 bill. Revenue mix for regulated operations: residential, 29%; commercial and industrial, 15%; transportation, 49%; other, 6%. Has around 3,279 employees. Officers and directors own 3.0% of common shares (1/18 proxy). Chairman: Edward Glotzbach; CEO: Suzanne Sitherwood. Inc.: Missouri. Address: 700 Market Street, St. Louis, Missouri 63101. Telephone: 314-342-0500. Internet: www.thelacledegroup.com.

Spire Inc. started this fiscal year on a mixed note. The top line grew 7% year over year, thanks to a colder-than-expected winter and higher commodity costs. Its Gas Utility segment was up 6%, due to elevated volumes from cold weather, rate design changes, and customer increases. Meanwhile, its Gas Marketing business benefited from favorable market conditions and an increased geographic presence. The bottom line clocked in at $1.32 per share, versus $2.39 a share in the year-ago period, including a tax benefit of $1.24. On an adjusted basis, share net (or net economic earnings) rose 9% over the previous year's tally, to $1.30, owing to the aforementioned growth. However, share net was, in part, weighed on by higher corporate costs and the operating loss from its Spire Storage line.

The company appears to be on track with its growth plan. Spire is actively investing in technology and restructuring its infrastructure to improve efficiency. Its STL Pipeline received approval from FERC and is under construction. The pipeline is anticipated to go into service by the end of 2019. Meanwhile, its Storage operations remain a sore spot for the company. Nonetheless, ongoing efforts should improve the Storage line and allow it to contribute meaningfully by 2020. Still, expenses from this business, along with higher interest charges, ought to weigh on profits for this year. On the plus side, its Gas Utility and Gas Marketing operations will likely counterbalance some of the aforementioned costs. In all, we estimate the bottom line to come in at $3.75 a share, versus $4.33 per share in 2017.

We are introducing estimates for 2020. All things considered, we figure revenues and share earnings will likely rise in the neighborhood of 10% and 3%, respectively, to $2.2 billion and $3.85.

Shares of Spire, Inc. are ranked to perform in line with the broader market averages in the year ahead. At the recent quotation, this issue has uninspiring long-term capital appreciation potential. Still, SR has some noteworthy points such as an Above Average (2) rank for Safety and a decent dividend yield. Too, the payout is poised to grow at a modest rate in the near term.

Emma Jalees *March 1, 2019*

(A) Fiscal year ends Sept. 30th. (B) Based on diluted shares outstanding. Excludes nonrecurring loss: '06, 7¢. Excludes gain from discontinued operations: '08, 94¢. Next earnings report due late April. (C) Dividends historically paid in early January, April, July, and October. ■ Dividend reinvestment plan available. (D) Incl. deferred charges. In '17: $920.2 mill., $19.07/sh. (E) In millions. (F) Qtly. egs. may not sum due to rounding or change in shares outstanding in 2014, 2016, and 2017.

Company's Financial Strength	B++
Stock's Price Stability	95
Price Growth Persistence	45
Earnings Predictability	75

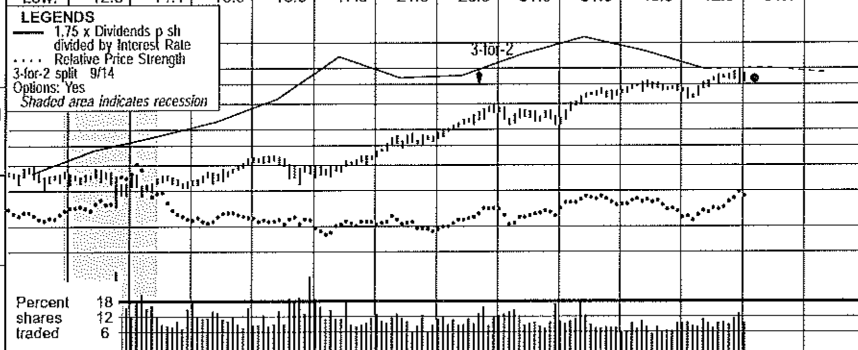
UGI CORP. NYSE-UGI

RECENT PRICE 53.54 | P/E RATIO 19.1 (Trailing: 21.1 / Median: 16.0) | RELATIVE P/E RATIO 1.10 | DIV'D YLD 1.9% | VALUE LINE

TIMELINESS 2 Lowered 2/15/19
SAFETY 2 Raised 9/17/04
TECHNICAL 1 Raised 2/22/19
BETA .80 (1.00 = Market)

High:	19.2	18.3	21.7	22.4	22.4	28.8	39.7	38.6	48.1	52.0	59.3	57.3
Low:	12.5	14.1	15.9	16.0	17.3	21.9	26.8	31.5	31.6	45.0	42.5	51.1

Target Price Range 2022 | 2023 | 2024



2022-24 PROJECTIONS

	Price	Gain	Ann'l Total Return
High	65	(+20%)	7%
Low	50	(-5%)	Nil

Insider Decisions

	A	M	J	J	A	S	O	N	D
to Buy	1	1	0	0	0	0	0	0	0
Options	0	2	3	0	1	0	0	6	0
to Sell	0	1	3	0	1	0	0	4	0

Institutional Decisions

	1Q2018	2Q2018	3Q2018
to Buy	198	189	222
to Sell	194	200	176
Hld's(000)	136099	136932	138741

% TOT. RETURN 1/19

	THIS STOCK	VL ARITH.* INDEX
1 yr.	27.1	-4.5
3 yr.	78.5	46.9
5 yr.	120.9	40.8

2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	© VALUE LINE PUB. LLC	22-24
23.62	24.63	31.10	33.01	34.24	41.27	35.25	34.01	36.31	38.56	42.10	47.92	38.65	32.84	35.18	43.94	45.40	46.85	Revenues per sh A	52.70
1.59	1.63	2.09	2.05	2.26	2.48	2.82	2.87	2.75	3.05	3.75	4.05	4.20	4.39	4.73	5.40	5.50	5.80	"Cash Flow" per sh	6.55
.76	.81	1.15	1.10	1.18	1.33	1.57	1.59	1.37	1.17	1.59	1.92	2.01	2.05	2.29	2.74	2.80	3.00	Earnings per sh AB	3.60
.38	.40	.43	.46	.48	.50	.52	.60	.68	.71	.74	.79	.89	.93	.96	1.02	1.04	1.08	Div'ds Decl'd per sh C ■	1.14
.79	.87	1.01	1.21	1.39	1.44	1.85	2.11	2.15	2.01	2.84	2.64	2.83	3.26	3.67	3.30	3.90	4.00	Cap'l Spending per sh	4.30
4.45	5.43	6.35	6.95	8.26	8.80	9.78	11.10	11.79	13.21	14.59	15.39	15.55	16.46	18.18	21.14	22.90	25.00	Book Value per sh D	32.00
128.10	153.63	157.20	158.18	159.97	161.09	162.78	164.38	167.75	169.06	170.88	172.73	173.12	173.15	173.99	174.14	174.00	174.00	Common Shs Outst'g E	174.00
12.6	13.4	13.8	14.0	15.1	13.3	10.3	10.9	15.0	16.4	15.4	15.8	17.7	19.3	20.8	18.36	Bold figures are	Value Line estimates	Avg Ann'l P/E Ratio	16.0
.72	.71	.73	.76	.80	.80	.69	.69	.94	1.04	.87	.83	.89	1.01	1.05	1.01			Relative P/E Ratio	.90
3.9%	3.7%	2.7%	3.0%	2.7%	2.9%	3.2%	3.5%	3.3%	3.7%	3.0%	2.6%	2.5%	2.3%	2.0%	2.1%			Avg Ann'l Div'd Yield	2.4%

2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020		22-24
5737.8	5591.4	6091.3	6519.2	7194.7	8277.3	6691.1	5685.7	6120.7	7651.2	7900	8150	Revenues ($mill) A	9165
258.5	261.0	232.9	199.4	278.1	337.2	353.8	360.0	406.5	485.6	495	530	Net Profit ($mill)	635
29.4%	32.0%	29.8%	34.8%	27.6%	30.6%	30.0%	31.4%	26.5%	23.0%	22.0%	22.0%	Income Tax Rate	22.0%
4.5%	4.7%	3.8%	3.1%	3.9%	4.1%	5.3%	6.3%	6.6%	6.4%	6.3%	6.5%	Net Profit Margin	6.9%
56.2%	44.0%	51.6%	60.0%	58.7%	56.4%	56.1%	56.9%	55.8%	50.3%	51.0%	49.0%	Long-Term Debt Ratio	43.5%
43.8%	56.0%	48.4%	40.0%	41.3%	43.6%	43.9%	43.1%	44.2%	44.6%	49.0%	51.0%	Common Equity Ratio	56.5%
3630.0	3256.7	4088.0	5580.7	6034.7	6092.7	6133.8	6616.9	7157.9	8246.5	8140	8530	Total Capital ($mill)	9855
2903.6	3053.2	3204.5	4233.1	4480.2	4543.7	4994.1	5238.0	5537.0	5808.2	6095	6390	Net Plant ($mill)	7375
8.9%	10.1%	7.4%	5.6%	6.6%	7.5%	7.7%	7.2%	7.2%	5.9%	6.0%	6.0%	Return on Total Cap'l	6.5%
16.2%	14.3%	11.8%	8.9%	11.2%	12.7%	13.1%	12.6%	12.9%	13.2%	12.5%	12.5%	Return on Shr. Equity	11.5%
16.2%	14.3%	11.8%	8.9%	11.2%	12.7%	13.1%	12.6%	12.9%	13.2%	12.5%	12.5%	Return on Com Equity	11.5%
10.9%	8.9%	6.0%	3.6%	6.1%	7.6%	7.4%	7.0%	7.5%	8.4%	8.0%	8.0%	Retained to Com Eq	8.0%
33%	38%	49%	60%	45%	40%	43%	45%	42%	36%	37%	35%	All Div'ds to Net Prof	31%

CAPITAL STRUCTURE as of 12/31/18
Total Debt $4846.5 mill. Due in 5 Yrs $839.7 mill.
LT Debt $4150.7 mill. LT Interest $230.1 mill.
(Total interest coverage: 4.0x) (51% of Cap'l)

Leases, Uncapitalized Annual rentals $88.0 mill.
Pension Assets-9/18 $579 mill. Oblig. $688 mill.

Pfd Stock None
Common Stock 173,844,100 shares as of 1/31/19

MARKET CAP: $9.3 bill. (Large Cap)

CURRENT POSITION ($MILL.)	2017	2018	12/31/18
Cash Assets	558.4	452.6	477.6
Other	1139.1	1435.5	1764.6
Current Assets	1697.5	1888.1	2242.2
Accts Payable	439.6	561.8	753.3
Debt Due	544.4	525.3	695.8
Other	706.1	645.0	734.0
Current Liab.	1690.1	1732.1	2183.1
Fix. Chg. Cov.	445%	445%	450%

ANNUAL RATES of change (per sh)	Past 10 Yrs.	Past 5 Yrs.	Est'd '16-'18 to '22-'24
Revenues	1.0%	-.5%	6.0%
"Cash Flow"	7.5%	9.0%	5.0%
Earnings	6.5%	9.0%	7.0%
Dividends	7.5%	7.0%	2.5%
Book Value	9.0%	7.0%	9.5%

Fiscal Year Ends	QUARTERLY REVENUES ($ mill.) A Dec.31	Mar.31	Jun.30	Sep.30	Full Fiscal Year
2016	1607	1972	1131	976	5685.7
2017	1680	2174	1153	1114	6120.7
2018	2125	2812	1441	1273	7651.2
2019	2200	2850	1550	1300	7900
2020	2260	2910	1615	1365	8150

Fiscal Year Ends	EARNINGS PER SHARE A B Dec.31	Mar.31	Jun.30	Sep.30	Full Fiscal Year
2016	.64	1.24	.23	d.05	2.05
2017	.91	1.31	.09	d.02	2.29
2018	1.01	1.69	.09	d.05	2.74
2019	.81	1.74	.15	.10	2.80
2020	.85	1.78	.24	.13	3.00

Cal-endar	QUARTERLY DIVIDENDS PAID C ■ Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2015	.22	.22	.23	.23	.90
2016	.23	.238	.238	.238	.94
2017	.238	.238	.25	.25	.98
2018	.25	.25	.26	.26	1.02
2019	.26				

BUSINESS: UGI Corp. operates six business segments: AmeriGas Propane (accounted for 24.3% of net income in 2018), UGI International (19.3%), Gas Utility (20.7%), Midstream & Marketing (27.4%), and Corp. & Other (8.3%). UGI Utilities distributes natural gas and electricity to over 642,000 customers mainly in Pennsylvania; 26%-owned AmeriGas Partners is the largest U.S. propane marketer, serving about 1.3 million users in 50 states. Acquired remaining 80% interest in Antargaz (3/04); Energy Transfer Partners (1/12). Vanguard Group owns 10.3% of stock; Blackrock, 9.8%; Officers/directors, 2.4% (12/18 proxy). Has 7,700 empls. President & CEO: John L. Walsh. Inc.: PA. Address: 460 N. Gulph Rd., King of Prussia, PA 19406. Tel.: 610-337-1000. Internet: www.ugicorp.com.

UGI Corp. is off to a so-so start in fiscal 2019 (ends September 30th). On the upside, the company's top line advanced 3.6%, to $2.2 billion. This reflected modest, mid-single-digit gains from the AmeriGas Propane division, thanks to a 2% rise in retail gallons sold stemming from colder-than-normal weather patterns. That unit makes up the lion's share of overall operations. Elsewhere, the Midstream & Marketing unit experienced a 40% uptick in volumes due to colder weather patterns across its service territory. Alternatively, the UGI International and UGI Utilities segments both registered year-over-year declines in revenues. Meanwhile, on the profitability front, cost of goods sold increased 11.2% as a percentage of the top line. This margin compression offset the revenue gains and, on balance, UGI's bottom line declined almost 20%, to $0.81 a share. This was markedly below our call for earnings of $1.10 a share.

As a result, we have reduced our outlook for this year. In fact, we sliced a dime off our fiscal 2019 share-net estimate, to $2.80. This is still well within management's guidance range of $2.75-$2.95. It would also represent a modest, low single-digit year-over-year earnings advance. The AmeriGas Propane and Midstream & Marketing units will likely continue to be the primary drivers this year.

The balance sheet is in decent shape at this juncture. So far this year, cash reserves advanced approximately 6%. That cushion now sits at roughly $478 million. Meanwhile, the long-term debt load remained relatively flat, and comprises a bit more than half of total capital.

These defensive shares may appeal to short-term investors. In fact, our Timeliness Ranking System has UGI stock pegged to outpace the broader market averages in the coming year (Timeliness: 2). That said, even though these high-quality shares registered a modest price decline of about 8% since our November review, the stock offers only modest capital appreciation potential for the pull to 2022-2024. Finally, even after accounting for the recent and somewhat regular increases in the quarterly dividend, the company's yield is still below the *Value Line* median for this industry.

Bryan J. Fong *March 1, 2019*

(A) Fiscal year ends Sept. 30. Quarterly sales and earnings may not sum to total due to rounding and/or change in share count. (B) Diluted earnings. Excludes nonrecur. gains/(losses): '03, 22¢; '04, d6¢; '05, 3¢; '06, 5¢; '07, 12¢; '15, (41¢); '16, 3¢; '17, 17¢; '18, $1.32. Next egs. report due late April. (C) Dividends historically paid in early Jan., April, July, and Oct. ■ Div. reinvest. plan available. (D) Incl. intang. At 9/18: $3,674 mill., $20.77/sh. (E) In mill., adjusted for stock splits.

Company's Financial Strength	B++
Stock's Price Stability	95
Price Growth Persistence	85
Earnings Predictability	80

WGL HOLDINGS NYSE-WGL

RECENT PRICE 88.19 | P/E RATIO 20.9 (Trailing: 21.8, Median: 16.0) | RELATIVE P/E RATIO 1.15 | DIV'D YLD 2.3% | VALUE LINE

TIMELINESS – Suspended 2/3/17

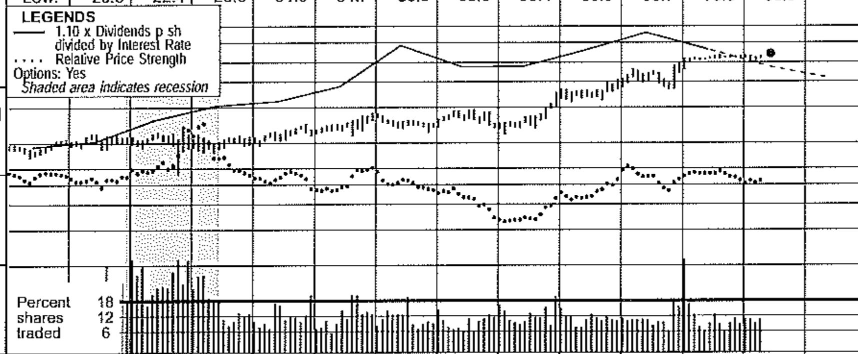
SAFETY 1 Raised 4/2/93

TECHNICAL – Suspended 2/3/17

BETA .75 (1.00 = Market)

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
High:	35.9	37.1	35.5	40.0	45.0	45.0	47.0	56.8	65.6	80.0	86.9	88.3
Low:	29.8	22.4	28.6	31.0	34.7	36.0	38.0	35.4	50.9	58.7	73.5	80.9

LEGENDS
—— 1.10 x Dividends p sh divided by Interest Rate
.... Relative Price Strength
Options: Yes
Shaded area indicates recession



Target Price Range 2021 | 2022 | 2023
120
100
80
64
48
32
24
20
16
12
8

2021-23 PROJECTIONS

	Price	Gain	Ann'l Total Return
High	100	(+15%)	6%
Low	85	(-5%)	2%

Insider Decisions

	J	A	S	O	N	D	J	F	M
to Buy	0	0	0	0	0	0	0	0	0
Options	0	0	0	14	0	0	8	0	0
to Sell	0	0	1	0	0	0	0	0	0

Institutional Decisions

	2Q2017	3Q2017	4Q2017
to Buy	132	113	103
to Sell	105	113	90
Hld's(000)	40665	41917	37069

% TOT. RETURN 4/18

	THIS STOCK	VL ARITH.* INDEX
1 yr.	5.7	9.5
3 yr.	68.0	25.8
5 yr.	114.1	68.8

2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	© VALUE LINE PUB. LLC	21-23
32.63	42.45	42.93	44.94	53.96	53.51	52.65	53.98	53.60	53.75	47.07	47.70	53.73	53.43	45.74	45.99	*47.65*	*47.70*	Revenues per sh A	*51.15*
2.63	4.00	3.87	3.97	3.84	3.89	4.34	4.44	4.11	4.01	4.53	4.29	4.80	5.60	5.77	6.11	*7.05*	*7.20*	"Cash Flow" per sh	*7.70*
1.14	2.30	1.98	2.13	1.94	2.09	2.44	2.53	2.27	2.25	2.68	2.31	2.68	3.16	3.27	3.11	*4.15*	*4.25*	Earnings per sh B	*4.60*
1.27	1.28	1.30	1.32	1.35	1.37	1.41	1.47	1.50	1.55	1.59	1.66	1.72	1.83	1.93	2.02	*2.06*	*2.12*	Div'ds Decl'd per sh C ■	*2.24*
3.34	2.65	2.33	2.32	3.27	3.33	2.70	2.77	2.57	3.94	4.87	6.04	7.63	9.33	10.33	10.09	*10.85*	*11.10*	Cap'l Spending per sh	*11.80*
15.78	16.25	16.95	17.60	18.86	19.83	20.99	21.89	22.82	23.49	24.64	24.65	24.08	24.97	26.78	29.35	*33.10*	*35.90*	Book Value per sh D	*43.10*
48.56	48.63	48.67	48.65	48.89	49.45	49.92	50.14	50.54	51.20	51.52	51.70	51.76	49.78	51.37	51.21	*53.00*	*54.00*	Common Shs Outst'g E	*55.00*
23.1	11.1	14.2	14.7	15.5	15.6	13.7	12.6	15.1	17.0	15.3	18.2	15.2	17.0	20.0	25.4	*Bold figures are*		Avg Ann'l P/E Ratio	*20.0*
1.26	.63	.75	.78	.84	.83	.82	.84	.96	1.07	.97	1.02	.80	.86	1.05	1.32	*Value Line*		Relative P/E Ratio	*1.10*
4.8%	5.0%	4.6%	4.2%	4.5%	4.2%	4.2%	4.6%	4.4%	4.1%	3.9%	3.9%	4.2%	3.4%	2.9%	2.6%	*estimates*		Avg Ann'l Div'd Yield	*2.4%*

CAPITAL STRUCTURE as of 3/31/18
Total Debt $2404.1 mill. Due in 5 Yrs $801.4 mill.
LT Debt $1879.3 mill. LT Interest $74.0 mill.
(LT interest earned: 6.2x; total interest coverage: 5.7x) (51% of Total Capital)
Pension Assets-9/17 $1,356.5 mill. Oblig. $1,413.0 mill.
Preferred Stock $28.2 mill. Pfd. Div'd $1.3 mill.

Common Stock 51,359,182 shs. as of 4/30/18

MARKET CAP: $4.5 billion (Mid Cap)

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019		21-23
2628.2	2706.9	2708.9	2751.5	2425.3	2466.1	2780.9	2659.8	2349.6	2354.7	*2525*	*2575*	Revenues ($mill) A	*2815*
122.9	128.7	115.0	115.5	138.4	119.7	139.0	158.2	165.1	160.2	*220*	*230*	Net Profit ($mill)	*255*
37.1%	39.1%	38.7%	42.4%	40.1%	30.2%	29.0%	39.9%	37.9%	39.2%	*22.0%*	*22.0%*	Income Tax Rate	*22.0%*
4.7%	4.8%	4.2%	4.2%	5.7%	4.9%	5.0%	5.9%	7.0%	6.8%	*8.5%*	*9.0%*	Net Profit Margin	*9.0%*
35.9%	33.3%	33.4%	32.3%	31.2%	28.7%	34.8%	42.6%	50.7%	48.3%	*50.0%*	*49.0%*	Long-Term Debt Ratio	*42.0%*
62.4%	65.0%	65.0%	66.2%	67.3%	69.8%	63.8%	56.1%	48.3%	50.7%	*49.0%*	*50.0%*	Common Equity Ratio	*57.5%*
1679.5	1687.7	1774.4	1818.1	1886.9	1826.8	1954.0	2215.6	2848.0	2961.7	*3580*	*3875*	Total Capital ($mill)	*4405*
2208.3	2269.1	2346.2	2489.9	2667.4	2907.5	3314.4	3672.7	4127.2	4630.1	*5195*	*5825*	Net Plant ($mill)	*8225*
8.5%	8.8%	7.6%	7.5%	8.3%	7.5%	8.1%	8.3%	6.7%	6.7%	*8.0%*	*8.0%*	Return on Total Cap'l	*7.5%*
11.4%	11.4%	9.7%	9.4%	10.7%	9.2%	10.9%	12.4%	11.8%	10.5%	*12.5%*	*12.0%*	Return on Shr. Equity	*11.0%*
11.6%	11.6%	9.9%	9.5%	10.8%	9.3%	11.0%	12.6%	11.9%	10.7%	*12.5%*	*12.0%*	Return on Com Equity	*11.0%*
5.0%	5.0%	3.3%	3.4%	4.8%	2.6%	4.3%	5.4%	5.3%	3.7%	*6.0%*	*6.0%*	Retained to Com Eq	*3.0%*
57%	57%	67%	64%	56%	72%	62%	58%	56%	65%	*49%*	*50%*	All Div'ds to Net Prof	*70%*

CURRENT POSITION ($MILL.)

	2016	2017	3/31/18
Cash Assets	5.6	8.5	46.3
Other	837.9	977.4	974.7
Current Assets	843.5	985.9	1021.0
Accts Payable	405.4	423.8	358.0
Debt Due	331.4	809.8	524.8
Other	290.1	255.4	271.0
Current Liab.	1026.9	1489.0	1153.8
Fix. Chg. Cov.	546%	550%	550%

ANNUAL RATES of change (per sh)	Past 10 Yrs.	Past 5 Yrs.	Est'd '15-'17 to '21-'23
Revenues	-.5%	-1.0%	*1.0%*
"Cash Flow"	4.0%	6.5%	*4.5%*
Earnings	4.5%	6.0%	*6.5%*
Dividends	3.5%	4.5%	*2.5%*
Book Value	3.5%	2.5%	*8.0%*

Fiscal Year Ends	QUARTERLY REVENUES ($ mill.) A Dec.31	Mar.31	Jun.30	Sep.30	Full Fiscal Year
2015	749.2	1001.7	441.2	467.7	2659.8
2016	613.4	835.7	440.6	459.9	2349.6
2017	609.5	841.7	474.4	429.1	2354.7
2018	652.4	886.4	*510*	*476.2*	*2525*
2019	*675*	*880*	*530*	*490*	*2575*

Fiscal Year Ends	EARNINGS PER SHARE A B Dec.31	Mar.31	Jun.30	Sep.30	Full Fiscal Year
2015	1.16	2.02	.22	d.23	3.16
2016	1.18	1.78	.33	d.01	3.27
2017	1.15	1.87	.26	d.17	3.11
2018	1.84	2.12	*.41*	*d.22*	*4.15*
2019	*1.90*	*2.02*	*.48*	*d.15*	*4.25*

Cal-endar	QUARTERLY DIVIDENDS PAID C ■ Mar.31	Jun.30	Sep.30	Dec.31	Full Year
2014	.42	.44	.44	.44	1.74
2015	.44	.463	.463	.463	1.83
2016	.463	.488	.488	.488	1.93
2017	.488	.51	.51	.51	2.02
2018	.51	.515			

BUSINESS: WGL Holdings, Inc. is the parent of Washington Gas Light, a natural gas distributor in Washington, D.C. and adjacent areas of VA and MD to resident'l and comm'l users (1,163,655 meters). Hampshire Gas, a federally regulated sub., operates an underground gas-storage facility in WV. Non-regulated subs.: Wash. Gas Energy Svcs. sells and delivers nat. gas and provides energy-related products in the D.C. metro area; Wash. Gas Energy Sys. designs/installs comm'l heating, ventilating, and air cond. systems. BlackRock owns 10.8% of common stock; Vanguard, 9.2%; Off./dir. less than 1% (1/18 proxy). Chrmn. & CEO: Terry D. McCallister. Inc.: D.C. and VA. Addr.: 101 Const. Ave., N.W., Washington, D.C. 20080. Tel.: 202-624-6410. Internet: www.wglholdings.com.

The acquisition of WGL Holdings by AltaGas Ltd. is progressing nicely and appears on pace to close in mid-2018. To that end, the share price continues to hover right around the tender offer price of $88.25 in cash. As a recap, this price point represents an almost 28% premium from the level WGL was trading at on November 28, 2016, the day prior to the announcement of the takeover. The stock had been trading at a discount from the purchase price for some time, which likely reflected the possibility that the deal could be derailed, given the lengthy time to completion. At this point, the equity is no longer trading on earnings, and as a result, we have suspended the Timeliness rank of these shares until the purchase is finalized. If for some reason the transaction is not completed, we would expect WGL shares to fall back toward preannouncement levels. In May, 96.22% of the voting shares approved the acquisition. More recently, the Maryland Public Service Commission passed the $4.5 billion merger. Finally, AltaGas and WGL Holdings announced a settlement agreement with key stakeholders in Washington, DC. Assuming all parties are on board and any final regulatory hurdles are cleared, the deal may well close in the middle of this year. Investors should note, however, that the merger was anticipated to be completed in the March quarter.

Meantime, the company posted better-than-expected second-quarter financial results. To that end, the top line advanced 5.3% on a year-over-year basis, to $886.4 million. This reflected an impressive 12.3% rise in utility volumes partially offset by a 3.3% downturn in non-utility operations. On the margin front, cost of goods sold increased 620 basis points as a percentage of the top line. Alternatively, operating expenses fell 470 basis points. On balance, WGL's March-quarter earnings increased 13.4%, to $2.12 a share. This was markedly above our call of $1.95. As a result, we have raised our outlook for fiscal 2018 by $0.15, to $4.15 a share.

Risk-averse accounts may wish to lock in gains now and redeploy capital elsewhere, rather than to wait for the deal to close.

Bryan J. Fong *June 1, 2018*

(A) Fiscal years end Sept. 30th.
(B) Based on diluted shares. Excludes nonrecurring losses: '02, (34¢); '07, (4¢); '08, (14¢) discontinued operations: '06, (15¢). Qtly egs. may not sum to total, due to change in shares outstanding. Next earnings report due late July.
(C) Dividends historically paid early February, May, August, and November. ■ Dividend reinvestment plan available.
(D) Includes deferred charges and intangibles. '17: $868.1 million, $16.95/sh.
(E) In millions.

Company's Financial Strength	A
Stock's Price Stability	85
Price Growth Persistence	55
Earnings Predictability	75

CASE: UG 366
WITNESSES: MATT MULDOON &
MOYA ENRIGHT

PUBLIC UTILITY COMMISSION OF OREGON

STAFF EXHIBIT 1111

Cost of LT Debt

Exhibits in Furtherance of Testimony in Support of Partial Stipulation

July 11, 2019

STAFF EXHIBIT 1111

IS CONFIDENTIAL AND SUBJECT TO

PROTECTIVE ORDER NO. 19-091

(PROVIDED IN ELECTRONIC FORMAT)

CASE: UG 366
WITNESSES: MATT MULDOON &
MOYA ENRIGHT

PUBLIC UTILITY COMMISSION
OF
OREGON

STAFF EXHIBIT 1112

Review of Financial Hedging

Exhibits in Furtherance
of Testimony in Support of Partial Stipulation

July 11, 2019

STAFF EXHIBIT 1112

IS CONFIDENTIAL AND SUBJECT TO

PROTECTIVE ORDER NO. 19-091

CASE: UG 366
WITNESSES: MATT MULDOON &
MOYA ENRIGHT

PUBLIC UTILITY COMMISSION
OF
OREGON

STAFF EXHIBIT 1113

Security Market News
News that Investors are Seeing

Exhibits in Furtherance
of Testimony in Support of Partial Stipulation

July 11, 2019

Bond-Yield Plunge Signals Unease

BY PATRICIA KOWSMANN, AVANTIKA CHILKOTI AND SAM GOLDFARB – WSJ 06.24.3019

The collapse in bond yields since this spring has been stark, swift and global, upending expectations that the world's economy would be strong enough to support a return to normal monetary policy after years of easy money.

The drop says investors expect a recession may be looming, and that central banks will have to step in with lower rates to try to forestall it. Ten-year bond yields last week fell to record lows in Germany and France and below 2% in the U.S. for the first time since 2016.

The drop in borrowing costs has spurred a rush by borrowers— home buyers seeking mortgages, corporations issuing bonds—to lock in the low rates.

Yet the signal from the bond market is confounding. Other measures of market sentiment remain buoyant: The S& P 500 on Thursday notched its first record close since April, reflecting expectations that Federal Reserve rate cuts later in 2019 will hold off a downturn.

The proximate causes of the bond-yield decline are numerous, interrelated and hard to quantify. The Chinese economy has been slowing, though fears of a crisis there haven't played out. Expectations of future inflation in developed countries have been plummeting, yet real measures of price change have declined only a little. Tariff threats out of Washington are throwing sand in the gears of global trade, but there are no signs of an outright collapse.

Another factor is a sense among investors that the global economy—hampered by aging demographics and weak productivity— just can't break out of a decade of tepid expansion and generate significant inflation. Yet even in Europe, where growth has weakened from its already labored pace, it isn't clear that economic contraction is imminent.

"**An aging population means lower potential growth. That in turn boosts savings and depresses investment.** Central banks struggle because they can't really control these factors, and in a way, they can make it worse," said Silvia Dall'Angelo, senior economist for Hermes Investment Management.

Europe, which faces these demographic challenges more than the U.S., has been ground zero for the fall in bond yields.

There is another quirk: a shortage of ultrasafe German government bonds. Known as bunds, they are the benchmark against which other assets in the region are measured. When investors seek safety, they pile into bunds, driving their prices higher. Yields fall as prices rise.

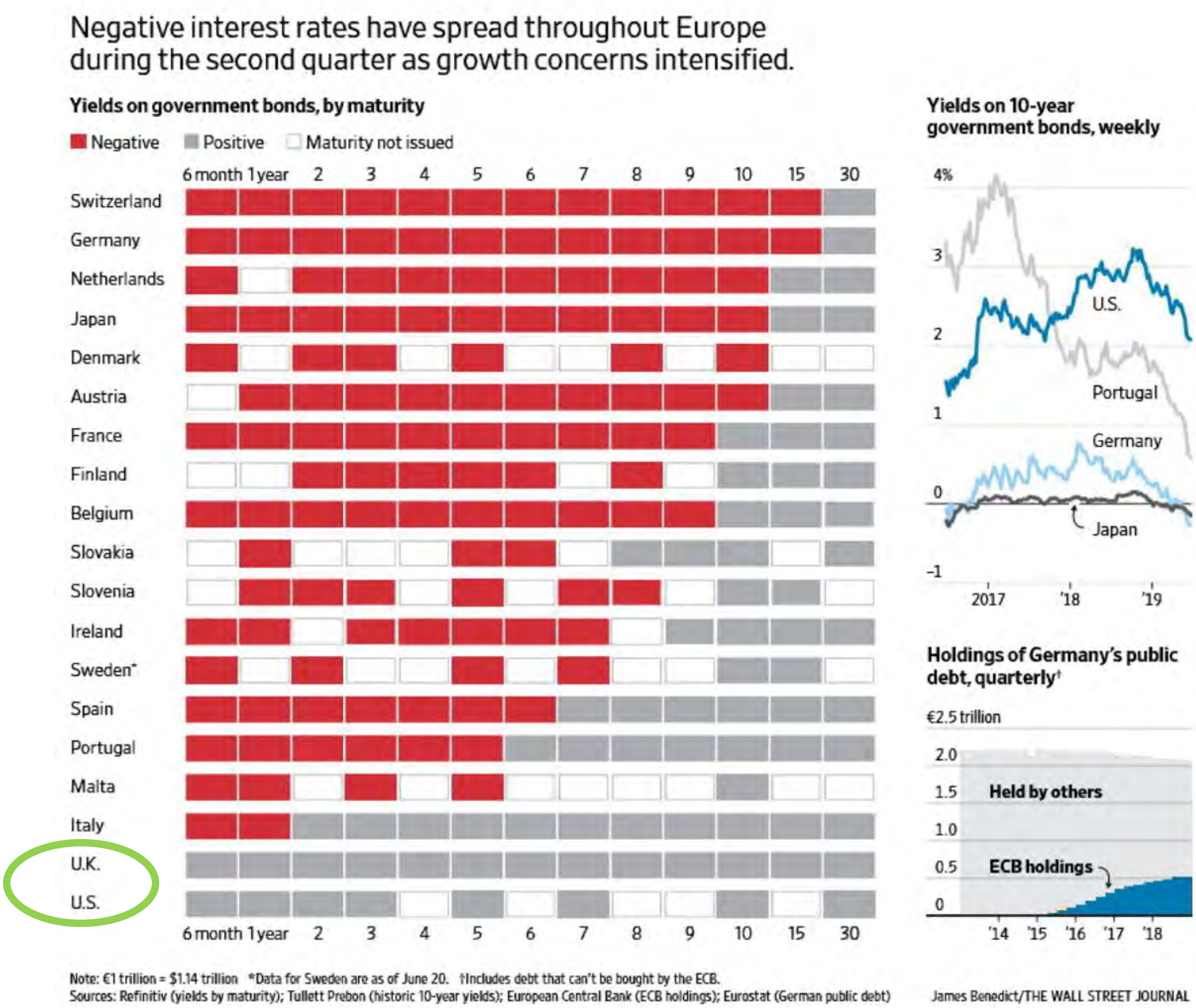
The yield on the 10-year bund last week hit minus- 0.32%, its lowest ever. A year ago, it was 0.5%.

"There's definitely a supply-demand crunch," said Ansgar Nolte, head of portfolio management at Frankfurt-based Berenberg, an investment bank.

There are about €1.5 trillion ($1.7 trillion) of German government debt securities, compared with about $16 trillion from the U.S. federal government. Germany's frugal government, which runs a budget surplus, has shrunk its debt to 59% of the size of the gross domestic product from 80% at the start of the decade. Over the past few years, the European Central Bank has gobbled up a huge chunk of bunds, reducing supply available to investors.

For big multinational companies and homeowners in the U.S., lower yields can spell opportunity. Companies that would have issued bonds later this year are doing so now instead "to lock in attractive rates as well as strong demand" from investors, said John Hines, head of global debt syndicate at Wells Fargo & Co.

In mid-June, U.K.-based telecom giant Vodafone Group PLC won low borrowing costs for decades by issuing a combined $2.25 billion of 30-year and 40year bonds. It will pay a slightly higher rate on the bond due four decades from now—5.125%—than the 4.375% it paid on a 10year bond issued in 2011.



Refinancing deals have picked up in the riskier high-yield bond arena, with independent power producer Talen Energy Supply LLC, hotel operator Hilton Worldwide Holdings Inc. and satellite-radio company Sirius XM Holdings Inc. among a large group of businesses able to push out debt maturities at relatively modest costs.

Homeowners also are rushing out to take advantage of the surprise fall in mortgage rates.The average 30-year mortgage rate has fallen to around 3.8%, from nearly 5% in November, according to Freddie Mac. That has led to a surge in applications for new mortgages, refinancings and home-equity lines, according to the Mortgage Bankers Association.

For savers around the world, meanwhile, low bond yields are punishing. Insurance companies, stuck with negative yields on government bonds, are increasingly lending directly to companies to get higher returns, buying packages of corporate loans—known as collateralized loan obligations—and mortgages, says Pascal Christory, chief investment officer at large insurer AXA France.

“It’s the beginning of a tsunami” away from safer bonds into these alternative investments, says Mr. Christory.

Some investors worry that low yields are a harbinger of slower growth that stock markets are ignoring.

“**The bond market is really saying that it thinks we are facing a significant slowdown or a recession, and the equity market thinks there has been no change at all**,” said Keith Guthrie, chief investment officer at Cardano, an investment group that advises or manages £120 billion ($94 billion) in the U.K. and the Netherlands.

He has piled into bonds in Canada and Australia where there are “overleveraged local consumers and overleveraged housing markets,” he said. That means central banks will be under pressure to keep rates low to prevent defaults.

Bond Yields Fall Across the Globe

BY AKANE OTANI – WSJ 03.28.2018

ECB hints at further delays in rate increases, signaling economic weakness

Government-bond yields from the U.S. to Germany slid, as signs that the European Central Bank could consider additional delays in interest-rate increases spurred a fresh round of bond buying.

The **yield on the benchmark 10-year U.S. Treasury note**, used as a reference for everything from mortgage rates to student debt, **fell to 2.374%—its lowest level since December 2017**—after settling at 2.418% Tuesday.

The yield on German 10-year government debt dropped to negative-0.078%, deepening a slide that recently took it into negative territory for the first time since 2016, while the yield on equivalent Japanese debt ended the day around its lowest level in more than two years.

Bond yields around the world have slipped this month as central banks have signaled they are willing to hold interest rates low for significantly longer than investors had expected just a year ago.

The moves have in large part been spurred by signs of slowing economic growth, particularly in the eurozone and China.

But in the U.S., where growth remains relatively steady, the Federal Reserve's argument for potentially delaying rate increases until next year has been strengthened by signs that inflationary pressures remain muted.

The bond market's rally on Wednesday appeared to accelerate after ECB President Mario Draghi suggested he could consider further delaying plans to raise interest rates.

"Just as we did at our March meeting, we would ensure that monetary policy continues to accompany the economy by adjusting our rate forward guidance to reflect the new inflation outlook," Mr. Draghi said in remarks prepared for a conference in Frankfurt.

Mr. Draghi's comments came weeks after the ECB unveiled plans to deploy additional stimulus and said it would hold interest rates below zero at least through December—months longer than investors had expected.

"The prospect of central banks tightening has diminished to the point where markets aren't expecting any further tightening" for the cycle, said Tracie McMillion, head of global asset allocation strategy at the Wells Fargo Investment Institute. "**Even if we see economic data turn, we're still looking at very low inflation and very low yields**."

Inflation is considered a major threat to bonds, since it chips away at the value of their fixed payouts and can push central banks to step up efforts to raise borrowing costs. Signs that prices across the U.S. economy are picking up modestly, even with a tight labor market and steady growth, have helped U.S. government bonds rally this year.

"In the absence of the threat of a Fed tightening or a surge of inflation, the 10-year is just a more attractive place to invest your money," said Kevin Giddis, head of fixed-income capital markets at Raymond James.

Confidence that the Fed will have to dial backits rate-increase plans for the foreseeable future has trickled into the futures market, where many traders have bet that the central bank may even have to lower rates by the end of the year.

Federal-funds futures showed Wednesday the market is pricing in a 26% chance of the Fed holding interest rates steady this year, compared with a 40% chance of one rate cut and a 25% chance of two rate cuts, according to CME Group.

That occurred even as some Fed officials, including Federal Reserve Bank of Dallas President Robert Kaplan, said this week that it was too soon for the central bank to consider cutting rates.

Part of investors' skepticism about the Fed's rate path stems from growing doubts about the economy's strength.

One widely watched indicator of growth expectations flashed a cautionary signal last week for the first time in more than a decade.

On Wednesday, the difference between yields on three-month and 10-year U.S. Treasurys fell even deeper into negative territory, trading at negative-0.065 percentage point—the lowest since August 2007.

Bull Market Isn't Helping Pensions

BY HEATHER GILLERS – WSJ 04.11.2019

Maine's public pension fund earned double-digit returns in six of the past nine years. Yet the Maine Public Employees Retirement System is still $2.9 billion short of what it needs to afford all future benefits to all retirees.

"**If the market is doing better, where's the money?**" said one of these retirees, former game warden Daniel Tourtelotte.

The same pressures Maine faces are plaguing public retirement systems around the country. The pressures are coming from a slate of problems, and the longest bull market in U.S. history has failed to solve many of them.

There is a simple reason why pensions are in such rough shape: **The amount owed to retirees is accelerating faster than assets on hand to pay those future obligations. Liabilities of major U.S. public pensions are up 64% since 2007 while assets are up 30%**, according to the most recent data from Boston College's Center for Retirement Research.

Public pension funds have to pay benefits—their liabilities. They hold assets, which grow or shrink through a combination of investment gains or losses and contributions from employers and workers. Those assets generally rose faster than liabilities for five decades starting in the 1950s because government was expanding and the number of retirees was smaller. **In the 1980s and 1990s, double-digit stock and bond returns convinced governments they could afford widespread benefit increases**.

But the value of their holdings— their assets—began to fall in the aftermath of the dot-com bust in the 2000s, and the 2008 financial crisis followed soon after. **State and local retirement systems lost 28% in 2008 and 2009**, according to the Boston College data.

"**The first thing you have to do is make up what you lost**," said Sandy Matheson, executive director of the Maine Public Employees Retirement System. "And it takes years. And **then you have to make up what you didn't earn on what you didn't have. It's a pretty steep climb**."

Cities and states set out to ramp up their yearly contributions to public pension funds as a way of making up for their investment losses.

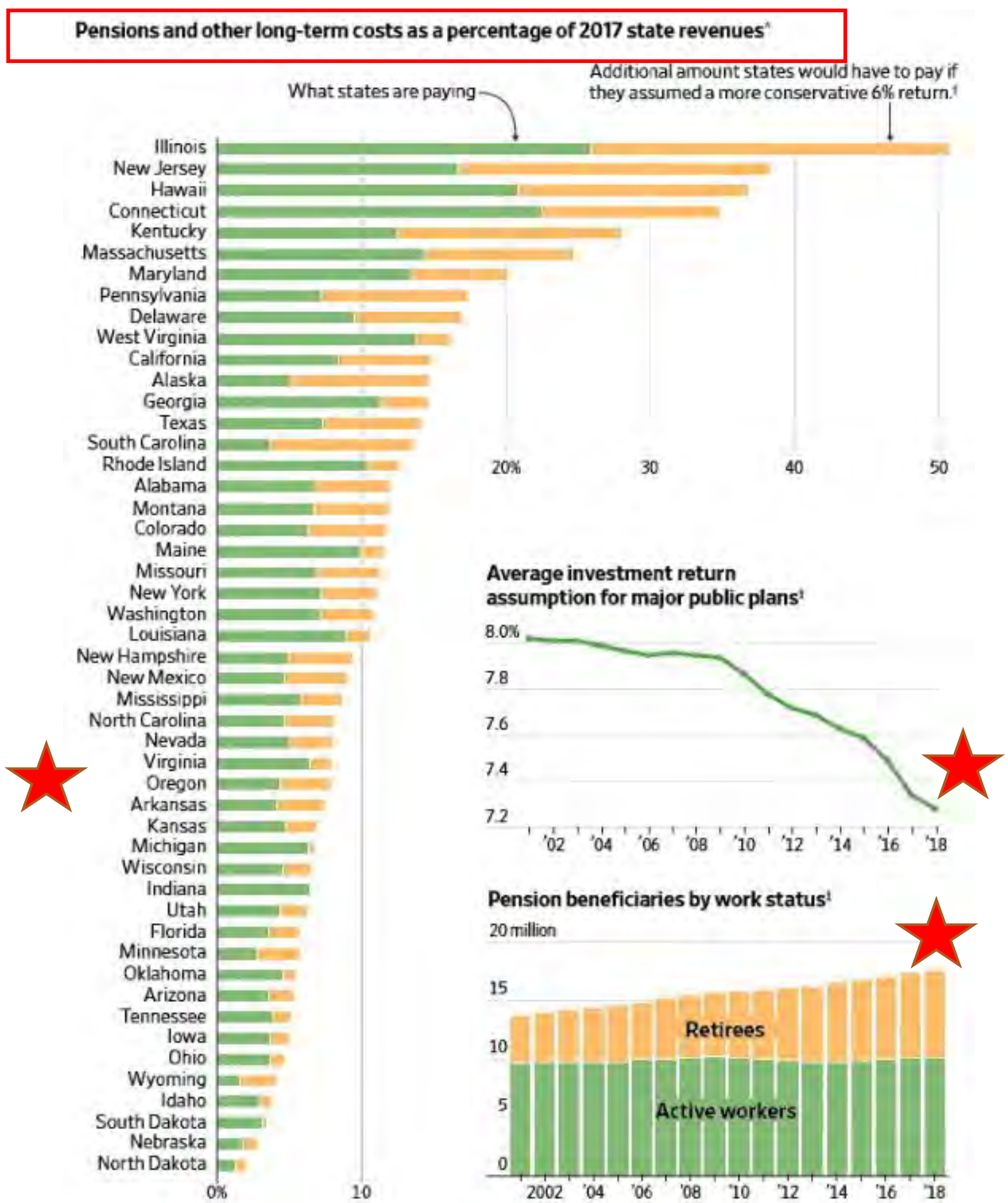
Some were able to keep up with those payments. But others weren't as they struggled with lower tax revenue and increased demand for government services in the aftermath of the 2008 crisis. New Jersey made less than 15% of its recommended pension payment from 2009 through 2012.

It now has a little more than one-third of the cash it needs to pay future benefits—despite robust investment returns in recent years.

State Treasurer Elizabeth Maher Muoio said New Jersey is on "the long road to addressing our unfunded liability after years of neglect."

"**Some of the states allowed themselves to get so underfunded that the higher returns aren't helping them enough**," said Michael Cembalest, chairman of market and investment strategy for the asset-management arm of JPMorgan Chase & Co. Mr. Cembalest is the author of an annual study on the financial health of cities and states.

Some states, including New York, Wisconsin, Tennessee and South Dakota managed to keep assets roughly in line with liabilities through funding discipline, benefit cuts, or both.



*Costs include retiree health care and interest on bonded debt. †Also assumes unfunded liability is paid off over 30 years in level payments. ‡Data cover 109 major pensions for which 2018 data is available.
Sources: J.P. Morgan Asset Management (pension cost); Boston College Center for Retirement Research (return assumption, beneficiaries)

Many states and cities reduced benefits for new employees after 2008. But deeper cuts often met resistance from judges, unions and angry constituents— even in some of the most indebted states.

The Illinois Supreme Court in 2015 threw out cuts by the legislature that were expected to save tens of billions of dollars. Kentucky's legislature last year declined to approve the governor's proposed cuts to cost-of-living increases for retired teachers after protests brought thousands to the state capitol and forced cancellations of classes in several school districts.

Maine, which has made more progress than many plans in addressing its unfunded liability, **did cut cost-of living increases for both retired and active state workers**. They earn a median pension of $27,000 after 25 or more years' service and don't receive Social Security. But that cut shaved only $1.6 billion off the fund's unfunded liability, which now stands at $2.9 billion.

Demographics became another problem as baby boomers aged. The number of pensioners jumped thanks to longer lifespans and a wave of retirees over the past decade, while the number of active workers remained relatively stable.

Maine's fund serves about the **same number of active workers that it did in 2008**—a little more than 51,000—while the **number of retirees has jumped 32% to about 45,000**. Many funds are experiencing the same trend.

That pattern contributes to an increasing gap between pension fund inflows and outflows— before the funds earn a dollar on investments. Maine's pension fund paid $982 million in benefits in 2018, $394 million more than the contributions it took in.

For a plan trying to improve its funding status, that type of gap makes it harder to recover from investment losses.

Many public pension funds have benefited from the 10year-long bull market. But now many are lowering their predictions of what they can earn in the future. That accounting change makes their liabilities look even larger, portending more strain in the coming decades.

The **Maine** pension fund, which back in the **early 1980s assumed a long-term investment return of 10%, now assumes a rate of 6.75%**. If that rate were just 1 percentage point higher—where it was about 10 years ago—the projected $2.9 billion shortfall, most of which must be paid off over the next decade, would drop by more than half to $1.1 billion.

The decision to lower the rate was based on discussions with the fund's actuarial and investment consultants and a goal of keeping costs predictable, said Ms. Matheson, the system's executive director. "There's also an element of better safe than sorry."

Cautious Fed Decides to Play It Safe

BY JUSTIN LAHART – WSJ 03.21.2019

The economy will probably climb out of the funk it fell into in the first quarter. But there is a difference between probably and certainly.

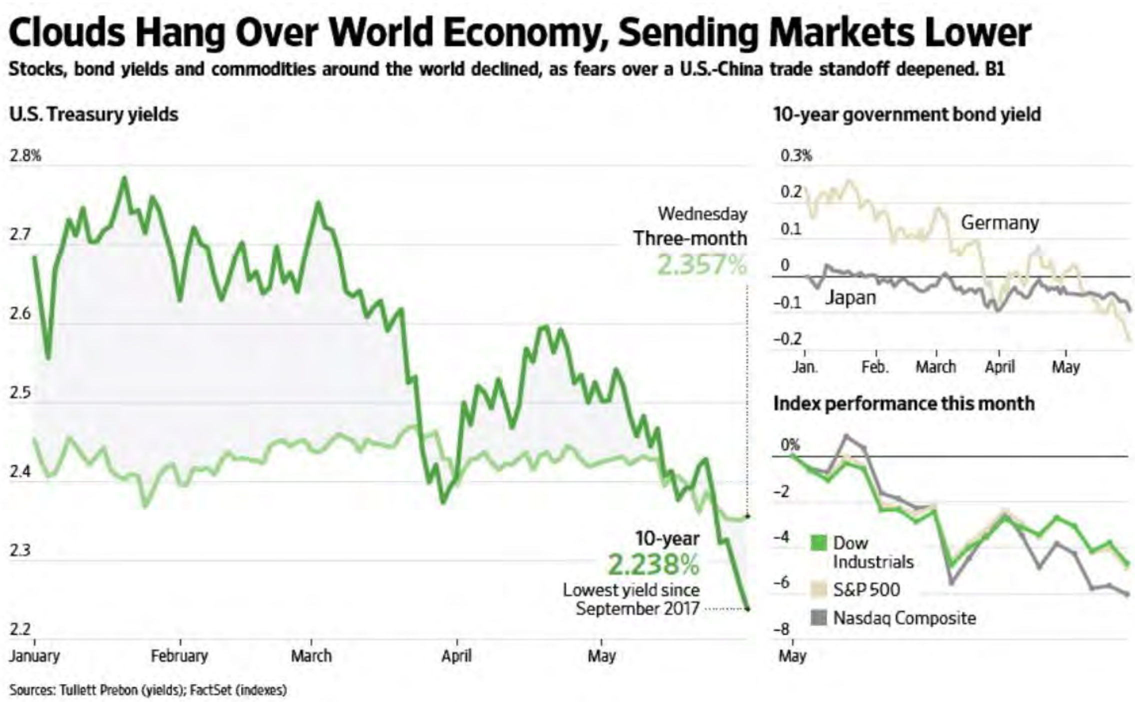
Federal Reserve policy makers decided to leave rates on hold Wednesday, which was no surprise. The degree of their dovishness was.

The statement released following their two-day meeting was downbeat on the economy. They also significantly dialed back their expectations of future rate increases.

Whereas in December their median projection called for two rate increases, now they expect none and next year they think they will raise rates only once.

In some respects, it seems like an overreaction. Sure, the economy has looked weak recently after being buffeted by the government shutdown, unusually inclement weather and the souring of sentiment that came with the stock market's selloff late last year. But the weakness seems temporary. Economists polled by Macroeconomic Advisers last week expect gross domestic product will grow at just a 1.1% rate in the first quarter, but that it will bounce up to 2.7% in the second quarter.

That rebound is just a forecast for a quarter that hasn't begun, however, and the Fed, which has had a tendency to err heavily on the side of caution since the financial crisis, can't count on it.

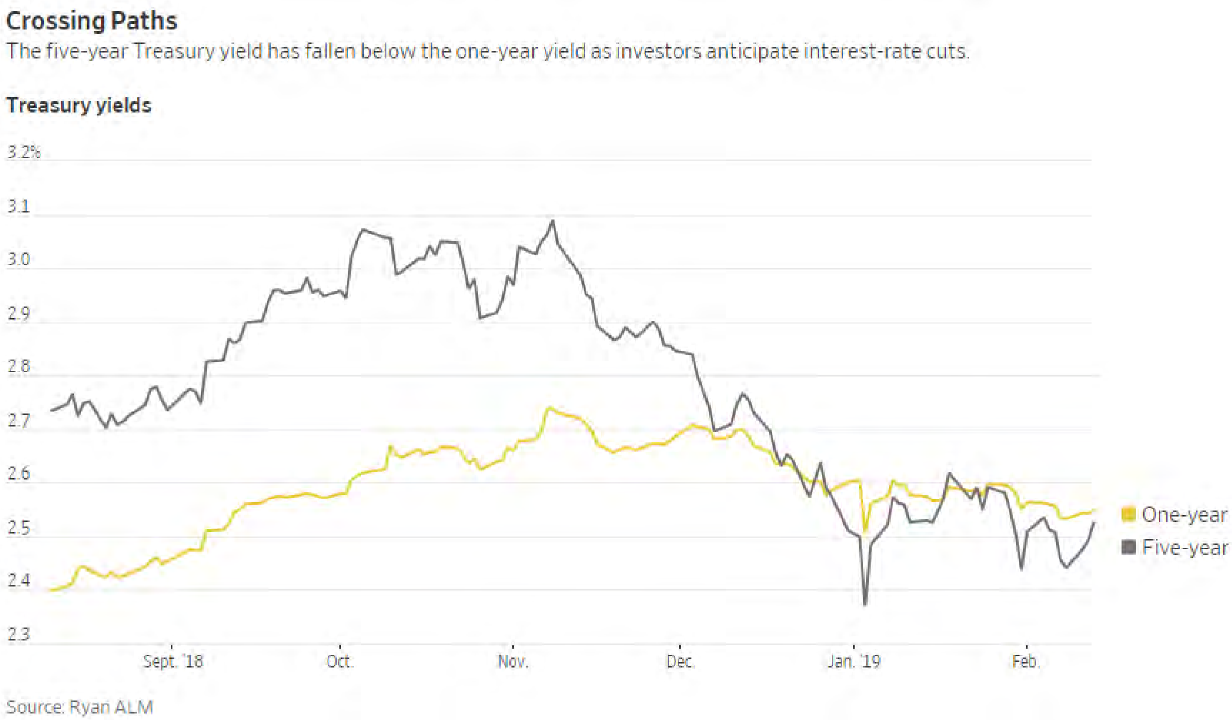


There is some sense to that caution, too: With its overnight target rate centered at just 2.375%, the Fed has little rate-cutting firepower if it gets its forecast wrong.

And what will the Fed do if, as seems probable, the economy revives? For now, as far as the central bank is concerned, that is a problem for another day.

Debt Investors Embrace 'Upside Down' World After Fed Shift

BY SAM GOLDFARB – WSJ 02.14.2019



Signs that the **Federal Reserve may be done with** its years long **campaign to raise interest rates** are sending ripples through fixed-income markets, **holding down interest rates** for a wide swath of borrowers.

The Fed's **latest policy stance** has **kept a lid on U.S. Treasury yields**, which play a major role in setting borrowing costs across the globe. It has provided a large boost to corporate bonds, particularly those that mature over roughly five to seven years, pulled down mortgage rates and **helped spark a shift in demand to fixed-rate debt from floating-rate debt**.

Taken together, recent moves show **investors are confident that the Fed is done raising rates** and that its shift to a more market-friendly posture can propel the economic expansion into a second decade even as concerns persist about slowing global growth and geopolitical tensions.

"Take the world that we were in over the past five years and flip it upside down," said Gennadiy Goldberg, U.S. rates strategist at TD Securities in New York.

For the Fed, the risk that another rate increase could cause significant economic harm outweighs the risk that not raising rates could lead to slightly higher inflation, Mr. Goldberg said. For investors, there is a growing opportunity cost to not owning bonds—particularly those that are more sensitive to changes in interest rates—since rates seem more likely to fall than to climb higher.

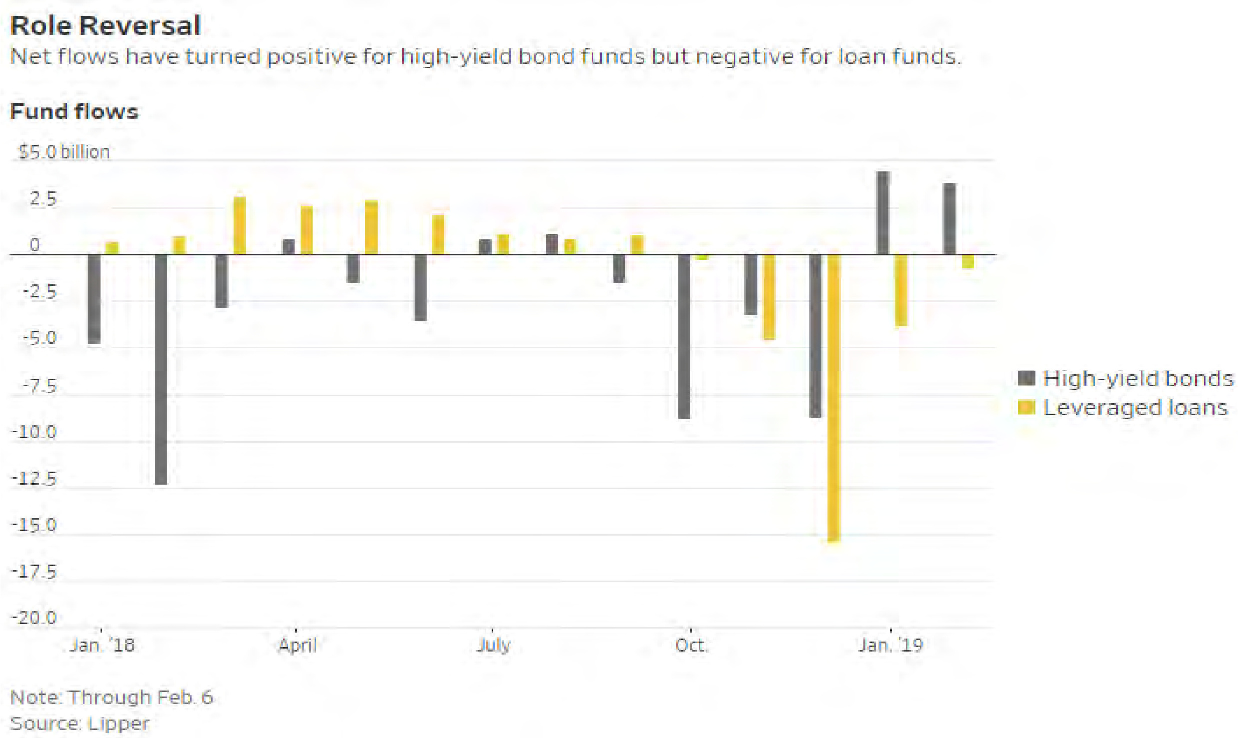
Central banks **raising interest rates pose one of the biggest threats to debt investors**, causing prices of existing bonds to fall to adjust for the higher rates on new bonds.

The **Fed's policy** turn has been **good for most bonds**, helping **keep Treasury yields low** despite a recent surge in riskier assets—something that often depresses appetite for ultrasafe government debt. The **yield** on the benchmark **10-year U.S. Treasury** note closed Wednesday at **2.706%, up from 2.557%** on Jan 3—the day before Fed Chairman Jerome Powell telegraphed the Fed's shift at a conference—but still well **below the multiyear highs around 3.2% it touched in November**.

Corporate bonds have fared even better than Treasurys, a result both of the diminished threat of interest-rate increases and the improved economic outlook now that the Fed has shifted to a more accommodative monetary policy.

The average extra yield, or spread, that investors demand to hold investment-grade corporate bonds instead of Treasurys has dropped 0.32 percentage points since its peak on Jan. 3—retracing about 60% of its widening in the last three months of 2018. Speculative-grade bonds have received an extra boost as investors have shifted money out of junk-rated loans, the coupons of which rise and fall with Fed-dictated interest rates.

The **Fed's** shift also has **caused some investors to move money from short-term bonds into slightly longer maturities**. The five-year U.S. Treasury note now yields less than the one-year Treasury bill—an indication **investors think the Fed will start cutting interest rates within the next few years**. Since Jan. 3, the average spread on investment-grade corporate bonds maturing in five to seven years has tightened more than the spread on one-to-three-year bonds or bonds maturing in at least 10 years.



Prices of bonds with longer maturities tend to fall more when their yields rise than shorter-term bonds do, typically making short-term corporate bonds a safer bet when the Fed is raising rates.

In recent weeks, five-year bonds have outperformed two-year bonds because “people aren’t as fearful of yields rising dramatically,” said Jeff Given, a portfolio manager at Manulife Asset Management, who favors corporate bonds over Treasurys because he doesn’t foresee a “big risk-off trade that is going to make Treasurys attractive.”

Still, corporate bonds that mature much beyond five years still don’t offer enough extra yield to overcome the increased risk that the businesses backing them could eventually encounter financial problems, several investors said.

In another sign that **investors are proceeding cautiously**, there has been an uptick in the amount of secured bonds issued by speculative-grade companies—an indication that **investors are eager to buy debt that offers them greater protection in bankruptcies than typical unsecured bonds**.

PHOTO - Key Takeaways From the Fed Statement and Powell's Press Conference. The Federal Reserve held its benchmark interest rate steady Wednesday and delivered its **strongest signal to date** that the central bank may have reached the **end of its latest series of interest-rate increases**.

ECB Floats Rate Cut to Counter Slowdown

BY TOM FAIRLESS AND BRIAN BLACKSTONE – WSJ 06.07.2019

VILNIUS, Lithuania—**European Central Bank President Mario Draghi opened the door to interest-rate cuts for the eurozone economy, a significant policy shift that amplifies a global trend toward easier monetary policy to combat weaker growth**.

The move, less than five months before Mr. Draghi leaves office, underscores the dovish tilt of Mr. Draghi's ECB over the past eight years—a positioning that has wowed investors but may not be repeated by his successor.

His comments on Thursday echo suggestions by Federal Reserve Chairman Jerome Powell this week that the U.S. central bank could cut short-term interest rates in response to any economic deterioration triggered by trade tensions.

The ECB was restrained in its policy statement, pledging to extend the time frame before any rate increase to the middle of 2020, from the end of this year, and announcing generous terms on a new batch of long-term loans for banks. The ECB's key interest rate is currently set at minus 0.4%.

But in a question-and-answer session, Mr. Draghi said several of the ECB policy makers, members of the 25-strong rate-setting committee, had raised the possibility of rate cuts while others mentioned restarting asset purchases.

Asked whether the ECB's next move on interest rates was more likely to be a rise than a cut, Mr. Draghi said, "No."

That marks a big shift, because the ECB had previously been moving to phase out its extraordinary policy tools, including negative interest rates, and had been steering investors to expect a future interest-rate increase. The central bank phased out its €2.6 trillion ($2.917 trillion) bond-buying program, known as quantitative easing, in December.

The euro rose after the ECB announced its decision and remained higher even after Mr. Draghi referred to the rate-cut discussion.

To be sure, the eurozone economy still appears to be growing, if more slowly than in recent years. Inflation in the region is expected to pick up gradually from its current level of 1.2%, according to new ECB staff forecasts published on Thursday. The ECB aims to keep inflation close to but below 2% over the medium term.

But ECB officials are increasingly concerned by foreign headwinds, including the rising threat of protectionism and vulnerabilities in emerging markets, which are leaving their mark on economic sentiment.

Many other central banks have either lowered interest rates or have put reductions on the table. India's central bank on Thursday cut its key lending rate for the third time this year. On Tuesday, the Reserve Bank of Australia lowered its benchmark rate.

Other central banks in the Asia-Pacific region including New Zealand, Malaysia and the Philippines have reduced interest rates in recent weeks. China's central bank has taken steps to encourage more bank lending to small businesses.

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ECB's Draghi Hints at Potential Stimulus

BY TOM FAIRLESS – WSJ 06.19.2019

SINTRA, Portugal—**European Central Bank President Mario Draghi signaled the bank could roll out fresh stimulus as soon as July**, sending the euro lower against the dollar and prompting an unusual rebuke from President Trump.

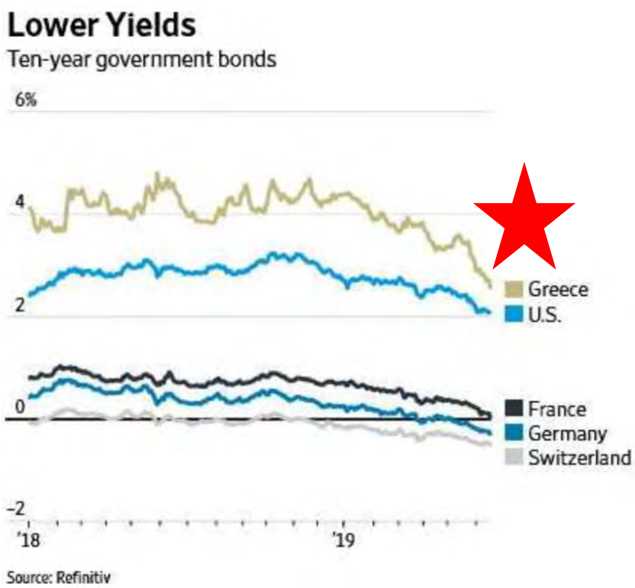
Mr. Draghi said Tuesday that ECB policy makers would consider in the coming weeks how to adapt their policy tools "commensurate to the severity of the risk" to the economic outlook. Options include extending the time frame before the next interest-rate increase, a reduction in the already negative- policy rate or restarting bond purchases.

"Mario Draghi just announced more stimulus could come, which immediately dropped the Euro against the Dollar, making it unfairly easier for them to compete against the USA," Mr. Trump tweeted after Mr. Draghi's comments were released.

Mr. Trump has taken a strong interest in short-rundevelopments in currency markets and has voiced concerns about the strength of the U.S. dollar. Those concerns reflect Mr. Trump's broader view that global trade can be a zero-sum game, in which the gains of one nation come at the expense of others.

Investors responded favorably to Mr. Draghi's remarks, which sent the euro down by more than half a cent against the dollar, to $1.1187. Yields on 10-year German government bonds fell to a record low of minus 0.315% as investors digested the prospect of new bond purchases by the ECB. French 10-year yields dropped sharply and hit 0%, their lowest ever.

In a panel discussion later Tuesday, Mr. Draghi responded to Mr. Trump's criticism, saying that the ECB doesn't directly target the euro-exchange rate with its policies. He stressed that the central bank is prepared to use all its policy tools to ensure inflation returns to its target of just below 2%.



"We have our remit, we have our mandate," Mr. Draghi said. "We are ready to use all instruments that are necessary to fulfill the mandate."

The European Union has long sold more goods to the U.S. than it has bought. But that trade surplus reached a record high of €139 billion ($155.6 billion) in 2018, up from €119 billion in 2017. Figures released Tuesday showed the bloc's surplus has continued to widen in 2019, although at a slower pace, amounting to €48.2 billion in the first four months of the year.

Advisers to Mr. Trump have complained for years that the euro is grossly undervalued. The U.S. administration has threatened to impose tariffs on Europe's auto exports unless the bloc strikes a trade deal with the U.S. "European Markets rose on comments (unfair to U.S.) made today by Mario D!" Mr. Trump tweeted. "They have been getting away with this for years, along with China and others."

His comments raise the prospect of a "nightmare scenario" in which the ECB and Federal Reserve engage in a race to the bottom on exchange rates, creating economic damage that could be aggravated by trade tariffs, said Frederik Ducrozet, an economist with Pictet Wealth Management in Geneva.

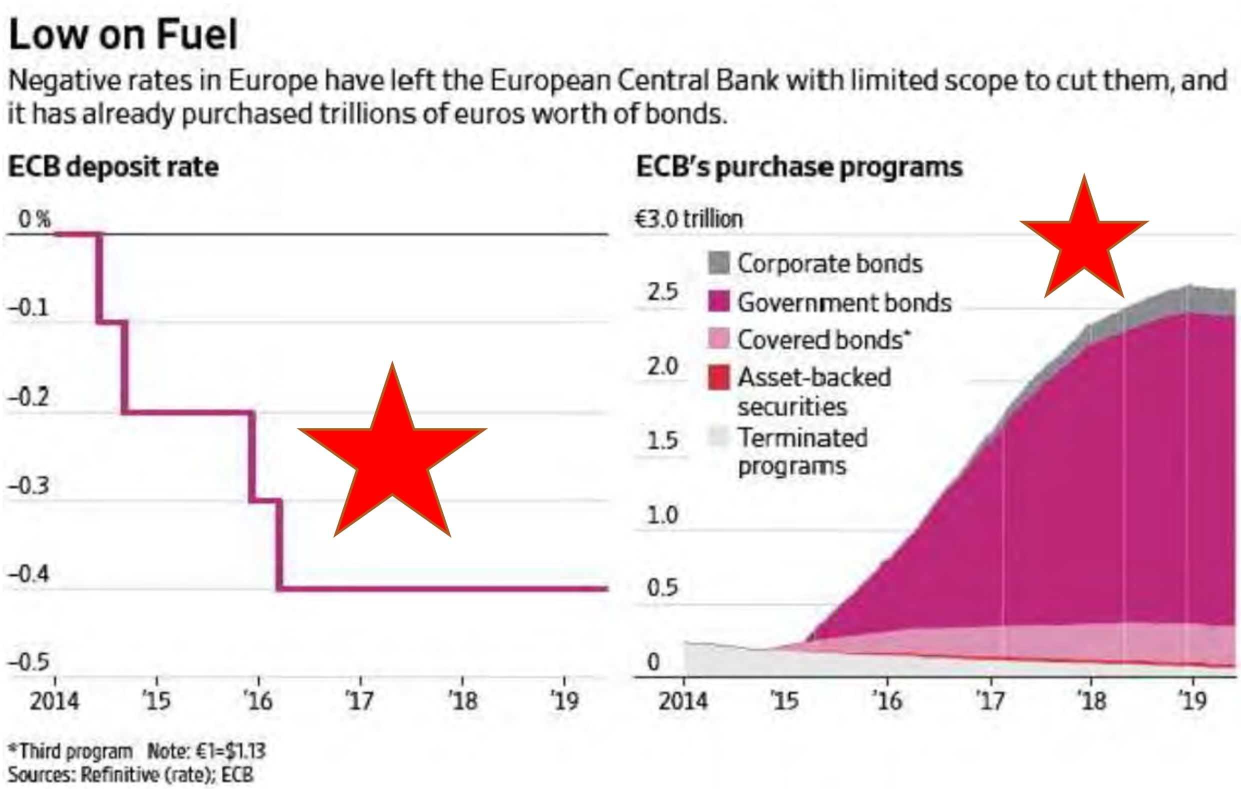
The speech was Mr. Draghi's last at the ECB's Sintra conference before his term ends in October. It indicates the Italian's impact could be felt for some time after he steps down.

ECB's Tools to Reverse A Slowdown Are Limited

BY BRIAN BLACKSTONE AND TOM FAIRLESS – WSJ 06.08.2019

The European Central Bank has pushed interest rates into negative territory and bought trillions of euros in bonds to sustain the eurozone's economy. Now, with the economic expansion flagging, a critical question is emerging: How much gas does it have left in the tank?

President Mario Draghi has said the ECB has 'considerable headroom' to buy assets again.



Not much, analysts say, unless the ECB gets more creative on interest rates and asset purchases.

ECB President Mario Draghi signaled Thursday that the ECB is considering rate cuts and restarting bond purchases, as central banks around the world weigh easier monetary policy.

Mr. Draghi's verbal signals— even though the ECB took no fresh action on rates— are one tool commonly used by central bankers: communication with financial markets that can ease financial conditions without doing anything.

Other ECB stimulus measures have included rate cuts, bond purchases and cheap long-term loans to banks, called TLTROs. The terms of those loans could be sweetened more to encourage lending, analysts say.

Yet the ECB is constrained in how forcefully it can deploy this traditional tool kit, a view underscored by the limited reaction in European markets to Mr. Draghi's comments. The euro rose, even though easier monetary policy usually weakens a currency. Germany's 10year bond yield fell to a record low but other European bonds were mixed. Bank stocks fell.

The ECB's key policy rate is already negative, and further cuts could weaken European banks by forcing them to pay higher fees to park excess reserves. Roughly €2.6 trillion ($2.9 trillion) in government and private-sector bond purchases from 2015 through 2018 left the ECB's balance sheet very high at about 40% of the eurozone's gross domestic product, limiting the scope for more large-scale purchases.

Acting incrementally on these fronts "would not be our famous big bazooka, but would show that they are able to do something," said Carsten Brzeski, an economist at ING Bank.

If the world economy is indeed on the cusp of a fresh easing cycle—central banks in the Asia-Pacific region have already lowered rates and the Federal Reserve has signaled it may do so—then the ECB is starting in a weaker position.

The Fed's policy rate is positive, at a range of 2.25% to 2.5%, giving it more room. The U.S. has a deeper pool of government bonds, giving the Fed plenty of assets to buy if it wishes.

Bolder steps by the ECB, Mr. Brzeski said, would require tweaking existing rules to make it easier to purchase more government bonds or corporate debt, which is a small share of the total.

But financing costs are already super low, and reducing them more could keep inefficient, profitless firms afloat— weighing on productivity—or fuel housing bubbles in places like Germany.

The ECB has "considerable headroom" to buy assets again, Mr. Draghi said Thursday.

An extreme move, Mr. Brzeski said, would be to expand the pool of available assets to include European equities. Japan's central bank already buys equities. Switzerland's does too, though the Swiss National Bank holds foreign equities only to weaken the strong Swiss franc and protect exporters.

The impact of equity purchases would be limited, however, because eurozone households tend not to own much in stocks.

Another step that Japan has used, explicitly targeting long-term yields, would be hard to replicate in Europe because the euro bloc has 19 different government bond markets.

Still, the need to quickly follow Mr. Draghi's words with actions was underscored Friday by grim economic reports from Germany. Industrial production dropped 1.9% in April from March. Exports fell by 3.7% in April. Germany's central bank warned Friday of a "marked cool down" in activity and shaved its forecast for gross domestic product growth this year to 0.6% from 1.6%.

The ECB refrained from taking fresh easing steps Thursday, though it did extend the time frame for any future rate increases to the middle of next year. In a press conference, Mr. Draghi said “several” members of the ECB’s 25-person governing council discussed a reduction in the bank’s minus 0.4% deposit rate while others raised the possibility of restarting asset purchases, which ended in December.

Central banks’ money-printing powers mean they never truly run out of options. Buying assets with freshly created reserves reduces long-term interest rates by raising the supply of money. That, in turn, makes it easier for households and businesses to borrow and spend.

But in the ECB’s case, its existing tool kit quickly runs into limits or negative consequences.

Some officials—notably Bundesbank President Jens Weidmann, a candidate to succeed Mr. Draghi when he steps down this year—are skeptical of government bond purchases, which are controversial in Germany due to concerns about central banks financing governments.

The ECB is also approaching self-imposed limits that restrict how much of an individual government’s debt the central bank can buy. Those limits could be raised, but that could pose legal risks.

ECB Reverses Course with New Stimulus Measures

BY TOM FAIRLESS AND BRIAN BLACKSTONE – WSJ 03.07.2019

European Central Bank announces new cheap loans for banks, a more aggressive response to the slowdown than investors had expected.

Left: Mario Draghi, President of the European Central Bank, at a news conference in Frankfurt on Thursday.

The European Central Bank made a **major policy reversal** Thursday, unveiling plans for **fresh measures to stimulate** the **euro-zone's faltering economy** less than three months after phasing out a €2.6 trillion ($2.9 trillion) bond-buying program, making it the first rich-country central bank to ease policy in **response to** the **global slowdown**.

The **ECB** said it would **hold interest rates at their current levels** at least **through** the **end of this year** – months longer than previously signaled – **and** announced plans for a fresh batch of **cheap long-term loans for banks**. The **first** loans will be launched **in September**, each **with** a **maturity** of **two years**.

Despite the new stimulus, **ECB President Mario Draghi said** that the **risks** to the economy remain **prevalent**, **though** the **likelihood** of a **recession** is very **low**. Thursday's **decision** was **unanimous**, he said at a press conference. "Given the complexity of the package, I think this is a very positive sign," he added.

The policy moves represent a more aggressive response to the economic slowdown than investors had expected. The euro fell against the dollar 0.4% on the day, with one euro buying $1.126. The Italian 10-year bond rallied, with yields falling to 2.586% from 2.647%. **German 10-year bund yields fell to 0.09% from 0.12%**, a sign of the **continued extraordinarily loose lending conditions** in the euro-zone.

The bank "surprised almost everyone by announcing a new series of measures, trying to avoid an unwarranted tightening" of its policy stance, said Carsten Brzeski, an economist at ING Bank.

The move reflects a reversal in Europe's outlook. Boosted by the ECB's stimulus measures – including bond buying and negative interest rates – and a surge in demand for its exports from China and elsewhere, the **euro-zone's economy** grew at the fastest pace in a decade during 2017, outpacing the U.S. But it **slowed sharply last year** as those sources of support waned, growing at its weakest pace since 2014.

The **ECB** also **slashed** is **forecast** for **gross domestic product growth this year to 1.1% from 1.7% in December**. It **lowered** its **inflation projection to 1.2% from 1.6%, further below** the **ECB's target** of just under **2%.**

"The persistence of uncertainties related to geopolitical factors, the threat of protectionism and vulnerabilities in emerging markets appears to be leaving marks on economic sentiment," Mr. Draghi said.

Unlike other parts of the world, Europe has largely relied on the ECB to boost growth since the financial crisis, with governments focusing on cutting debts through austerity programs. The **U.S. launched large cuts in corporate taxes in 2017**, **boosting growth while widening the budget deficit**.

China's government has **unveiled growth-enhancing remedies**, including **new tax cuts and increased bank lending to small and private companies**. But while some European countries recently announced targeted tax cuts, they aren't on the scale of what the U.S. and China have done.

The **ECB** is the first **major developed-country central bank to provide new stimulus** at a time when the global economy is softening. The Fe**deral Reserve has paused** its **march toward higher interest rates** in recent months **but hasn't signaled any new easing steps**. The **Bank of Japan is buying bonds under a longstanding program**.

The ECB has in the past been criticized for waiting too long to stimulate its economy – it launched large-scale bond purchases in early 2015, several months after the Fed ended its own program – and Thursday's measures underscore the sharp weakening in Europe's growth prospects.

"We never thought we were behind the curve," Mr. Draghi said, and "in any event today we are not behind the curve, for sure."

Officials are seeking to shore up an economy that has been rattled by **shocks ranging from** a **slowdown in China to mass protests in France** and **bottlenecks** in **Germany's** crucial **auto industry**. They are treading a careful path between providing sufficient support for the region's softening economy while avoiding any appearance of panic, which could ricochet through financial markets.

Recent economic data show few signs of a rebound in euro-zone growth, even if the outlook appears to have stabilized in parts of the region. **Italy**'s economy, the bloc's third largest, **slid into recession at the end of last year**, and the region's inflation rate has fallen to 1.5%.

Although the global economy has weakened in recent months, Europe seems to be feeling the brunt of it. On Wednesday, the **Organization** for **Economic Cooperation and Development slashed** its **forecast** for **euro-zone growth** this **year to 1%,** from a 1.8% projection in November. In contrast, it only shaved slightly its projections for the U.S. and China, by 0.1 percentage point each to 2.6% and 6.2%, respectively.

Still, the **ECB refrained from more extreme measures such as restarting** its **bond-buying program or cutting its deposit rate further <u>from minus 0.4%</u>.** These options weren't discussed, Mr. Draghi said.

"In a dark room, you move with tiny steps," he said.

Emerging Markets Cut Rates on Expectations of Fed Easing

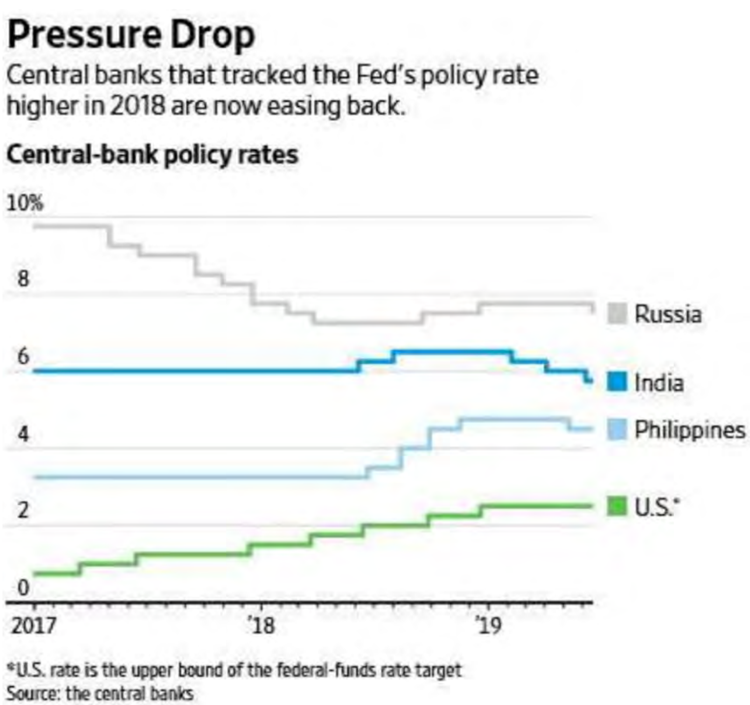
BY PAUL HANNON – WSJ 06.15.2019

Central banks in emerging markets around the world are cutting interest rates, with Russia the latest example, as expectations of easier money in the U.S. give them the room to stimulate their economies.

The Russian central bank cited the recent change in course by the Federal Reserve toward looser monetary policy in its decision to lower its key interest rate by a quarter-percentage point to 7.5%. Bank of Russia Gov. Elvira Nabiullina said a further rate cut was possible at one of the bank's coming board meetings.

Just six months ago, the Russian central bank had to raise interest rates to get ahead of the Fed's ninth rise in three years. Last year, tighter monetary policy in the U.S. pressured a raft of emerging markets' central banks to keep monetary policy tight.

U.S. central-bank officials are now considering whether to cut rates, if not at their meeting next week, than in July or coming months.



In January, the Fed surprised investors by signaling it was done raising interest rates for now, opening the way for a series of cuts in developing countries.

U.S. monetary policy has an outsize effect on central banks in emerging markets because of its influence over global flows of capital and currency moves. When the U.S. raises rates, it encourages investors to bring their capital back home, forcing developing countries to follow—even if their economies are slowing— to keep their currencies steady and avoid a surge in inflation as the prices of imports rise.

When the Fed is easing, others can follow suit, and indeed sometimes have to avoid appreciations in their currencies that would hurt exports and push inflation down.

Since April, India, Malaysia and the Philippines all have lowered rates, while China's central bank has taken steps to encourage more bank lending. **That trend is likely to broaden over coming months, particularly if the Fed cuts its key rate, as officials have signaled it may. The European Central Bank is also considering cutting rates**.

The South African Reserve Bank could cut borrowing costs this summer to help counter an economic contraction there. The bank has been criticized for not slashing rates more aggressively as South Africa battles with high unemployment.

Egypt, Indonesia, Mexico and South Korean could also follow suit, analysts say.

Central banks are responding to signs that the global economy is losing momentum. The World Bank expects the global economy to expand 2.6% this year, due to falling trade and investment flows, in what would be the slowest expansion since 2016.

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Fed Begins Debate on Whether to Cut Rate as Soon as June

BY NICK TIMIRAOS – WSJ 06.06.2019

Trade tensions darken economic outlook, raising possibility of interest-rate cut in weeks or months ahead.

Fed officials have signaled recently that they are attentive to the risks of a sharper-than-expected slowdown in growth – a sign that an interest-rate cut could be on the table in coming months.

Federal Reserve officials are beginning preparations for a June policy meeting with difficult choices to deliberate.

One month ago, Fed Chairman Jerome Powell played down speculation of a rate cut this summer. **Now** officials face a **darker economic outlook**, making a **rate cut possible** – if not at their meeting on June 18-19, then possibly in July or later.

Officials need to decide what would trigger such action, how much more information they want before making a decision and how to signal their intentions and plans. The Fed is set to begin its customary pre-meeting quiet period at the end of this week.

Traders in futures markets have placed about a 25% chance of a rate cut by the June 18-19 meeting, and a 75% chance of at least one cut by the meeting after that, on July 30-31, according to CME Group. Unlike in May, officials haven't expressly pushed back against market pricing on rate cuts in recent days.

Instead, Fed officials, who gathered at the Federal Reserve Bank of Chicago this week for a research conference, signaled in broadcast interviews and speeches that they are attentive to the risks of a sharper-than-expected slowdown in growth, a sign that an interest-rate cut could be on the table at coming meetings.

"We do not know how or when these trade issues will be resolved," Mr. Powell said on Tuesday. "We are closely monitoring the implications of these developments for the U.S. economic outlook and, as always, will act as appropriate to sustain the expansion."

Fed Vice Chairman Richard Clarida and Governor Lael Brainard made similar statements in recent days without indicating when any action might be needed.

Just two weeks ago, Fed leaders indicated they didn't see a strong reason to move rates up or down. New York Fed President John Williams, a top ally of Mr. Powell, was set to speak Thursday afternoon in New York.

While U.S. economic data hasn't weakened dramatically, an escalation of separate trade tensions between the U.S. and both China and Mexico has convinced bond investors in recent days that it is only a matter of time before these developments hit business investment, which could slow hiring and consumer spending.

On May 5, just days after the Fed concluded its most recent policy meeting, President Trump announced he would increase tariffs on China. Mr. Powell on May 1 had cited a possible trade resolution as one reason for an optimistic outlook.

Then on May 30, Mr. Trump delivered an even bigger surprise, threatening to impose 5% tariffs on Mexico beginning June 10 to force that country to stem rising migration of Central Americans at the U.S. southern border.

Fed officials face the following tension: On one hand, they don't want to react prematurely to events that could quickly change. Just as President Trump's sudden decisions to increase tariffs on China and Mexico have blindsided markets, so too could potential White House deals that avert further escalation, improving the economic outlook.

On the other hand, one loud message out of this week's Chicago conference is that Fed officials should move more quickly than the central bank has in the past to shore up growth at the first sign of weakness because with their short-term benchmark at a historically low level, they don't have as much room to cut rates as in previous downturns.

In other words, officials must balance the risks of easing too soon with the costs of waiting too long. In recent weeks, some Fed officials have approvingly cited examples from 1995 and 1998 in which the central bank took out "insurance" against looming economic weakness by cutting rates, extending an economic expansion.

In addition to debating the merit of such a move, one question they could confront at their coming meeting is whether the window for acting might close sooner than they anticipate.

Officials already **expect** the **economy to slow to around 2% growth this year from 3% last year**, but any forecast of a sharper slowdown would be worrisome because they have already revised down their projections of inflation. **They no longer expect inflation to rise to their 2% target this year** after a string of surprisingly soft readings in the first quarter.

Both **weakening growth and inflation could be** a **sign** the Fed's policy stance, with a **benchmark rate** between 2.25% and 2.5%, is **too tight**.

Fed officials preparing for the June 18-19 meeting will be closely watching the freshest economic data and the state of trade talks. Mexican ministers are meeting in Washington this week to head off the tariffs, meaning a resolution is still possible before the meeting. Indications that the economy is holding up and progress is being made in the Mexico negotiations could bolster the Fed's current wait-and-see policy stance.

Fed officials would then watch the same developments ahead of their July 30-31 meeting, including any changes in U.S – China trade talks. Mr. Trump and Chinese President Xi Jinping are set to attend the G-20 summit of world leaders, in Japan, at the end of June.

Central-bank policy makers will aim to avoid a rerun of their December policy meeting, in which they raised interest rates by a quarter-percentage point and signaled more increases were likely at a time when markets believed the economy couldn't support higher borrowing costs.

Markets didn't think the Fed was acknowledging the risks to the outlook and tumbled in the weeks after the meeting, leading Mr. Powell to signal a pause in early January. By March, most officials concluded the economy wouldn't warrant higher rates this year.

Fed Considers More Flexibility in Inflation Target

BY NICK TIMIRAOS – WSJ 02.25.2019

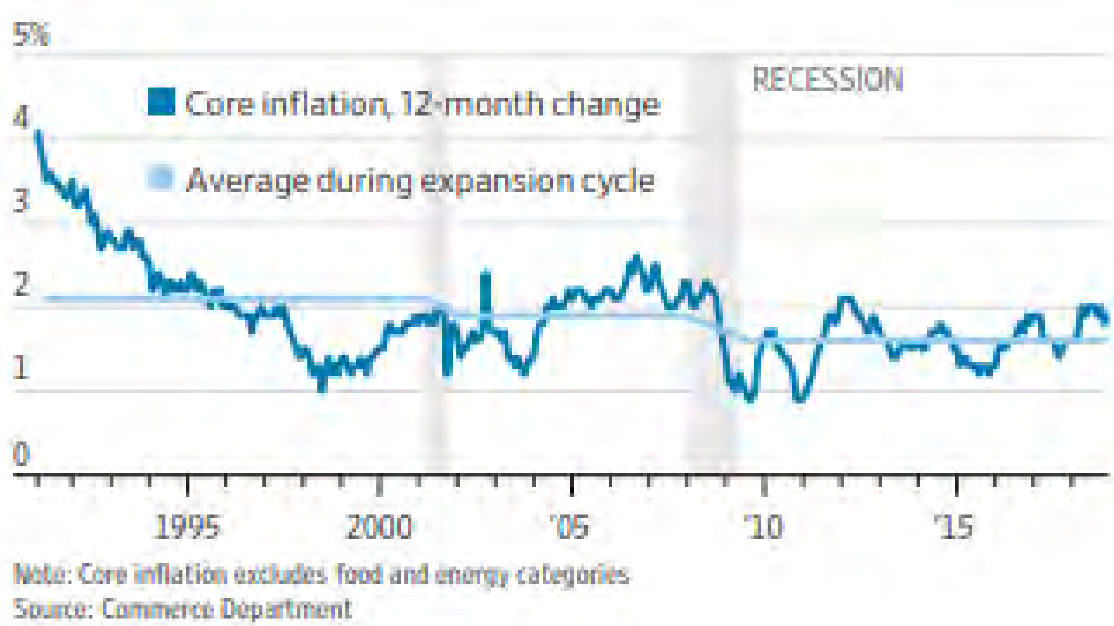
Federal Reserve officials are considering whether to allow inflation to rise above their 2% target more often as they grapple with the prospect that interest rates are likely to remain much lower than in the past.

The discussions are preliminary but are heating up now because the Fed formally kicks off a monthslong review of its policy framework with a national listening tour beginning this week in Texas.

Animating the review is the uncomfortable prospect that the Fed's benchmark shortterm rate could peak at or slightly above the current range between 2.25% and 2.5%.

Such low rates leave the Fed less room than in the past to cut rates in a downturn and increase the possibility they might be pinned near zero for longer in future recessions. In each of the last three downturns, the Fed lowered its benchmark by roughly 5 percentage points.

"It's a good discussion—to think about how we have policy space, particularly if interest rates through this cycle are not going to be much higher than they already are," said Boston Fed President Eric Rosengren in an interview.



Fed Chairman Jerome Powell could be questioned about the review when he testifies on Capitol Hill this week.

Fed officials have said they could employ the unconventional stimulus tools they used after the 2008 crisis, including bond-buying programs. But some, including Fed Vice Chairman Richard Clarida, who is heading the review, have expressed misgivings about the programs' effectiveness.

When central banks were first setting inflation targets in the 1990s, they were worried about inflation running too high and sought to establish expectations that future inflation would be tame. Behind this approach was the belief that expectations play a role driving actual inflation.

The Fed established a 2% inflation target in 2012, but inflation has run below that target for much of the recent expansion. Fed officials have defined this target as symmetric, meaning they would tolerate inflation running modestly above or below it. A measure of inflation that excludes volatile food and energy categories has averaged 1.6% since the target was adopted in 2012, though it has been running recently at 1.9%.

The risk that Americans could start expecting inflation to languish below 2% “calls for a reassessment of the dominant inflation-targeting framework,” New York Fed President John Williams said Friday at a conference in New York.

The Fed isn’t looking to raise the 2% target as part of its review, Mr. Powell said in December. Rather, “we are looking for better ways to achieve the inflation goal, for example, on a symmetric basis,” he said.

Changes in how the central bank defines its target could boost the power of monetary policy in a downturn, said Mr Rosengren.

“You can have the exact same inflation target, but…how you measure it [can] give you more space,” said Mr. Rosengren. Right now, the Fed isn’t very specific about how it sets the target, he said.

With the current target, the Fed aims for 2% inflation every year, no matter what happened the year before—a “let bygones be bygones” approach.

A couple of alternatives are getting a serious look.

The first, a price-level target, would call for the Fed to react to what happened before. If inflation undershot 2% one year, the Fed would try to catch up by allowing an overshoot in the next.

Former Fed Chairman Ben Bernanke has proposed a modified version of a price-level target that would be used only after periods in which the Fed cut interest rates to zero, essentially promising to keep rates lower for longer to ward off deflationary expectations.

The second approach, called an average inflation target, would be a hybrid of a pricelevel target and the current framework. It would target 2% inflation “on average” over the business cycle, meaning inflation would need to be a bit higher than 2% during good times to make up for a shortfall during downturns.

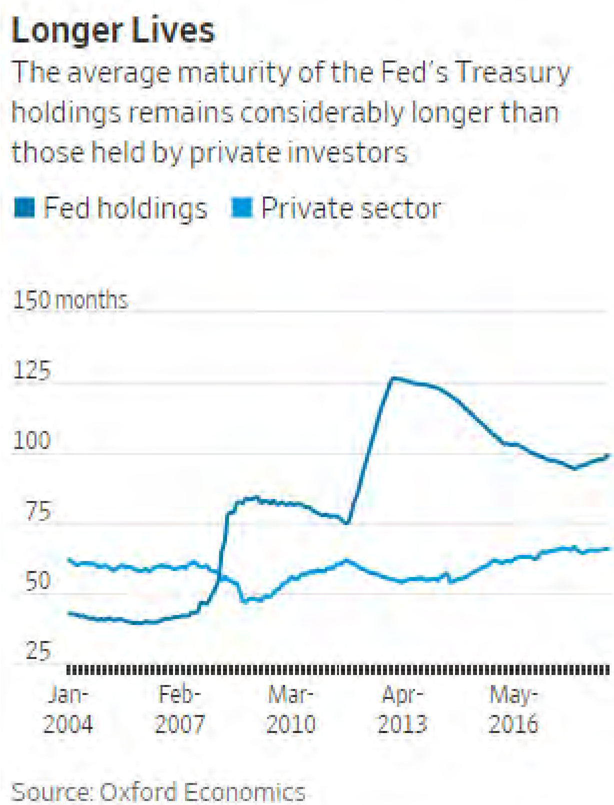
Fed Faces Crucial Decision on Mix of Treasurys in Its Portfolio

BY NICK TIMIRAOS – WSJ 03.19.2019

Markets have cheered the Federal Reserve's imminent announcement that it will stop shrinking its asset portfolio later this year, but determining that date is just one challenge facing central-bank officials.

Now, they are turning to the arguably more sensitive task of determining the composition of the Treasury securities the central bank will hold.

Specifically, they need to decide the right combination of Treasurys of varying duration to hold—whether mostly short-term bills or a mix that also includes more longer-term notes and bonds. This composition will be a matter of intense interest to the markets for those securities, with implications for the economy and monetary policy.



"Favoring short-term notes is seen as giving central bank more flexibility if economic growth slows"

The composition "is more policy-relevant than many of the things people have discussed about the balance sheet," such as the size, said Boston Fed President Eric Rosengren in an interview last month.

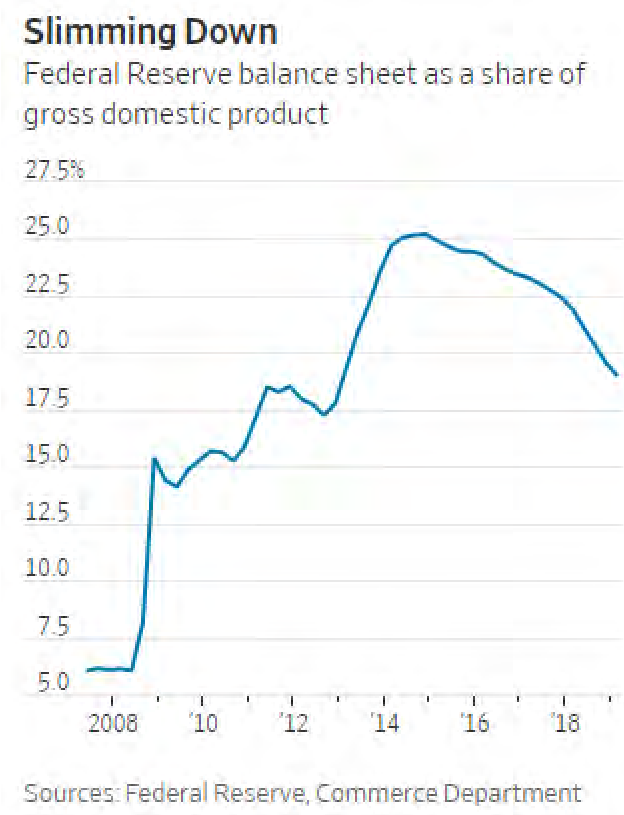
Fed Chairman Jerome Powell has signaled the central bank is prepared to announce Wednesday, after its two-day policy meeting, when it will end the runoff of its $4 trillion portfolio later this year. Officials are likely to take up the composition question this week, though the discussions are likely to continue for at least through their next meeting, which concludes May 1.

Several Fed officials in recent interviews and public statements have expressed a preference for boosting their holdings of short-term bills, but they want to do it in a way that won't rattle markets.

The Fed purchased trillions of dollars of mortgage-backed securities and longer-dated Treasurys between 2008 and 2014 to spur growth. Officials believe holding long-term securities stimulates financial markets and the economy by lowering long-term rates and driving investors into stocks and bonds. They think a portfolio weighted toward short-term Treasurys provides little stimulus.

Before the 2008 crisis, the average maturity of the Fed's Treasury holdings was less than four years. Now, it's around nine years. The average maturity of all Treasury debt outstanding is nearly six years.

After the portfolio stops shrinking, the Fed will likely continue reducing its mortgage holdings by letting them mature, currently by around $15 billion a month. It could choose to invest the proceeds from maturing mortgage bonds into Treasurys.



Fed officials are considering two different approaches to the composition question. Minutes from the central bank's December meeting show more officials favor weighting their holdings toward shorter-maturity holdings, returning the portfolio composition to something that reflects its precrisis configuration.

A few officials at the meeting supported maintaining a mix of short-, medium- and long-term securities in proportions that would reflect the outstanding Treasury market. Kansas City Fed President Esther George, in an interview in January, said she prefers this strategy.

Under the theory that buying and holding longer-term securities provides more stimulus, the first approach would be less stimulative to financial markets.

The key appeal of this approach is that the Fed could more easily move to stimulate growth in a downturn by shifting back into long-term securities without first increasing its holdings, as it did during the bond-buying campaigns known as "quantitative easing."

"It gives you more quantitative-easing ammunition if you define quantitative easing as not just size but duration," said William Dudley, who served as New York Fed president from 2009 to 2018, in a recent interview.

"It would be nice to have maximum room to use that instrument. If the Fed had a shorter-duration Treasury portfolio, they'd have more room," he said.

Mr. Rosengren has noted the Fed will have fewer tools to respond to the next downturn because lower nominal interest rates will leave the central bank with less room to cut them.

He said in a February interview the Fed should consider shortening the duration of the Treasury portfolio now "so that whenever we have that next recession, we have the ability to lengthen the maturity and take some of the duration out of the market."

The Fed doesn't currently own any Treasurys with maturities of one year or less, which represent 15% of outstanding Treasury securities. "What's remarkable is whichever of the two approaches they choose, they're going to have to buy a bunch of short-term paper," said Seth Carpenter, chief U.S. economist at UBS who previously worked at both the Fed and the Treasury.

One key consideration is how fast to transition to any new normal. One possible argument against moving to a bill-heavy portfolio is that it might tighten monetary policy more rapidly than some officials would want right now, though doing so more slowly could alleviate this concern.

Fed officials agree they should move over time to a portfolio of only Treasury holdings, but this could take many years because their mortgage bonds won't fully mature for decades. At the recent pace of home refinancing, the Fed could still own around $500 billion in mortgage holdings at the middle of the next decade.

Officials aren't eager to discuss the possibility of selling mortgage bonds because they don't want to do anything to disturb an already fragile housing market.

"At some juncture there might be a more active approach [to reducing the mortgage holdings], but that is certainly not something that I see as relevant in the shorter term," said Fed governor Lael Brainard earlier this month.

Fed Hints at Future Cuts in Rates

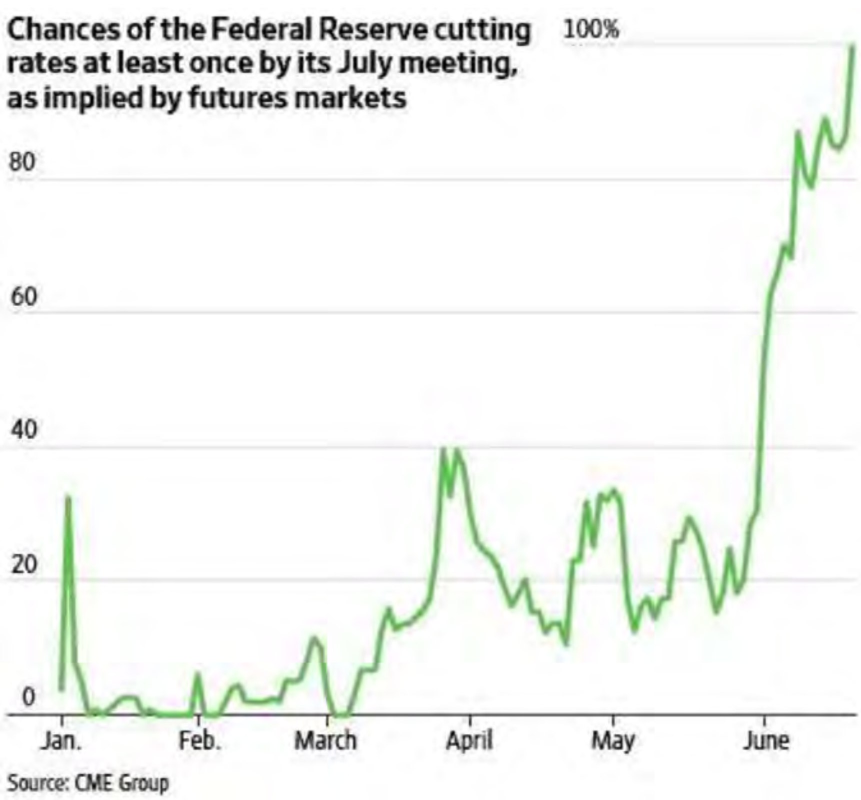
BY NICK TIMIRAOS – WSJ 06.20.2019

Bank is likely to move if economic outlook, clouded by trade fights, doesn't improve

WASHINGTON—**Fed**eral Reserve officials held benchmark interest rates steady on Wednesday but **strongly suggested** they **would cut** them in the months ahead **if** an **economic outlook** clouded by uncertainty over trade policy **didn't improve**.

"The case for somewhat more accommodative policy has strengthened," Fed Chairman Jerome Powell said at a news conference after the central bank announced its decision. Still, citing recent favorable economic data, the Fed didn't bow to pressure from President Trump for an immediate rate cut.

U.S. stocks rose toward record highs. The S& P 500 added 8.71 points, or 0.3%, to 2926.46, leaving the index just 0.7% from its record high in April. The benchmark 10-year Treasury yield fell for the seventh straight session to 2.023%, its lowest level since 2016, from 2.060% on Tuesday. In Asia early Thursday, the yield fell below 2% for the first time since late 2016.



The Fed is set to meet next on July 30-31, and investors in interest-rate futures markets have priced in at least a quarter-percentage- point cut then in the central bank's benchmark short-term rate. "The market now knows the Fed is going to ease unless the data dramatically reverse," said Steven Blitz, chief U.S. economist at TS Lombard.

Since Fed officials met last month, escalating trade tensions between the U.S. and China and weaker global growth have raised the risks of a sharper slowdown for the U.S. economy than they had anticipated this year. "**It's really trade developments and concerns about global growth that are on our minds," Mr. Powell said. Because many of these issues had arisen suddenly, many Fed officials wanted to wait a little longer before cutting rates, he said.**

For the Fed to not cut rates at its July meeting, "it would take all of the data coming in to be consistently strong," together with an end to trade-related uncertainty, said Seth Carpenter, chief U.S. economist at UBS.

The central bank's rate-setting committee on Wednesday dropped language from its policy statement describing its stance as "patient"—which implied rates were on hold. Instead, it said uncertainties about the economic outlook have increased, a phrase it has used during past periods of rate cuts.

Interest-rate projections released Wednesday showed eight of 17 officials—the reserve bank presidents and board governors who participate in the Fed meetings—expect they will cut the benchmark rate by year's end from its current level in a range between 2.25% and 2.5%. Seven of those officials see lowering the rate by a half percentage point by the close of 2019, and one expects just a quarter-percentage- point reduction. Eight officials projected the Fed would hold rates steady, and one projected a rate increase.

"What surprised us most was the number of participants that shifted down to rate cuts. It was about half the committee," said Tiffany Wilding, U.S. economist at Pimco.E Even though some officials didn't project rate cuts, "our deliberations made clear that a number of those [officials] agree that the case for additional accommodation has strengthened," said Mr. Powell.

Mr. Powell said there was "not much" support for cuttingrates at the meeting, and the vote to hold rates steady passed on a 9-1 vote. St. Louis Fed President James Bullard dissented from the rate decision, preferring lower rates.

If the Fed lowers rates next month, it would be the first cut since 2008, when the central bank lowered rates to near zero during the financial crisis.

The Fed has initiated a sequence of rate cuts four times in the past 25 years. In 2001 and 2007, a recession began within three months. In 1995 and 1998, the Fed lowered rates in time to prevent an economic slowdown from turning into a full-fledged downturn, and officials later reversed some of those cuts.

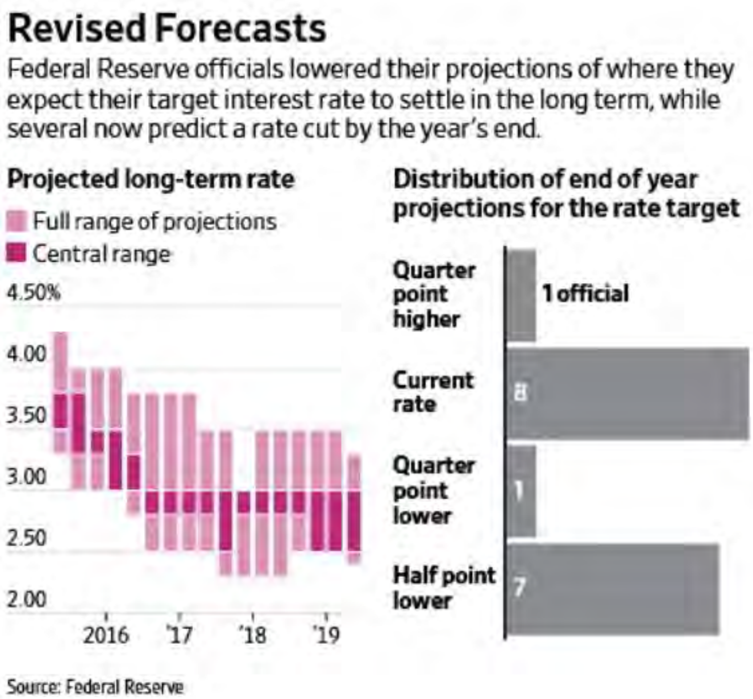
Mr. Powell said the Fed was prepared to react aggressively to any weakness, drawing from research that says when rates are historically low, as they are now, officials should move faster and sooner because they have less room to cut hem. "In other words, an ounce of prevention is worth a pound of cure," he said.

Fed officials have been trying to navigate a so-called soft landing, in which inflation stays contained and growth moderates but doesn't slow so much that the economy tips into recession.

Officials raised rates four times last year and in December projected several more rises would be needed this year and next. Slowing global growth and muted inflation earlier this year led Mr. Powell to signal an earlier end to rate rises.

More recently, the global outlook and uncertainty over Mr. Trump's trade policies have led to a pullback in business investment and sentiment.

"Trump is providing the headwinds the Fed thought they'd have to provide" through their rate increases, said Vincent Reinhart, chief economist at Mellon and a former senior economist at the Fed.



Markets are likely to focus now on the prospects for Mr. Trump and Chinese President Xi Jinping to put trade negotiations back on track during a meeting at next week's G-20 world leader summit in Japan.

The Fed's rate projections highlighted two different possible trajectories for the economy that have surfaced amid an escalation of trade tensions in recent weeks. Under one, trade negotiations avoid further disruption of global supply chains and prevent drags on business investment. Under the other, worsening trade frictions and weak global growth lead to a sharper slowdown for the U.S. economy.

Mr. Trump has called on the Fed to cut its benchmark rate by 1 percentage point. As the Fed began its two-day policy meeting on Tuesday, Mr. Trump responded to speculation that he would try to remove Mr. Powell by saying obliquely, "Let's see what he does."

Mr. Powell suggested Wednesday he didn't believe the law gave Mr. Trump the authority to remove him. "I have a four-year term, and I fully intend to serve it," he said.

Fed Minutes: Officials See Little Need to Change Rates This Year

BY NICK TIMIRAOS – WSJ 04.10.2019

FOMC members cited greater risks from global slowdown, muted inflation readings in keeping rates steady.

Officials said interest rates "could shift in either direction based on incoming data and other developments." Left, Fed Chairman Jerome Powell testifying before a Senate panel in Washington on Feb. 26.

Federal Reserve officials signaled greater conviction at their meeting last month that they don't need to move interest rates up or down.

Officials **voted** to **hold rates steady** at their **March 19-20 policy meeting** after having lifted the Fed's benchmark rate four times last year, most recently in December to a range of 2.25% to 2.5%.

Minutes of the March meeting **released Wednesday suggest** the **Fed** has **set** a **high bar to raise rates** again because of greater risks to the U.S. economy from the **global growth slowdown** and **muted inflation** that took more of the officials by surprise.

"A majority of participants expected that the evolution of the economic outlook and risks to the outlook would likely warrant leaving the target range unchanged for the remainder of the year," the minutes said.

At the same time, the minutes show officials didn't see any need to cut their benchmark rate absent a broad deterioration in the economy. Officials said their view of the appropriate setting for interest rates "could shift in either direction based on incoming data and other developments," according to the minutes.

Since the meeting, President Trump has called on the Fed to cut rates. Central bank officials have said they would base their decisions on the economic outlook and not political pressure.

Fed officials raised rates last year to guard against the risk that accelerating economic growth could lead to unwanted inflation or financial bubbles. Inflation reached the central bank's 2% target last year after falling short for years, but it has since retreated slightly – defying expectations that it would firm more as the economy expanded.

The weakness of inflationary pressures, despite a strong job market and accelerating output last year, has puzzled Fed officials. At last month's meeting, they discussed reasons that inflation might have been muted, including the prospect that the estimated unemployment rate consistent with stable prices is lower than previously thought.

Many officials noted that while inflation neared the Fed's target last year, "it was noteworthy that it had not shown greater signs of firming in response" to strong hiring, rising wages and short-term impacts from tariffs, the minutes said.

At the beginning of this year, Fed officials signaled they were ready to move to the sidelines and pause rate increases until they could better judge how a sharp rise in market volatility late last year – together with concerns about greater economic weakness in China and Europe – might affect the U.S. economy.

The minutes, released after a customary three-week lag, show the Fed "is in a comfortable place and probably has little interest in moving significantly in the absence of convincing evidence that it needs to do so," said Roberto Perli, an analyst at Cornerstone Macro, in a note to clients Wednesday.

The minutes highlighted some **concern** with **weaker consumer spending**, **housing activity** and **business investment**. Most Fed officials last month said they didn't expect weak consumer spending late last year to carry over beyond the first quarter.

Other sources of potential unease included a downward drift in consumers' and businesses' expectations of future inflation and a decline in yields on long-term government debt. An **inverted yield curve**, in which long-term yields fall below short-term yields, **has often preceded recessions by a year or two**.

Fed officials agreed last month to **slow** the **pace** at which they are **shrinking** their **$3.9 trillion asset portfolio in May** and to **end** the **runoff** of their Treasury holdings **by October**. The decisions to end the portfolio runoff have been driven by technical factors related to how the Fed implements its policy decisions rather than by a desire to provide more or less stimulus to the economy.

Officials last month debated when to allow the portfolio to start growing again, but didn't reach any conclusions. At issue is gauging demand for deposits held by banks at the Fed, known as reserves.

With the balance sheet at a fixed size, reserves will very slowly decline as other liabilities, namely currency, continue growing. At some point, reserves could become scarce enough to boost the rate banks charge in overnight money-market accounts, which would raise the Fed's benchmark rate.

More Fed officials appeared to favor allowing the portfolio to start growing again "relatively soon after the end of runoff, because they saw little benefit" to allowing reserves to fall to a level that could create rate volatility, the minutes said.

Some others favored keeping the portfolio steady for a longer period to learn more about banks' underlying demand for reserves.

Fed Missteps with Bond Message

BY JON SINDREU – WSJ 02.26.2019

Some investors are now blaming last year's market rout on bond sales by the Federal Reserve. But the central bank's apparent admittance of guilt could pose bigger problems than any bond sale.

The Fed has gone from raising interest rates to suggesting they will likely stand pat this year due to the global economic slowdown—a shift that looks heavily influenced by the market's woes in 2018. The Fed also suggested last week that sales of bonds—designed to unwind the $4 trillion portfolio accumulated under postcrisis policies—will stop in the second half of this year.

Officials said Friday that this won't have a big market impact, justifying it as a technical tweak related to central-bank operations. But **talking about it** now has **created** the **appearance** of a **link between** the **reduction in the Fed's balance sheet and its policy on interest rates**. This **could backfire**.

When the market selloff started in October, most investors blamed U.S.-China trade tensions, high valuations and the fear that a U.S. recession was overdue. Now the story seems to have shifted: The problem was actually those pesky Treasurys coming back to the market, many have argued, including analysts at State Street, hedge-fund stars such as Stanley Druckenmiller, and even President Donald Trump.

Yet the Fed has been selling bonds since 2017, and the Treasury market has been stable. Its estimates find that the part of 10-year yields that is responsive to buying and selling, known as the "term premium," has actually gone down, meaning that yields only rose because rates were increasing.

It's not strange that sovereign bonds seem unresponsive to supply and demand: During most earlier rounds of bond-buying by central banks, yields often rose instead of falling. A research summary by the Bank for International Settlements found that the impact of the purchases was small. The chances of that having a knock-on effect on stocks are even slimmer.

Components of 10-year Treasury yields.

Source: Federal Reserve

The power of postcrisis stimulus policies was instead based on providing certainty to investors about what rates would do—often using bond purchases as a sign of their commitment to keeping rates low.

After the Fed and the European Central Bank stopped buying bonds, they went to great lengths to hold on to this signaling power by stating that their balance sheets weren't connected to future interest-rate policy anymore. Initially it didn't work: In **2013**, when the **Fed said it would "taper" bond purchases**, **investors panicked** because they **interpreted that to mean higher rates**.

Officials have since been able to separate the two in investors' minds, but **the Fed undermined those efforts last week**. Chairman Jerome **Powell** has **sometimes been criticized for not being flexible enough**. This time, **he may come to regret bending too much**.

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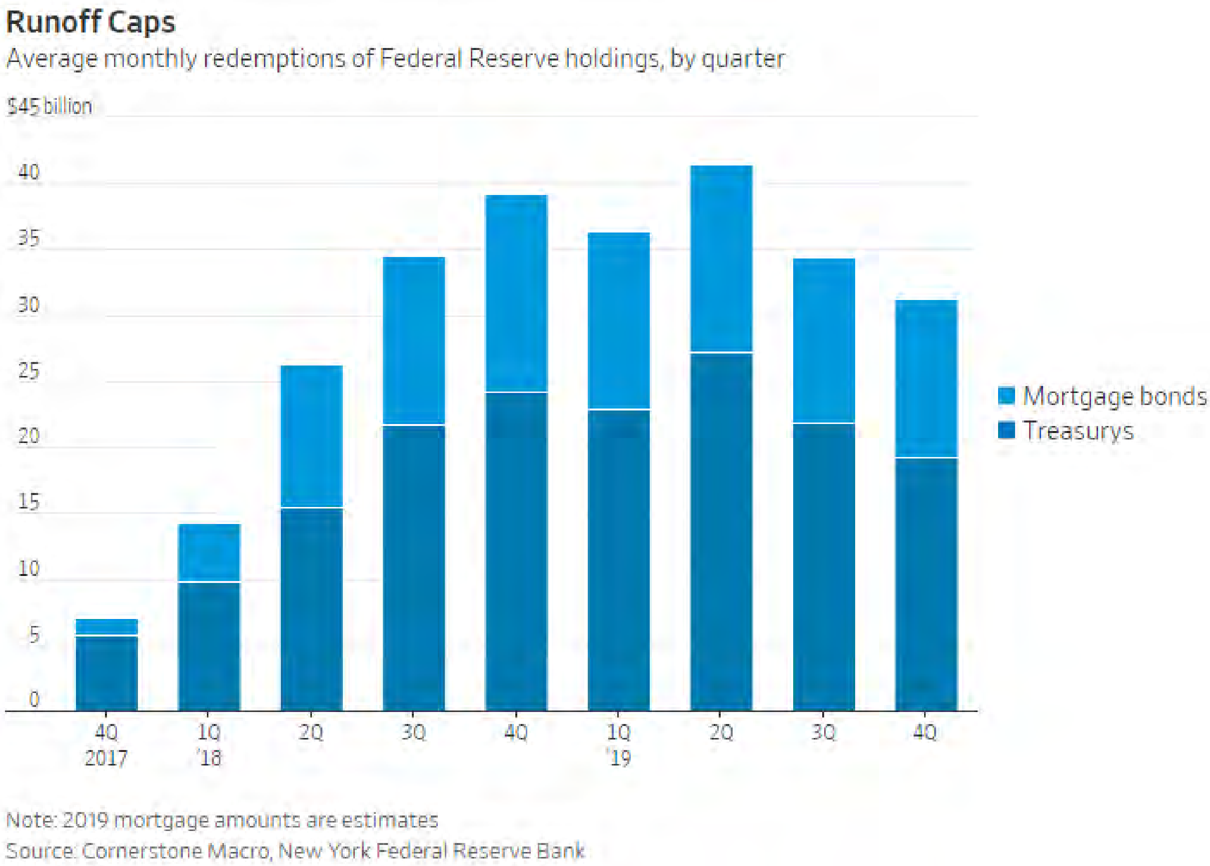
Fed Officials Near Plan to Finish Portfolio Wind-Down

BY NICK TIMIRAOS – WSJ 02.14.2019

Federal Reserve officials are zeroing in on a strategy to end the wind-down of their $4 trillion asset portfolio as soon as this year, which would conclude an effort to drain stimulus from the financial system earlier than they had once anticipated.

Fed officials could finalize more details of their strategy, including whether to slow the pace of shrinking their bondholdings, at their policy meeting next month.

Some officials signaled in recent days they favor ending the bond runoff relatively soon. The process “probably should come to an end later this year,” Fed governor Lael Brainard said on CNBC on Thursday.



Cleveland Fed President Loretta Mester, in a speech Wednesday, said they would wrap up the planning at coming meetings.

The **Fed began to reduce its portfolio in 2017** by **allowing limited amounts of Treasury and mortgage securities to mature without replacing them**. The **holdings** of bonds and other assets has **fallen to about $4 trillion** from around **$4.5 trillion when the runoff began.**

The Fed bought bonds between 2008 and 2014 to support the postcrisis economy, but officials in recent months have said they plan to end the runoff for reasons unrelated to any desire to provide more or less stimulus. Instead, the decision is being driven by a technical debate about the demand for reserves, the money banks deposit at the Fed.

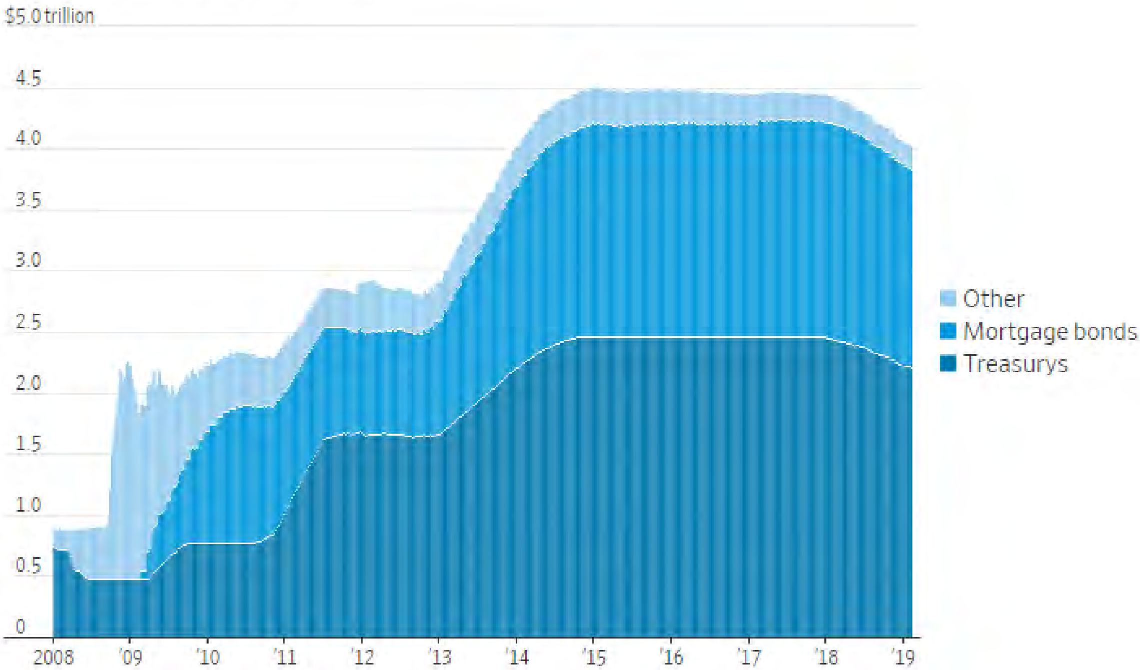
After the runoff began, several Fed officials cautioned the asset holdings wouldn’t ever decline to their **precrisis level** of **less than $1 trillion** because demand for currency, reserves and other Fed liabilities has grown substantially. Still, they said they wanted the portfolio to be as slim as possible.

Several Fed officials recently have said they don’t want to reduce reserves to levels that might fuel volatility in short-term money markets. “I want reserves to be high enough where that's not a particular concern," said Boston Fed President Eric Rosengren in an interview Monday.

Reserves have fallen to $1.6 trillion last month from a peak of $2.8 trillion in 2014. A survey of financial institutions by the New York Fed indicated market participants thought reserves could probably decline to $1 trillion, which at the current pace of bond runoff would be reached in roughly one year.

Uncle Sam's Club

Federal Reserve holdings by asset type



Source: Federal Reserve

Ms. Brainard said Thursday she would prefer to have a "substantial buffer" of reserves above whatever level is estimated to be adequate for regular market operations.

Mr. Rosengren appeared to share that view, and said determining an ample amount of reserves "is probably more art than science."

Fed officials reached one critical decision at their meeting last month when they agreed to operate monetary policy with a larger level of reserves than they did before the crisis.

When the Fed expanded its portfolio during and after the crisis, it pumped money into banks in exchange for bonds, increasing the amount of reserves in the financial system.

Initially after the crisis, some Fed officials wanted to wind down these reserves to precrisis levels, which would have meant shrinking the portfolio dramatically. Keeping reserves scarce would help them control interest rates as they rose from near zero, the thinking went.

Over time many officials grew more confident they could manage rates even with an abundance of reserves.

In addition to determining when to stop the runoff, officials have to decide how they will do it.

When the Fed began to shrink its holdings in 2017, it allowed $10 billion in bonds to run off every month for the first three months. Each quarter, it increased the monthly pace by $10 billion until reaching a ceiling of $50 billion last October. Actual redemptions have been running lower, closer to $40 billion per month on average, in part because of muted mortgage payoffs from low refinancing activity.

One question now is whether Fed officials will similarly taper the monthly pace as they approach the end. Officials debated such an approach in December but didn't come to an agreement.

Because demand for reserves isn't static and fluctuates depending on market conditions, slowing down redemptions could help officials minimize potential volatility in money markets if they find demand for reserves is strong enough to put upward pressure on their short-term benchmark rate.

"We don't have a precise understanding of this at all," Fed Chairman Jerome Powell said at a news conference last month. "The only way you can figure it out is by surveying people…and then, ultimately, by approaching that point quite carefully."

Officials also must decide what types of Treasury securities they purchase when they are done running down the portfolio. Officials plan to continue shrinking their holdings of mortgage-backed securities, and they will need to reinvest the proceeds of those maturing bonds into Treasurys.

"It won't be the first thing we work on but it will be one of the first things that we try to resolve," Mr. Powell said last month.

Fed officials' embrace of a larger portfolio than originally conceived has coincided with less political opposition to a bigger balance sheet, particularly from Republican lawmakers who for much of the past decade said the Fed kept policy too easy but now say it could be too tight.

One other set of decisions revolves around how officials communicate their plans. Markets have been on edge over the Fed's intentions.

Minutes from the Fed's January policy meeting, due next Wednesday, could shed more light on recent discussions, as could testimony from Mr. Powell before Congress later this month.

Fed Official Urges Firms to Speed Shift From Libor

BY DANIEL KRUGER – WSJ 06.04.2019

Randal Quarles, the Federal Reserve vice chairman in charge of financial regulation, urged companies and financial institutions on Monday to speed up their preparations for a looming interest-rate shift.

Libor, the London interbank offered rate, is a **floating-rate benchmark** that underpins everything from home mortgages to corporate loans. It has been **slated for replacement** at the end of 2021 in light of a manipulation scandal. But years after that decision, settling on a replacement remains a challenge facing banks, companies and investors.

The Fed convened a working group in 2014 intended to settle on a reference rate that would replace Libor for an array of borrowers and investors without the risk of being manipulated. Properly setting the rates on business and consumer loans can determine whether such loans are affordable for borrowers and profitable for lenders.

That group, the Alternative Reference Rate Committee, settled on a new reference rate created by the Fed, derived from trading activity in the market for overnight repurchase agreements for government securities, or repos. The Fed began publishing that rate, known as the **secured overnight financing rate**, in April 2018.

So far, however, **SOFR** is less widely embraced than Libor. While the amount of debt linked to SOFR surpassed $100 billion last month, roughly eight times that amount of Libor-linked notes have been sold, according to data from Wells Fargo & Co.

“The transition should be happening in earnest,” Mr. Quarles said in taped remarks broadcast on Monday at a conference at New York University. The Wall Street Journal has reported that companies are using the new benchmark only sparingly.

Companies that continue to use Libor rather than SOFR are adding to operational, financial and legal risks they face from the transition, Mr. Quarles said.

It is “important for prudent risk management and your fiduciary responsibilities” to prepare for the changeover from Libor by modifying contracts to reflect cessation risks, Mr. Quarles said. The easiest way to mitigate risk from the fading benchmark is “simply to stop using Libor,” he said.

Officials on the Alternative Reference Rate Committee have said they needed more data from trading in the futures market, where volume has grown quickly, to generate interest rates for longer-term SOFR maturities.

Libor

One month	**2.42988**	2.42813	2.52238	2.01297
Three month	**2.47850**	2.52488	2.82375	2.30963
Six month	**2.45550**	2.54863	2.90788	2.45550
One year	**2.41338**	2.61900	3.14413	2.41338

“Those who are able to use SOFR should not wait for the term rate in order to transition,“ said Tom Wipf, a Morgan Stanley banker who also leads the working group on reference rates. Data from their activity will help speed development of those longer-term maturities, he said.

Fed Officials Contemplate Thresholds for Rate Cuts

BY NICK TIMIRAOS – WSJ 04/20/2019

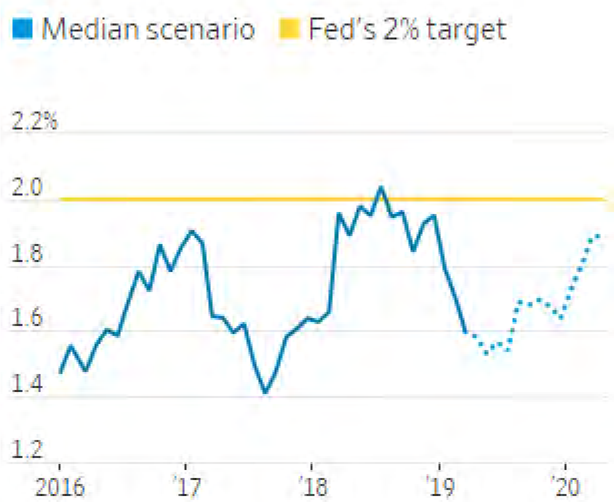
Federal Reserve officials are starting to talk about the conditions under which they would cut interest rates, including a scenario where inflation drifts lower even if the economic growth doesn't falter.

Such a scenario isn't seen as particularly likely, and a rate cut isn't imminent or under consideration for their meeting April 30-May 1. But the thresholds for such action have been a topic of conversations in recent interviews and public remarks.

Target Test

Inflation has run below the Fed's 2% inflation target in recent years.

Personal-consumption expenditures price index, excluding food and energy, change from a year earlier*



*February and March 2019 figures are estimated based on reports produced by the Labor Department. Median scenario assumes monthly inflation of 0.16%, the median increase over the last two years.
Source: J.P. Morgan

Inflation rose last year to the Fed's 2% target after years of undershooting it. Central bank officials say the target is symmetric, meaning they expect inflation will drift mildly above and below it at different times.

Price pressures softened beginning last fall, although officials had expected inflation to keep rising amid strong hiring and a burst of fiscal stimulus fueled by tax cuts and government spending.

If inflation runs too far below 2% for a while, it would show "our setting of monetary policy is actually restrictive, and we need to make an adjustment down in the funds rate," Chicago Fed President Charles Evans said Monday, referring to the central bank's benchmark federal-funds rate.

Mr. Evans said his forecast was for inflation to rise over the coming year, justifying a rate increase in late 2020 and possibly again in 2021 to keep price pressures under control.

But if it turns out that core inflation, which excludes volatile food and energy categories, falls and stays near 1.5% for several months, "I would be extremely nervous about that, and I would definitely be thinking about taking out insurance in that regard" by cutting rates, he said.

Dallas Fed President Robert Kaplan didn't endorse such a move outright but said Thursday that inflation running persistently around 1.5% or lower is "something I'm going to certainly take into account" when setting rates.

Clearly communicating the rationale for an interest-rate cut would be especially important to avoid signaling alarm about the broader economic outlook, which could chill spending and investment. “We would need to be very careful,” said Mr. Evans.

Fed Vice Chairman Richard Clarida, speaking earlier this month on CNBC, appeared to be lowering the bar for such a move. He volunteered that a recession wasn’t the only situation in which the Fed had cut rates in the past, pointing to instances in the 1990s in which the central bank “took out some insurance cuts.”

Over a 12-month period beginning in February 1994, the Fed raised its benchmark rate to 6% from 3.25%. It then cut rates at three meetings between July 1995 and January 1996 after inflation rose less than anticipated.

Fed officials raised the rate four times last year, most recently in December to a range between 2.25% and 2.5%. They signaled last month they didn’t expect to change rates in 2019.

Recent data indicate the economy has rebounded from a slowdown at the start of the year, which could make officials more comfortable with their wait-and-see posture. While muted inflation may not warrant a rate cut for some officials, it could raise the bar for others to consider additional increases.

Cutting rates also would be complicated coming after President Trump has called on the Fed to do so. Central bank officials have said politics never influence their decisions. But Mr. Trump’s commentary puts more pressure on them to explain why they are changing policy so that doubts about their independence don’t erode their credibility in markets.

The question of whether to reduce rates if inflation slows may not be hypothetical for much longer.

Inflation readings for February and March, measured by the Fed’s preferred gauge, will be released on April 29, just before the coming policy meeting.

Forecasters at JPMorgan Chase expect to see that core inflation rose 1.6% in March from a year earlier, down from 1.8% in January. They see core inflation dipping to 1.5% in July. They estimate a 48% chance that core inflation falls below that level in July, and just a 7% chance it exceeds 2% in October.

Roberto Perli, a Fed analyst at Cornerstone Macro, is among those who view an interest-rate cut as unlikely absent broader economic deterioration. “It is a tough argument to make in the near term…because while it makes sense, what if all of a sudden inflation comes back up,” he said. Being forced to later reverse the cuts by raising rates more rapidly could raise the risk of a recession.

On the other hand, if consumers’ and businesses’ expectations of future inflation were to drift lower, “the case becomes a lot stronger,” said Mr. Perli.

Fed officials believe inflation expectations strongly influence actual inflation and could partly explain why price pressures have been soft. The University of Michigan’s April consumer survey showed expectations of annual inflation over the next five to 10 years fell to 2.3% from 2.5%, matching an all-time low for the 40-year series.

Central bank officials believe 2% inflation is consistent with a healthy economy. Also, higher inflation can provide more room to reduce nominal interest rates in a downturn.

Fed Chairman Jerome Powell expressed his frustration with the recent readings at his press conference last month. “We’re really 10 years deep in this expansion, and inflation is still not clearly meeting our target,” he said.

The problem of soggy inflation is puzzling because economists last year expected that tax cuts and federal spending increases would boost demand at a time when they believed there was already little economic slack, pushing up inflation.

The lack of such a response suggests the economy might have more idled resources, such as workers on the job-market sidelines, or that globalization has limited the extent through which declining economic slack leads to more domestic inflation.

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Fed Signals Hold on Rate Increases

BY NICK TIMIRAOS – WSJ 01.30.2019

The Federal Reserve indicated Wednesday that **it was done raising interest rates for now**, fueling a market rally.

Officials voted to **hold their benchmark rate steady** and **delivered an about-face from their policy stance six weeks earlier**. Last month, they raised their benchmark rate by a quarter percentage point to a range between 2.25% and 2.5% and signaled two more rate rises were likely this year.

“**The case for raising rates has weakened somewhat**,” Fed Chairman Jerome Powell said at a news conference after the central bank’s latest policy meeting.

He declined, when asked, to say whether the Fed’s next rate move was more likely to be an increase or a cut. “It’s going to depend entirely on the data,” he said.

The Federal Reserve held its benchmark interest rate steady Wednesday and **delivered its strongest signal to date** that **the central bank may have reached the end of its latest series of interest-rate increases**.

Stocks, which were already rallying on earnings reports from Apple Inc. and Boeing Co. , extended their gains after the Fed statement. The Dow Jones Industrial Average ended the session up 435 points, or 1.8%—its best day since Jan. 4. The yield on the benchmark 10-year Treasury note fell to 2.694% from about 2.73% before the announcement. Bond yields fall as prices rise and have stabilized following their December slide, with analysts more confident in the U.S. economy.

It was the opposite of what unfolded before and after the Fed’s December meeting. Stocks had been sliding heading into that meeting and tumbled even further after the Fed raised its short-term rates and signaled it expected to lift them more in 2019 and beyond. Bond yields slid as investors grew more concerned the Fed was likely to push borrowing costs higher than the economy could handle.

On Wednesday, **Mr. Powell cited growing risks of a sharp U.S. economic slowdown** due to **cooling growth** in **Europe and Asia**. He also said officials were **paying close attention to policy-related headwinds from trade disputes**, **Brexit** and the potential for **future U.S. government shutdowns.**

"**We think that…these risks are going to be with us for a while**," Mr. Powell said.

Central-bank officials had been reluctant to signal such a pause in interest-rate increases until recently because U.S. economic data have been strong and, until last fall, asset markets were buoyant, fueling worries about potential financial bubbles.

Fed officials now face more contradictory data: The U.S. job market has been steadily adding jobs, but manufacturing and some interest-rate-sensitive sectors of the economy, such as housing, have slowed. Officials are essentially stepping to the sidelines until the picture is less muddy.

"This was the full pivot," said Diane Swonk, chief economist at Grant Thornton. "They listened, they're awake at the wheel and they're willing to take it easy."

Mr. Powell faced a tricky balancing act in highlighting the growing risks to the expansion without alarming markets. The central bank usually says definitively in its policy statements whether it sees risks to the economy as balanced, or tilted toward strength or weakness.

The fact that officials didn't offer an assessment of risks to the outlook highlighted doubts they now have about the economic impact of tumbling stock and oil prices, weak growth abroad and political uncertainty.

"They are catching up finally to the signs that the trade war could matter, and that they just need to be more cautious," said Seth Carpenter, chief U.S. economist at UBS and a former Fed economist

The Fed underscored its more-flexible posture by providing key updates about its policy of shrinking its $4 trillion asset portfolio, which swelled after the 2008 financial crisis during successive stimulus campaigns.

The central bank said officials had agreed on a critical operational matter that will effectively require the central bank to maintain a larger stock of Treasury securities than had been expected when they began reducing those holdings 16 months ago.

They also showed greater willingness to change the pace of the portfolio reduction if the economy weakens. About $40 billion in Treasury and mortgage securities are running off the Fed's balance sheet every month.

While the Fed still prefers to use adjustments to its benchmark federal-funds rate to actively provide more or less support to the economy, "occasional changes could be warranted" to the balance-sheet policy depending on developments in the economy or in financial markets, Mr. Powell said.

Fed officials began laying the groundwork for a pause in rate increases earlier this month, pointing to little evidence of building price pressures that had justified earlier rate rises. Inflation has held just below the Fed's 2% target, and with oil prices falling, it shows few signs of breaking higher in the coming months.

Markets expect the Fed will be on hold indefinitely. After the release of the statement Wednesday, futures markets placed a 4% probability on a rate increase by June, according to CME Group. Markets placed a 6% probability that rates would be higher one year from now, and a 22% probability that rates would be lower.

Seeing an acceleration in inflation would be an important factor to justify any additional rate increase. "It wouldn't be the only thing, but it would certainly be important," Mr. Powell said.

By reacting to recent market turmoil, Mr. Powell risks facing criticism of a so-called Powell "put," in which the central bank won't let stock prices fall below a certain level. Some analysts dismissed those criticisms as unfair on Wednesday.

"The Fed should not cheerlead when markets go up, and shouldn't fret over minor selloffs. But it can't ignore markets when they send a consistent message, as they did in December," said Marc Sumerlin, managing partner at economic consulting firm Evenflow Macro and a former adviser to President George W. Bush.

President Trump's criticism of Fed rate increases also raises the danger the Fed will appear to have reacted to political pressure.

Mr. Trump had repeatedly called on the Fed last month not to raise interest rates and was furious with its decision to lift the benchmark rate. Shortly after the December meeting, he fumed to advisers about Mr. Powell, whom he appointed to a four-year term that began last February, and mused about whether he could replace him as chairman.

Advisers later said Mr. Trump wasn't seriously considering firing Mr. Powell, in part because it isn't clear the president has the legal authority to do so. But the episode further amplified market worries about political uncertainty and economic growth.

Mr. Powell said Wednesday that such political pressure hadn't and wouldn't influence the Fed.

"We're human, we make mistakes, but we're not going to make mistakes of character or integrity," Mr. Powell said. "And I would want the public to know that, and I would want them to see that in our actions."

Fed Would Consider Interest-Rate Cuts if Growth Outlook Darkens

BY NICK TIMIRAOS – WSJ 05.30.2019

Central bank's vice chairman, Richard Clarida, **says** any persistent inflation shortfall would also prompt policy reassessment. The Fed official offered no suggestion that any cuts are imminent and affirmed the Fed's current policy stance.

Federal Reserve Vice Chairman Richard Clarida said the U.S. economy is in good shape but that **central bank** officials **would consider interest-rate cuts should economic data reveal** a **material risk** of a **sharper slowdown than** they currently **expect**.

"Let me be very clear that we're attuned to potential risks to the outlook," Mr. Clarida said Thursday during a moderated discussion at the Economic Club of New York. "And if we saw a downside risk to the outlook, then that would be a factor that could call for a more accommodative policy."

Fed officials didn't indicate any willingness to change their make-no-moves policy footing at their April 30 – May 1 meeting. Shortly after that meeting, a breakdown in trade talks between the U.S. and China led President Trump to raise tariffs on roughly $200 billion in goods to 25% from 10%, representing a significant escalation in tensions.

In recent days, bond investors have increasingly calculated that economic weakness would prompt the Fed to cut rates to bolster growth.

All of this has unfolded at the same time that Fed officials have been surprised by weakness in inflation that has defied forecasts of a sustained return to its 2% goal. Mr. Clarida said officials reaffirmed their current policy stance at the meeting because they expect some of the recent inflation softness to be temporary.

"We think some of that, a lot of that may be transitory, but the reality is it has been softer," he said.

Mr. Clarida, in prepared remarks Thursday, offered no suggestion that rate cuts are imminent or that he is in any hurry to change the Fed's policy stance.

But he added an important caveat: Fed officials would reassess that stance "if the incoming data were to show a persistent shortfall in inflation below our 2% objective, or were it to indicate that global economic and financial developments present a material downside risk to our baseline outlook," he said.

The Fed raised its short-term benchmark rate four times last year but scrapped plans in January to continue lifting it. Mr. Clarida cited two big factors for the pivot: **weaker inflation** and a **slowdown in global growth**.

While the U.S. economy isn't as exposed as others to shifts in global demand, "when there is a slowdown in the rest of the world, it does show up in our data," Mr. Clarida said.

He added that it was **too soon to draw conclusions** about the implications of recent bond-market developments in which yields on long-term government debt have fallen below yields on shorter-maturity securities. Such so-called **inverted yield curves** have **tended historically to precede interest-rate cuts and recessions**. He said it was important to distinguish between the recent flat yield curve and an inversion that lasted for some period of time. “We really haven’t seen that yet,” he said.

The central bank’s No. 2 official also said the economy’s performance over the past year suggested it may have greater capacity to grow without pushing inflation to undesirable levels than Fed models had previously anticipated.

“While predicting the future is difficult, with available data it appears that in 2018 and in the first quarter of 2019, the supply side of the economy – employment, participation and productivity – expanded faster than most forecasters outside and inside the Fed expected,” Mr. Clarida said.

He didn’t elaborate on the policy implications of any such rethinking, though at a minimum it would suggest even less need for the central bank to raise interest rates.

Since raising rates in December, some Fed officials have grown uneasy about their inability to keep inflation at their 2% target. In March, inflation excluding volatile food and energy categories rose 1.6% from a year earlier, according to the Fed’s preferred gauge, down from 1.8% in January and 2% in December.

At issue is a framework that has long animated thinking in mainstream economics and inside the Fed. It holds that inflation rises as slack across the economy declines, and that the disappearance of slack can best be measured as unemployment falls below a level estimated to be consistent with stable prices.

While the relationship between declining unemployment and rising wages has held up in recent years, the relationship between declining unemployment and rising prices has been very weak.

Fed officials have revised down their estimates of the lowest unemployment rate consistent with stable prices, to 4.3% in March from 4.7% two years ago. Mr. Clarida said Thursday that the range of plausible estimates “may extend to 4% or even below.” The unemployment rate was 3.6% in April, a half-century low.

Fed's 'Normal' Is Anything But, and That Is Cause for Worry

BY GREG IP – WSJ 03.21.2019

The Federal Reserve now believes its monetary policy is back to normal. That should worry you: If this is normal, then the Fed has precious little ammunition for when economic conditions again turn abnormal. Since 2015, the Fed has been "normalizing" monetary policy by raising interest rates and shrinking its bond-holdings from levels intended for a weak, postcrisis economy.

This week, it declared the process all but done: Fed officials see no more rate increases this year and perhaps one next year, and they will stop shrinking the balance sheet in September.

Yet by any historical benchmark, this "normal" stance of monetary policy is extremely stimulative. The federal-funds rate, at between 2.25% and 2.5%, is just 0.25% when adjusted for long-term expected inflation. By comparison, the real rate was 2.75% at the end of the Fed's last tightening cycle in 2006, and 4% at the end of the prior cycle in 2000.

And the Fed will still hold more than $3.5 trillion in bonds in September, equal to 17% of gross domestic product, compared with 6% in 2006.

To be sure, the Fed can be satisfied with whatit has achieved. The economy is expected to grow solidly this year, unemployment

at 3.8% is below officials' median estimate of its "natural" level of 4.3%, and inflation this year, excluding food and energy, should hit its target of 2%.

What's worrisome is that maintaining these conditions requires such expansive monetary policy. It suggests that powerful underlying forces such as slow-growing populations and diminished investment opportunities continue to weigh on economic growth and inflation around the world.

Should the economy stumble again, the Fed won't have much ammunition with which to respond. It can, at most, cut interest rates a bit more than 2 percentage points, less than half what's required in most recessions. It could restart bond buying, but that would expand the balance sheet past levels reached in the depths of the last downturn.

By global standards, the U.S. is the lucky one. The European Central Bank never managed to raise its interest rate out of negative territory or shrink its balance sheet. Earlier this month, responding to a slowdown in the European economy, it said it would keep rates below zero through December, longer than originally planned, and offered special, cheap loans to banks for the first time in three years. The Bank of Japan has, similarly, given no sign of raising its target rate from negative territory anytime soon.

Until recently, the question of what the Fed would do when the economy hit another recession was largely hypothetical. Thanks to a big tax cut and federal spending boost, growth topped 3% last year and unemployment fell steadily.

Inflation excluding food and energy hit 2%, the Fed's target, for the first time since 2012.

But while Fed Chairman Jerome Powell said Wednesday he still expects solid growth, he noted recent data such as retail sales, business investment and job growth have been downbeat. Officials' median projection for growth this year has dropped to 2.1% from 2.5% in September 2018. Core inflation has slipped back below 2% and inflation expectations have sagged. Mr. Powell said: "Ten years in this expansion and inflation is still not clearly meeting our target."

Markets are also getting worried. Normally a dovish decision such as what the Fed delivered would send the stock market higher. Instead, it rallied briefly then slumped anew. Bond yields dived to 2.53%, the lowest in a year, and the disappearing gap between short- and long-term rates suggest heightened chances of a recession.

'Inflation is still not clearly meeting our target,' Fed Chairman Jerome Powell says.

Even if this slowdown doesn't presage a recession, it lends urgency to the Fed's recently launched review of whether its 2% inflation-target framework and tools can cope with the next downturn, when interest rates are likely to hit zero again. The Fed "should be changing the framework in ways that might at least help at the margin deal with this very challenging environment," said Krishna Guha, central bank strategist at Evercore ISI, a broker.

One possibility is that the Fed may respond to periods of below-2% inflation by targeting above-2% inflation. This would keep the public from expecting below-2% inflation to persist.

But getting inflation above 2% requires an economy running hot for a prolonged period. If the economy is indeed losing altitude, it may be too late.

Fed's Pivot Boosts Bonds

BY SAM GOLDFARB – WSJ 04.01.2019

Investors piled into bonds in the first few months of 2019, buying everything from Treasurys to riskier corporate debt as a newly supportive Federal Reserve eased concerns about rising interest rates and the potential for a near-term recession.

Now, a sharp drop in Treasury yields has stirred a debate among investors about whether to take heart from the Fed's pivot to a more growth-friendly posture or be wary of the potentially troubling causes that prompted the central bank's shift.

As of Friday, the closely watched yield on the 10-year U.S. Treasury note, which falls when bond prices rise, stood at 2.416%. That was down from 2.684% at the end of last year and 3.23% in early November. Before Friday, when the yield on the three-month Treasury bill settled at 2.396%, the 10-year yield had spent five sessions below that of the three-month bill, the first time that had happened for any amount of time since 2007.

That so-called inversion of the yield curve generally signals falling growth expectations and often precedes recessions.

"I think we're at a pretty interesting inflection point," said Priya Misra, head of global rates strategy at TD Securities in New York. The Fed, she said, has either extended the economic expansion, in which case investors can keep buying corporate bonds and other riskier securities, or it has sent a "signal that the end of the cycle is upon us," in which case investors should be rushing into government debt.

Bond bulls still seem to have the upper hand. Even as Treasurys have rallied recently, corporate bonds have largely kept pace, indicating investors aren't overly worried about the economic outlook.

As of Thursday, the extra yield that investors demand to hold speculative-grade bonds over U.S. Treasurys stood at 4.02 percentage points, down from 5.26 percentage points at the end of 2018.

For the most part, conditions have been favorable for U.S. corporate borrowers this year. After Fed Chairman Jerome Powell persuaded investors in early January that the central bank might significantly rein in its pace of rate increases, companies this year have sold $138 billion of speculative- grade corporate bonds and loans in the U.S. market, according to LCD, a unit of S& P Global Market Intelligence.

That is up from just $4 billion in December and $25 billion in November, when there were widespread concerns that the Fed might derail the economic expansion by continuing to raise rates about once every quarter.

Briefly after the Fed's March policy meeting, it appeared conditions were only improving for investors and borrowers. Not only had Fed officials confirmed they no longer planned to raise rates in the near future, but other major threats to bonds were muted: Inflation remained benign and the U.S. economy was neither hot enough that investors might dump bonds for stocks nor cold enough to pose a serious threat to the financial stability of most corporate borrowers.

Then, two days later, a batch of dreadful economic data out of Europe showed a deepening contraction in that region's manufacturing sector. That prompted the 10-year Treasury yield to drop below the three-month yield and rekindled the kind of concerns about global growth that contributed to overall market tumult in the fourth quarter.

Some investors now worry that the current bond rally is based on unsteady foundations. In particular, it is unclear whether strong demand for corporate debt this year has been driven by confidence in the U.S. economy or a more knee-jerk, and potentially risky, reach for yield as underlying Treasury rates have fallen.

Investors have some good reasons for buying corporate bonds. But "my biggest concern is that it's mostly a yield grab," said Scott Kimball, a portfolio manager at BMO Fixed Income.

Still, many investors, including Mr. Kimball, ultimately don't see the economic situation as that dire. Despite the troubling weakness in the European manufacturing sector, Europe generally still has a tight labor market, a reasonably strong service sector and a very supportive central bank, said Julien Scholnick, a portfolio manager at Western Asset Management.

Growth in the U.S., meanwhile, is widely expected to speed up over the next three months after a slow start to the year.

Firms Tighten Capital Spending

BY AMRITH RAMKUMAR AND THEO FRANCIS – WSJ 05.20.2019

Spending on factories, equipment and other capital goods slowed in the first quarter among a broad cross-section of large, U.S.-listed firms, bolstering investor concerns that a key driver of economic growth is fading.

Capital spending rose 3% from a year earlier in the first quarter at 356 S& P 500 companies that had disclosed figures in quarterly regulatory filings through midday May 8, according to an analysis by The Wall Street Journal of data supplied by Calcbench, a provider in New York and Cambridge, Mass. That is down from a 20% rise in the year-ago period for the same companies, the analysis shows.

Executives at several companies said lingering trade tensions with China were making them and their customers cautious, raising the prospect that slower business spending could hamper economic growth later in 2019 and in 2020. U.S. nonresidential fixed investment—which reflects business spending on software, research and development, equipment and structures— rose at a 2.7% annual rate in the first quarter, pulling back from a 5.4% pace in the fourth quarter, the government said last month.

Among the 10 firms that spent the most last year, five lowered their spending in the first quarter, including Alphabet Inc., **Apple** Inc., **AT& T** Inc. and **Verizon Communications** Inc. Even so, gross capital spending for the group fell only slightly, reflecting continued investments and the impact of onetime items in the year-earlier period, which benefited in part from the timing of federal tax cuts. Together, the top 10 capital spenders invested $38.2 billion in the period, down from $40.7 billion a year earlier.

Broad trends in capital spending are closely watched by many analysts and investors, who view longer-term investments by large corporations as among the most robust sources of future economic growth. They contend this spending tends to spur further investment by partner firms and suppliers, and over time to lift worker productivity and overall economic output.

“Several executives said trade tensions with China were making them more cautious.”

That is a process that many view as the key to extending the nearly 10-year old U.S. economic expansion at a time when trade dynamics are unsettled, global growth is softening and the effect of 2017’s federal tax cuts is fading.

“Any time there’s trade tensions of this kind, it does put a certain amount of conservatism, I think, into all of our plans for capital spending, ”**Caterpillar** Inc. Chief Executive Jim Umpleby said on the company’s April 24 earnings call in response to a question about spending plans for Caterpillar customers. The maker of heavy machinery lowered capital spending to $547 million in the first quarter from $757 million in the same period a year earlier.

Caterpillar’s capital spending typically is focused on building new plants and buying equipment needed to manufacture tools used in mining and construction. The company has closed factories across the country in recent years in a bid to boost its continuing profitability even as it continues to invest in new projects, executives said at the company's investor day this month.

The first-quarter spending slowdown was most pronounced in the communication-services and consumer-discretionary sectors, where capital spending fell from a year earlier. Most large financial and tech companies reported strong increases for the quarter.

Google parent Alphabet, the biggest S& P 500 spender last year, lowered spending by more than one-third in the first quarter to $4.6 billion. Alphabet's outlays include spending on data centers, servers and office buildings. The company's spend- ing in the first quarter of 2018 included a purchase of the Chelsea Market building in Manhattan for more than $2 billion.

"We continue to expect a sizable investment in both compute requirements to support long-term growth as well as in office facilities," said Chief Financial Officer Ruth Porat on an earnings call April 29.

The overall trend masked dramatic differences among companies, even within the same sector. While most technology companies increased capital spending—the median increase was about 14%—total spending for the sector declined by about 8% in the first quarter.

Apple, whose capital spending fell by $1.8 billion compared with the first quarter of 2018, essentially accounted for that decline. The iPhone maker's spending is typically for manufacturing equipment, data centers, corporate facilities and infrastructure. An Apple spokeswoman didn't respond to a request for comment.

Spending growth also softened for some semiconductor companies that have been en-snared by the U.S.-China trade fight because they rely on Chinese demand and trade flows to drive revenue. **Micron Technology** Inc., one of the 20 biggest spenders last year, slowed its spending growth in the first quarter and lowered its estimate for the current fiscal year amid softer-than-expected demand and swelling inventories of memory chips.

The company typically spends heavily on factories and equipment needed to build chips. "We believe macroeconomic uncertainty is also contributing to hesitation in buying behavior at some customers," Micron CEO Sanjay Mehrotra said on the company's earnings call in late March.

In response to a question about the company's profit expectations for the 2020 fiscal year, **FedEx Corp.** Chief Financial Officer Alan Graf also cited economic unknowns on the company's earnings call in March. The shipping company lowered capital spending to $1.1 billion in its latest quarter from $1.4 billion a year earlier. FedEx has said its capital priorities include updating its aircraft fleet and expanding FedEx Express hubs in Memphis, Tenn., and Indianapolis.

"If you could tell me, 'Are we going to get a trade deal done with China?' And, 'Is Brexit going to come out good?' I could give you a lot better answer… than I can sitting here at the moment," Mr. Graf said.

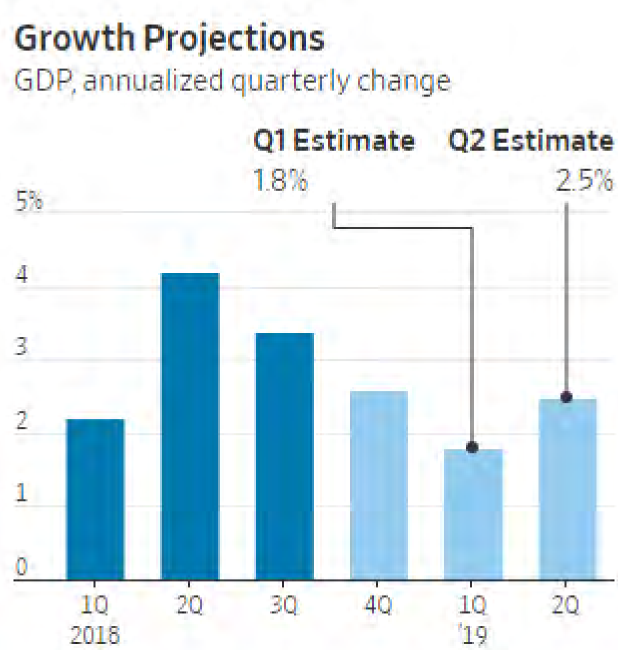
U.S. Economy Is Slowing, Survey Says

BY JOSH MITCHELL – WSJ 01.30.2019

The U.S. economy's brief flirtation with 3% growth is over for now, economists say, cut short by a dimming global outlook, market tremors and sluggish business investment.

Gross domestic product, or the total value of goods and services produced in the U.S., grew at a 2.6% annual rate in the fourth quarter, economists estimate in a Wall Street Journal survey conducted this week. Output will grow at a 1.8% clip in the first quarter and a 2.5% rate in the second quarter, according to the poll.

That would average out to **2.3% growth for the nine-month period through this June**—not bad, but **slower than the 3% growth** notched in the year through last September.



Note: Growth estimates for Q4 2018 through 2Q 2019 are based on a Wall Street Journal survey of economists
Source: Commerce Department

Economists believe a big slowdown in **China's economy** and **slower growth in Europe** are **holding back the U.S.**, reducing demand for American exports and making companies more reluctant to begin long-term projects.

"The economy is slowing but not enough to derail the expansion," said Diane Swonk, chief economist at Grant Thornton. "The bad news is the straws on the camel's back are really piling up and the back's beginning to bend."

The Journal conducted the poll of 50 economists this week in lieu of the Commerce Department's report on fourth-quarter gross domestic product, originally scheduled for Wednesday. The government postponed the release along with a bevy of other economic data in January because of the 35-day partial government shutdown that ended last Friday.

The upshot: Economists' latest estimates rely on a lot of guesswork. "We are a bit blind in the first quarter," Ms. Swonk said.

The U.S. expansion is set to turn 10 years old this summer and thereafter become the longest on record. Economists believe it will reach that milestone, largely because employers continue to hire steadily and households—buoyed by bigger paychecks—continue to spend. **Consumer spending drives more than two-thirds of economic demand in the U.S**.

Consumers, however, are a wild card. Overall they're in decent shape financially, benefiting from low unemployment, modest but steady wage growth, an earlier run-up in stocks and a tax cut last year.

"I don't think we're seeing anything that we can measure at the macroeconomic level—at least not in the restaurant space—that would point to any downturn," said David Portalatin of data and analytics firm STR, who studies restaurant-industry data.

Consumers appeared to boost spending during the holidays but, at least in the retail industry, pulled back a bit in recent weeks.

Retail sales rose 6.5% in the first three weeks of January compared with the same period a year earlier, according to Redbook Research Inc. That was a steady gain but smaller than December's 7.9% increase. A separate report this week from the Conference Board showed consumer confidence fell in January for the third consecutive month.

Meanwhile, the boost to Americans' pocketbooks and paychecks is expected to fade later this year as the impetus from tax cuts wanes.

Other factors appear to be more clearly **weighing on economic growth**.

The Federal Reserve's campaign to keep inflation tame by steadily raising interest rates has hurt some sectors, chief among them housing. Higher mortgage rates, on top of a yearslong run-up in prices, have priced out many prospective buyers. Existing-home sales fell about 10% in December from a year earlier, according to the National Association of Realtors.

Perhaps the biggest obstacle is China's cooling economy, which grew at the slowest pace in nearly three decades last year, due in part to a trade fight with the U.S. marked by tariff increases. Economists believe many companies are holding off on expanding facilities or buying equipment until they are more certain of the outcome of the trade battle. That hurts China but spills back into the U.S., too.

Caterpillar Inc., the Deerfield, Ill.-based manufacturer of construction-related equipment, this week joined more industrial companies reporting that sales are being hurt by weakening demand in China. A key measure of the manufacturing industry—the Institute for Supply Management's manufacturing index—showed factory growth slowed sharply in December.

One big question is just how much the government shutdown affected the economy. About 380,000 workers were furloughed and another 420,000 were required to work without pay. The Congressional Budget Office said this week it believes the shutdown reduced output by $11 billion in December and January, $8 billion of which will likely be made up in the second quarter.

Economists think the shutdown took a chunk out of growth this quarter but will lead to a boost in output in the spring as federal employees work through a backlog of work. Economists in the Journal poll said the shutdown will shave 0.3 percentage point off first-quarter growth.

The Federal Reserve, which will conclude its latest policy meeting Wednesday, also projects that the economy will slow this year. In December the central bank projected output would expand 2.3% this year, down from 3% it estimated the economy grew in 2018. White House officials have dismissed predictions of a slowdown. Treasury Secretary Steven Mnuchin said Tuesday that administration officials believe GDP grew 3% last year and will keep up that pace this year.

Germany Pressured to Spark Growth

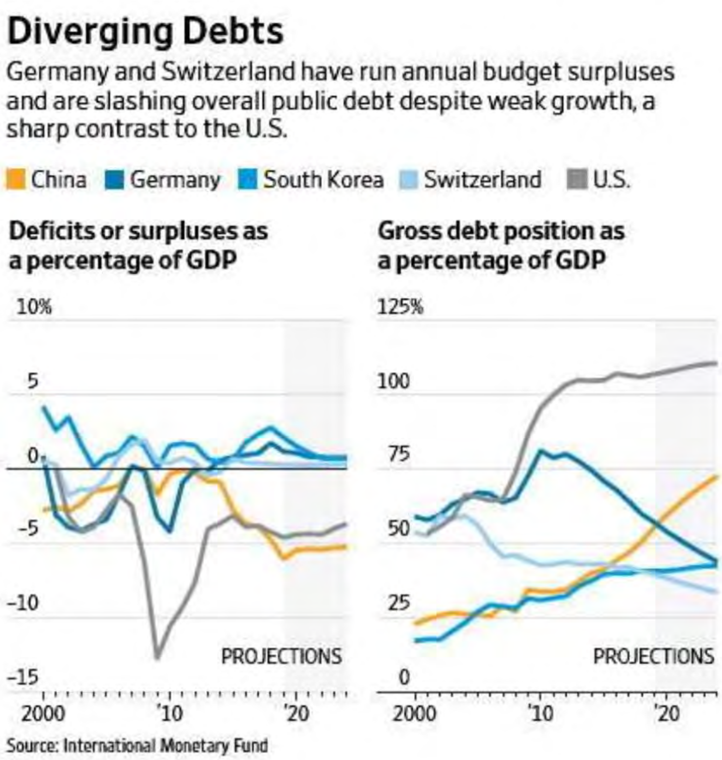
BY BRIAN BLACKSTONE – WSJ 04.15.2019

With the global economy slowing and showing signs it may need support, economists are pointing fingers at Germany and a few other countries that are in a position to provide a lot of stimulus but are choosing not to.

What stimulus measures policy makers can use to support their flagging economies was a key issue during weekend meetings at the International Monetary Fund in Washington. In its annual report on global fiscal policies, the IMF singled out Germany, Korea and Australia as places where fiscal stimulus could make sense. Earlier this month, the IMF called on Switzerland to ramp up public spending.

The IMF, backed by the U.S., has pressed Germany and others with budget surpluses to cut taxes or raise spending to prop up growth. Countries with a budget surplus "should certainly make use of it and have the space to invest and to participate in the economic development and growth," IMF Managing Director Christine Lagarde said, "but not enough has been done on that front."

Treasury Secretary Steven Mnuchin said he agreed with the IMF's stance on surplus countries such as Germany. The U.S. is now running large deficits.



The idea behind debt-financed stimulus is that when economies are weak, governments substitute for a lack of private demand through spending or tax cuts. In times of intense stress such as the global financial crisis a decade ago, economists agree that governments should do all they can to boost growth.

But using large-scale fiscal stimulus to address an economic soft patch has met with resistance from countries like Germany that run a conservative economic policy.

Germany's finance minister, Olaf Scholz, fired back at criticisms, pointing to his nation's increased public investment, reduced taxes and higher support for low-income families.

"It would be a very nice service if you could tell the rest of the world that they are demanding something we already did," he said to a reporter at a press conference Friday. Germany's stable finances put it in a better position to respond to the next recession, he said, and the current global risks aren't Germany's finances but rather "man-made" ones including Brexit and trade disputes.

Korea, meantime, runs an annual budget surplus while Australia is expected to swing to a surplus in coming years. Unlike in Europe, these economies don't appear to be in need of much stimulus.

Germany and Switzerland are using annual surpluses to cut debt and prepare for expected budget strains from future retirees.

If Germany were to launch a big stimulus program, it could encourage deficit countries like France and Italy to ease off measures to bring their budgets closer to balance. European rules set a ceiling on deficits at 3% of gross domestic product, though exceptions are made in times of stress. The U.S. has no such limit.

Germany's export-dependent economy contracted in the third quarter of last year and was flat in the fourth. A string of weak manufacturing figures suggests it may contract again in the first half of this year. That soft patch will affect the 19-member euro-zone, where Germany is the biggest member, and ripple across noneuro countries like Switzerland that rely on Europe for exports.

China's economic slowdown "has hit the Germany economy hard, and there is a good case for using fiscal policy to smooth [the] adjustment," said Ken Rogoff, a professor at Harvard University, who noted Germany's "huge latitude" from its low public debt, which equals less than 60% of gross domestic product and could shrink to less than 50%, by 2022 according to IMF estimates.

Germany has run annual surpluses since 2014 and is expected to do so through 2024, according to the IMF. Tax revenue has increased 8% since 2017, faster than welfare spending, and working Germans today pay the second highest level of income tax of all members of the Organization for Economic Cooperation and Development, behind only Belgium.

The U.S. position is in stark contrast to Germany's despite facing similar problems with old-age spending. The government has pumped the U.S. economy with tax cuts and higher spending with the aim of generating 3% annual GDP growth rates. Annual deficits are over 4% of GDP.

The hope is that by expanding the size of the economy, the U.S. will be better positioned to service its debt. The usual side effects of stimulus— higher bond yields and rising inflation—have failed to materialize, strengthening the argument of the stimulus camp and weakening Germany's view that it's best to keep the powder dry for the next recession.

Germany is "currently learning the hard way that they are the only country around playing according to these rules," said Carsten Brzeski, an economist at ING Bank.

German Manufacturing Slump Piques Fears Over Europe's Flagship Economy

BY NINA ADAM AND BERTRAND BENOIT – WSJ 04.04.2019

The slowdown is bad news for the rest of Europe, where a return of economic hardship could prove a boon for populists

German manufacturers saw orders drop sharply in February, increasing the likelihood that Europe's flagship economy could contract in the first half of 2019 in a setback for a weakened continent.

Total orders for the sector dropped 4.2% from January, Germany's statistics office said Thursday, missing forecasts by a large margin. Compared with February 2018, order volumes were down a steep 8.4%.

"It's devastating," said VP Bank economist Thomas Gitzel.

The steep slowdown in Germany is bad news for the rest of Europe. With Italy already in recession and the French economy hit by protests against President Emmanuel Macron's reform agenda, the eurozone economy will find it hard to expand in the coming months.

A slump would hit the continent as both its governments, with their **high public debts**, and the European Central Bank, after years of ultraloose monetary policy, are reaching the limits of how they can support the economy.

While Germany, which has a budget surplus and low borrowing costs, could theoretically spend itself and the region out of a slump, Berlin's iron domestic commitment to a balanced budget makes this unlikely.

A return of economic hardship could be a boon for the populist insurgency that first flared up with the continent's refugee crisis of 2015 and continues to simmer across the region.

Illustrating the alarm among economists, minutes of the European Central Bank's March 6-7 policy meeting released Thursday showed officials had discussed more aggressive stimulus measures and signaled they could take fresh action to shore up growth.

The drop in German orders will only affect production in coming months. But some economists fear that Germany's output may have contracted slightly in the first quarter, despite signs that manufacturing in both the U.S. and China started to perk up.

"We've still penciled in GDP growth of 0.2% [in the first quarter], but the risks are to the downside after those [manufacturing order] numbers," said Natixis economist Dirk Schumacher.

Economists typically define recession as two consecutive quarters of declining gross domestic product. German gross domestic product contracted by 0.2% on a quarterly basis in the third quarter and was flat in the fourth, according to Eurostat.

Germany, with its large, export-oriented manufacturing sector, is particularly exposed to the disruptions caused by international trade disputes. A slowdown in China, the U.K.'s frustrated attempts to leave the European Union, and structural difficulties in Germany's large auto industry have also weighed on growth.

A recession could have political implications. For the past decade, successive German governments have used rocketing tax revenues to boost welfare payments without resorting to unpopular budget deficits.

Between 2012 and 2018, federal-level welfare spending—which accounts for about half of federal expenditures—grew more than 11% on the back of a nearly 26% increase in tax revenues, according to finance ministry data. Spending on pensions, health and the unemployed has increased faster than GDP in the past five years, despite unemployment falling to record lows.

Centrist politicians have argued that this aggressive redistribution policy had softened discontent over immigration, maintained social peace, and kept nativist and far-left parties out of government. But it depends on continuously rising tax revenues, which could dry up if growth falters.

Given the sacrosanct nature of a balanced budget in Germany and the country's strict fiscal rules, which are enshrined in the constitution, the current government could find it difficult to support a flagging economy by generating its first budget deficit since 2014. On the contrary, the center-left finance minister recently floated a possible tax increase for the rich to fund future spending commitments.

"The economic cycle shouldn't be sacrificed on the altar of the budget surplus," Germany's top economic institutes said Thursday in their regular assessment of the economic climate.

Earlier this week, the World Trade Organization slashed its growth projections for global trade, citing the trade dispute between the U.S. and China. The many uncertainties facing global businesses also prompted Germany's Mechanical Engineering Industry Association to half its production forecast Monday for this year to a 1% increase.

Economists are now watching to see whether recent steps by Beijing to stimulate the Chinese economy are having an effect.

In Europe, the ECB rolled out fresh monetary stimulus on March 7, unveiling a new batch of cheap loans for banks and pledging not to increase interest rates through the end of 2019. The ECB's key interest rate is currently set at minus-0.4%.

The ECB minutes revealed deep concerns that the eurozone's current soft patch could drag on longer than expected. Some officials at the meeting argued that the bank shouldn't increase rates before March 2020, according to the minutes.

While officials still hope for a rebound in growth in the second half of 2019, they admitted that such projections "might be considered optimistic."

"Some of the factors behind the slowdown, such as developments in China, were unlikely to fade away in a few months," the minutes said. Persistent uncertainty could start to have a stronger adverse impact on investment, they warned.

Global Rally in Stocks Gathers Momentum

BY AKANE OTANI – WSJ 04.15.2019

Global stocks are rising at the fastest pace in decades as growth around the world slows, leaving many investors questioning how much longer the market can defy the gravity of the underlying economics.

Indexes from New York and Europe to China have soared double-digit percentages this year to regain most of their ground after tanking in the fourth quarter, supported by signs that central banks are willing to keep holding interest rates at low levels for the foreseeable future. The S& P 500 has risen 16%, vaulting above the level where banks ranging from Morgan Stanley to Barclays expected it to end the year. Benchmark indexes elsewhere have rallied, too, with the Shanghai Composite rising 28%, the Stoxx Europe 600 up 15% and a measure of emerging-market stocks up 13%.

All told, global stocks would close out 2019 with their best annual returns ever if they keep rising at their current pace, according to a Bank of America analysis.

Still, investors are trying to square their big returns with the fact that they have arrived while the global economic outlook has grown progressively dimmer. Fund managers also have increasingly questioned whether **the Federal Reserve's pivot from raising rates to holding them steady reflects economic weakness that will ultimately derail the market's rally**.

The International Monetary Fund in April cut its outlook for 2019 global growth to 3.3% from estimates of 3.5% in January and 3.7% in October, warning that trade tensions and declining business confidence were weighing on nearly all countries around the world. The IMF isn't alone: The Fed and European Central Bank also have trimmed growth forecasts in recent months. And in China, officials have ramped up spending and cut taxes to try to boost a slowing economy.

"A pullback would not surprise us at a time like this," said Tony Roth, chief investment officer at Wilmington Trust Investment Advisors. This year, the firm has shifted more money into shares of large U.S. companies while trimming positions in developed markets outside the U.S. That is a bet that growth in the U.S. will hold up better than in places like Europe and Japan, which "don't look like they have much in the way of upside catalysts," Mr. Roth said.

Fund managers and analysts will see a test of that thesis this week, when dozens of U.S. companies— including Goldman Sachs Group Inc. and Netflix Inc.—report first-quarter earnings.

Because of the global growth slowdown and the waning boost from 2017's U.S. tax cuts, S& P 500 companies are expected to post their first year-over-year decline in earnings since 2016. Investors are still debating how much effect, if any, the slowdown will have on the stock market's 2019 rally.

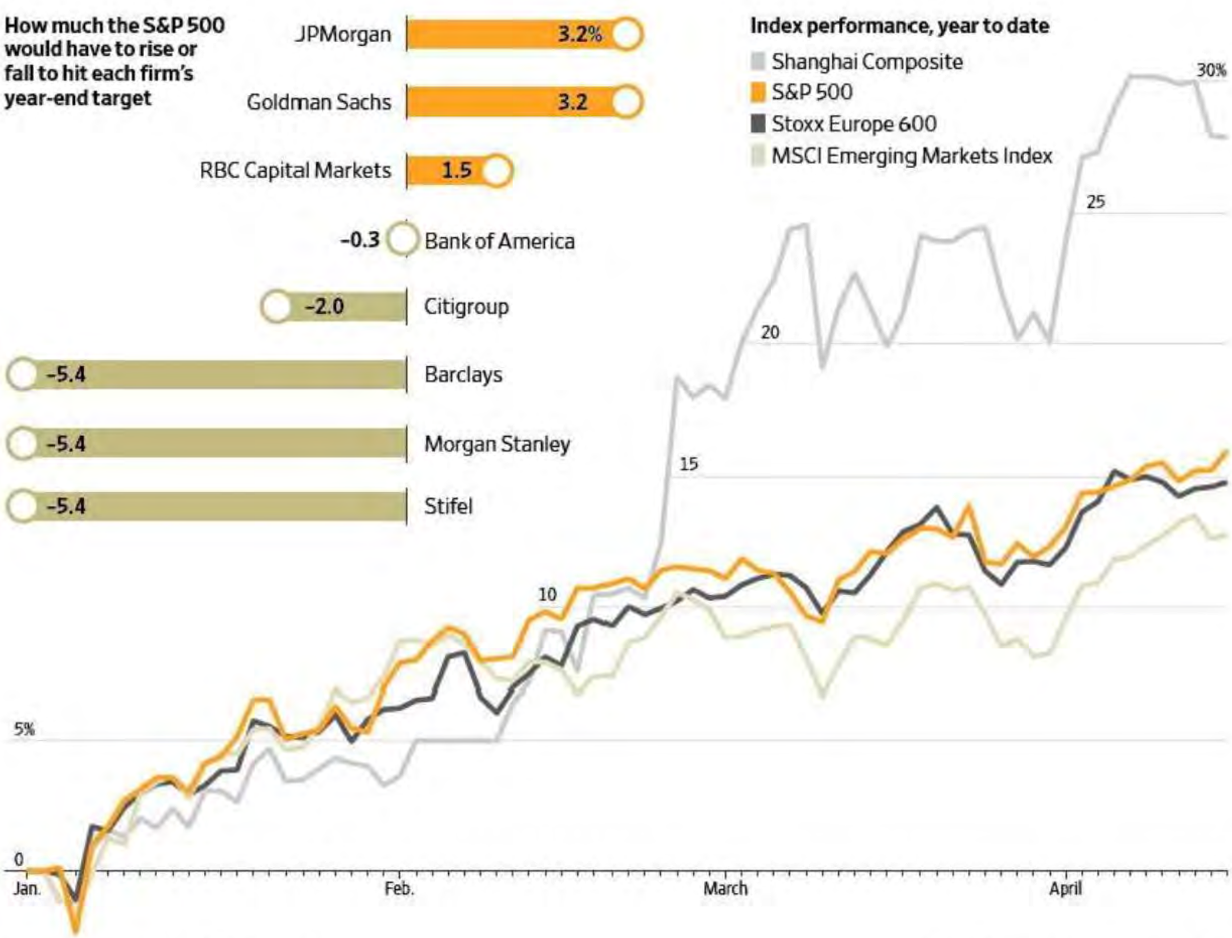
"Most folks are already anticipating a pretty 'blah' earnings year," said Jason Ware, chief investment officer at Albion Financial Group, adding that a big question for financial markets will be whether earnings end up contracting more than expected.

The stock market has stumbled when companies such as Apple Inc. and Caterpillar Inc. have warned their profits would come in short of analysts' expectations. That is partially because those companies, among many others in the S&P 500, generate much of their profits overseas, making them bellwethers for the health of the global economy.

"We don't know when China is going to catch fire," Mr. Ware said, adding that his firm has avoided taking outsize positions in stocks in foreign markets because of high uncertainty about the economic outlook.

For stocks to keep rising, many market watchers believe the world economy must hold at a sweet spot—showing signs neither of rolling over nor unexpectedly heating up.

The S&P 500 has rallied this year along with other international stock indexes, jumping past the point where many banks thought it would end the year.



Sources: the companies (target); FactSet (index performance)

Thaddeus Chambers/THE WALL STREET JOURNAL

The latter point is particularly important, since central bankers have signaled their willingness to forbear raising interest rates as long as inflationary pressures continue to look muted.

"I don't have any worries on financial stability right now [or] worries about inflation pressures getting red hot," John Williams, president of the Federal Reserve Bank of New York, told reporters after a speech Thursday. In a separate address, ECB President Mario Draghi said inflationary pressures in the eurozone were likely to decline, not increase, over coming months.

Some investors also are taking comfort in the fact that the current stock rally bears few apparent similarities to so-called melt-ups, periods when share prices rise rapidly because money managers wary of missing out on further gains decide to pile into the market.

During a melt-up at the start of 2018, stocks around the world flew higher—then began careening in a matter of weeks.

Unlike at the start of that rally, however, surveys this year have suggested investors' risk appetite is modest. Just 3% of fund managers say they have overweight—or larger-than average—positions in global stocks, the lowest share since September 2016, Bank of America found in a March survey. To contrarians, market rallies can look more durable when investor enthusiasm appears more muted.

"We're neither running too hot nor too cold," Mr. Roth said of the economy, adding that this has helped stocks get as far as they have this year. The labor market has added jobs for a record 102 consecutive months. Relative weak spots like the housing market have shown signs of firming. And inflation has remained tame: At the start of the year, the Fed's preferred inflation gauge, the price index for personal-consumption expenditures, notched its smallest year-over-year gain since 2016.

But after a banner first quarter, Mr. Roth and others say markets look vulnerable to pullbacks— especially if continuing trade negotiations between the U.S. and China break down.

"If something happened to the trade situation and it unraveled, it'd be catastrophic to markets," he said.

Growing Economic Worries Spark Slide in Bond Yields

BY DANIEL KRUGER AND SAM GOLDFARB – WSJ 05.29.2019

Investors around the world pushed government bond yields near multiyear lows Tuesday, reflecting growing concern that global economic growth is slowing.

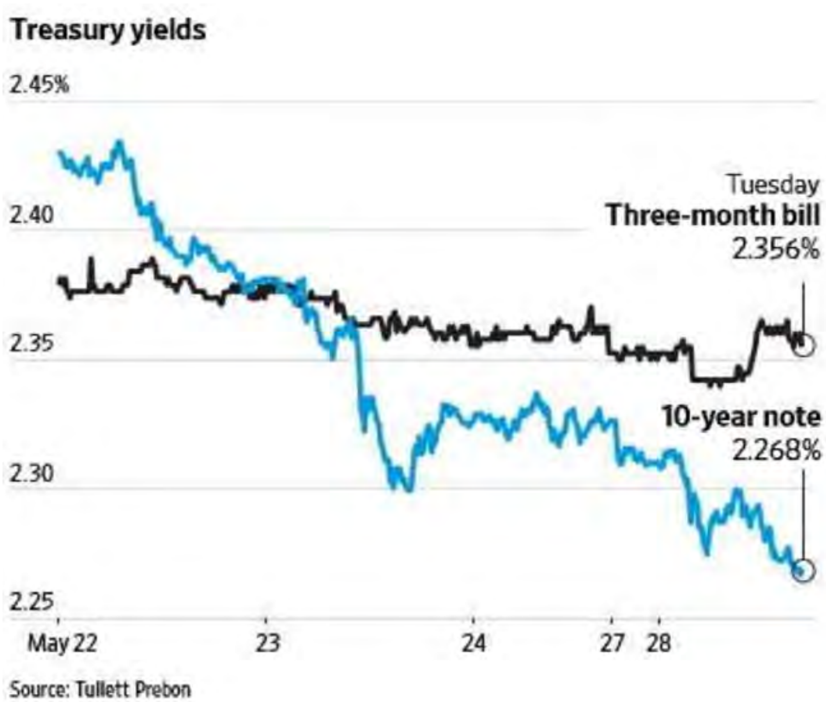
Bond yields, which fall as prices rise, have slid in recent weeks in response to a host of factors, including **tepid economic data**, **geopolitical tensions** and **signs of caution from the Federal Reserve**.

While few see an imminent recession, many investors worry that economic growth could falter as the effects of Trump administration tax cuts fade, companies cut back on spending and higher tariffs restrict global trade.

Falling Treasury yields can be a warning sign to riskier assets, like stocks, if the decline signals doubts about the economy.

The **yield** on the benchmark **10-year U.S. Treasury** note settled Tuesday at **2.268%,** its lowest close since September 2017. The Dow Jones Industrial Average fell 0.9%, after on Friday notching a fifth-consecutive week of declines, its longest string of weekly losses since June 2011. U.S. markets were closed Monday for Memorial Day. Investors and analysts have struggled to understand the reasons behind the move because Treasury yields are seen as a barometer of economic sentiment and help set the cost of debt for a range of borrowers, from home buyers and college students to multinational corporations.

Falling yields can also work to bolster stocks and growth by lowering borrowing costs and pushing yield-hungry investors into riskier assets. The decline in yields has already made home purchases more affordable, driving down the average rate on 30-year fixed-rate mortgages almost half a percentage point since the start of the year to 4.06%, according to Freddie Mac.



Rising Treasury yields jarred financial markets last fall when investors worried the Fed would raise short-term interest rates too high, crimping growth. Early-year signals from the Fed that it would at least pause increases helped power stocks to records.

But investors now have new questions about the economy and the central bank's plans, and several said they have been cutting back on risk.

While major indexes have fallen recently, shares of utilities and real-estate companies, considered a relatively stable source of income akin to bonds, have held on to slight gains over the past 30 days. U.S. oil prices have fallen almost 8% from their 2019 highs. And corporate bond yields have fallen at a slower rate than those on Treasurys, a sign of investors' caution.

Underscoring those worries, the **10-year yield Tuesday fell further below the yield on the three-month Treasury bill**. Investors watch the dispersion between yields on short- and longer-term Treasurys—called the yield curve—because **shorter-term yields tend to exceed longer-term ones before recessions**. That has happened several times this year; it is a phenomenon known as an **inverted yield curve**.

Some investors are now increasingly wagering that the Fed could cut interest rates to try to prolong the expansion. Treasury notes maturing from two to seven years are all trading below the 2.25% lower range of the federal-funds rate, a development analysts said suggests investors are betting that the fed-funds rate will fall.

"**Recession fears** are here and now, and it's getting priced into the [Treasury] market," said Priya Misra, head of interest-rate strategy at TD Securities.

On Tuesday, the possibility that Italy could violate the European Union's fiscal limits sent Italian yields higher and drove the yield on the 10-year German bund further into negative territory, settling at negative 0.159%, its lowest closing level since July 2016.

Negative yields are generally considered a sign of growth fears, and analysts worry they could make it more difficult for developed economies to revive growth in a recession.

The European Central Bank's deposit rate is currently minus 0.4%, and policy makers this year ended bond purchases that were intended to boost growth and inflation.

The slide in global bond yields has dented many investors' hopes that the global economy could become less reliant on central banks' easy-money policies. Many hoped recent tax cuts would break the U.S. out of a long period of slow growth and low interest rates. Now, some wonder if the Fed raised rates too quickly when tax cuts boosted growth in recent quarters.

"It seems in hindsight that the stimulative effects of the tax cuts were temporary and may have masked how tight monetary policy was getting," said Thomas Graff, who manages bond portfolios at Brown Advisory.

The additional yield bond investors demand to take the risk of holding longer-term government debt rather than shorter-term securities, known as the term premium, fell to a record low Tuesday, according to Torsten Slok, chief economist at Deutsche Bank Securities. The decline is a sign that demand for the debt is outpacing the supply.

Meanwhile, economic anxieties have helped push up the average extra yield, or spread, that investors demand to hold corporate bonds over U.S. Treasurys—though spreads are still well below where they were at the start of the year when investors feared the Fed would keep raising rates.

Still, some investors still view low U.S. rates as a positive development for stocks and believe yields are due for a rebound.

“Investors tend to catastrophize” and bet on worst-case-scenarios, said Brian Jacobsen, a multi-asset strategist at Wells Fargo Asset Management. He is betting that yields will be higher in the next three to six months, despite recent softening economic data.

Growth Fears to Keep Fed on Hold

BY NICK TIMIRAOS – WSJ 03.21.2019

Officials project no rate rises this year; 10-year Treasury yield declines to a 14-month low

Federal Reserve officials indicated Wednesday they are unlikely to raise interest rates this year and may be nearly finished with the series of increases they began more than three years ago now that U.S. eco- nomic growth is slowing.

The Fed left its policy rate unchanged in a range between 2.25% and 2.5%. Chairman Jerome Powell suggested the central bank was likely to leave it there for many months.

"It may be some time before the outlook for jobs and inflation calls clearly for a change in [interest rate] policy," Mr. Powell said at a news conference after the central bank's two-day meeting.

In response, the yield on the benchmark 10-year Treasury note fell to 2.537% from 2.614% Tuesday, ending the session at its lowest level since January 2018. U.S. stocks, which rose immediately after the release of the Fed's policy statement and projections, ended the day lower. The Dow Jones Industrial Average fell 0.5% to 25745.67.

The Fed also announced that in May it would slow the pace at which it is shrinking its $4 trillion asset portfolio and end the runoff of its Treasury holdings at the end of September, exactly two years after it began the process.

After a period of exceptional market volatility late last year—brought on by concerns over slowing global growth, trade tensions and the Fed's policy stance—leaders of the central bank signaled early this year a reversal from their December plans to keep raising rates.

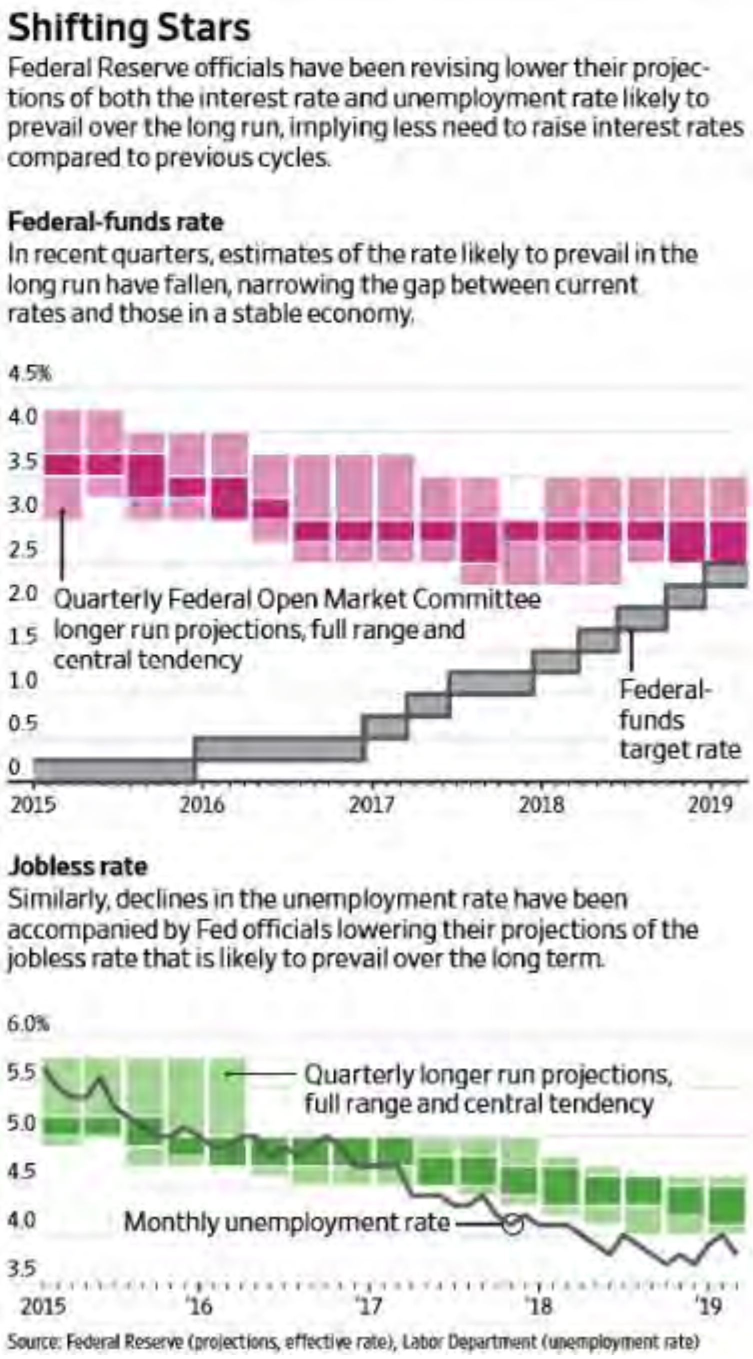
Mr. Powell cited mild inflation pressures, a sharp pullback in financial risk-taking and clear threats to U.S. growth in explaining the Fed's new wait-and-see stance after its meeting in late January.

Projections released Wednesday underscored the turnabout. They showed 11 of the 17 Fed officials who play a role in interest-rate policy didn't think the bank would need to raise rates at all this year, up from two in December. The remaining six officials projected between one and two increases would be needed in 2019.

By contrast, most Fed officials in December had projected between one and three rate rises would be appropriate this year.

"They faced this wall of market opposition coming out of the December meeting," said Nathan Sheets, chief economist at PGIM Fixed Income and a former senior Fed economist. "There's enough uncertainty out there that they're not going to fight the markets."

The Fed projections suggest more of its officials judge they may have reached the end of their rate-increase cycle. “There are many plausible scenarios where they’re done and a smaller number of scenarios where they’re not,” Mr. Sheets said.



He sees the economy eventually strengthening as uncertainty clears, warranting another rate increase. “But the bar for that move is high,” Mr. Sheets said. “We can’t tell how much the softness reflects some extraordinary global shocks that will abate slowly or a softer underlying engine in the economy.”

The Fed’s shift has came as inflation fell shy of the officials’ estimates last year that it would rise above their 2% target.

In a particularly revealing admission, Mr. Powell said he was discouraged that inflation hadn’t risen in a more sustainable fashion.

“I don’t feel we have convincingly achieved our 2% mandate in a symmetrical way,” he said. “It’s one of the major challenges of our time, to have downward pressure on inflation” globally.

Mr. Powell also said he wasn’t significantly worried that the Fed’s policy shift on rates would fuel destabilizing asset bubbles.

Fed officials believe 2% inflation is consistent with a healthy economy. They see inflation much lower than that as a sign of weak economic demand. Also, because short-term interest rates haven’t returned to higher levels, the Fed has less room to cut rates in a future downturn. Higher inflation can provide a greater cushion to reduce nominal rates in a downturn.

Mr. Powell's candor shows "they want to see higher inflation, and they're not convinced they can achieve that," said Michelle Meyer, an economist at Bank of America.

Since 2015, the Fed raised rates on the theory that declining unemployment would eventually generate stronger price pressures. This framework dictated that, even with inflation running below the Fed's 2% target, the probability of higher future inflation demanded pre-emptive rate increases.

The new projections show the officials continue to revise downward their thinking about the point at which the unemployment rate is consistent with stable prices. The officials' median rate for this metric fell to 4.3% Wednesday— down from 4.5% a year ago and 4.8% in 2016.

This revision suggests the economy can employ more people without risking an acceleration in inflation.

Other changes to the forecast show officials no longer believe they will need to raise rates to slow economic growth to a level that will prevent overheating. They revised lower their projection for gross domestic product growth and revised higher their projection for the unemployment rate at year's end.

On the asset-portfolio front, the Fed has been shrinking its holdings to $4 trillion from $4.5 trillion when it began the process in October 2017.

Announcing the coming end of the runoff marked another significant pivot for Mr. Powell, who in December had said the process was on "autopilot" and running smoothly. Markets reacted poorly to the comment.

The Fed currently allows $30 billion in Treasurys and $20 billion in mortgage bonds to mature every month without replacing them; the actual amounts have been slightly lower because the Fed's stock of maturing bonds is smaller in most months.

Beginning in May, the Fed will slow to $15 billion the amount of bonds it allows to mature every month, and will stop the runoff of the Treasury holdings in October. The central bank will continue to allow the mortgage holdings to mature, and they will reinvest maturing principal below the $20 billion cap into new Treasury securities.

The same factors prompting the end of the runoff will one day require the portfolio to grow again. The Fed said Wednesday it hasn't decided when that will occur. At issue is gauging demand for deposits held by banks at the Fed, known as reserves.

With the balance sheet at a fixed size, reserves will very slowly decline as other liabilities, namely currency, continue to grow. At some point, reserves could grow scarce enough to raise the rate banks charge in overnight money-market accounts, which would lift the Fed's benchmark rate.

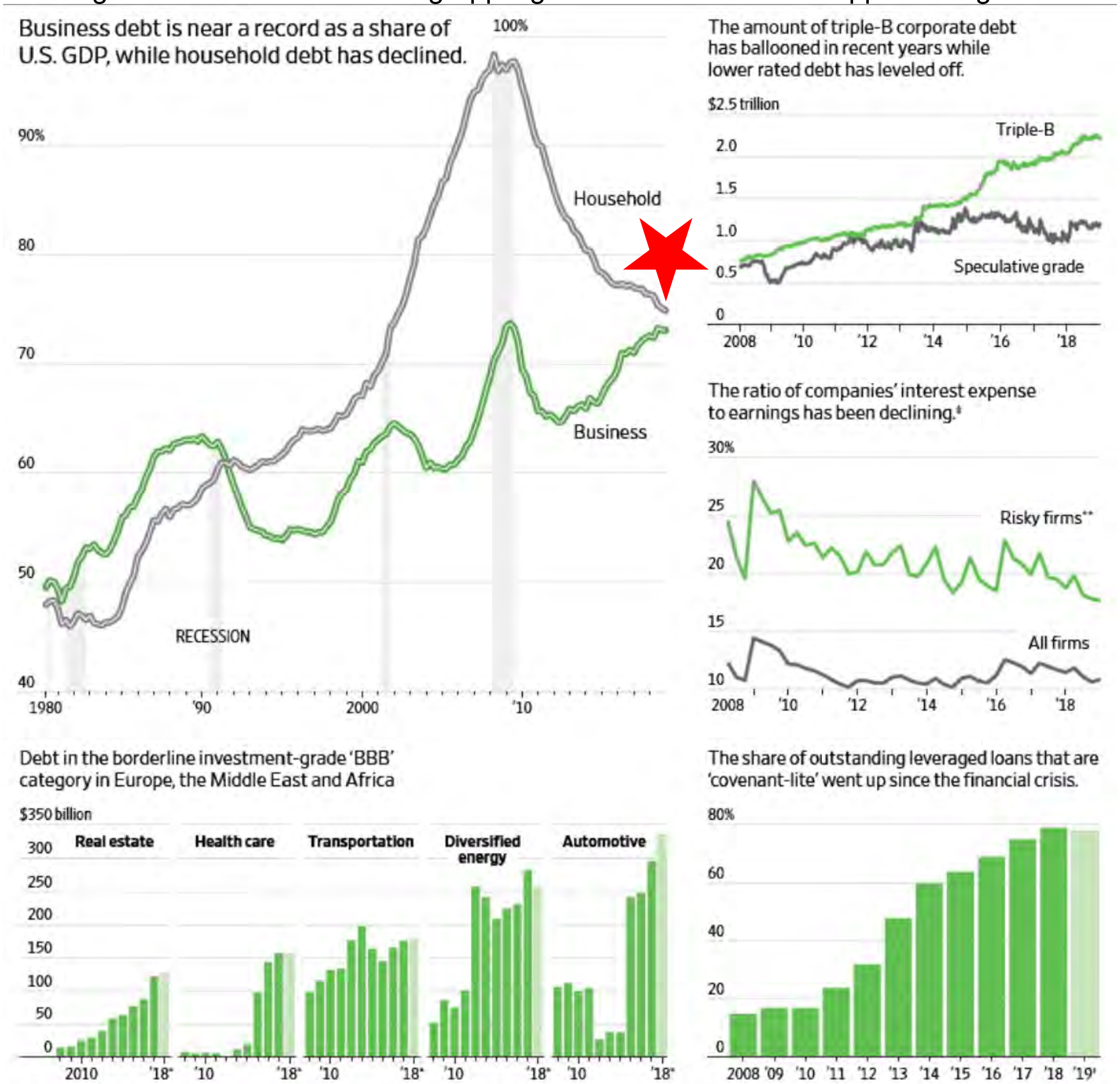
Fed officials said they would allow the balance sheet to resume growing by purchasing more Treasurys before reserves fall to such a level.

Growth in Corporate Bonds Sounds Alarm

BY SAM GOLDFARB AND AVANTIKA CHILKOTI – WSJ 05.28.2019

A decade-long rise in corporate borrowing is prompting new scrutiny about how debt markets might hold up in an economic downturn.

While few observers worry that the corporate-debt market is in imminent danger, both regulators and investors are grappling with how stress could ripple through it.



*Estimate †Through May 21 ‡Earnings before interest, taxes, depreciation and amortization **Risky firms are those with debt that is unrated or rated speculative-grade by S&P Global Ratings.
Sources: Federal Reserve (debt to GDP); S&P Global Ratings (debt); S&P Global Fixed Income Research (corporate debt); Federal Reserve board calculations based on S&P Global, Compustat data (interest expense to earnings); LCD, a unit of S&P Global Market Intelligence (leveraged loans)

Attention to the area has only increased since the financial crisis, which was incubated by excesses in the housing- debt market.

In a speech last week, Federal Reserve Chairman Jerome Powell ticked through a number of topics of concern, including the near-record level of business debt as a share of the economy; the increase in debt at the bottom end of the investment-grade ratings scale and the rapid disappearance of protections for lenders to higher-risk companies.

As of the end of last year, the ratio of business debt to U.S. gross domestic product reached 73.1%, Fed data show, just short of the high of 73.7% set in 2009.

Meanwhile, the amount of triple-B rated U.S. corporate debt—the lowest category of investment- grade credit—has more than doubled since the financial crisis.

Covenant-lite loans—which require companies to meet certain financial metrics, such as a level of earnings relative to their interest expense— have increased to nearly 80% of the speculative-grade, or leveraged, loan market from 6% in 2006.

Though Mr. Powell concluded that elevated levels of corporate debt don't "present notable risks" to financial stability, he cautioned in a speech at a conference on financial markets in Fernandina Beach, Fla., that it "certainly could stress borrowers if the economy weakens."

One of the reasons companies have borrowed more in recent years is that the burden of holding debt has been lightened by years of easy monetary policy, which have helped lower the interest they have to pay.

Meanwhile, a strong economy has bolstered earnings.

Still, investors and regulators generally watch debt markets closely because periods of exuberant lending often have been followed by sharp pullbacks in credit availability.

Investors sometimes have bristled at comparisons between the corporate-debt market of today and the mortgage market before the financial crisis.

But many have been adjusting their behavior based on their own research into the current market.

Rob Zable, senior portfolio manager at GSO Capital Partners, the credit investment arm of Blackstone Group, said he believes leveraged loans remain attractive given strong U.S. corporate earnings and relatively appealing yields, among other factors.

Still, Mr. Zable's team has been paying closer attention to the details within the terms of such loans—particularly those that give borrowers the flexibility to pay their owners dividends and strip collateral from lenders.

Given the current low-default environment, prices of loans in the secondary market aren't necessarily reflecting differences in loan documents, Mr. Zable said.

Nevertheless, GSO has developed its own covenant-scoring system and integrated it into its investment process to reduce its risk if the economy slows and businesses do more to exploit the weakness of their covenants.

Concerns about rising corporate- debt levels are hardly confined to the U.S.

In Europe, the Middle East and Africa, gross reported debt of nonfinancial businesses in the triple-B category grew by 80% between 2007 and the end of 2018, reaching $2.2 trillion, S& P Global Ratings estimates.

As much as $250 billion of that could be downgraded to the speculative grade "BB" if there is a severe downturn in the next two years, the rating agency estimates. That could pose problems because many investment funds aren't allowed to hold speculative-grade bonds. If bonds are downgraded to speculative-grade territory en masse, those funds would become forced sellers, further exacerbating likely declines in those bond prices.

Paul Watters, head of Europe, the Middle East and Africa credit conditions at S& P Global Ratings, said that recent attention on the amount of triple-B debt "has been investor- led," starting in the U.S. and increasing when investors dumped riskier assets in the fourth quarter.

Still, Mr. Watters said that concerns are overblown unless there is another recession comparable with the 2008 financial crisis, something S& P isn't forecasting.

Hopes for Easing Cut Treasury Yields

BY IRA IOSEBASHVILI – WSJ 06.26.2019

The yield on the 10-year Treasury note fell to its lowest level in more than 2½ years Tuesday after weak U.S. economic data bolstered the case for the Federal Reserve to cut interest rates in coming months.

The benchmark **10-year yield**, which helps set borrowing costs on everything from mortgages to corporate loans, **settled at 1.994%**, the **lowest** level **since November 2016**, from 2.021% on Monday.

Yields, which fall as bond prices rise, slipped after Tuesday morning data releases showed U.S. consumer sentiment in June had declined to its lowest in nearly two years, while purchases of newly built single-family homes decreased in May.

Yields temporarily pared those declines later in the session after James Bullard, president of the Federal Reserve Bank of St. Louis, told Bloomberg TV he doesn't yet think the economic situation warrants a 50 basis-point rate cut. Later in the session, Fed Chairman Jerome Powell said officials are debating whether uncertainty about trade policy will cause the economy to slow and require rate cuts later in 2019.

Bond yields around the world have fallen in recent days after central banks, including the Fed, signaled they were preparing to ease monetary policy.

Several investors said they would be closely watching the Group of 20 meeting in Japan at the end of the week. Signs that China and the U.S. are closer to reaching a deal on trade would likely weigh on bond prices and send riskier assets higher, some market participants believe.

"Our sense of things at the moment is that if the G-20 meeting at the end of the week…produces even a very modest amount of good news about trade, risk assets will move sharply higher," said Steven Barrow, head of G-10 strategy at Standard Bank, in a note to investors.

How Long Can This Bull Market Run?

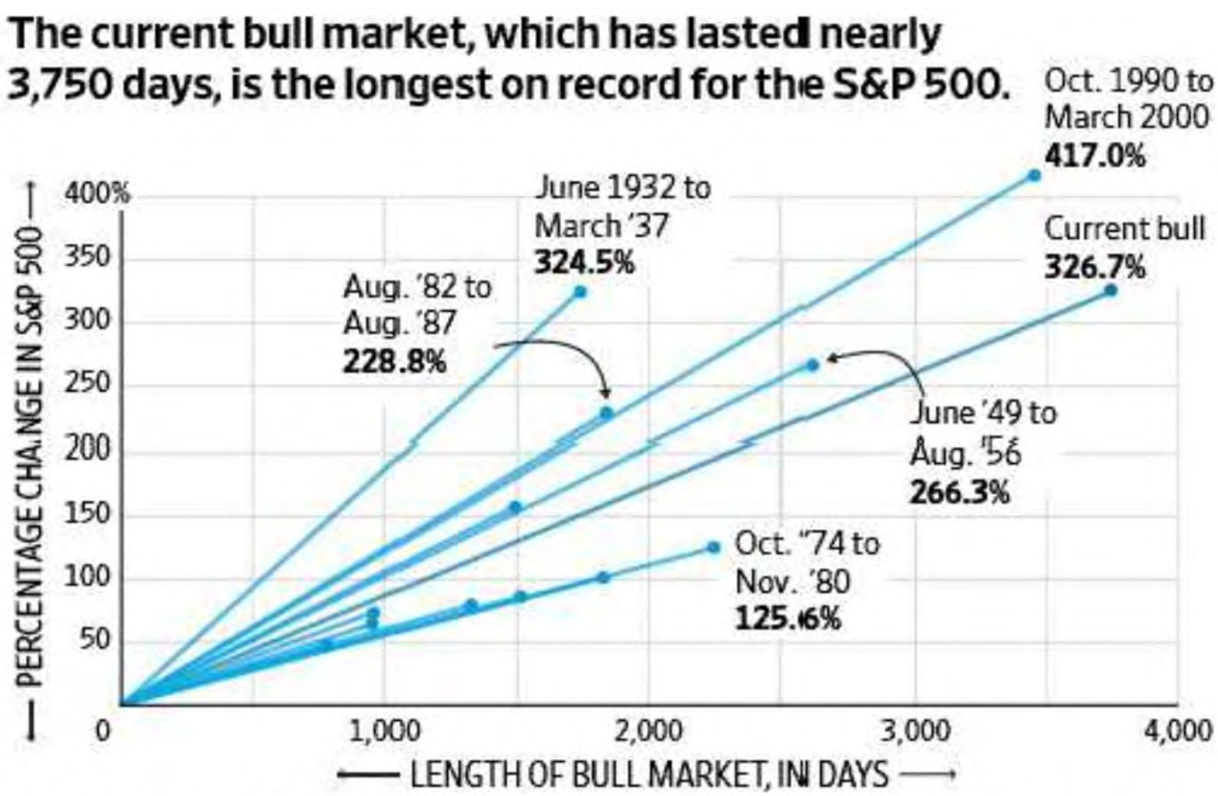
BY JASON ZWEIG – WSJ 06.15.2019

As Yogi Berra might have said: All we can know for sure is that it's later in this cycle than it used to be.

It's late in the market cycle. In the past week, at least six professional investors have told me that—and they are probably right. This bull market for U.S. stocks is by far the longest on record, and only a lunatic would think it can last indefinitely.

How late is it and what, if anything, should investors do to protect themselves?

The S& P 500 hasn't fallen by at least 20% from a previous high since March 2009. **As commonly defined, this bull market is nearly 3,750 days old, the longest in the S& P 500's more-than-90-year history. That's twice as long as the average bull market**, according to Howard Silverblatt, senior index analyst at S& P Dow Jones Indices. Since 2009, stocks have more than quintupled, counting dividends.



Note: The current bull market–defined as a 20% rise in the S&P 500 from its previous low, ending when the index reaches its high and subsequently declines by 20%–began on March 9, 2009. Returns do not include reinvested dividends.
Source: S&P Dow Jones Indices

Stocks will stop going up. You can be as sure of that as you are that the sun will set in the west. Unlike today's sunset, however, you can't know exactly—or even approximately—when the bull market will end.

Because market cycles tend to last for years, major turning points are few and far apart. There is little comparability in the history of these inflection points, making it hard to draw firm conclusions.

Or, as Yogi Berra might have said if he played the market: All we can know for sure is that it's later in this cycle than it used to be.

And cycles can last for a remarkably long time. Australia hasn't had a recession in nearly 28 years. **U.S. interest rates have been falling almost continuously since 1981—longer than many bond investors have been alive**.

Naturally, what you expect depends on what you have experienced. The investment thinker Peter L. Bernstein, who died in 2009, often spoke of "memory banks," the collective experiences that investors live through and that live on in their minds.

In the 1950s, portfolio managers argued that stocks weren't worth owning unless their dividend yield exceeded the yield on long-term bonds. That's what their memory banks told them. Yet in 1958, the dividend yield fell below the bond yield—and stayed there for the next half century.

In the late 1990s, young investors believed internet stocks would soar ever higher—as they had already done for years. Those memory banks also failed.

After 10 bullish years in stocks, some younger investors have no memory of losing serious amounts of money. That could make them think it can't happen. Saying "this time is different" is easier when you compare it to a previous time didn't live through yourself.

As Fred Schwed Jr. wrote in his book "Where Are the Customers' Yachts?" in 1940: "There are certain things that cannot be adequately explained to a virgin either by words or pictures. Nor can any description that I might offer here even approximate what it feels like to lose a real chunk of money that you used to own."

For now, at least, complacency seems to be more common than enthusiasm, suggesting the market isn't about to overheat. "I don't think there are that many people out there saying this is the last best chance to buy stocks because they're going to the moon," says Howard Marks, co-chairman of Oaktree Capital Management and author of "Mastering the Market Cycle." He adds, "**I just don't think the psychology is that euphoric right now. Most people are not risk-oblivious**."

Some warning signs are flashing, however. With unemployment at half-century lows and consumer confidence high, “there’s no slack in the economy,” says Doug Ramsey, chief investment officer at the Leuthold Group in Minneapolis. Companies can’t easily keep increasing profits after they’ve already tapped all available resources.

“**Economic growth is still relatively high, but the pace has been decelerating, putting us closer to the turning point**,” says Andrew Ang, head of factor investing strategies at BlackRock Inc. “**This is a time when investors should seek resilience in their portfolios**.”

Granted, the same has been said often over the past decade. But, if you are worried that it is late in the cycle and the bull can’t keep running for much longer, you could take a few small steps.

First, you can favor international stocks, which on average offer significantly higher dividends and lower valuations than U.S. stocks.

You could also tilt a bit toward so-called quality companies that earn high and stable profits with low levels of debt, as well as toward low-volatility stocks whose prices tend to fluctuate less sharply than market averages.

Such companies have outperformed slightly in economic slowdowns and recessions, say Jesse Barnes and Chris Covington, who manage systematic strategies at HighVista, an investment firm in Boston. However, they tend to underperform as the economy recovers and expands.

So any changes you do make should be incremental rather than drastic. Protecting against losses if this bull market keels over could also restrict your gains when the next one starts to run again.

“For investors, making significant changes based on where we seem to be in the cycle is almost always a really bad idea,” says Mr. Barnes.

How Washington Learned to Love Debt and Deficits

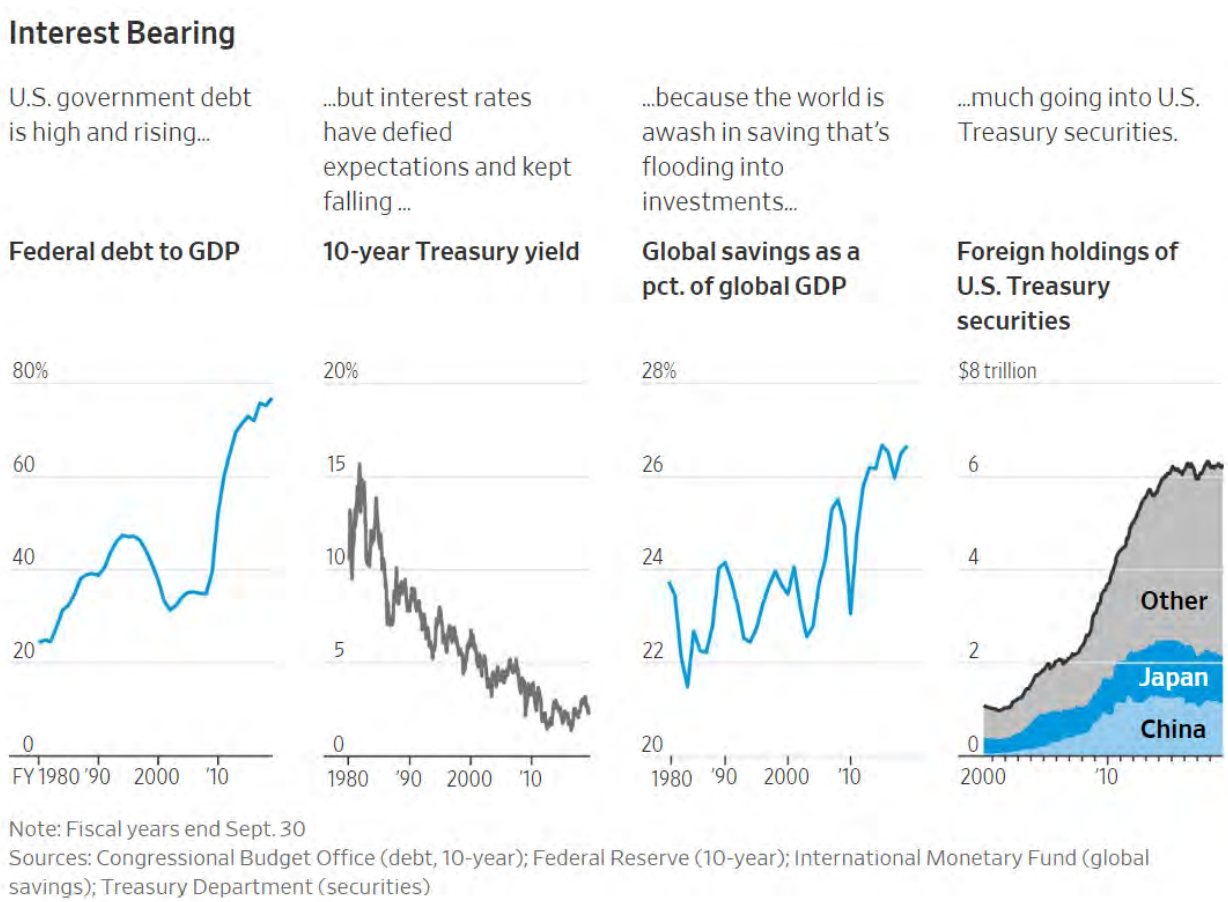
BY KATE DAVIDSON AND JON HILSENRATH – WSJ 06.13.2019

Political support for taming federal debt has melted away, and the U.S. is testing just how much it can borrow.

William Hoagland has engaged in nearly every Washington budget-deficit battle for four decades. A longtime analyst and onetime senior Republican congressional budget aide, he brought a sensibility learned growing up on an Indiana farm: You've got to balance the books over time.

He feels like a voice in the wilderness now.

The **theories about debt and deficits** and whether they matter—once widely shared in Washington, on Wall Street and in academia—**have fundamentally changed**.



Political **support for taming deficits has melted away**, with **Republicans accepting bigger deficits** in exchange for tax cuts and **Democrats making big spending promises around 2020 election campaigns**. Global **demand for U.S. Treasury assets has displaced the "bond-market vigilante" mentality of the 1990s that scared Washington**.

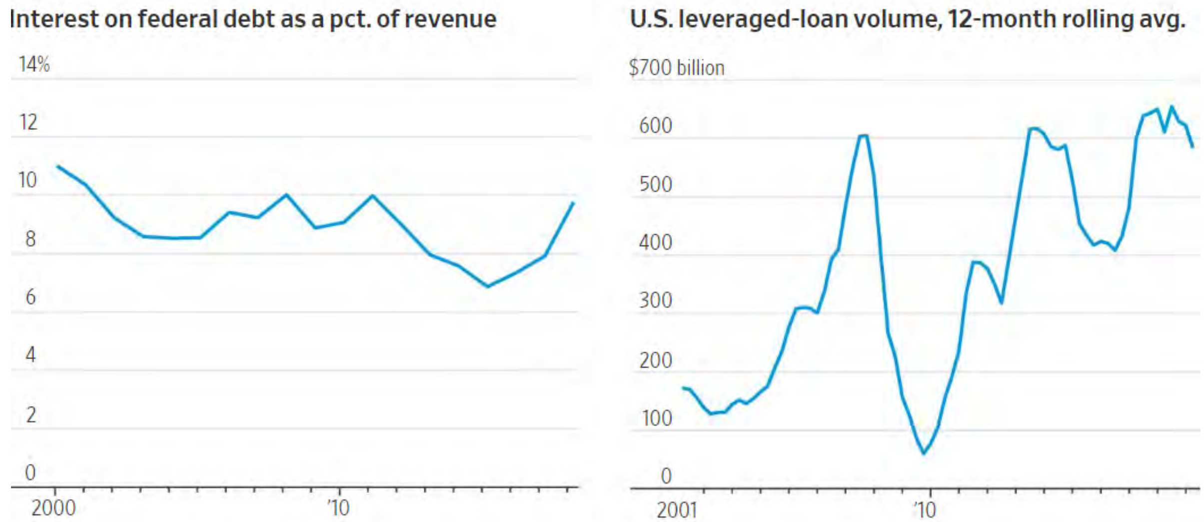
Leading scholars, in a mini-revolution hitting academia, are debating whether large federal debt and deficits might be tolerable. They aren't a top concern for voters anymore, either.

Even some former deficit hawks say rising government red ink might not be the grave problem they once believed.

Cost Control

The flow of money into U.S. Treasury securities has helped keep interest costs low...

...and kept the government from crowding out the private sector.



Sources: Office of Management and Budget via St. Louis Fed (interest); LCD/S&P Global (loans)

The new bottom line: The **U.S., despite a record-long economic expansion, is on course to test just how much it can borrow**.

"I've thought it's time to box up all these budgets surrounding me right here and going back to the farm and forgetting all about it," says Mr. Hoagland, a senior vice president at the Bipartisan Policy Center, who remains a deficit hawk and thinks the rising red ink will end badly. "It's almost like I've wasted my, whatever it's been, 45 years in this town."

Debt as a share of economic output has more than doubled over the past decade. **Deficits, after falling in the expansion's first six years as a share of the economy, are rising again,** approaching $1 trillion a year.

In theory, an increased supply of government bonds—sold to raise funds when spending exceeds revenues—should increase government borrowing costs. Theory also says big deficits crowd out business borrowing and increase private borrowing costs, too.

The opposite has happened. While government debt soared after the 2007-09 financial crisis, **10-year Treasury yields have fallen to near 2%** from more than 5% in

2006, holding down government interest payments. **U.S. business debt rose** to $15 trillion in 2018 from $9 trillion in 2006.

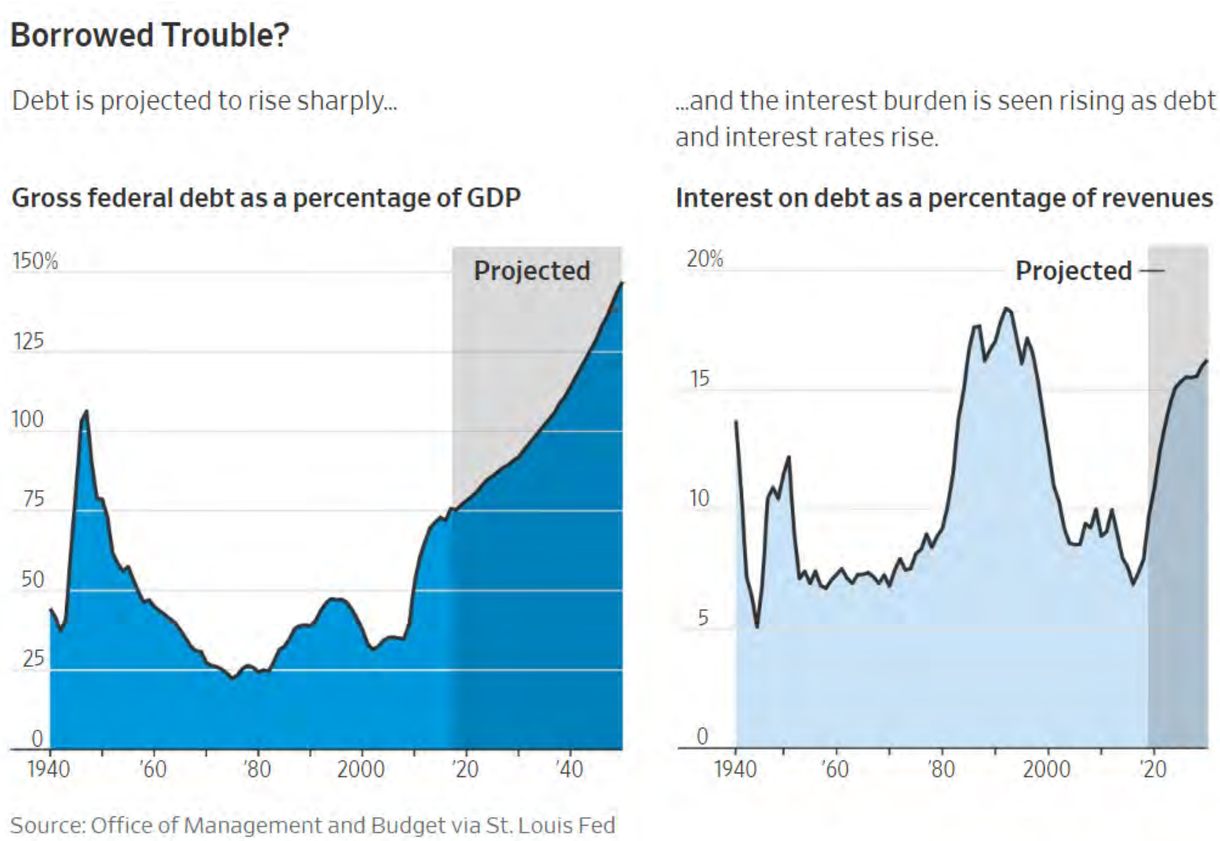
Debt isn't catastrophic, says Olivier Blanchard, former International Monetary Fund chief economist. "If you have good uses for it, use it."

The U.S. government borrowing cost has tended since World War II to be less than the economy's growth rate, he said in the keynote address at the American Economic Association's annual meeting in January. The profound implication: Government borrowing might cover its costs over time if the economy keeps growing.

Last year, economic output grew 5.2%, not adjusted for inflation, while 10-year Treasury yields never exceeded 3.25%. Mr. Blanchard, the association's former president, says he is rewriting the fiscal-policy chapter of his macroeconomics textbook.

"Olivier Blanchard is basically saying there is a free lunch," says Valerie Ramey, a University of California, San Diego fiscal-policy expert and one of a shrinking number of voices leery of dangers down the road.

Her research shows government-funding costs tend to decline during wartime when spending increases, jibing with Mr. Blanchard's work. But she worries that past relationships will lose power once policy makers try exploiting them.



"We don't know how long the real interest rate is going to stay this low," she says. "It could suddenly start increasing, and the U.S. could be left in a really bad situation if it has a lot of debt to finance."

The **Congressional Budget Office**, which expects the average interest cost on debt to rise to 3.5% over the next decade from 2.3%, **estimates the government will spend more on interest in 2020 than on Medicaid and more in 2025 than on national defense**.

A recession would test how much debt the government is prepared to accumulate. Spending on safety-net programs like unemployment insurance rises during recessions, and tax receipts fall. Policy makers are pressured to increase spending or cut taxes to stimulate growth—so when the economy sinks, already large deficits will soar.

Countries with high debt before crises have weaker recoveries, partly because policy makers pull back on stimulus quickly for fear of pushing debt levels too high, found University of California, Berkeley economists Christina Romer and David Romer.

Robert Rubin, who as Treasury Secretary pushed President Clinton for deficit reduction, says bond markets are out of sync with the economy. A reset in investor views could become a "real problem" for America, he says. "To believe in free lunches isn't a very sound basis for policy."

In the black

The federal government has run deficits in all but four of the past 50 years. Budget deals during the George H.W. Bush and Clinton administrations, which included tax increases on high-earning Americans, and spending cuts, plus economic growth, put the budget in the black in 1998 for the first time since 1969.

Smaller deficits meant lower interest rates that stimulated spending and investment. Yields on 10-year Treasurys fell from near 9% in 1990 to under 5% by 1998. The CBO projected annual surpluses for the next 10 years.

But recession hit in 2001. Republicans cut taxes, and America spent on wars in Afghanistan and Iraq. A financial crisis, and another recession starting in 2007, led to bank bailouts, safety-net-program spending and hundreds of billions in fiscal stimulus. Publicly held debt swelled to 76% of gross domestic product in 2016 from 32% in 2001.

A political movement to tame deficits proved short-lived after tea party Republicans poured into Congress in 2010 decrying debt. They pressed President Obama to cut discretionary spending. He forced Republicans to accept increased top tax rates. Deficits began receding, but neither side could reach agreement to rein them in long-term.

"I'm the master of lost causes," says Alan Simpson, former Republican senator from Wyoming, who in 2010 co-headed a commission Mr. Obama created to make deficit-reduction recommendations. Mr. Obama didn't endorse his proposals, and none of his recommendations saw a Congressional vote. "Everyone out there just began to pick it apart," he says of the plan he co-wrote with Democrat Erskine Bowles.

Donald Trump campaigned in 2016 promising to eliminate the $19 trillion national debt in eight years but offered policies cutting taxes and increasing military spending, and a vow not to cut entitlement-spending programs.

Debt kept rising under his leadership and with Republicans in control of Congress.

Political will vanished partly because there was no discernible effect on bonds. Yields on 10-year Treasurys have rarely poked above 3% in this economic expansion. Theory says the inflation rate should rise with government borrowing, but it fell. In response, the Federal Reserve became a big market player, buying nearly $2 trillion in long-term government bonds.

Foreign investors flocked to U.S. bonds as safe investments relative to alternatives. Foreign holdings of Treasury securities grew to over $6 trillion in 2018 from $1 trillion in Dec. 2000.

"There are plenty of savings around the world to be invested," says former Federal Reserve Bank of New York President William Dudley.

Today, few Republicans or Democrats exhibit much interest in reducing deficits. Republicans cut taxes in 2017 and agreed with Democrats in 2018 to boost spending on the military and domestic programs nearly $300 billion above spending caps set during 2011 deficit battles. Both parties are now negotiating whether to bust those caps again this year.

"If the markets were overwhelmingly worried about our budgets and our spending and our deficits, you would see that interest rate rise," Lawrence Kudlow, director of Mr. Trump's National Economic Council, told Fox News in March.

White House chief of staff Mick Mulvaney, a deficit hawk in Congress during the Obama years, at an April conference said the national debt "doesn't seem to be holding us back from an economic standpoint." At a Wall Street Journal event Tuesday, **he said Mr. Trump wants to reduce deficits but there isn't enough political support in either party to curb spending**.

GOP lawmakers see higher deficits from tax cuts as a trade-off for stronger growth they say will fill the budget shortfall long-term. To control deficits, they argue for spending cuts. Democrats reject that argument, saying Republicans raised deficits after criticizing them in the Obama era.

"They passed a $2 trillion tax cut," says Rep. Barbara Lee (D., Calif.). "And they are using the argument that we don't have the resources as a need to cut budgets. We're not going to let them do that."

Rep. Tom McClintock (R., Calif.) says many House Republicans care about deficits but efforts to rein them in never gained traction among GOP leadership—even when it controlled both chambers. "I think it's a tremendous opportunity for the Democrats," he says, "to step forward, bring our spending under control while there's still time, and show the Republicans up."

'Why worry?'

A January Pew Research Center survey found 48% of Americans—54% of Republicans, 44% of Democrats—said deficit-reduction should be a priority, compared with 72% in 2013 at the start of Mr. Obama's second term.

Rep. John Yarmuth (D., Ky.), House Budget Committee chairman, says he rarely hears from constituents concerned about rising deficits and debt. Many voters' attitudes, he says: "There haven't been any cataclysmic consequences, so why worry about it?"

After taking House control this year, Democrats considered a resolution holding deficits steady as a share of the economy over 10 years. They abandoned it after progressive lawmakers signaled they wouldn't support a budget without major spending initiatives, such as a Green New Deal and Medicare for All.

"The deficit hawk wing of the Democratic Party has just lost a tremendous amount of power," says Douglas Elmendorf, dean of the Harvard Kennedy School of Government. One reason, he says: It sought compromise with Republicans who abandoned deficit control once in power.

As an economic adviser in the Clinton White House and Treasury Department, he sought smaller deficits. Mr. Elmendorf, CBO director from 2009 to 2015, now is among economists who argue deficits aren't the threat they once believed because interest rates have proven persistently low.

Though debt has soared as a share of GDP, government interest payments have fallen to 1.6% of GDP last year from 3% in 1989, says Jason Furman, chairman of the White House Council of Economic Advisers under Mr. Obama. "Talk about climate change, talk about jobs, talk about all the things you want to do," he says. "Then just have the deficit in the background as something you're not going to make worse."

Messrs. Furman and Elmendorf say they worry the argument can go to extremes, including a concept many Democrats have warmed to, called Modern Monetary Theory. It holds that the U.S. government can always create more money to fund itself, only stopping if that creates inflation. "Some are taking this too far," says Mr. Furman.

Moody's Investors Service in December warned that, while the U.S. maintains a triple-A credit rating, "rating pressures could emerge in the coming years in the absence of a shift in fiscal policy to reduce the government's budgetary imbalances and stabilize debt metrics."

Moody's projects that within a decade interest payments will consume over 20% of federal revenue, well above most other developed nations and exceeding U.S. levels in the 1980s and 1990s when debt worries consumed Wall Street and Washington.

Former Sen. Simpson, retired in Wyoming, anticipates a reckoning: "If you spend more than you earn, you lose your butt."

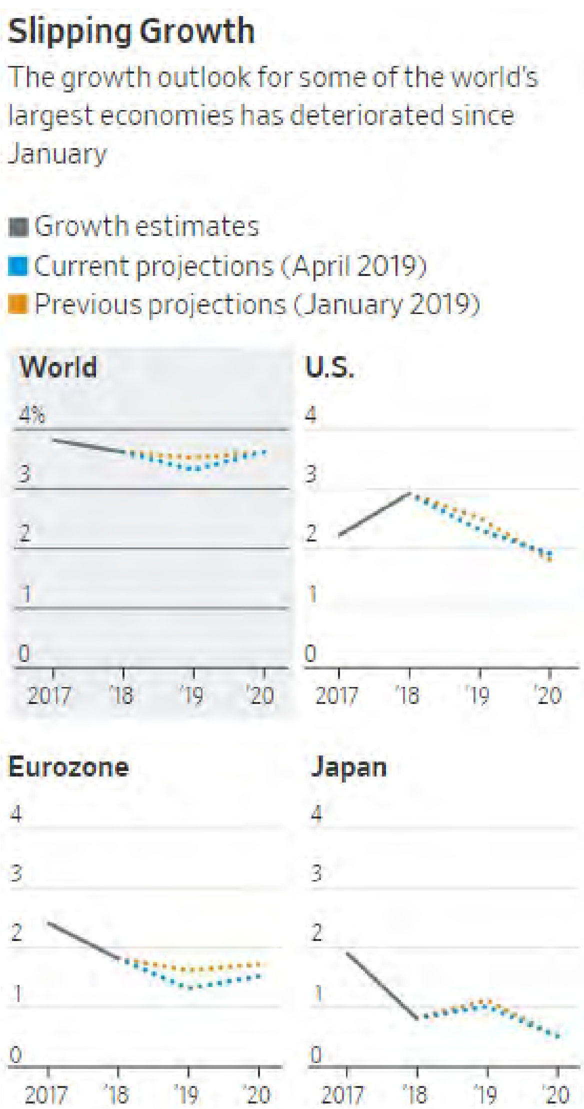
IMF Cuts 2019 Global Growth Outlook

BY JOSH ZUMBRUN – WSJ 04.09.2019

Global economic growth in 2019 is off to a worse start than was apparent earlier in the year, with nearly the entire world economy stumbling, according to new forecasts from the International Monetary Fund.

The IMF's latest economic forecasts cut the outlook for growth in 2019 to 3.3% from estimates of 3.5% in January and 3.7% in October. The decline has been broadly felt, with all major advanced economies, including the U.S., and most major emerging-market economies seeing deterioration in their outlook.

In explaining the lowered expectations, the IMF pointed to an environment of increased "**trade tensions and tariff hikes between the United States and China**, a decline in business confidence, a **tightening of financial conditions**, and **higher policy uncertainty** across many economies."



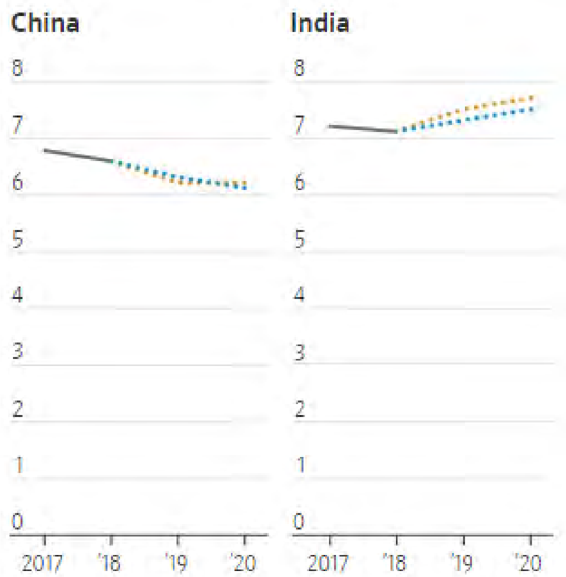
The release of the World Economic Outlook report, the IMF's flagship barometer of the health of the global economy, provides another window into the economic fallout more than a year after trade tensions flared among major economies.

After an international boom in 2017, in which trade surged and the world enjoyed a synchronized economic expansion boosting the fortunes of most countries, trade faltered sharply last year and is expected to stumble again in 2019.

World trade, which had been growing at about 5%, expanded by 3.8% last year and is forecast to rise 3.4% in 2019. While trade was clearly decelerating in the IMF's quarterly forecasts released in January, the new data represent an additional downgrade of 0.6 percentage points for trade growth.

Trade tensions aren't the only factor weighing on economic growth around the world, the IMF said. In Europe, the report also pointed to declining consumer and business sentiment, and the difficulties brought about by political uncertainty in Italy and the United Kingdom and protests in France that halted its economic growth.

Economic growth appears on course to slow nearly everywhere. Growth forecasts dropped 0.5 percentage points from January for Germany, Italy and Mexico, 0.6 points for Latin America as a whole, 0.4 points for Canada, 0.3 points for the U.K., and 0.9 points for the Middle East.



Source: International Monetary Fund
Soo Oh/THE WALL STREET JOURNAL

The IMF's chief economist, Gita Gopinath, said Tuesday that the data shows "a slowdown in growth for 70% of the global economy" and described the world economy as being in "a delicate moment."

David Malpass, the new president of the World Bank, said in an interview Tuesday during his first day in office, that the report underscored the urgency of focusing the World Bank's mission on reducing poverty and boosting growth rates in the developed world.

"It's very important that global growth be faster," he said, especially to meet the World Bank's goals for raising median incomes around the world.

In 2018, the U.S. had been an outlier, posting strong growth while the rest of the world stumbled. It is becoming clear that the U.S. is slowing too.

After growing at more than a 4% rate in the second quarter of 2018, well above its trend, the U.S. slowed through the second half, and posted 2.9% growth for the year from a year earlier. The IMF forecasts U.S. growth will slow to 2.3% this year.

The forecast for slowing global and U.S. growth is shared by many other forecasters.

"A major theme in my global forecast is we're going to see a downshift in economic activity this year," said Karen Dynan, a senior fellow at the Peterson Institute for International Economics. "I'm forecasting that the United States is heading rapidly back to trend growth."

The Federal Reserve, in March, cut its estimates for U.S. growth this year to 2.1% from 2.3%.

The White House sees growth continuing at 3% this year and into the future. The differing outlooks boil down to different assessments of the tax cuts passed in 2017. The administration argues its tax cuts will provide a lasting boost to investment and productivity, while forecasters like the Fed and IMF see a temporary fiscal stimulus that has already begun to fade.

In part because assessments like those of the Fed have darkened, the IMF forecasts see the possibility for a stabilization and improvement next year. The Fed has called a halt to interest-rate increases in response to a more tentative outlook.

The Trump administration has been working to resolve many of the trade disputes it started last year. The administration is working to pass its renegotiated trade deal with Canada and Mexico through Congress, and both Chinese and American negotiators have said trade talks between the world's two largest economies are making progress.

If those improvements come to pass, the IMF forecasts global growth could improve somewhat in 2020.

Inflation Outlook Powers Treasurys

BY SAM GOLDFARB AND DANIEL KRUGER – WSJ 06.15.2019

U.S. government-bond prices briefly surged Friday after a measure of inflation expectations fell to a record low, reinforcing concerns about how slowly consumer prices have been increasing despite solid economic growth and a tightening labor market. The yield on the 10-year U.S. Treasury note settled at 2.093%, down from 2.096% Thursday. The yield fell as low as 2.079% after the inflation report was released.

Yields, which fall when bond prices rise, declined after the University of Michigan said its monthly survey of consumers showed they expect annual inflation to average 2.2% over the next five years. That was down from expectations in May of a 2.6% annual inflation rate and the lowest level in the 40 years the question has been included in the survey.

Prices of Treasurys tend to rise in response to soft inflation data, because rising consumer prices are a major threat to bonds, chipping away at the purchasing power of their fixed payments. Recent declines in inflation expectations have also increased bets the Federal Reserve will lower interest rates—another action that would increase the value of outstanding bonds.

Friday's report was the latest evidence that soft inflation data is feeding expectations for future inflation, something economists watch closely because those expectations are seen as a factor in the actual rate of price increases.

The 10-year break-even rate, a market-based measure of investors' expectations for the average annual rate of inflation over 10 years, has fallen below 1.7% from nearly 2% in late April. Some analysts say inflation expectations have fallen partly in response to a decline in oil prices.

Inflation, however, has remained stubbornly low for years, even excluding volatile food and energy prices. One of the Fed's preferred measures of inflation, the price index for personal-consumption expenditures excluding food and energy, rose 1.6% in April from a year earlier. That was well below the Fed's target of a 2% annual inflation rate.

Economists have been puzzled by the persistence of soft inflation because the conditions for faster price increases are generally thought to be in place. Those include a growing economy and a very low unemployment rate, which would be expected to push up labor costs and prices generally.

The U.S. faces the risk of the persistently slow growth and low inflation that has afflicted the Japanese economy and is taking root in Europe, said Aron Pataki, a London-based bond manager with Newton Investment Management.

While the U.S. has stronger economic growth and the 2017 tax cuts gave a temporary boost to inflation, "with the next business cycle, the U.S. will face the same problems" of decelerating price pressures, Mr. Pataki said.

U.S. Inflation Stayed Tame in March

BY SARAH CHANEY – WSJ 04.10.2019

U.S. consumer **prices rose more than usual** in March, driven by an increase in volatile oil prices that masked moderate underlying price pressures.

The consumer-price index, which measures what Americans pay for household items and services such as fresh fruit or lawn care, increased 0.41% in March from the prior month, the Labor Department said Wednesday. Rising prices for energy and food helped push the annual headline inflation measure up to 1.86% in March from 1.50% in February.

Excluding the volatile food-and-energy categories, so-called core prices rose 0.15% from February, another soft gain. Core prices were up 2.04% on the year, the slowest annual pace since early 2018. One reason: a drop in apparel prices, which may be affected by a new data-collection method used by the Bureau of Labor Statistics.

"Overall we continue to see pretty tame inflation," said Sarah House, economist at Wells Fargo. "**It's tough to see core inflation breaking meaningfully higher from here**."

Signs of moderating inflation emerged across several categories. Airfares declined 0.6% on the month, while prices for used cars and trucks fell 0.4%.

Apparel prices declined 1.9% in March from February, the largest monthly decline on record. A major retailer as expected reported its own transaction prices, and these prices, rather than Labor Department surveyor estimates pulled from the department store's website, were included in the published price index for the first time in March. This could have made seasonal adjustments in the apparel category less accurate, said Steve Reed, a Labor Department economist.

"This new dataset is an entirely different set of prices essentially than what it's replacing," Mr. Reed said. "These are transactions data from things people buy in the store as opposed to prices being selected off of a website...There might be different seasonal trends in items bought online compared to items purchased in the store."

Mr. Reed said volatility in seasonally adjusted apparel prices could continue.

The Labor Department's usage of the retailer's prices data could serve as a prelude to the government using big, private-sector datasets into its reports.

Some price categories strengthened in March. Rent inflation, which had cooled over the last year, accelerated to 0.4% in March. Prices for food at home were also firm in March, continuing a string of higher readings.

"Those Whole Foods price cuts aren't filtering through quite yet," Ms. House said.

Separate data showed inflation ate into wage gains in March. After adjusting for the fresh inflation data, average hourly earnings fell a seasonally adjusted 0.3% from February. They were up 1.3% from a year earlier, a deceleration from recent months.

Much of the weakness in so-called real earnings was likely due to the rise in energy and food prices.

Tame core inflation likely keeps the Federal Reserve on track to remain patient in interest-rate decisions.

The Fed follows the consumer-price index for clues about the trajectory of inflation, though the central bank's inflation target of 2% is tied to a separate measure, the Commerce Department's price index for personal-consumption expenditures. The consumer-price index tends to run a bit higher than the personal-consumption index, but both gauges generally follow the same path.

The price index for personal-consumption expenditures fell 0.06% in January from December and was up just 1.37% from a year earlier. The figures were released with a lag due to the partial government shutdown.

Low inflation has helped support the Fed's plans to take a patient approach in policy decisions, Fed Chairman Jerome Powell said at a press conference in March.

"What I see is inflation that's close to 2% but that sort of keeps bumping up against 2% and then maybe moving back down a little bit," Mr. Powell said. "I don't feel that we have kind of convincingly achieved our 2% mandate in a symmetrical way."

How Retirees Should Invest at a Time of Low Interest Rates

BY MICHAEL A. POLLOCK – WSJ 04.21.2019

By gradually lifting short-term interest rates, the Federal Reserve has made it easier for retirees to get steady investment income while taking less market risk.

But only up to a point. Because rates remain low by historic standards, it still isn't possible for retirees to base their investment strategies entirely on cash or other relatively safe sources, investment professionals say. Instead, they need to own some combination of bonds or bond funds, dividend-paying stocks and other noncash assets to get both cash flow and the appreciation they'll need to make it more likely they won't outlive their assets.

In creating that mix, it is also important to consider the current financial climate, which has grown riskier as the Fed has stopped pumping as much money into financial markets and the economy. Retirees in particular should make sure they are using some conservative income strategies—such as owning high-quality, dividend-paying stocks—that will provide a dependable source of cash flow regardless of how the economy fares during the next phase of the market cycle, professionals add.

For those who want to review their portfolio mix and incorporate some more conservative income strategies, here are some suggestions from financial advisers.

• **Hold more cash, but with a better yield.** Besides being key from a spending perspective, a cash stash also can figure into an overall portfolio strategy, says Tom Stringfellow, president of Frost Investment Advisors, San Antonio. Keeping 15% or a little more in cash may soften the impact of gyrations in the equity area of a portfolio, making it easier for an investor to ignore volatility and stick with the plan, he says.

Many high-yielding bank money-market accounts currently yield under 2.5%, which is less than an investor might get from bonds or some stock dividends. To do better, investors might consider putting cash that isn't needed immediately into a bank certificate of deposit. CDs pay more than most money-market accounts, but often levy a penalty if a saver withdraws funds before maturity.

Eighteen-month CDs, which have yields nearer to 3%, are the best right now from a term and rate standpoint, says Jeff Carbone, managing partner at Cornerstone Wealth, in Charlotte, N.C. He suggests creating a ladder, buying a new 18-month CD every six months and reinvesting the proceeds as each matures. That enables an investor to tap higher CD rates while providing cash that can be spent or reinvested whenever one matures.

• **Buy high-grade corporate bonds.** Savings rates will decline again as the economy eventually cools and the Fed starts lowering rates again. But short-maturity corporate bonds probably will continue to generate decent yields, says Jim Barnes, director of fixed income at Bryn Mawr Trust. While their principal value will rise or fall on news affecting an issuer or the broad bond market, such bonds can offer a relatively conservative play if they carry investment-grade credit ratings, triple-B or higher, Mr. Barnes says. Many yield north of 3% now.

He cautions against loading up on lower-rated, so-called high-yield corporate bonds, though. While they yield much more, their prices can tank in scenarios where investors are stampeding from risk. In last year's fourth quarter when stocks plunged, the SPDR Bloomberg Barclays High Yield Bond ETF (JNK) lost about 5% in price.

• **Look for alternatives.** Preferred shares rank in between common stock and bonds in the asset spectrum with regard to balance between returns and safety. They trade like stocks, but make regular payouts like bonds. And when companies make payouts, holders of preferred—as the name suggests—get preference over holders of common stock.

The yields on preferred shares can be attractive. The iShares Preferred & Income Securities ETF (PFF), with about 49% of its portfolio rated triple-B, yields around 5.3%. Invesco Preferred ETF (PGX), meanwhile, whose portfolio predominantly comprises low-investment-grade securities rated triple-B, generates about 5.4% in yield.

Although preferred shares pose lower risk than some other income plays, they aren't without risk, says Doug Cohen, a managing director at Athena Capital Advisors, Boston. A key concern would be a big rise in long-term yields—those rates that tend to be influenced more by fear of inflation than by modest changes in Fed policy. If long-term rates go up, principal values will drop, Mr. Cohen cautions.

• **The argument for equities.** If the economy and corporate profits grow more slowly, stocks certainly won't boost portfolios as much as in recent years. But only equities can give investors a reasonable cushion over U.S. inflation, which is broadly around 2% and may be higher for older Americans because of the escalating costs of items such as pharmaceuticals. "It's important to get returns that clear the inflation rate so people aren't being robbed of purchasing power," says Hans Olsen, chief investment officer at Fiduciary Trust Co., Boston.

Financial-data provider CFRA gives high ratings to both Vanguard High Dividend Yield(VYM) and iShares Core High Dividend (HDV), ETFs that both generate yields above 3% by investing in blue-chip dividend payers such as Johnson & Johnson (JNJ) and Exxon MobilCorp. (XOM).

Todd Rosenbluth, who heads ETF and mutual-fund research at CFRA, says that because of the bigger income component these higher-yielding ETFs contain, they also decline less at times, like last fall, when stocks are tanking.

People who don't care as much about an income stream, Mr. Rosenbluth adds, instead might choose an ETF that owns companies that raise their dividends consistently. Such ETFs have lower yields—maybe around 2%, compared with 3% or more for VYM and HDV—but the companies in their portfolios build capital and increase their dividends over time.

"If you are concerned that the market is likely to weaken, the higher-yielding dividend strategies are more appropriate" than dividend-growth plays, he says.

Utilities Are Eating Up Too Much Wattage

by Jon Sindreu – WSJ – Jun. 29, 2019

In 2019's reluctant rally, investors have bet on stocks seen as safe. It's time to question that logic.

It is hard to know whether to like the stock market when economic data remain decent but **geopolitical tensions flare** up, **so investors** have **found** a compromise: **utility companies**. But this strategy may be getting out of hand.

The **S&P 500 hit another record this month**, even though money managers remain concerned about risks such as President Trump's aggressive trade policy and a China-led global economic slowdown. **Equities** are **going up even though few investors** are **buying more of them**, according to fund-flow data.

This is because **promises** of **easier policy by** the **world's top central banks**, particularly the Federal Reserve, have pushed down government-bond yields – making stocks look cheap by comparison.

This reluctant rally has been the theme of 2019. **Following 2018's selloff**, **most** of the **money coming back to** the **market** has **gone into companies with steady dividends** – often **perceived as bond substitutes** – and earnings that are less dependent on economic booms. Equity fund **flows into utilities**, consumer staples and real-estate firms have **accelerated** over the past four weeks, data from Bank of America Merrill Lynch confirmed Friday. These three **sector**s are starting to look **overbought**. Between the start of the 2018 selloff in September and now, their constituent stocks have raced ahead of the rest of the S& P 500 compared with their expected earnings over the next 12 months.

Utility firms look particularly pricey by historical standards. They currently **fetch on average 18.6 times earnings**, **versus** only **16.6 times for** the **S&P 500 overall** – **close to** the **highest gap on record**. Of the 28 companies in the S&P 500 Utilities sub-index, 24 are more expensive than in September by this yardstick.

The poster child of this utility-mania is **American Water**, which services 15 million people in the U.S. and Canada. Over the past few months, its **stock** has surged to a whopping **30.9 times** its **expected earnings** – the kind of valuation more often associated with a technology giant. Admittedly, American Water has been a star performer over the past decade.

Investors' unwavering faith in the safety of utility stocks isn't really justified by the historical record

The sector's recorded volatility is roughly in line with that of the S& P 500, and its peak-to-trough performance during recent big selloffs is also similar to that of the broader index. Following the 2000 stock-market bubble, utilities actually fell by more than the average. This is in contrast to the proven lower volatility of consumer staples, which would be more likely to offer money managers protection in a downturn.

Investors would still be best off buying sovereign bonds if the global economy does fall off a cliff. Or if it doesn't – which is more likely – they are giving up on returns by shunning growth-led sectors.

Investors have spent months trying to avoid making a definitive call on the stock market. That can go on for only so long.

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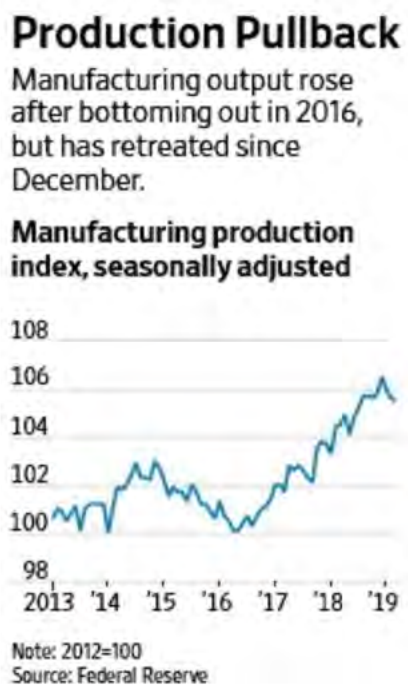
U.S. Manufacturing Stays Muted

by Sarah Chaney and Austen Hufford – WSJ – Apr. 17, 2019



American manufacturing production failed to **bounce back last month after slumping earlier** in the **year**, showing that the **global slowdown** is **squeezing** a key sector in the **U.S. economy**.

The manufacturing sector has sent mixed signals in recent weeks, but Federal Reserve data released Tuesday reinforce the view that **manufacturing** has hit a **soft patch**.

Manufacturing output was flat in March after falling in the first two months of 2019, according to the Fed data. For the **first quarter** as a whole, **manufacturing output declined** at an **annual rate of 1.1%,** the first drop since output fell 1.6% in the third quarter of 2017.

More broadly, **industrial production**, a measure of **output at factories**, **mines** and **utilities**, **fell 0.1% in March.**

Declines among wood products as well as **motor vehicles** and **parts**, both of which **fell** by **more than 2%** on the month, dragged down manufacturing output. **Production of textiles**, **coal** products and **chemicals** all **rose**, helping offset losses in other categories.

While the **U.S. manufacturing sector** is **clearly pulling back from** a **robust 2018**, it **remains** to **be seen how sharp** and **persistent** the **slowdown might** be.

Manufacturers are still generally upbeat in their outlook, but the weakness in output underscores challenges posed by the global slowdown, said Chad Moutray, chief economist for the National Association of Manufacturers.

"The **U.S. economy continues** to **plug along**," Mr. Moutray said. "The real risk to the outlook comes from abroad, when it comes to the slowing global economy both in Asia and in Europe."

Figures from a series of **purchasing managers' indexes** – which measure manufacturing conditions based on surveys of companies – **indicate** a **broader economic slowdown in recent months**, as trade tensions drag on businesses across global markets.

Based on such **PMIs**, the **International Monetary Fund expects continued pullback this year** and, in its world economic outlook report last week, attributed recent industrial-production slowdowns in many countries to global trade pressures.

JPMorgan's global manufacturing PMI flashed further signs of slowing growth in March. Europe's manufacturing sector appears particularly hard hit by trade pressures. The IHS Markit PMI index for the euro-zone logged the biggest fall in output in nearly six years in March. Germany, which relies relatively more on exports to drive growth than other large economies, saw its PMI decline in March to near a seven-year low.

In the U.S., some manufacturers are feeling the crunch from tariffs.

Marshallberg, N.C.-based Budsin Electric Boats increased marketing spending in Europe last year to take advantage of new electric boat mandates. However, increased sales and a planned production expansion didn't materialize after the European Union tariffs on boats from the U.S. made its products less competitive. Canada and Mexico instituted similar duties on U.S. boats in retaliation for tariffs the Trump administration placed on steel and aluminum.

The company, which produces around 20 boats a year, had to cut back production plans when it lost two sales abroad after the tariffs were announced and buyers backed out.

"U.S. sales are pretty much steady, but the EU sales and Canada and Mexico are severely impacted," said Tom Hesselink, Budsin's owner. "It's impossible to compete."

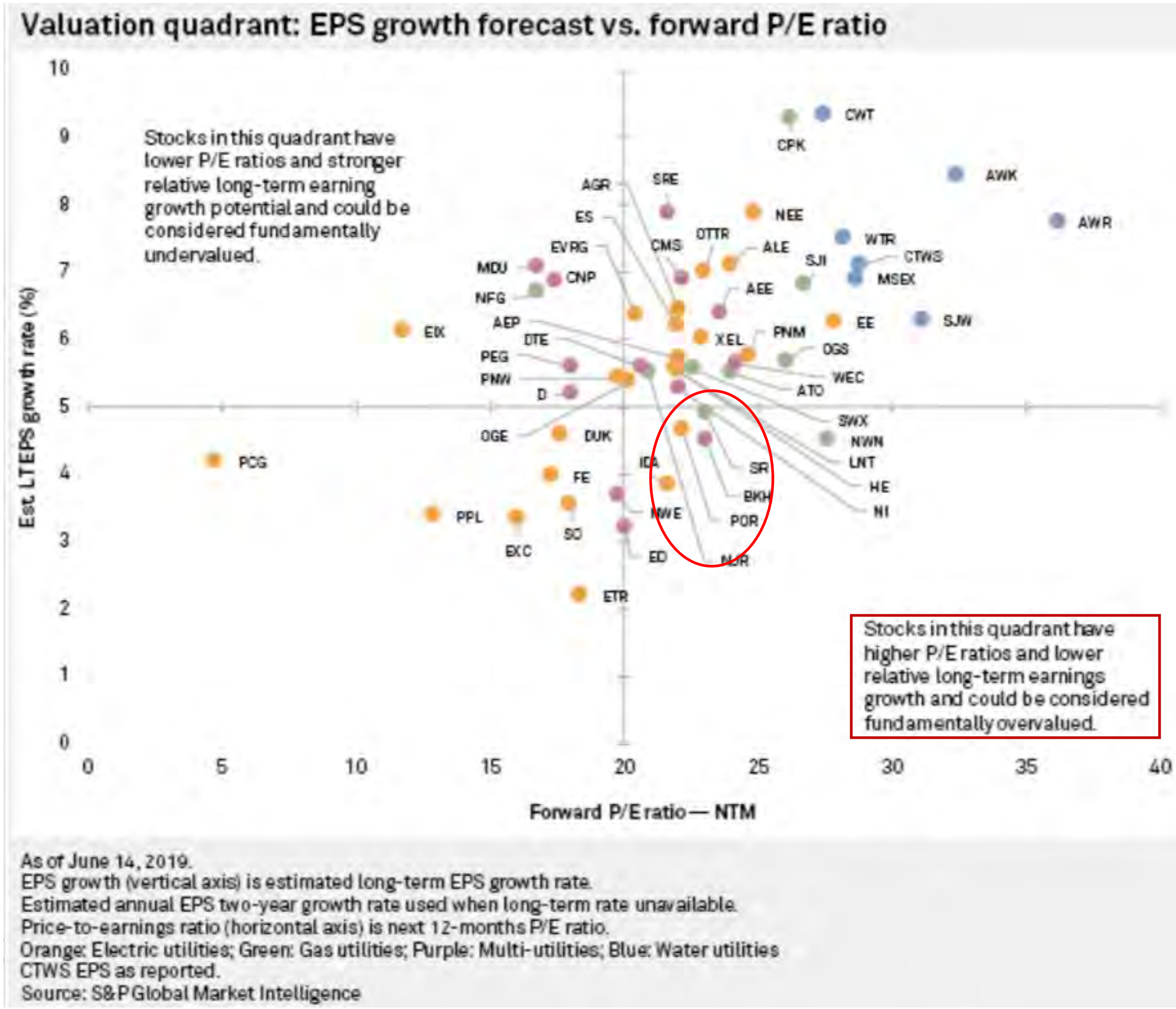
Although **manufacturing** accounts for a small share of gross domestic product, the sector is **highly sensitive to shifts in global demand**, making it a **bellwether for** the **broader U.S. economy**.

Economists are watching the sector closely since it has sent diverging signals recently. Gauges of factory activity in the U.S. and China stabilized in March, but U.S. employment in the industry declined for the first time since mid-2017 last month, and **Tuesday's Fed report indicated broad-based weakness**.

Manufacturing capacity use, a measure of slack, decreased 0.1 percentage point to 76.4% in March. That is about 2 percentage points below its long-run average.

Outperforming Markets, Utility Stocks Command Top Dollar as Valuations Swell

by Jason Lehmann – Regulatory Research Associates (RRA)
An Affiliate of S&P Global Market Intelligence – Jun. 25, 2019



Unsettled by rising interest rates and the U.S./China trade dispute, the **S&P 500 underperformed** the **S&P 500 Utilities sector in 2018**. The indexes' **divergence** that began in third-quarter 2018 has **persisted well into 2019**, **with utility valuations on** a **price-to-earnings basis swelling** over the **past several months**.

The utility sector's recent outperformance could be attributable to several factors, including a relatively **low degree of earnings volatility**, given utilities' largely regulated nature, and **relatively higher dividend yields**. **Rate base growth** and **modest earnings expansion** at most utilities should continue to be **driven by investments** in **regulated infrastructure expansion**, **upgrades** and **modernization**.

As of June 21, the S**&P 500 index** was **trading at** a **17.5x next-12-months**, or **NTM**, **forward P/E ratio**, **versus 19.2x** for the **S&P 500 Utilities**. By sector, **utilities continue** to **trade** at a **premium to broad markets** through, with RRA-covered **water utilities trading** at a lofty **forward 2020 P/E** of about **29x**, followed by **gas utilities** at

22x and **multi-utilities** at **20x**. **Electric** utilities were priced at a **forward 2020 P/E** of **17.6x**.

Consistent with our recent observations, **small- and mid-cap utilities continue to command higher P/E valuations**, with investors assigning premiums to those companies for various reasons, likely including strong financial quality, a **solid earnings** and **dividend growth outlook and**, in some instances, the **potential to be acquired** by **larger utility holding companies looking to** sustain and **grow earnings**. Small-cap El Paso Electric Co. has traded above the RRA electric group average P/E likely due to **takeover speculation**, and on June 3 the company announced it would be taken private in a $4.3 billion transaction.

Performance versus the broader market

Through the **12 months ended mid-June**, **utility stocks** have **handily outperformed** the **S&P 500**, asserting their position as **defensive investment** opportunities given their largely regulated business models and their comparatively stable earnings and cash flows and elevated dividend yields. **Assuming** the **Fed** does **cut rates** at **least once in/** it is possible broad markets will outperform utilities this year. Should the slowdown in economic growth be more pronounced and/or the Fed not cut interest rates in accord with market expectations, the overall market would probably show signs of weakness, and utilities would likely outperform in this scenario.

Price versus growth — a valuation assessment

The **quadrant chart above** shows how the RRA utility universe looks when comparing the P/E ratio and the estimated long-term earnings growth rate. Companies in the lower right quadrant, with higher P/E multiples and lower long-term growth rates, might be considered **overvalued**, all other things considered equal. **Gas utilities** Spire Inc. and **Northwest Natural Holdings fall into this category**. Expansion of **Northwest Natural's forward P/E** coincided with a growing trend of announced large-cap electric utility acquisitions of gas LDCs in 2015 and iness, **potential M&A interest in Northwest should not be discounted in assessing its relative overvaluation**, particularly **considering** the company's **below-average, long-term EPS growth** outlook. For additional detail, see the March 4 RRA Financial Focus report, **Acquisition potential may eclipse capex-driven growth in utility stock valuation**.

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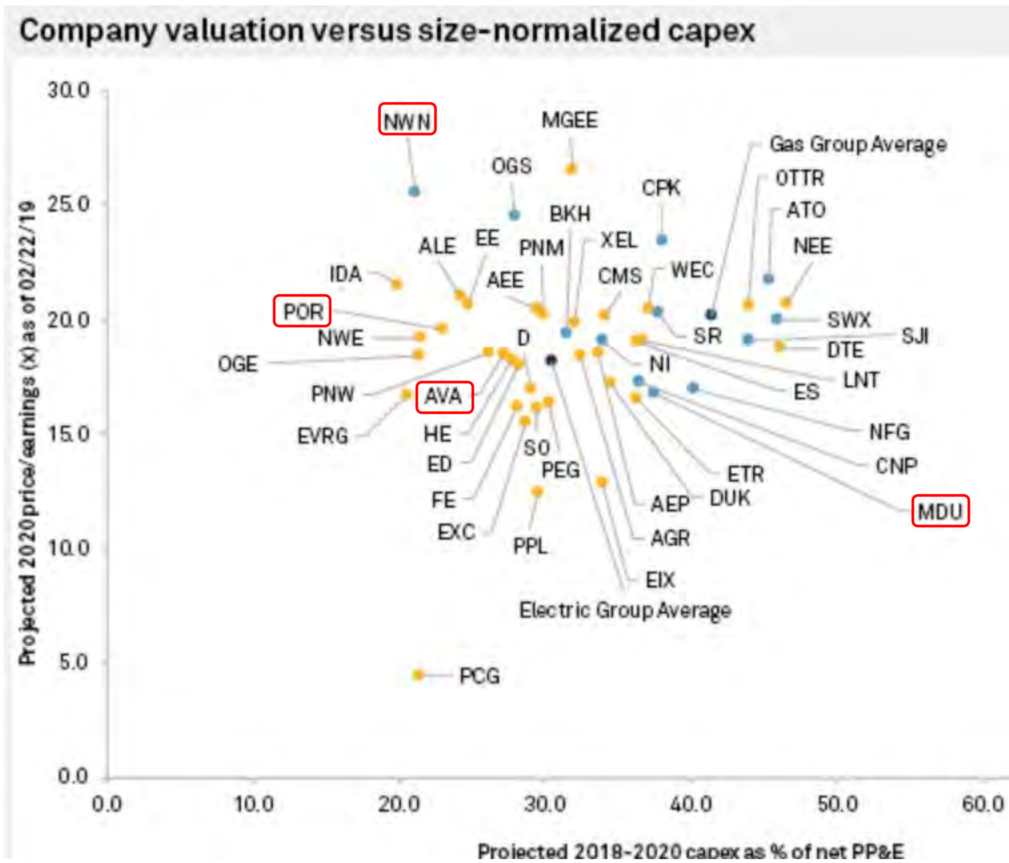
Continued on Next Page

Acquisition Potential May Eclipse Capex-Driven Growth in Utility Stock Valuation

by Dennis Sperduto – Regulatory Research Associates (RRA)
An Affiliate of S&P Global Market Intelligence – Mar. 4, 2019

For each utility in our 48-company universe, the chart below plots the projected 2020 price/earnings, or P/E, as of Feb. 22, 2019, versus projected 2018-2020 capex in percentage terms relative to the Sept. 30, 2018, net PP&E balance. We discuss certain of the more interesting results of this analysis in the following paragraphs.



A **company's** status as a **possible acquisition target may influence** its **stock valuation more than projected capital expenditures relative to company size**. While variation exists in Financial Focus' 48-company electric and gas universe, our analysis indicates that the four companies with the **highest valuations**, MGE Energy Inc., **Northwest Natural** Holding Company, ONE Gas Inc. and Chesapeake Utilities Corp., as measured by **projected 2020 price/earnings**, are **relatively small**. Three of them are natural gas companies, and all four are arguably reasonable **candidate**s **for acquisition**. The projected 2018-2020 capex in percentage terms relative to the Sept. 30, 2018, net property, plant and equipment, or PP&E, balance of the three gas utilities is below the gas group average of 41.4%, while this metric for electric company MGE Energy is only slightly above the electric industry average of 30.4%.

This analysis is an elaboration of a previous Financial Focus article examining the relationship between projected capital expenditures and PP&E balance for each company in our coverage universe. The table at the end of the current article presents each company's projected 2018-2020 capex in percentage terms relative to its Sept. 30, 2018, net PP&E balance. The table also includes the projected 2020 price/earnings for each company.

A group of five electric companies, **IDACORP** Inc., ALLETE Inc., El Paso Electric Co., PNM Resources Inc. and Ameren Corp., while having 2018-2020 relative capex that are below the electric average, nevertheless, have **P/E** ratios that are **above** the **industry average**. Given that these companies, with the exception of Ameren, are small electric utilities, it is **possible** that they also are considered **acquisition target**s, hence the relatively high P/E ratios.

NextEra Energy Inc. and DTE Energy Co. also merit comment. NextEra has the highest projected 2018-2020 relative capex for electric companies and a notably above-average P/E of 20.7x. DTE has the second-highest projected 2018-2020 relative capex and a P/E of 18.8x that is slightly above the group average.

Several very large electric utilities, Dominion Energy Inc., Public Service Enterprise Group Inc., Duke Energy Corp., Exelon Corp. and American Electric Power Co. Inc., have projected 2018-2020 relative capex close to the electric average, but their P/E ratios are below average. Atmos Energy Corp., a gas utility, has both a P/E ratio and projected 2018-2020 relative capex that are above the gas industry averages.

The above-mentioned Financial Focus article highlighted Sempra Energy, New Jersey Resources, NextEra Energy, DTE Energy and Southwest Gas Holdings Inc. as the companies with the highest projected 2018-2020 capex in percentage terms relative to their respective Sept. 30, 2018, net PP&E balance. These companies' comparatively high level of projected capex, however, did not uniformly translate into commensurately high valuation levels relative to other companies in RRA's coverage universe. The report also found that the five companies with the lowest ratio of projected 2018-2020 capex to Sept. 30, 2018, net PP&E are IDACORP Inc., Evergy, Inc., PG&E Corp., Northwest Natural Holdings and OGE Energy Corp.

For additional detail regarding projected and historical capex for the 48 companies in Financial Focus' coverage universe, please refer to the Oct. 30, 2018, report, Utility Capital Expenditures Update. For additional analysis regarding valuation versus company size, see here and here.

Methodology

For the 48 companies in RRA's electric and gas utility universe, we have compared the projected 2020 price to earnings ratio as of Feb. 22, 2019, to projected 2018-2020 capex as a percentage of net PP&E. The P/E ratios represent the market's valuation of each company's 2020 earnings.

The 2018-2020 capex data are those that were included in our *Utility Capital Expenditures Update.* In the instant analysis, we used the three-year total to avoid the lumpiness that could skew shorter periods and the reduced accuracy that could impact forecasts that extend past 2020.

Net PP&E is utilized as a proxy for a company's earning assets or in the case of stand-alone utilities, rate base. Because some utilities may not have filed a recent rate case and for others a settlement may have been adopted that does not specify rate base, it is virtually impossible to obtain a rate base value for all or even most of the companies at the same recent point in time. Moreover, for companies with notable non-utility operations, significant earning assets exist that are not included in utility rate base. Thus, we concluded that utilizing the net PP&E metric would overcome these issues and provide a reasonable proxy for earning assets that can be compared for all 48 companies at the same point in time.

2020 company P/E and projected capex compared to existing net PP&E

Company	Ticker	Net PP&E, 9/30/18 ($M)	Projected 2018-2020 capex ($M)	Projected 2018-2020 capex as % of net PP&E	Projected 2020 price/earnings (x) as of 2/22/19
ALLETE Inc.	ALE	3,847	930	24.2	21.0
Alliant Energy	LNT	12,005	4,395	36.6	19.1
Ameren Corp.	AEE	22,379	6,575	29.4	20.5
American Electric Power Co.	AEP	53,356	17,925	33.6	18.6
Avangrid	AGR	23,125	7,486	32.4	18.4
Avista Corp.	AVA	4,555	1,237	27.2	18.5
CMS Energy Corp.	CMS	17,790	6,060	34.1	20.2
Consolidated Edison Inc.	ED	39,383	11,104	28.2	18.0
Dominion Energy	D	54,185	15,747	29.1	17.0
DTE Energy Co.	DTE	21,612	9,960	46.1	18.8
Duke Energy Corp	DUK	89,865	30,973	34.5	17.2
Edison International	EIX	40,412	13,716	33.9	12.9
El Paso Electric Co.	EE	3,045	752	24.7	20.6
Entergy Corp.	ETR	31,396	11,385	36.3	16.6
Evergy Inc.	EVRG	19,007	3,901	20.5	16.7
Eversource Energy	ES	24,968	9,041	36.2	19.0
Exelon Corp.	EXC	75,840	21,700	28.6	15.5
FirstEnergy Corp.	FE	29,407	8,250	28.1	16.2
Hawaiian Electric Industries	HE	4,694	1,300	27.7	18.3
IDACORP Inc.	IDA	4,353	863	19.8	21.5
MGE Energy	MGEE	1,459	465	31.9	26.5
NextEra Energy Inc.	NEE	68,572	31,936	46.6	20.7
NorthWestern Corp.	NWE	4,460	956	21.4	19.2
OGE Energy Corp.	OGE	8,557	1,825	21.3	18.4
Otter Tail Corp.	OTTR	1,565	688	44.0	20.6
PG&E Corp.	PCG	56,205	11,979	21.3	4.4
Pinnacle West Capital Corp.	PNW	13,557	3,545	26.1	18.5
PNM Resources Inc.	PNM	5,167	1,542	29.8	20.3
Portland General Electric Co.	POR	6,782	1,557	23.0	19.5

Continued on Next Page

PPL Corp.	PPL	34,018	10,031	29.5	12.5
Public Service Enterprise Group	PEG	33,781	10,213	30.2	16.3
Southern Co.	SO	78,432	23,100	29.5	16.1
WEC Energy Group	WEC	21,664	8,040	37.1	20.4
Xcel Energy Inc.	XEL	35,879	11,500	32.1	19.8
Electric average	**Electric Group Average**			30.4	18.2
Atmos Energy Corp.	ATO	10,371	4,700	45.3	21.7
Black Hills Corp.	BKH	4,700	1,481	31.5	19.4
CenterPoint Energy Inc.	CNP	13,653	4,976	36.4	17.2
Chesapeake Utilities	CPK	1,263	480	38.0	23.4
MDU Resources Group	MDU	4,306	1,614	37.5	16.8
National Fuel Gas	NFG	4,977	2,000	40.2	16.9
New Jersey Resources	NJR	2,651	1,841	69.4	21.7
NiSource Inc.	NI	15,174	5,150	33.9	19.1
Northwest Natural Holdings	NWN	2,373	500	21.1	25.5
ONE Gas Inc.	OGS	4,196	1,173	28.0	24.5
Sempra Energy	SRE	35,498	24,875	70.1	16.5
South Jersey Industries	SJI	3,530	1,552	44.0	19.1
Southwest Gas Holdings	SWX	4,870	2,233	45.9	20.0
Spire Inc.	SR	4,145	1,565	37.8	20.3
Gas average	**Gas Group Average**			41.4	20.1
48-co. average				33.6	18.7

Net PP&E data as of Sept. 30, 2018. Projected 2018-2020 capex data as of Oct. 23, 2018. Projected 2020 price/earnings as of Feb. 22, 2019.
P/E = price to earnings ratio
Capex = capital expenditures
PP&E = property, plant and equipment
Source: S&P Global Market Intelligence

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Continued on Next Page in Part 2 of 2.

Investors Turn to Safety of Treasurys

BY DANIEL KRUGER – WSJ 04.03.2019

U.S. government-bond prices rose as investors sought safe assets after signs that global economic growth faces headwinds.

The yield on the benchmark **10-year Treasury note fell to 2.478%** from 2.496%, snapping a three- session streak of gains. Yields, which decline when bond prices climb, fell after the Reserve Bank of Australia Tuesday hinted at a shift toward policies that might be more supportive of economic growth. Many investors watch Australia closely because of its trade ties to China, where growth has slowed amid unresolved trade tensions with the U.S.

The decline in yields extended after the U.K. Parliament again failed to reach an agreement on a Brexit plan a little more than a week before an April 12 deadline which could trigger a no-deal Brexit.

U.K. Prime Minister Theresa May said she would seek a deadline extension and try to work with the opposition Labour Party to craft a deal that would win approval. This is seen as important for investors because a separation between the U.K. and European Union without mutually acceptable terms could harm growth prospects for both sides.

Yields rebounded from their lows after the Commerce Department said that orders for durable goods designed to last at least three years declined 1.6% in February, compared with a 2.1% reduction predicted by economists surveyed by The Wall Street Journal.

The yield on the 10-year note held above the rate for three-month Treasury bills after rising above the shorter-term rate March 29. Investors and Fed officials closely watch the dispersion of short- and longer-term yields—known as the yield curve—because shorter-term rates often exceed longer-term ones ahead of recessions.

The 10-year yield had fallen below the three-month Treasury bill yield for five consecutive trading sessions in late March, spurring concerns among investors about the pace of economic growth and the risk of a future contraction.

Still, with most economists expecting the economy to continue growing, some investors think yields have fallen too far, too fast.

The recent inversion may be "more of a read on global growth expectations rather than the U.S.," said Michael Cloherty, head of interest-rate strategy at RBC Capital Markets. There are more "meaningful risks overseas, but the U.S. looks solid right now," he said.

Three-Month Libor Falls the Most Since 2009

BY DANIEL KRUGER – WSJ 02.07.2019

The cost for banks to borrow U.S. dollars for three months posted its biggest one-day decline in a decade Thursday, reflecting the easing of financial conditions after the Federal Reserve's recent shift to a cautious approach toward raising interest rates.

The decline in the London interbank offered rate, or Libor, suggests a response to changes in monetary policy and not rising concerns about economic growth, analysts said.

The rate is calculated by asking banks how much it theoretically would cost them to borrow money from other banks.

The move is significant because Libor serves as a reference rate for trillions of dollars in debt including mortgages and commercial loans.

Yet analysts were still grappling with the reasons behind Thursday's sudden dip.

The three-month rate had been declining gradually since the end of last year leading up to Thursday's 0.04-percentage-point drop. It has lost about 0.11 percentage point this year to 2.697%. Several said the day's move suggested Libor was catching up with a recent decline in the 10-year Treasury yield, a global benchmark for borrowing costs which has retreated since hitting multiyear highs in November.

"The move makes sense over time," said Thomas Simons, a money-market economist at Jefferies Financial Group. "I just don't know why it all happened today."

Analysts said that it is difficult to know how the banks determine their forecasts for bank-lending costs because the underlying market for inter-bank loans has very little activity.

At the same time the Libor rate has fallen, the yield on three-month Treasury bills has risen. The bill yield settled at 2.410% Thursday, up from 2.365% at the end of 2018.

Fed Chairman Jerome Powell said at a Jan. 4 conference the central bank would take a more flexible approach to setting rates, easing concerns the Fed would raise rates too quickly and hurt economic growth.

The move rippled through markets, lifting stocks and driving bond yields lower.

Policy makers had raised rates in eight of the past nine quarters starting in December 2016, and at their December 2018 meeting had penciled in two more rate increases for this year.

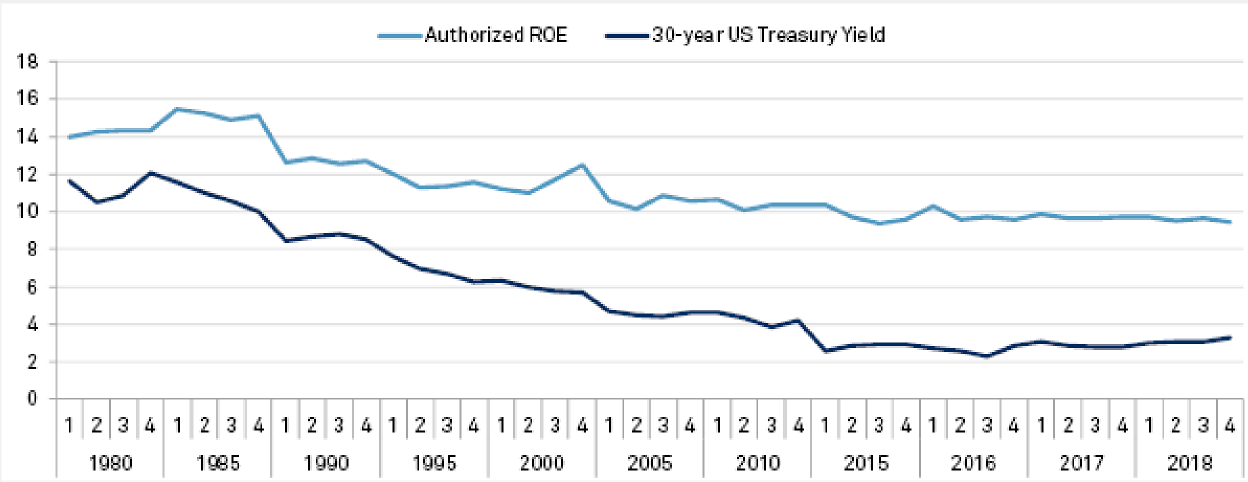
Libor is set to expire at the end of 2021 after **evidence of manipulation by bank traders** trying to make profits led to a **loss of confidence in the benchmark**. It has been under the supervision of U.K. regulators since 2012. Banks were fined billions of dollars and several traders were sent to prison.

Perceived Lower Risk Pull Down Electric ROEs in 2018 RRA

BY LISA FONTANELLA – SNL MARKET INTELLIGENCE 02.14.2019

The average allowed returns on equity for electric utilities have trended lower since the 1980s. The generally downward trend in authorized ROE over the past several years is consistent with the declining interest rate environment. In addition, the proliferation of automatic adjustment and investment recovery mechanisms that reduce the business risk of a utility have often been cited as a contributing factor by commissions in authorizing lower ROEs.

Authorized electric returns on equity versus long-term interest rates



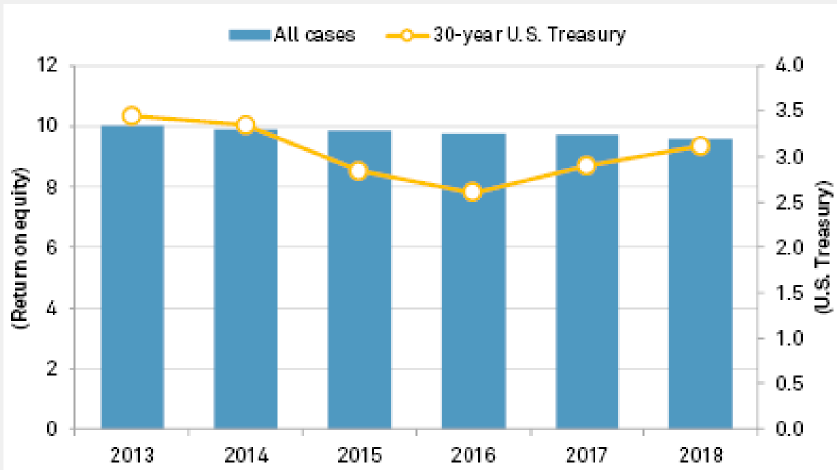
Data compiled Feb. 12, 2019.
Source: Regulatory Research Associates, a group within S&P Global Market Intelligence

Looking at recent years, the average authorized ROEs for all electric utilities have declined from 9.85% in 2015, 9.77% in 2016, 9.74% in 2017 and 9.59% in 2018. The yield on the U.S. Treasury 30-year bond has increased slightly since bottoming out in 2016. Even though interest rates in 2018 rose in the broader economy, average authorized ROEs did not immediately follow.

These aforementioned returns include several limited-issue rider cases. Excluding these cases from the 2018 data, the authorized ROEs set by state public utility commissions have averaged 9.55% in rate cases decided in 2018, somewhat below the 9.68% average in 2017. The difference between the ROE averages including rider cases and those excluding the rider cases is largely driven by ROE premiums of up to 200 basis points approved by the Virginia State Corporation Commission, or SCC, in riders related to certain generation projects (see the Virginia Commission Profile). For further information regarding rate of return trends, refer to RRA's latest Rate Case Decisions Quarterly Update.

There were 48 electric ROE determinations in 2018 rendered in 28 different state jurisdictions and the District of Columbia. The ROE determinations authorized by state public utility commissions during this period have ranged from 8.58% to 11.20%, with a median of 9.57% and an average of 9.59%. Of those 48 determinations, 22 were authorized in vertically integrated cases, 16 were authorized in distribution only cases and 10 were authorized in limited-issue rider proceedings. In the relevant 12-month period of 2018, 26 of the 48 cases were settled and 22 were fully-litigated.

Average electric return-on-equity authorizations (%)



Data compiled Feb. 12, 2018. Reflects return authorizations in 2018.
Source: Regulatory Research Associates, a group within S&P Global Market Intelligence

As noted in the accompanying chart, for those electric companies in which an ROE authorization was rendered in a case decided in 2018, both the highest and lowest electric ROEs have been authorized in limited-issue rider proceedings. Authorized ROEs in these cases have ranged from 8.58% to 11.2%, averaging 9.74% in 2018, with a median of 9.7%.

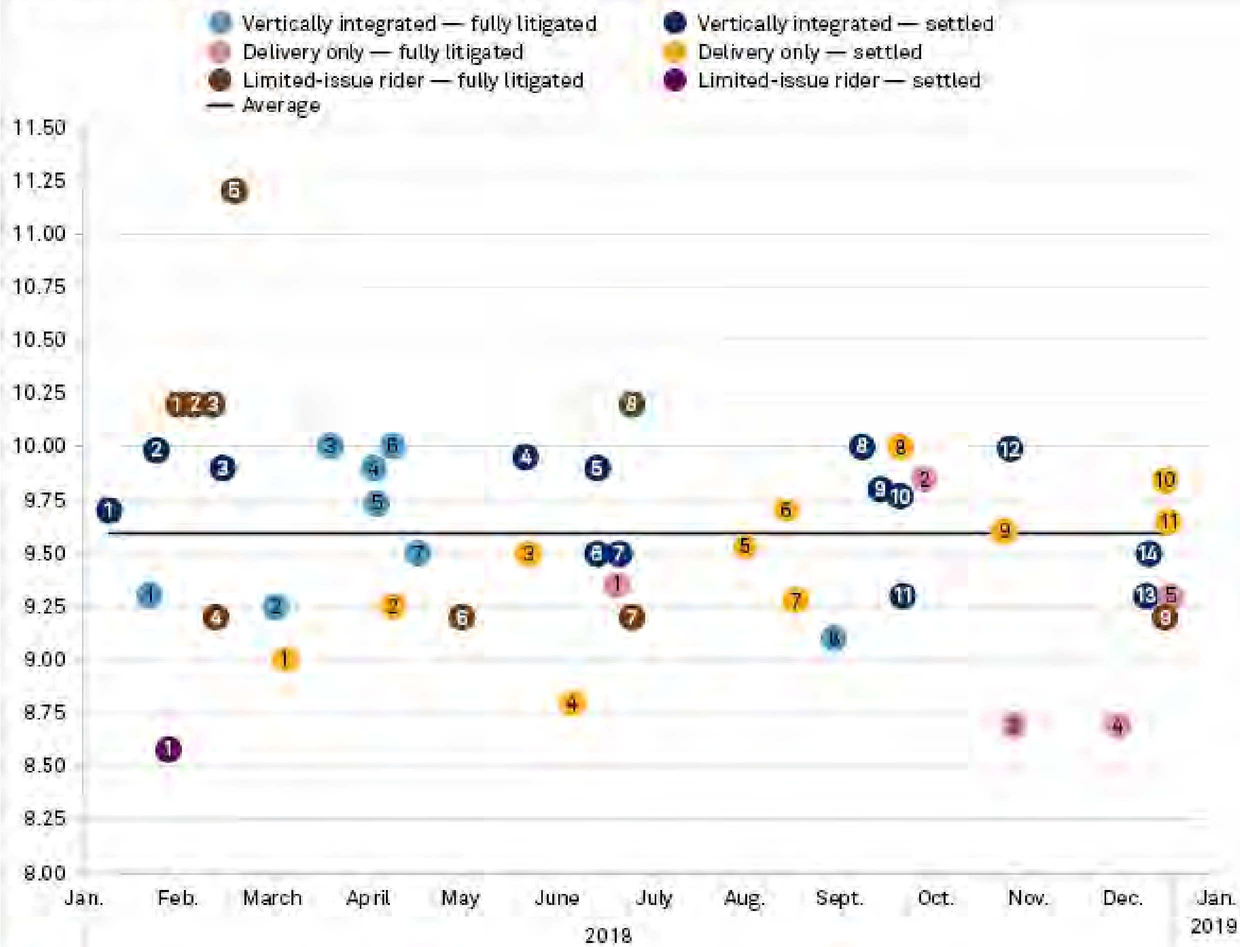
The highest ROE authorized in the limited-issue proceedings, at 11.2%, was authorized by the SCC in a proceeding for Virginia Electric and Power Co.'s investment in biomass conversions at the Hopewell - Polyester, Altavista and Southampton VA plants. The conversions were completed in 2013. The rider was initially approved in 2012, at which time the SCC indicated that, as permitted by law, a 200-basis-point premium would apply to the projects beginning with construction through the first five years of the units' useful lives. The 11.2% ROE includes the 200-basis-point incentive. The underlying base ROE of 9.2% was below the industry average.

The lowest ROE authorized, at 8.58%, was approved by the Mississippi Public Service Commission for Southern Co. subsidiary Mississippi Power Co. following a settlement in a limited issue proceeding that pertained to the company's integrated coal gasification combined cycle Kemper plant.

The 22 authorized ROEs in vertically integrated cases in 2018 ranged from 9.1% to 10%, with a median of 9.75% and an average of 9.68%. The highest ROEs, at 10%, were approved by the Michigan Public Service Commission as part of fully-litigated rate case proceedings for both Consumers Energy Co. and DTE Electric Co. in March 2018 and April 2018 and by the Public Service Commission of Wisconsin for Wisconsin Power and Light Co., or WP&L, in September 2018.

For CMS Energy Corp. subsidiary Consumers Energy, the Michigan PSC found a 10% ROE to "best achieve the goals of providing appropriate compensation for risk, ensuring the financial soundness of the business, and maintaining a strong ability to attract capital." For DTE Energy Co. subsidiary DTE Electric, the Michigan PSC indicated that it factored into its determination the company's unique circumstances and characteristics and rising interest rates.

Authorized electric returns on equity (%)



1 Public Service Co. of Oklahoma, OK
2 ALLETE (Minnesota Power), MN
3 Consumers Energy Co., MI
4 Indiana Michigan Power Co., MI
5 Duke Energy Kentucky, Inc., KY
6 DTE Electric Co., MI
7 Avista Corp., WA
8 Southwestern Public Service Co., NM

1 Kentucky Power Co.,KY
2 Interstate Power and Light Co.,IA
3 Duke Energy Progress LLC,NC
4 Indiana Michigan Power Co.,IN
5 Hawaiian Electric Co. Inc.,NC
6 Duke Energy Carolinas LLC,HI
7 Hawaii Electric Light Co. Inc.,HI
8 Wisconsin Power and Light Co.,WI
9 Madison Gas and Electric Co.,WI
10 Otter Tail Power Co.,ND
11 Westar Energy, Inc.,KS
12 Indianapolis Power & Light Co.,IN
13 Kansas City Power & Light Co.,KS
14 Portland General Electric Co.,OR

1 Emera Maine, ME
2 UGI Utilities, Inc., PA
3 Ameren Illinois Company, IL
4 Commonwealth Edison Co., IL
5 Green Mountain Power Corp., VT

1 Niagara Mohawk Power Corp., NY
2 Connecticut Light and Power Co., CT
3 Potomac Electric Power Co., MD
4 Central Hudson Gas & Electric Corp., NY
5 Potomac Electric Power Co., DC
6 Delmarva Power & Light Co., DE
7 Narragansett Electric Co., RI
8 Dayton Power and Light Co., OH
9 Public Service Electric and Gas Co.,NJ
10 Duke Energy Ohio Inc., OH
11 Texas-New Mexico Power Co., TX

1 Virginia Electric and Power Co., VA
2 Virginia Electric and Power Co., VA
3 Virginia Electric and Power Co., VA
4 Virginia Electric and Power Co., VA
5 Virginia Electric and Power Co., VA
6 Virginia Electric and Power Co., VA
7 Virginia Electric and Power Co., VA
8 Virginia Electric and Power Co., VA
9 Virginia Electric and Power Co., VA

1 Mississippi Power Co., MS

Data compiled Feb. 12, 2018; reflects return authorizations in 2018.
Source: Regulatory Research Associates, a group within S&P Global Market Intelligence

The 10% ROE adopted by the Wisconsin commission for WP&L followed the adoption of a settlement that freezes the company's electric and gas rates at 2017 levels for 2018 and 2019. WP&L's settlement is the first application of a new settlement law for the state of Wisconsin. The law, enacted Jan. 31, 2018, gives the PSC authority to approve rate case settlements negotiated between utilities and intervening parties. Prior to 2018, Wisconsin law did not contain a specific statutory provision related to settlements. The law embodies the substantive standards under existing law that were previously applied by the commission for approving previous settlements and adds additional procedural and substantive criteria. The law encourages parties to enter into settlements when possible and allows parties to file objections or non-objections within 30 days after service of the settlement agreement. WP&L is a unit of Alliant Energy Corp.

The lowest authorized equity return, at 9.1%, was authorized by the New Mexico Public Regulation Commission in a fully litigated case for Xcel Energy Inc. subsidiary Southwestern Public Service Co., or SPS. In adopting this below industry average return, the commission found that this ROE "would result in fair compensation for investors and no higher cost than necessary to retail customers and would also support SPS's financial integrity and credit standing."

The second lowest ROE determination for this group was 9.25%, which was authorized by the Minnesota Public Utilities Commission in a fully litigated case for ALLETE Inc. utility Minnesota Power Inc. The commission found a 9.25% equity return to be "sufficient to establish just and reasonable rates, while adequately assuring a fair and reasonable return in light of the Company's unique risk profile, capital structure, and costs of obtaining equity investment."

The 16 ROE authorizations rendered in delivery only cases ranged from 8.69% to 10%, averaging 9.38% in 2018, with a median of 9.43%.

2018 electric return on equity authorizations

Vertically integrated cases

Companies	State	Date of decision	ROE (%)	Decision type
Kentucky Power Co.	KY	01/18/18	9.70	Settled
Public Service Co. of Oklahoma	OK	01/31/18	9.30	Fully Litigated
Interstate Power and Light Co.	IA	02/02/18	9.98	Settled
Duke Energy Progress LLC	NC	02/23/18	9.90	Settled
ALLETE (Minnesota Power)	MN	03/12/18	9.25	Fully Litigated
Consumers Energy Co.	MI	03/29/18	10.00	Fully Litigated
Indiana Michigan Power Co.	MI	04/12/18	9.90	Fully Litigated
Duke Energy Kentucky Inc.	KY	04/13/18	9.73	Fully Litigated
DTE Electric Co.	MI	04/18/18	10.00	Fully Litigated
Avista Corp.	WA	04/26/18	9.50	Fully Litigated
Indiana Michigan Power Co.	IN	05/30/18	9.95	Settled
Hawaiian Electric Co. Inc.	HI	06/22/18	9.50	Settled
Duke Energy Carolinas LLC	NC	06/22/18	9.90	Settled
Hawaii Electric Light Co. Inc.	HI	06/29/18	9.50	Settled
Southwestern Public Service Co.	NM	09/05/18	9.10	Fully Litigated
Wisconsin Power and Light Co.	WI	09/14/18	10.00	Settled
Madison Gas and Electric Co.	WI	09/20/18	9.80	Settled
Otter Tail Power Co.	ND	09/26/18	9.77	Settled
Westar Energy Inc.	KS	09/27/18	9.30	Settled
Indianapolis Power & Light Co.	IN	10/31/18	9.99	Settled
Kansas City Power & Light Co.	KS	12/13/18	9.30	Settled
Portland General Electric Co.	OR	12/14/18	9.50	Settled
Average			**9.68**	
Median			**9.75**	

For utilities engaged in distribution only operations, the highest return, just shy of 10%, was issued for AES Corp. subsidiary Dayton Power and Light Co., or DP&L, by the Public Utilities Commission of Ohio following the adoption of a settlement. The DP&L decision was the first electric authorization rendered by the commission since 2013 and the first ROE authorized the company since 1992.

The lowest ROE authorized for delivery only cases, at 8.69%, were authorized by the Illinois Commerce Commission, or ICC, for both Ameren Illinois Co. and Commonwealth Edison Co. In Illinois, the state's major electric utilities operate under formula rate plans, or FRPs, where the ROE is reset annually

Delivery only cases Companies	State	Date of decision	ROE (%)	Decision type
Niagara Mohawk Power Corp.	NY	03/15/18	9.00	Settled
Connecticut Light and Power Co.	CT	04/18/18	9.25	Settled
Potomac Electric Power Co.	MD	05/31/18	9.50	Settled
Central Hudson Gas & Electric Corp.	NY	06/14/18	8.80	Settled
Emera Maine	ME	06/28/18	9.35	Fully Litigated
Potomac Electric Power Co.	DC	08/08/18	9.53	Settled
Delmarva Power & Light Co.	DE	08/21/18	9.70	Settled
Narragansett Electric Co.	RI	08/24/18	9.28	Settled
Dayton Power and Light Co.	OH	09/26/18	10.00	Settled
UGI Utilities Inc.	PA	10/04/18	9.85	Fully Litigated
Public Service Electric and Gas Co.	NJ	10/29/18	9.60	Settled
Ameren Illinois Co.	IL	11/01/18	8.69	Fully Litigated
Commonwealth Edison Co.	IL	12/04/18	8.69	Fully Litigated
Duke Energy Ohio Inc.	OH	12/19/18	9.84	Settled
Texas-New Mexico Power Co.	TX	12/20/18	9.65	Settled
Green Mountain Power Corp.	VT	12/21/18	9.30	Fully Litigated
Average			**9.38**	
Median			**9.43**	

Limited-issue rider cases Companies	State	Date of decision	ROE (%)	Decision type
Mississippi Power Co.	MS	02/06/18	8.58	Settled
Virginia Electric and Power Co.	VA	02/09/18	10.20	Fully Litigated
Virginia Electric and Power Co.	VA	02/14/18	10.20	Fully Litigated
Virginia Electric and Power Co.	VA	02/20/18	10.20	Fully Litigated
Virginia Electric and Power Co.	VA	02/21/18	9.20	Fully Litigated
Virginia Electric and Power Co.	VA	02/27/18	11.20	Fully Litigated
Virginia Electric and Power Co.	VA	05/10/18	9.20	Fully Litigated
Virginia Electric and Power Co.	VA	07/03/18	9.20	Fully Litigated
Virginia Electric and Power Co.	VA	07/03/18	10.20	Fully Litigated
Virginia Electric and Power Co.	VA	12/19/18	9.20	Fully Litigated
Average			**9.74**	
Median			**9.70**	

All electric cases	ROE (%)
Average	**9.59**
Median	**9.57**

Data compiled Feb. 12, 2018.
Reflects return authorizations in 2018.
Source: Regulatory Research Associates, a group within S&P Global Market Intelligence

and calculated using a formula that is tied to long-term Treasury bond rates. In recent years, the formula has typically yielded ROEs that are below prevailing industry averages. The FRP proceedings are being conducted under state law that requires the companies to invest specific amounts in their transmission and distribution systems over the years 2012 through 2021, with recovery of these investments to occur in the context of annual FRP proceedings, subject to ICC approval. Ameren Illinois is a subsidiary of Ameren Corp. and Commonwealth Edison is a subsidiary of Exelon Corp.

The second lowest ROE determination for this group was authorized by the New York Public Service Commission for Central Hudson Gas & Electric Corp., or CHG&E, following the adoption of a settlement. The adopted 8.8% ROE is lower than the equity returns authorized for the state's major utilities operating under a PSC approved multiyear rate plan. However in this case, the commission adopted settlement authorizes a capital structure with an increasing equity ratio during the course of the rate plan, 48% in rate year 1, 49% in rate year 2, and 50% in rate year 3, in large part to address concerns regarding the negative credit implications on the company as a result of the federal tax reform law. The PSC's longstanding practice has been to cap a utility's equity ratio for ratemaking purposes at 48% absent extenuating circumstances. CHG&E is a subsidiary of CH Energy Group Inc., which is a subsidiary of Fortis Inc.

Market's Long Gain Faces a Squeeze

BY JUSTIN LAHART – WSJ 03.23.2019

Profit-margin growth has fueled stocks' climb for years. Emerging signs of a reversal should concern investors.

It isn't how much you make but how much you keep.

Most investors grasp that concept when it comes to their own finances, but they also need to consider how it applies to the companies they own. A long-term tailwind to stocks from expanding profit margins is at risk of flipping into reverse.

Steady increases in margins have been the stock market's secret sauce since the 1980s, allowing earnings to grow at a much faster clip than sales and pushing share prices higher as a result. **If profit margins were merely to return to their levels of 20 years ago, then earnings—and share prices—might be 40% lower than they are today.**

Now, corporate profit margins are falling. In a shifting economic and political environment, this may be only the beginning of a long slide. The S& P 500's forecast first-quarter profit margin—or earnings as a share of sales—is 10.7%, according to FactSet. While down nearly a percentage point from a year earlier, that would, with the exception of 2018, still count as a record high.

The decades-long increase in profit margins was the result of many things going right at once, including a steady decline in labor costs, increases in global trade, lower taxes and gains in market share. Unfortunately for companies, each one of these trends seems at risk to at least partially reverse itself in the years ahead.

Start with labor costs. One way to consider these is to look at the income earned by U.S. workers as a share of gross domestic income— a sum of all wages, profits and taxes in the economy. This has been falling for decades, dropping to about 53% in the first three quarters of last year from about 58% in 1980 according to the Commerce Department. Among the reasons for this downtrend: a diminution of employees' bargaining power as union membership declined and an expansion of global trade that allowed companies to shift production to countries where labor costs are cheaper— particularly China.

Next, taxes. Last year's tax cut was just the most recent in a series of actions that have dramatically lowered companies' tax bill. Taxes came to about 11% of before-tax U.S. corporate profits in the first three quarters of last year, according to the Commerce Department. In 2000, the tax share was about 32%. Additionally, U.S. multinationals appear to have steadily shifted more of their domestic profits to tax havens such as the Cayman Islands since the 1990s, effectively reducing their tax rates by even more than the Commerce Department data show.

Big companies, like those in the S& P 500, also have gained market share. This hasn't only given them a larger share of the profit pie, but it's also allowed them to reduce costs through greater scale. It also has reduced competition for labor, some economists argue, adding to big companies' power to set wages. As of 2016—the most recent year with available data— about 47% of U.S. workers were employed at firms with 1,000 or more employees. That compared with about 42% in 1996.

But all of these trends—the reduction in labor's share of the economy, the decline in corporate taxes and big companies' amassing of increased market share—seem unlikely to persist.

Worries about inequality are on the rise and, with Democrats vying for their party's 2020 presidential nomination viewing it as a hot-button issue, proposals to combat it through higher taxes and other redistributive policies are gathering momentum. Meanwhile, the U.S. trade fight with China and the fact that Chinese wages have steadily risen may give U.S. multinationals second thoughts about shifting more production abroad.

Criticism of large companies' power has risen, too. As part of his beef with Amazon.com Chief Executive Jeff Bezos, President Trump has argued that the giant internet retailer's business practices are unfair. Massachusetts senator and presidential hopeful Elizabeth Warren this month proposed breaking up Google, Amazon.com and Facebook.

At the very least, this is an environment in which companies will struggle to squeeze out much more from these favorable trends. It seems unlikely workers' income share will continue to decline. Corporate taxes probably aren't heading even lower. The forces of globalization that helped bolster earnings are on the wane. Profits will come under pressure if companies can't enjoy the marginal benefits of these trends.

Climbing margins have given investors a sweet ride. The downhill portion could be bumpy and highly unpleasant.

If margins return to their levels of 20 years ago, earnings and shares could fall by 40%.

Markets Shudder as Growth Worries Swell

BY AKANE OTANI AND GEORGI KANTCHEV – WSJ 03.23.2019

Global stocks and bond yields slid Friday as investors' anxiety mounted about the health of the world economy.

Major stock indexes have rallied this year despite a slowdown in global growth, in part because central banks have signaled that, for the foreseeable future, they will back off plans to normalize monetary policy.

But signs that momentum continues to cool across major economies have challenged investors, raising questions about whether a soft patch of data could mark the start of a more persistent downturn.

A report Friday showed factory output in the eurozone fell in March at the fastest pace in nearly six years, while a gauge of U.S. manufacturing activity slipped to its lowest level in nearly two years. The data sent bond prices rising and yields sliding, with the German 10-year bond yield dropping below zero for the first time since 2016 and the yield on the 10-year Treasury note falling to 2.459%, the lowest since January 2018.

Meanwhile, stocks across the world retreated. The Dow Jones Industrial Average fell 460.19 points, or 1.8%, to 25502.32, the S& P 500 lost 54.17 points, or 1.9%, to 2800.71 and the Nasdaq Composite declined 196.29 points, or 2.5%, to 7642.67.

All three indexes posted weekly losses, as did benchmark indexes in France, the U.K. and Germany.

"The global economy has clearly become an issue, with big headwinds there," said Tim Anderson, managing director at broker-dealer TJM Investments, pointing to concerns in Europe and China in particular.

For much of 2019, stocks and bond yields had moved in opposite directions. That troubled fund managers, who noted bond yields typically rise—not fall—when investors are confident in growth prospects.

But they moved lower in lockstep Friday, as **investors across markets bet on an environment in which growth across the world is expected to slow.**

Friday's data "confirms the softening data tone the market has been observing and central banks have been forced to take note of," said Matt Cairns, strategist at Rabobank.

Bank stocks slid again, with the KBW Nasdaq Bank Index of large lenders posting its biggest one-week slide since 2016.

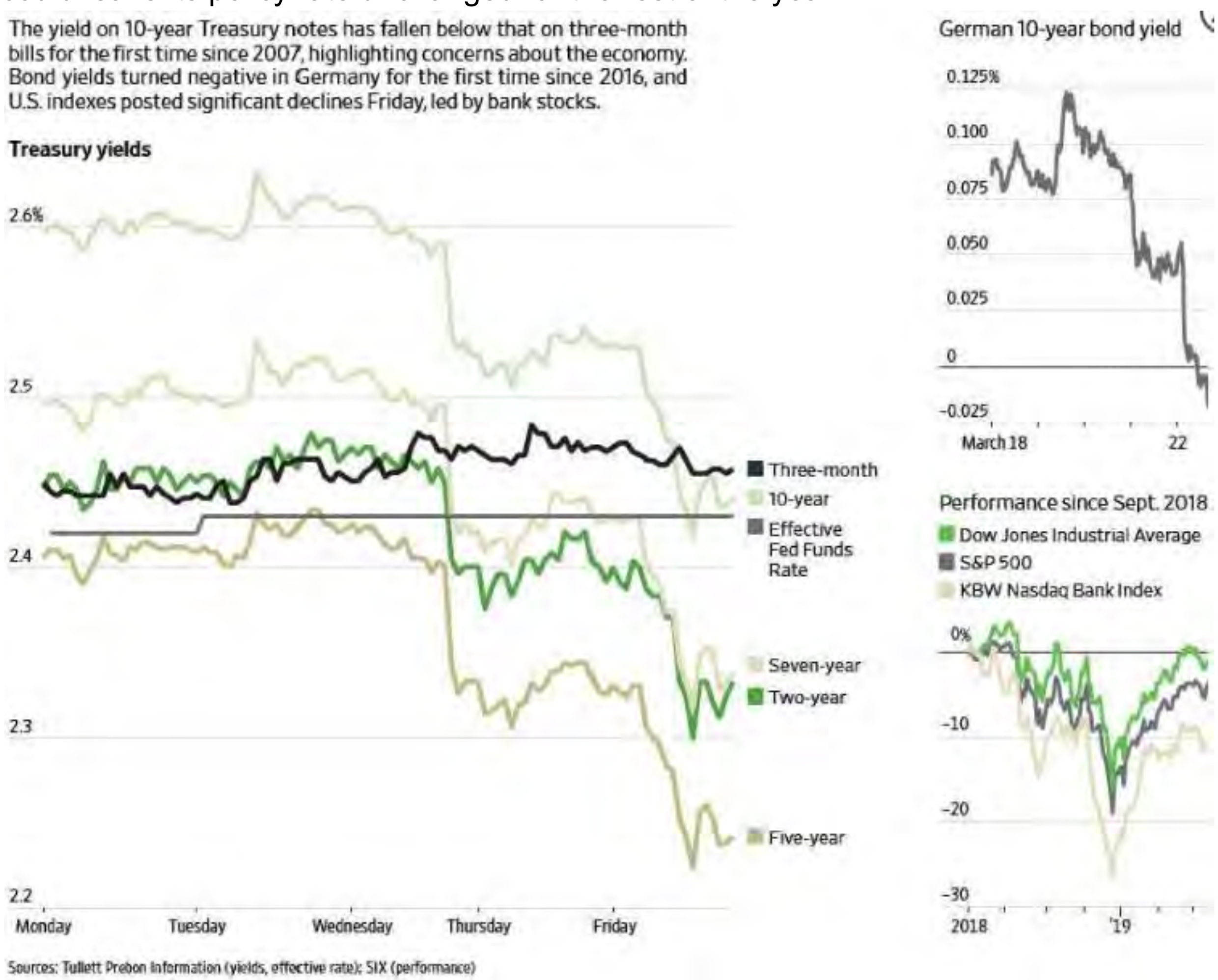
The group has been hit particularly hard by recent stock declines, in part because lower interest rates and slowing growth bode poorly for lending profitability. Bank of America shed $1.17, or 4.2%, to $27.01, and Morgan Stanley declined $1.41, or 3.3%, to $41.72.

Commodities prices and stock sectors tied to them retreated, underscoring the dimming outlook.

The S& P 500 energy and materials sectors lost more than 2% apiece, while copper futures—which tend to rise when investors expect growth to boost consumption of industrial materials—settled at their lowest level in a month.

Part of investors' anxiety, many say, stems from doubts about whether central banks' wait-and-see approach to monetary policy will be enough to avert a global economic protracted slowdown.

Earlier this week, Federal Reserve officials indicated they are unlikely to raise interest rates this year and may be nearly finished with the series of increases they began more than three years ago. On Wednesday, the central bank suggested it could leave its policy rate unchanged for the rest of the year.



This change of tactic by the Fed has divided the market. For some, it is the latest sign that economic growth in the U.S. and around the world is slowing. Others think a more dovish Fed could prolong the bull market.

"The market is polarized: Half thinks we are in a bull-market recovery and the other half thinks we are in a bear-market rally," said Eoin Murray, head of investment at asset manager Hermes.

To be sure, many believe that in the U.S., a recession isn't imminent.

Corporate earnings, while cooling, are still expected to post single-digit percentage growth in 2019, according to FactSet.

The labor market has added jobs for 101 consecutive months, its longest streak ever, and unemployment remains low.

Even weaker segments of the economy have appeared to stabilize in recent months, with data Friday showing that sales of previously owned homes soared 11.8% in February— far more than economists had expected.

But the question investors say they are contending with is whether the slowdown in the eurozone could have a ripple effect, hitting profits at multinationals in the U.S.

In one warning sign, a closely watched yield curve, the spread between three-month and 10-year Treasurys, inverted Friday for the first time since 2007.

Investors and Fed officials closely watch the dispersion of short- and longer-term yields because the three-month yield has exceeded the 10-year yield ahead of every recession since 1975.

In another sign of pessimism, traders doubled down on bets that the Fed will go as far as lowering rates soon—something the central bank hasn't done since the midst of the financial crisis in 2008.

Federal-funds futures, used by traders to place bets on the course of monetary policy, showed the market pricing in a roughly 57% chance of the Fed lowering rates by the end of the year, up from 11% a month ago, according to CME Group.

Traders doubled down on bets that the Fed will go as far as lowering rates soon.

Markets Split into 2 Packs – Risk-On, Risk-Off

BY AVANTIKA CHILKOTI AND PAT MINCZESKI – WSJ 06.25.2019

Bonds, stocks and currencies are moving in tandem more often, as central-bank surprises and trade uncertainty assert their grip over markets.

Known by investors as "risk-on, risk-off," the phenomenon happens when markets essentially **split into two broad buckets that move together: risk-off, or haven assets, which rally when investors grow skittish; and risk-on, or growth assets, which rally when risk appetite returns**.

A basket of assets that reflect either risk-on or risk-off sentiment has moved together nearly a quarter of the past 100 days through June 21, the highest level since mid-2016, according to a Wall Street Journal analysis.

Two assets, the S& P 500 and the euro's value against the dollar, tend to rise when investors are optimistic. Two others, the yield on 10-year Treasurys and the dollar's value against the Japanese yen, tend to fall when investors grow skittish.

The number of risk-on, risk-off days has stepped up quickly since the beginning of the year as investors focus on the change in strategy from the Federal Reserve and the European Central Bank, the on-and-off trade tensions coming out of Washington and signals of whether China will move to stimulate its economy.

"**A lot of these things feel very binary**," said Andrew Harman, senior portfolio manager for multiasset solutions at First State Investments.

Brooks Ritchey, senior managing director and head of portfolio construction at Franklin Templeton's K2 Advisors, labels it a "tweets-on, tweets-off" phenomenon when market moves are guided by what President Trump says about trade and monetary policy on Twitter.

A case in point: May 6 and 7 were both risk-off days, with stocks falling along with bond yields after Mr. Trump tweeted the day before that the U.S. would impose fresh tariffs on China.

"The Trade Deal with China continues, but too slowly, as they attempt to renegotiate. No!" he wrote.

A month later on June 4, the S& P 500 shot up by 2% and bond yields rose when comments from Fed Chairman Jerome Powell showed the Fed had ended a debate over whether its next move would be to raise or lower rates and was focusing on whether and when to cut them.

The risk-on, risk-off way of describing markets came into vogue following the global financial crisis, inspired by traders' lingo that mimicked a line from the film "The Karate Kid." The master compares a karate move to waxing a car: "Wax on, wax off."

In contrast to a market where investors buy and sell bonds and stocks based on their individual characteristics, such as the underlying corporate profitability, the pattern of assets moving together grew stronger following the introduction of quantitative easing, the giant central bank bond-buying programs. Investors saw the future as black or white: Either exceptional policies would pull the global economy out of a recession, or they would fail and there would be another leg down in the crisis.

When risk-on, risk-off patterns emerge, Neil Dwane, global strategist at Allianz Global Investors, said he remains focused on stock picks, using risk-off periods as a buying opportunity. And he looks for investments where returns might not be correlated to big market moves, such as infra-lion structure financing for clean-energy projects.

So far, stock picking hasn't been washed away by the big risk-on, risk-off moves, as happened in the early part of the decade, when stocks tended to move up and down in a block. One-year correlation among stocks in the S& P 500, a measure of how much individual stocks deviate from the index, is around 0.41 compared with above 0.75 in 2013, according to Morgan Stanley and Bloomberg data. Zero signifies no correlation and one signifies perfect correlation.

"Sometimes our business can get quite complex and there can be some very interesting relationships to investigate and exploit," said Gregory Perdon, co-chief investment officer at Arbuthnot Latham, a private bank, referring to the process of picking one stock or bond over another. Lately, he said, "our business is just so basic."

James Athey, senior investment manager at Aberdeen Standard Investments, sees investors rushing into certain assets as policy makers respond to the market mood.

He points to gold, for example, which tends to benefit during times of uncertainty.

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Mortgage Refinancing Soars

WSJ 06.13.2019

Negative Yields Mount Along with Europe's Problems

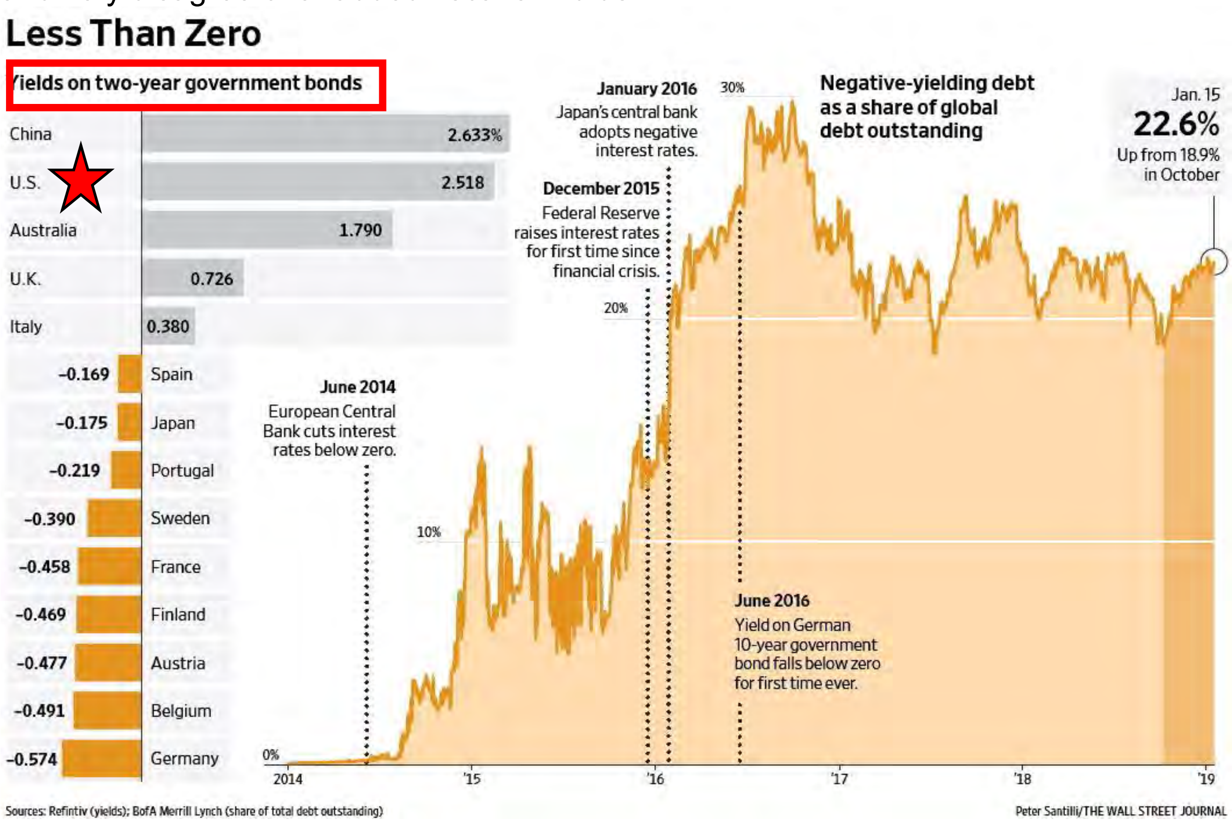
BY DANIEL KRUGER – WSJ 02.18.2019

Investors around the globe are effectively **paying governments to hold** more than $11 trillion of their **bonds**, a fresh **sign of ebbing economic confidence** in Europe and Japan.

Negative-yielding government bonds outstanding through mid-January have risen 21% since October, reversing a steady decline that took place over the course of 2017 and much of last year, according to data from Bank of America Merrill Lynch. While the stock of negative-yielding debt still remains below its 2016 high, the proliferation of these bonds—which guarantee that a purchaser at issuance will receive less in repayment and periodic interest than they paid—underscores the uncertainty over the growth prospects in much of the developed world.

"Europe is an absolute quagmire," said Matt Freund, co-chief investment officer at Calamos Investments. "There are significant headwinds that we've been talking about for a long time—now they're showing up in the numbers."

Negative yields have become increasingly common as growth in the region continues to slow. The European Central Bank ended its bond purchase program in December, potentially adding to economic slowdown concerns, and Germany, France and Italy disagree over added fiscal stimulus.



Investors are buying five-year German debt, sending yields down to about -0.4% from 0.03% in April, while in many cases avoiding similar-maturity Italian securities, which yield about 1.8%, versus roughly 0.6% during the same period.

Negative-yield debt hit a peak of roughly $13 trillion in 2016, according to Bank of America. Until recently it had been declining as the eurozone economy accelerated amid growing exports. The amount of negative-yielding bonds in the region first began growing substantially in 2014.

The ECB is examining reviving a program of lending to banks that analysts say could give a small boost to the economy without suggesting a turn away from the goal of normalizing policy. ECB President Mario Draghi's term expires in October, leaving officials handcuffed by his departure, said Laura Sarlo, a sovereign-debt analyst at Loomis Sayles & Co.

At the same time, tensions are rising within Germany and France as populist movements have undermined the power of governing coalitions. That same populism has also set countries against each other, as Italy has sought EU permission to increase government spending to stimulate growth while Germany and France have tried to block that move.

"Europe cannot figure it out," said Simona Mocuta, an economist at State Street Global Advisors. By deciding to restrict growth measures to central bank rate cuts, "you have this effect on rates, but it's not giving you the real-economy response."

The ECB first lowered its deposit facility rate below zero in June 2014, and has lowered it three times since, most recently to -0.4% in March 2016. The policy was intended to dissuade businesses and consumers from keeping money idle in the bank, and instead encourage more consumption and investment.

Many investors buy the debt simply because they have to. Insurance companies need bonds to ensure they can align maturing assets with expected liabilities. Many mutual funds buy the debt because they follow an index that includes the securities. Holding bonds with negative yields can also be a more palatable option for institutional investors who face a surcharge of 0.1% on cash for simply keeping deposits in a bank.

While investors who buy at current prices stand to lose money if they hold negative-yield bonds to maturity, they can be traded profitably, said John Taylor, a London-based bond manager at AllianceBernstein who has purchased five-year sovereign debt from Austria and Finland with negative yields.

Low returns on bond portfolios send investors a message that their retirement savings aren't growing enough to meet their needs, causing them to save more and spend less, Mr. Taylor said. That is important because it **suggests the policy isn't working as intended** and **could lead to a deeper slowdown**. The longer negative rates are in place, "the more it changes people's behaviors," he said.

Negative-Yield Bonds Abound in Europe

BY DANIEL KRUGER – WSJ 04.30.2019

A growing number of investors are paying governments in Europe for the privilege of holding their bonds.

The amount of negative-yielding government bonds outstanding through 2049 has risen 20% this year to about $10 trillion, the highest level since 2016, according to data from Deutsche Bank Securities.

The expanding pool of such bonds—which guarantee that a buyer will receive less in repayment and periodic interest than the buyer paid—highlights how expectations for growth in much of the developed world have deteriorated.

Government debt sold by countries including Germany, Ireland and Sweden are among those with negative yields. Late Monday, German debt maturing in 2024 yielded minus 0.42%, while Irish and Swedish bonds of the same maturity traded at minus 0.15% and minus 0.32%, respectively. Corporate bonds issued by Sanofi SA maturing in 2022 and LVMH Moët Hennessy Louis Vuitton SE maturing in 2021 also traded at negative yields, according to data from FactSet.

Negative yields also mean it will be difficult for developed economies to revive growth should they enter a recession, with historically low interest rates still in place. The European Central Bank's deposit rate is minus 0.4%, and policy makers this year ended bond purchases that were intended to boost growth and inflation, adding trillions of euros of government and corporate bonds to the ECB's balance sheet.

"It's just not a great starting point to already have negative interest rates," said Torsten Slok, chief economist at Deutsche Bank Securities. "It's getting more and more difficult for policy makers to respond to headwinds."

Policy makers upended expectations for a rate increase later this year and lowered growth and inflation expectations, suggesting negative interest rates will remain in place well into the future. In March, the ECB slashed its forecast for real gross domestic product growth this year to 1.1%, from 1.7% just three months earlier, and its forecast for consumer-price inflation to 1.2%, from 1.6%.

Consumer confidence also weakened this month, after improving in the three previous months, according to a monthly European Commission survey. And that decline followed purchasing managers' surveys earlier this month that showed business activity slowing in April.

Europe's growth problems are evident in two of its largest economies. In Germany, where growth has stalled, officials plan on running a budget surplus rather than stimulating growth by running a budget deficit. This is a problem because such fiscal restraint by Europe's largest economy could choke off growth in the rest of the region. By contrast, in Italy, where the heavy debt burden is already seen as a problem, officials have proposed borrowing more to kick-start persistently slow growth.

The discrepancy highlights the conflicts that can arise from having a monetary union but not a fiscal union and a political union, said Gershon Distenfeld, co-head of fixed-income at AllianceBernstein. The ECB sets interest rates for the 19 nations that use the euro currency, but there is no comparable entity that coordinates government spending among those countries.

Still, Mr. Distenfeld has bought German government debt at negative yields, while hedging the euro against the dollar to make the trade more profitable.

“One day, people are going to wake up and say, ‘What was I doing buying five-year German debt at negative yields?’ ” he said. “But that may not happen in the next year.”

The gap in yields between U.S. government securities and sovereign debt from Germany of similar maturity has been unusually wide at nearly 3 percentage points. That is about what foreign investors pay on an annualized basis to hedge against fluctuations in the dollar, and conversely what U.S. investors gain by hedging against the euro.

Many investors in Europe have opted not to hedge and instead are buying negative-yielding European debt, pushing those yields lower.

Investors in currencies, which are heavily swayed by expectations for interest-rate policy, have recently pushed the dollar to a 22-month high against the euro. That reflects speculation that the Federal Reserve is less likely to cut interest rates than the ECB.

While a weaker currency is good for European exports, it doesn’t provide much help because of continuing trade tensions throughout the global economy that are slowing commerce, Deutsche Bank’s Mr. Slok said.

Policy makers have already moved to make low-cost loans available to banks in an attempt to stimulate lending and are examining a tiered approach to deposit rates. That could exempt banks from punishing fees imposed by the ECB on part of the excess liquidity that the firms parked with the central bank.

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UNITED STATES

SECURITIES AND EXCHANGE COMMISSION

Washington, D.C. 20549

FORM 8-K

CURRENT REPORT

Portland General Electric Co. (POR) | 8-K (8-K)

Filed on 4/15/2019 | Event on 4/12/2019

On **April 12, 2019**, **P**ortland **G**eneral **E**lectric Company (PGE, or the Company) entered into a Bond Purchase Agreement (the Agreement) with certain institutional buyers (Buyers) in the **private placement** market, relating to the sale by the Company of **$200 million** aggregate principal amount of the Company's **First Mortgage Bonds** (the Bonds). The Bonds consist of the 4.30% Series **due 2049** and will bear interest at an **annual rate of 4.30%.**

On April 12, 2019, the Bonds were issued and funded in full. Pursuant to the Agreement, the Bonds were **issued under PGE's Indenture of Mortgage and Deed of Trust**, dated July 1, 1945, between PGE and Wells Fargo Bank, National Association (as successor to HSBC Bank USA, National Association) in its capacity as trustee, as amended and supplemented to date and from time-to-time, including a Seventy-fifth Supplemental Indenture dated April 1, 2019, a copy of which is included as Exhibit 4.1 in this Current Report on Form 8-K. The Bonds are **redeemable** at the **option** of **PGE at** the **designated** "**make-whole**" **redemption** price as described in the Seventy-fifth Supplemental Indenture.

For a complete description of the terms and conditions of the Seventy-fifth Supplemental Indenture, please refer to the Seventy-fifth Supplemental Indenture, which is incorporated herein by reference and attached to this Current Report on Form 8-K as Exhibit 4.1.

PORTLAND GENERAL ELECTRIC COMPANY

Date: April 15, 2019 By: /s/ James F. Lobdell

James F. Lobdell

Senior Vice President of Finance,

Chief Financial Officer and Treasurer

–

Portland General beats analyst estimates with Q4, FY'18 net income

BY S&P GLOBAL MARKET INTELLIGENCE – 02.15.2019

Portland General Electric Co. on Feb. 15 posted fourth-quarter net income of **$49 million, or 55 cents per share, compared to $42 million, or 48 cents per share, for the comparable quarter of 2017**.

The S&P Global Market Intelligence consensus GAAP EPS estimate for the 2018 fourth quarter was 53 cents. On a **full-year** basis, Portland General booked **$212 million**, or $2.37 per share, in 2018 net income, **compared with $187 million**, or $2.10 per share, **in 2017**.

The S&P Global Market Intelligence consensus GAAP EPS estimate for 2018 was $2.34. Full-year 2018 revenues fell to $1.99 billion from $2.01 billion in 2017, while income from operations was down to $346 million from $380 million in the previous year.

Looking ahead, the company is targeting full-year 2019 earnings in the range of $2.35 per share to $2.50 per share.

Policy U-Turns of ECB, Fed Cascade Around the World

BY BRIAN BLACKSTONE – WSJ 03.22.2019 - ZURICH

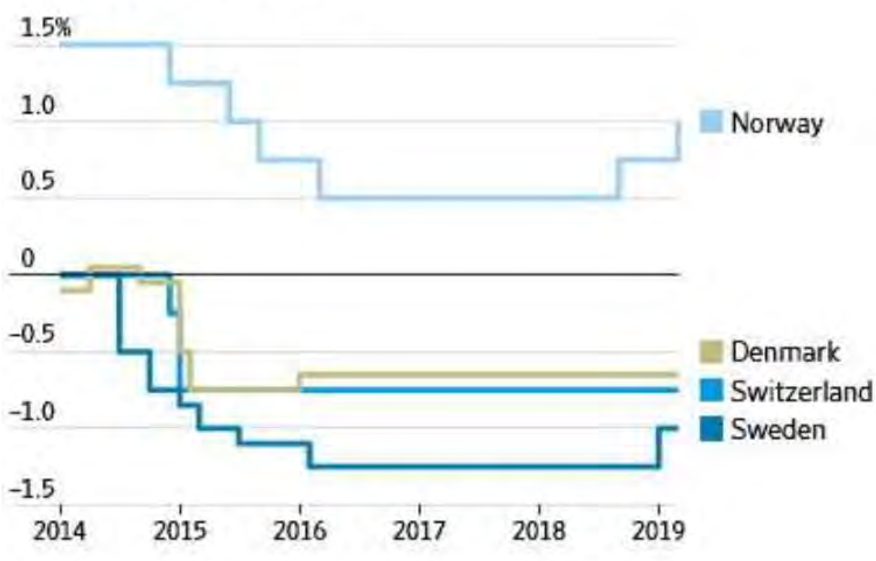
Abrupt changes in the policies of the world's largest central banks have rippled through smaller economies, leaving them with the prospect of low and even negative interest rates for years to come despite having mostly healthy economies.

The danger is that these easy-money policies could fuel destabilizing bubbles in real estate and other asset markets. They may also leave banks with little ammunition to respond to the next economic downturn. Economies like Switzerland's, whose central bank signaled no change in its negative- rate policies for years to come, are small compared with the U.S. and eurozone. Still, they are home to major global banks and companies that are sensitive to exchange rates and financial conditions. With financial markets so interconnected, problems in small countries can quickly spread to larger ones.

On Wednesday, the Federal Reserve left its key policy rate in a range between 2.25% and 2.5% and indicated that it is unlikely to raise rates this year. **In late 2018, officials had signaled they expected between one and three increases this year**.

Policy rates are negative at many central banks in Europe, and are likely to stay that way at least into 2020.

Central bank deposit rates



Source: the central banks

Two weeks ago, the European Central Bank went further, saying it would launch new stimulus to support the eurozone economy via cheap loans for banks. It also said it expected to keep its key interest rate at minus 0.4% at least through 2019, a longer horizon than before.

The Swiss National Bank said Thursday that it would keep its policy rate at minus 0.75%, where it has been since January 2015, and reduced its inflation forecast to 0.3% this year and 0.6% in 2020. The SNB cited weaker overseas growth and inflation and "the resulting reduction in expectations regarding policy rates in the major currency areas going forward."

Norway's central bank took an opposite turn, raising its policy rate by 0.25 percentage point to 1% and signaled more increases this year. Norway's reliance on oil production sets it apart from other European countries because higher oil prices provide a stimulus to its economy that its neighbors don't receive. Its currency, the krone, rose about 1% against the euro after its decision.

Still, Norway's bank lowered its long-term rate forecast, citing "a more gradual interest rate rise among trading partners."

Here's why Fed and ECB decisions matter for countries that don't use the dollar or euro: Switzerland and countries near the eurozone but not part of it—like Sweden and Denmark, which also have negative rates—rely on the bloc for much of their exports and imports. That makes growth and inflation highly dependent on the exchange rate. Central-bank stimulus tends to weaken a country's exchange rate, so when the ECB embraces easy-money policies as it did two weeks ago it tends to weaken the euro against other European currencies such as the Swiss franc. Because the ECB is so large, Switzerland and others can do little to offset it.

It isn't just Europe that is affected by the actions of big central banks. On Thursday, Bank of Korea Gov. Lee Ju-yeol signaled he would maintain the current pause in policy tightening, saying the Fed's "more-accommodative-than-markets-expected" statement would allow his bank "more leeway" in taking action.

Indonesia's central bank kept rates unchanged for a fourth meeting in a row Thursday. The Philippine central bank stayed its hand, too.

Economy Grows at 3.2% Rate, Shrugging Off Slowdown Fears

BY HARRIET TORRY – WSJ 04.27.2019

The U.S. economy started 2019 with a pop, growing rapidly despite multiple headwinds, including weaker domestic demand, suggesting the current expansion has more room to run in its 10th year.

Gross domestic product— the value of all goods and services produced in the U.S., adjusted for inflation and seasonality—rose at a 3.2% annual rate from January through March, the strongest rate of first-quarter growth in four years, the Commerce Department reported Friday.

Rising exports, falling imports and higher inventory investment drove much of the growth, helping to offset weaker gains in consumer spending and business investment.

The strong report marked a turnaround from a gloomy start to the year, when the economy looked close to stalling due to challenges including a partial U.S. government shutdown, market turmoil in late 2018 and slowing global growth.

The outlook brightened as the Federal Reserve shelved plans to raise interest rates this year, the shutdown ended in late January, stocks started climbing toward new highs, and the global picture improved as China's growth in the first quarter beat expectations.

President Trump, who had pledged to lift U.S. economic growth to a sustained annual pace of 3% or better, welcomed the 3.2% figure, calling it “an incredible number” Friday. “We have great growth and also very, very low inflation,” Mr. Trump told reporters at Joint Base Andrews.

His top economist, Council of Economic Advisers Chairman Kevin Hassett, told The Wall Street Journal the report “confirms our view that the momentum from last year was not a sugar high but a serious response to long-run policies that have made the U.S. a more attractive place for business.”

Many economists cautioned that some of the contributors to first-quarter growth could prove temporary. Trade, for instance, played a large role, as exports rose while imports declined, a positive for growth since exports boost GDP while imports reduce it.

Analysts said firms boosted imports in late 2018 ahead of anticipated increases in trade tariffs, which didn’t materialize due to progress in U.S.-China trade talks, leading to a drop in the first quarter. Inventory investment also contributed strongly to U.S. growth, a factor that could dent the second quarter if companies draw down on stockpiles rather than place new orders.

Measures of underlying demand were also muted. After stripping out the volatile categories of trade, inventories and government spending, sales to private domestic buyers rose at an annual rate of 1.3%—half the rate of the prior quarter and a far slower pace than the overall GDP growth number. The housing sector was a drag on growth for the fifth straight quarter.

Consumer spending, which makes up two-thirds of economic activity, rose at a mere 1.2% rate in the first quarter, down from a stronger 2.5% in the fourth quarter of

2018. Americans reined in purchases of big-ticket items such as vehicles.

“Spending slowed to a crawl,” said Diane Swonk, chief economist at Grant Thornton, adding: “It’s a report that affirms we did in fact have weak domestic demand.”

Still, she and other economists expect consumer spending to pick up this spring after seeing strong retail sales growth in March. Unemployment remains low, incomes and wages are rising, and consumer sentiment remains robust, which all underpin solid spending in the months ahead.

While Ford Motor Co.’s vehicle sales declined 1.6% in the first quarter, U.S. sales chief Mark LaNeve expressed optimism they would pick up over the rest of the year during a call with analysts in early April.

“The consumer is in great shape,” he said, adding that “if you simplify a lot of the data, people have a job and some level of income growth or [are] at least optimistic about their prospects for employment and income growth. They tend to buy vehicles.”

JPMorgan Chase & Co. Chief Executive Jamie Dimon expressed a similar outlook during an April 12 earnings call, saying, “People are going back to the workforce. Companies have plenty of capital.” He added that “business confidence and consumer confidence are both rather high…it could go on for years. There’s no law that says it has to stop.”

The economic expansion, which began under President Obama in mid-2009, is set to become the longest on record in the second half of 2019.

Friday's report offered evidence of solid, but not accelerating, corporate demand. Nonresidential fixed investment— which reflects business spending on software, research and development, equipment and structures—rose at a 2.7% rate, pulling back from 5.4% in the fourth quarter.

Inflation slowed in the first quarter, the Commerce Department reported, a factor likely to reaffirm the Fed's wait-and-see stance on rates.

The Fed's preferred inflation measure, the price index for personal-consumption expenditures, increased at a 0.6% seasonally adjusted annual rate in the first quarter, down from 1.5% in the final quarter of 2018 and below the Fed's 2% target. Core prices—which exclude volatile food and energy costs—rose at a 1.3% rate.

Fed officials seek to keep inflation at 2% because they see that as consistent with a healthy economy: Inflation persistently below that level can be a signal of weak demand. They signaled last month they didn't expect to change rates in 2019. They hold their next policy meeting on Tuesday and Wednesday.

Meantime, the global outlook has improved as the European Central Bank launched new monetary stimulus, Japan passed a fiscal stimulus package, and China has enacted tax cuts and loosened credit to boost its economy.

Powell Says Fed in No Rush to Raise Rates

BY NICK TIMIRAOS – WSJ 02.27.2019

Federal Reserve Chairman Jerome Powell said the central bank is in no rush to move interest rates while officials assess the impact on the U.S. economy of slower global growth and financial- market turbulence.

"With our policy rate in the range of neutral, with muted inflation pressures and with some of the downside risks we've talked about, this is a good time to be patient and watch and wait and see how the situation evolves," Mr. Powell told lawmakers on the Senate Banking Committee on Tuesday.

Fed officials raised their benchmark short-term rate four times last year, most recently in December, but have since signaled further increases are on hold.

Senators appeared content with the Fed's stance: They asked Mr. Powell so few questions about interest rates during the nearly two-hour hearing that he volunteered to better define the "patient" policy in the final minute.

"When I say we're going to be patient, what that really means is we're in no rush to make a judgment about changes in policy," he said. "We're going to allow…the data to come in. I think we're in a very good place to do that."

Mr. Powell described the U.S. economy as healthy, but he also pointed to headwinds from abroad. These include slower growth in China and Europe, political uncertainty over trade negotiations between Washington and Beijing, and the discussions surrounding the U.K.'s decision to leave the European Union.

"Over the past few months we have seen some crosscurrents and conflicting signals," Mr. Powell said. "Right now, the predominant risks to our economy are slowing global growth." Financial markets turned volatile late last year and conditions, including stock and bond prices, "are now less supportive of growth than they were earlier last year," he said.

While Fed officials seem unlikely to change rates soon, they appear much closer to announcing modifications concerning the runoff of the central bank's $4 trillion asset portfolio. They have indicated recently they are ready to end the runoff later this year.

Mr. Powell said Tuesday the Fed is preparing to evaluate the "appropriate timing and approach for the end of the balance sheet runoff."

'This is a good time to be patient and watch and wait,' the Fed chairman says.

Officials began shrinking their crisis-era holdings of Treasury and mortgage securities in 2017 and plan to continue reducing their mortgage-bond holdings after the runoff ends, leaving primarily Treasurys.

The central bank had been raising rates steadily over the past two years: With unemployment falling to half-century lows, many officials warned of the potential for the economy to expand beyond its long-run capacity, fueling more inflation.

Officials have been surprised by both higher-than-anticipated levels of workforce participation, which have so far prevented steeper declines in the jobless rate, and modest price pressures, which have held year-over-year inflation readings just below the Fed’s 2% target in recent months.

While recent energy-price declines are expected to hold down measures of overall inflation in the months ahead, Mr. Powell said those effects are likely to prove transitory. As those effects subside, “we expect that inflation will run close to 2%,” he said.

Meantime, he said it appeared there was more slack, or excess capacity, in the job market because of a stabilization in workforce-participation rates, which had been projected to fall as baby boomers retire.

“If people weren’t coming back in, then the unemployment rate would be substantially lower,” he said. “But they are, or they’re staying…and that tells us there is more room to grow, and that certainly has implications for monetary policy.”

Mr. Powell defended a proposal that would redefine the Fed’s 2% inflation target to encourage periods of modestly higher inflation when the economy is strong to compensate for weaker inflation during downturns.

He said the change would be evaluated as part of a broader review the Fed is conducting.

Mr. Powell also warned about rising federal borrowing, with budget deficits projected to surpass $1 trillion in the coming years.

“It is widely agreed that federal government debt is on an unsustainable path,” he said. He later added, “The idea that deficits don’t matter for countries that can borrow in their own currencies is just wrong.”

Powell Says Runoff Set to End This Year

BY NICK TIMIRAOS – WSJ 02.28.2019

FEDERAL RESERVE

Powell Says Runoff Set to End This Year

Federal Reserve Chairman Jerome Powell said Wednesday that the central bank is close to announcing plans for ending the runoff of its $4 trillion portfolio of bonds and other assets this year.

"We're going to be in a position...to stop runoff later this year," Mr. Powell told members of the House Financial Services Committee.

Mr. Powell said Fed officials are near agreement on a plan. "My guess is we'll be announcing something fairly soon," he said. The Fed's rate-setting committee next meets on March 19-20.

Officials began shrinking their crisis-era holdings of Treasury and mortgage securities in 2017 and they plan to continue reducing their mortgage-bond holdings after the runoff ends, leaving primarily Treasurys.

—*Nick Timiraos*

Powell Signals No Need for Cuts

BY NICK TIMIRAOS – WSJ 05.02.2019

Markets slide as Fed holds rates steady and chairman plays down low-inflation worries

Federal Reserve officials agreed to keep their benchmark interest rate unchanged and signaled comfort that their wait-and-see posture had steadied the economy after fears of a slowdown had sent markets reeling at the end of last year.

Fed Chairman Jerome Powell, speaking at a news conference Wednesday, played down concerns that recent soft inflation might hint at broader economic weakness. He repeatedly highlighted individual price declines that could prove transitory and, in doing so, pushed back against some market hopes the Fed might be preparing to lower interest rates later this year.

"Overall the economy continues on a healthy path, and the committee believes that the current stance of policy is appropriate," Mr. Powell said after officials ended their two-day policy-setting meeting. **For now, "we don't see a strong case for moving [rates] in either direction," he said**.

All 10 members of the central bank's rate-setting committee, comprising the five Fed governors and five regional Fed bank presidents, voted to keep the benchmark federal-funds in a range between 2.25% and 2.5%.

Stocks fell, with the Dow Jones Industrial Average sliding 162.77 points, or 0.6%, to 26430.14, while the S& P 500 lost 22.10 points, or 0.8%. The yield on the benchmark 10-year U.S. Treasury note fluctuated but closed up at 2.511% from 2.505% a day earlier. Bond yields rise as prices fall.

While the Fed's monetary policy remains on hold for now, declining annual inflation could make for lively discussions inside the central bank if it persists.

So-called core inflation, which excludes the volatile food and energy categories, rose just 1.6% in March from a year earlier, down from 1.8% in January and 2% in December, the Commerce Department said Monday.

Fed officials said their 2% inflation target is symmetric, meaning they expect inflation will drift mildly above and below it at different times. They seek to keep inflation at that level because they see it as consistent with a healthy economy.

The Fed raised rates once every quarter last year, most recently in December. Market turmoil in late 2018, fueled in part by worries about a global-growth swoon, prompted the officials early this year to signal they were done raising rates.

Since then, global growth has improved, the U.S. economy expanded at a strong 3.2% annual rate in the first quarter and stocks climbed to new highs.

After the officials last met in March, Mr. Powell signaled greater frustration that inflation had struggled to stay on target. But Wednesday, despite evidence that core inflation had slipped even lower, he kept a calm bearing and pointed to idiosyncratic price declines in clothing, due to methodological changes, as well as in investment-management services.

"There's reason to think that these will be transient," Mr. Powell said. "We of course will be watching very carefully to see that that is the case."

Economists said other forces outside the Fed's control and unrelated to domestic demand are crimping inflation as well.

Among them, sluggish economic growth abroad may be damping prices for many globally traded goods. Technological improvements mean the capability of electronic products is rising faster than their prices, which government statisticians count as a price decline. Smartphones and online shopping are making bargain-hunting easier, sapping sellers' power to raise prices. And health care prices are rising more slowly because of the Affordable Care Act and other regulatory changes.

Because most Fed officials have said they expect inflation to hold close to 2%, any sustained undershooting of the target could unnerve the central bankers, particularly if it sends consumer and business' expectations of future inflation lower.

The officials worry that expectations can become self-fulfilling, leading price pressures to weaken further.

Mr. Powell noted that most of the central bank's forecasting errors on inflation "are on the downside." This creates a risk that "inflation expectations over time could be pulled down," he added.

In an interview last month, Chicago Fed President Charles Evans said that if an inflation shortfall was persistent, he would support cutting rates to take out insurance against the risk of economic softness.

On Wednesday, "we learned that an insurance cut is not imminent," said Julia Coronado, founder of MacroPolicy Perspectives LLC, a New York economics advisory firm. Mr. Powell "didn't close the door to such an idea, but he could have left it more open."

The central bank has faced other episodes of idiosyncratic price drops in recent years, such as one from a price war among cellphone network providers in 2017. Fed officials didn't change their policy plans as a result, and the declines ultimately proved temporary.

Even so, recurring low inflation spells, even if brought on by outside forces, poise a challenge for the Fed, which has been committed to raising inflation back to its 2% goal, said Ms. Coronado.

"It means you have to stimulate the other pieces of inflation with greater force," she said. "Are you willing to do that when the rest of the economy is humming along fine?" Michael Gapen, chief U.S. economist at Barclays, said he largely agreed with the Fed's inflation outlook and expects core inflation to return to 1.8% or 1.9% later in the year, but not until after July. "We have a few more months for this to play out," he said. "It pushes out that day of reckoning."

Cutting rates could be complicated coming after President Trump has called repeatedly on the Fed to do so. Central bank officials have said politics never influence their decisions. But Mr. Trump's comments would put more pressure on them to explain any policy changes so that doubts about their independence don't erode their credibility in the markets.

On Tuesday, Mr. Trump called on the Fed to cut rates by 1 percentage point and to resume its crisis-era bond-buying program to stimulate growth.

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Ratings Firm DBRS Is Sold

BY GUNJAN BANERJI – WSJ 05.30.2019

Morningstar Inc. **will buy** credit-rating firm DBRS Inc. for $669 million, marking the company's largest acquisition and merging two smaller players in a market for U.S. ratings that continues to be dominated by three giants.

Morningstar, which also has a team grading mutual funds, acquired rating firm Realpoint LLC for $52 million in 2010 as it sought to expand into bond ratings.

It had just 0.1% of market share in outstanding credit ratings as of the end of 2017, according to the Securities and Exchange Commission's annual report on credit ratings.

Backed by private-equity firms Carlyle Group LP and Warburg Pincus, **DBRS is the fourth-largest credit-rating** firm **in the U.S**. by market share but had just 2.3% of the share of total outstanding credit ratings as of 2017.

Morningstar said the deal is expected to close in the third quarter and that it is subject to regulatory approval.

It will name a leader of the combined business by then, the company said.

New entrants have cropped up to rate debt since the global financial crisis, but the three largest players— Moody's Corp., S& P Global Inc. and Fitch Ratings— still lead most grades.

Kunal Kapoor, Morningstar's chief executive officer, said in a note to shareholders that there is an opportunity in the growing market for global debt.

He said that DBRS's areas of coverage "round out" Morningstar's.

"Ratings activity hasn't kept pace with the proliferation of new structured product categories, particularly in esoteric asset-backed securities, where we believe we can improve transparency," Mr. Kapoor said.

Toronto-based DBRS has snapped up market share in sectors such as student loans, while it lags behind in areas like corporate bonds.

For example, DBRS rated more than 50% of transactions backed by student loans that were priced from June 2017 to June 2018, according to the SEC's report.

Meanwhile, it rated just 2.6% of corporate debt as of the end of 2017.

Debt across sectors has boomed in recent years as interest rates have stayed low. For example, U.S. corporate and mortgage-related debt outstanding hit a record in 2018, data from the Securities Industry and Financial Markets Association show. Assetbacked debt outstanding hit the highest level since 2009 last year.

Despite backlash over their ratings in the financial crisis, shares of Moody's and S& P have outpaced the S& P 500's rise over the past 10 years.

Moody's and S& P's stock prices have soared more than 500% apiece over the past decade. Morningstar's stock price has gained more than 230% since then. It rose 2.8% to $139.14 Wednesday.

Some companies have to merge to compete and show growth in the ratings business, said Christopher Whalen, chairman of consulting firm Whalen Global Advisors, who used to work at Kroll Bond Rating Agency.

"It's a brutally competitive business," Mr. Whalen said. "The small people can't last."

Replay of Late 1998's Drop by Interest Rates May Materialize

BY JOHN LONSKI - MOODY'S CAPITAL MARKETS RESEARCH 03.07.2019

Weakness abroad and a **faltering demand for U.S. output** now **put downward pressure on** both **earnings sensitive securities' prices and benchmark Treasury yields**. The equity and high-yield credit rallies will be put on hold until the earnings outlook stabilizes. **Worth recalling** is how the **booming U.S. economy** of **late 1998** did **not prevent** the **Fed from cutting rates** in order **to contain risks arising from economic weakness abroad**. Late 1998 is distinguished from the current situation by how **U.S. real GDP growth is now much slower than** its **pace above 4.5% in 1998's second half**.

On **March 7**, not only did the **European Central Bank slash its forecast for 2019's euro zone economic growth from 1.7% to 1.1%**, the ECB also revised upward its projection for the euro zone's 2019 unemployment rate from 7.8% to 7.9%. For the U.S. at least, year-over-year increases by the unemployment rates often are hallmarks of a recession.

Projections of slower economic growth and higher unemployment complemented the lowering of the ECB's consumer price inflation forecast from 1.6% to 1.2%. Thus, more in the way of monetary accommodation may be necessary if the ECB is to reach its 2% inflation target for the euro zone.

These downward revisions prompted **ECB President Mario Draghi** to **announce** that key **ECB interest rates** are likely to **remain** at **current levels through** the **end** of **2019**. In further response to the downside risks now facing the euro zone outlook, Mr. Draghi added that the **ECB will reinvest principal payments from maturing bonds** of the **ECB's asset portfolio** well past the start of hiking the ECB's key interest rates (whenever that might be). In other words, there will be **no tapering of** the **ECB's considerable bond holdings** as long as ample monetary accommodation is needed to assure sufficient systemic liquidity.

In quick response to the ECB's more downbeat assessment of euro zone prospects, European equity markets moved lower by 0.40% to 0.60%. By contrast, the market value of U.S. common stock sank by a deeper 1.0% during the afternoon trading of March 7.

Sovereign government bond yields plunged in response to the euro zone's downwardly revised outlook. For example, the **10-year German government bond yield fell from March 6's 0.13% to 0.06%** for its lowest reading since the 0.03% of October 25, 2016, or when the 10-year U.S. Treasury yield closed at 1.76%. Thus, until convincing upward momentum is reestablished for U.S. business activity, **the 10-year U.S. Treasury yield is likely to fall under its recent 2.65%**.

S&P 500 Reaches a Record as Yields Drop Off

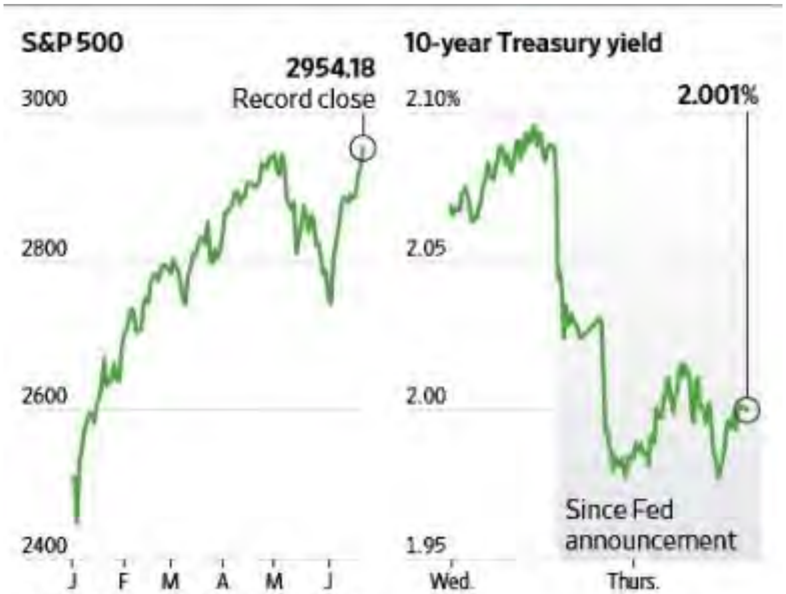
BY JESSICA MENTON – WSJ 06.21.2019

The S& P 500 surged to its first record close since April, underscoring confidence on Wall Street that the U.S. economy and global markets remain healthy despite a fresh tumble in bond yields around the world.

The yield on the 10-year U.S. Treasury note slipped below 2% Thursday for the first time since late 2016, hitting 1.99% early in the morning in Asia and touching that level several times in New York trading before closing at 2.001%.

Yields remained near all-time lows in Germany and France, reflecting rising bond prices.

Traders and portfolio managers said stocks' rally, marked by a 249-point gain in the Dow Jones Industrial Average and a fourth straight day of gains in the S& P, Dow and Nasdaq Composite Index, is driven by expectations that an about-face this spring by global central bankers will keep the decade-long economic expansion on track and help avoid a potential recession. Worries about trade friction and a souring outlook for growth, particularly in Europe, have spurred the tumble in bond yields and pushed the Federal Reserve and European Central Bank toward loosening monetary policy, analysts and investors said, likely ending the Fed's multiyear effort to tighten policy.



Sources: FactSet (index); Tullett Prebon (yield)

Investors currently appear sanguine about the likelihood that the end of the Fed tightening cycle will put the economy on firm footing, offsetting any negative surprises in future economic activity that may be implicit in the recent yield decline.

The 10-year yield has dropped 0.14 percentage point in the past eight days and is down 1.23 percentage points since November, raising fears among many traders that the economy is at risk of a sharp slowdown.

"**The potential rate cuts may be more about fending off danger than reacting to danger**," said Michael Antonelli, market strategist at investment bank Robert W. Baird & Co. "The market is looking at what the Fed is doing and thinking that if the Fed is on our side, then this economic expansion can continue."

Bond and stock prices alike rallied Tuesday after ECB President Mario Draghi signaled officials could start new stimulus measures, and the gains accelerated Wednesday and Thursday after the Fed signaled a possible cut in the months ahead.

On Thursday, the broad index rose 27.72 points, or 0.9%, to 2954.18. The Dow industrials surged 0.9% to 26753.17, putting the blue-chip index within 0.3% of its October closing record. The technology- heavy Nasdaq Composite added 64.02 points, or 0.8%, to 8051.34.

Trade tensions and uncertainty over central-bank policy had rattled investors last month, with stocks posting their worst May since 2010. But the potential for thawing trade relations between Washington and Beijing has helped lift share prices this month, putting the S& P 500 on pace for its best June since 1955.

Investors also received some clues from the Fed Wednesday on the direction of interest rates. **Fed Chairman Jerome Powell** said the bank will hold interest rates steady for now, but he dropped **strong hints** that **further easing would be necessary if global trade tensions continue** to damp economic growth. Many economists expect the Fed to propose a 0.25-percentage-point cut at its July meeting.

The recent bounce in stocks comes as President Trump is set to meet with President Xi Jinping of China at the Group of 20 summit next week in Japan.

“The market’s reaction after the Fed meeting is kind of crazy,” said Jonathan Corpina, senior managing partner at broker-dealer Meridian Equity Partners. “I would have thought things would have quieted down and investors would [have sold shares] after the recent run-up. But investors are now really banking on the G-20 summit.”

Energy shares in the S& P 500 led the broader market higher Thursday, with the sec-more tor gaining 2.2%. Shares of U.S. oil producers rose, with Whiting Petroleum and Centennial Resource Development jumping 8.3% and 6%, respectively.

The gains were driven by a sharp rise in oil prices after Iran said it shot down a U.S. military drone. U.S. oil prices rose 5.4% to settle at $56.65 a barrel.

“Risk is being embraced following the Fed meeting, which is helping stocks broadly,” said Justin Wiggs, managing director in equity trading at Stifel Nicolaus. “The pop in crude prices has forced investors to take a look back at the energy space.”

The dollar dropped broadly against major currencies. The WSJ Dollar Index, which measures the dollar against a basket of currencies, fell 0.7%. Meanwhile, gold surged 3.6% to $1,392.90 per troy ounce as the prospect of lower interest rates spurred investors to seek returns from alternative assets.

In Thursday’s action, Slack Technologies made its debut on the New York Stock Exchange, closing at $38.62 to give it a fully diluted valuation of about $23.2 billion.

Safety Seekers Stoke Treasury Demand

BY SAM GOLDFARB AND DANIEL KRUGER – WSJ 05.14.2019

Yield on benchmark 10-year note hits its lowest level since March 28

A broad flight to safer assets on Monday pushed the yield on the 10-year U.S. Treasury note to its lowest close since March, highlighting the spreading effects of the escalating U.S.-China trade battle.

Yields, which fall when bond prices rise, have slid since President Trump tweeted on May 5 that the U.S. would raise tariffs on Chinese goods, dashing hopes on Wall Street that the world's two largest economies were just days away from settling their differences.

On Monday, China said it would raise tariffs on roughly $60 billion worth of U.S. imports, after the U.S. on Friday increased tariffs to 25% from 10% on $200 billion worth of Chinese goods.

Having spent much of Monday's session below 2.4%, the yield on the benchmark 10year U.S. Treasury note ultimately settled at 2.405%, compared with 2.455% on Friday. That was the lowest closing level since March 28, shortly after the Federal Reserve signaled it was unlikely to raise interest rates this year.

Before the uptick in trade tensions, investors had been growing more optimistic about the global economy, holding the 10-year Treasury yield above 2.5%. The prospect for a lengthy standoff, however, has bolstered demand for government bonds, which investors often seek out during times of political and economic uncertainty.

Zhiwei Ren, a portfolio manager at Penn Mutual Asset Management Inc., said tensions between the U.S. and China will likely be long-lasting, as the two countries compete over technology and economic and political prominence.

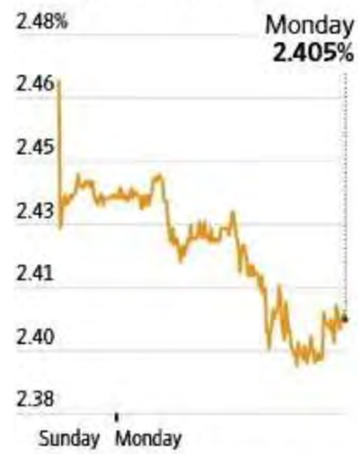
What that would mean for Treasurys—and by extension a broad swath of consumers and businesses whose borrowing costs are influenced by the Treasury market—is a matter of debate among investors and analysts.

Weighed down by concerns the impact of a trade war on China's economy, the Chinese yuan was down 0.8% to 6.8784 per dollar—a large move for the currency, which trades within a band set by the People's Bank of China and the China Foreign Exchange Trade System.

Some investors and analysts have warned that a significant decline in China's currency could prompt China's government to defend the value of the yuan by selling Treasurys and converting those dollars into yuan, putting upward pressure on Treasury yields.

Shelter From Storm

The yield on the 10-year Treasury note has been falling steadily since President Trump's tweets on May 5.



Source: Tullett Prebon Information

Higher tariffs on Chinese goods could also lead to higher prices on many goods that Americans buy, which is another threat to Treasurys because inflation erodes the purchasing power of their fixed payments.

China sold Treasurys in 2014 and 2015 and likely in 2018 to support the value of the yuan, said Brad Setser, an economist at the Council on Foreign Relations who studies the international flow of capital.

“I’d be surprised if there isn’t some intervention” to support the yuan before it falls below recent points where Chinese officials have intervened in the past, he said, adding those levels would likely come before the yuan falls to 7 per U.S. dollar.

Still, China doesn’t need to sell Treasurys to bolster its currency and might use other means, such as selling mortgage- backed securities or cash holdings, Mr. Setser said.

AUCTION RESULTS

Here are the results of Monday’s Treasury auctions. All bids are awarded at a single price at the market-clearing yield. Rates are determined by the difference between that price and the face value.

13-WEEK AND 26-WEEK BILLS

	13-Week	26-Week
Applications	$137,203,887,600	$117,455,291,800
Accepted bids	$39,000,725,400	$36,000,011,800
*noncomp	$1,125,074,600	$932,344,200
*foreign noncomp	$100,000,000	$105,000,000
Auction price (rate)	99.403444 (2.360%)	98.809417 (2.355%)
Coupon equivalent	2.414%	2.423%
Bids at clearing yield accepted	38.38%	78.64%
Cusip number	912796QV4	912796SS9

Both issues are dated May 16, 2019. The 13-week bills mature on Aug. 15, 2019; the 26-week bills mature on Nov. 14, 2019.

A decision by China to sell Treasurys could also push yields lower because it would signal that the conflict between the two countries had reached a more severe stage, other analysts said.

That could intensify concerns about the potential for global economic growth to slow further, as countries that export commodities to China could see diminished demand for their raw materials. This could lead to further weakness in global currencies versus the dollar, analysts said.

“Regardless of the motive, its effect has been nervous-about ness in the equity market and a flight-to-quality in Treasurys,” said Ian Lyngen, head of U.S. government bond strategy at BMO Capital Markets.

China held $1.13 trillion of U.S. government debt in February, or about 7% of tradable debt, according to the latest available Treasury Department data.

That is a much smaller share than in previous periods when investors have been concerned that China could sell its Treasury holdings. About $6.4 trillion, or 40% of the debt, is held abroad.

Short-Term Bond ETFs Suffer Outflow

BY ASJYLYN LODER – WSJ 03.07.2019

Investors are liquidating their investments in funds that own some of the safest short-term debt and buying stocks and longer-term bonds, another sign that the central bankers' dovish stance has stoked appetite for risk.

Short-term debt provides a safe place to stash cash during times of market stress. Exchange-traded funds that invest in those securities raised money at a record clip late last year when stock-market turbulence surged. Now that tide has reversed. The latest Morningstar data show that short-term debt ETFs have seen two consecutive months of outflows, and investors are instead snapping up riskier assets.

Behind the shift in sentiment is the Federal Reserve's course correction. Fed Chairman Jerome Powell said on Jan. 4 that the central bank would be patient when raising its benchmark interest rates, allaying fears that quickly rising rates would strangle economic growth.

The central bank's caution calmed markets, and stocks have since resumed their steady climb.

"It really tells you how quickly interest-rate expectations can change," said Dan Suzuki, portfolio strategist for Richard Bernstein Advisors, a New York firm with $9 billion under management, most of it in ETF strategies. "A lot of the surveys we looked at last year suggested that people were very afraid of how high interest rates could go, how high inflation could go and how quickly the Fed could tighten. And that fear has now completely gone away."

Yields on benchmark two-year Treasurys have risen faster than yields on 10-year notes this year, indicating that investor demand for short-term debt has softened. Yields rise as prices fall. The two-year yield is 2.52% compared with a 10-year yield of 2.69%.

The combination of a rising stock market and stagnating rates makes short-term debt less appealing. Now that equity markets are less volatile, investors are less likely to forgo the potential for greater gains in favor of the relative safety of bonds.

The lull in rate increases also eliminates a major risk factor for longer-term debt, which typically pays higher returns but is more vulnerable to losses when interest rates rise. If a rate increase isn't imminent, then the higher payout on longer-term debt is the better bet.

The ETF flows offer a glimpse of how that calculus is playing out. Almost $4.1 billion came out of short- and ultra-short-term debt ETFs in the first two months of the year, according to Morningstar. Those same funds raised more than four times that amount in the last two months of 2018.

By contrast, ETFs that invest in long-term government debt have seen inflows rise, and investors are continuing to add money to emerging-market ETFs and funds that own large U.S. companies, Morningstar data show. Realestate ETFs picked up almost $2.8 billion in February, the most since September 2016.

ETF flows are, at best, a rough barometer of investor sentiment. Other factors, like portfolio rebalancing and tax considerations, drive substantial trading. Investors may be moving money within in an asset class, switching from a mutual fund or individual stocks and bonds into an ETF that offers similar exposure. Traders may also be buying and selling an ETF as part of a more complex strategy that involves offsetting wagers in another part of the market.

Still, ETFs are a fast and convenient way to bet on a variety of asset classes, and traders and portfolio managers often use them to express their views on fast-changing markets.

“It’s been a complete 180degree reversal of people’s expectations, and that’s what’s driving the flows,” Mr. Suzuki said.

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Signs of Slow Growth Whip Markets

BY AMRITH RAMKUMAR – WSJ 05.20.2019

Stocks, bond yields and commodities around the world declined again, as **worries about slowing economic growth spurred a further retreat from riskier investments**.

Risk assets slid to start the day Wednesday, at one point sending the Dow Jones Industrial Average down more than 400 points and oil prices down more than 3%, before they trimmed some of their drops near the end of the session.

Markets have been stung lately by fears that a drawn-out U.S.-China trade dispute will add pressure on an already slowing world economy. President Trump indicated on Monday that a near-term deal between the two sides is unlikely, and economic data pointing to weakness around the globe have added to growth concerns in recent days.

Reports in Chinese media outlets on Wednesday that China could cut exports of rare-earth metals critical to products ranging from electronics to military equipment were the latest trigger for trade-related volatility, investors said.

“**The industrial side of the world is still slowing, and that’s concerning**,” said Paul Zemsky, chief investment officer of multi-asset strategies and solutions at Voya Investment Management. “While I think the U.S. will continue to plow through, the rest of the world becomes more questionable.”

Mr. Zemsky said the firm has lowered the total amount of risk in its portfolios in recent months.

Drops in long-term bond yields have hurt shares of lenders recently, though bank stocks stabilized and were roughly flat on Wednesday.

The Dow industrials closed down 221.36 points, or 0.9%, at 25126.41—its lowest level since Feb. 11— following a sixth decline in eight sessions.

The S& P 500 dropped 19.37 points, or 0.7%, to 2783.02, with each of its 11 sectors falling. The broad equity gauge logged its lowest close since March 8 and is 5.5% below its April 30 record.

The tech-laden Nasdaq Composite finished down 60.04 points, or 0.8%, to 7547.31.

The yield on the benchmark 10-year U.S. Treasury note— which is tied to interest rates on mortgages, auto loans and student debt—also extended a recent slide, dropping to 2.238% from 2.268% a day earlier. The yield is at its lowest level since September 2017. Bond yields fall as prices rise and have dropped with investors seeking safety in Treasurys lately.

Data showed Germany's jobless rate rose unexpectedly in May, according to the Federal Employment Agency, fueling fresh concerns about the health of Europe's largest economy.

Commodities that are the building blocks of construction and manufacturing slipped on Wednesday, the latest example of demand concerns hurting growth-sensitive materials. U.S. crude prices declined by 0.6%, after earlier falling more than 3%, with oil extending a recent stretch of volatility amid rising stockpiles. Copper futures fell by 1.1%. Both commodities are down 10% or more from their 2019 peaks, a warning sign to those who use materials as a gauge of the economy.

Their recent declines also signal concerns that purchases by businesses would slow as the U.S.-China tariff fight continues. "Companies are just going to use up their inventories a bit more before reordering these new inputs to production," Mr. Zemsky said.

Analysts were looking ahead to a second reading of first-quarter U.S. economic growth, scheduled for Thursday. The first reading showed gross domestic product rose at a 3.2% annual rate, even with growth in consumer and business spending slowing.

Friday consumer-spending figures from April could also shift expectations for the U.S. economy, after industrial production and retail sales for that month were weaker than expected.

Despite strength in the U.S. labor market, some analysts expect weakness overseas to eventually spread as tariffs escalate, threatening the nearly 10-year old economic expansion.

Elsewhere, the Stoxx Europe 600 fell by 1.4%. Asian markets continued the declines early Thursday. At midday, Japan's Nikkei was down 0.9% and Hong Kong's Hang Seng Index was down 0.7%.

Stocks, Bond Yield Slump, Signaling Market Jitters

BY DAMIAN J. TROISE AND ALEX VEGA – OREGONIAN 05.29.2019

U.S. stocks fell broadly Tuesday as anxious investors shifted money into bonds, sending yields to their lowest level in nearly two years.

Rising bond prices, which pull yields lower, are typically a sign that traders feel jittery about long-term growth prospects and would rather put their money into safer holdings.

The yield on the benchmark 10 year Treasury fell to 2.26% Tuesday, the lowest level since September 2017. That put it below the 2.35% yield on the three-month Treasury bill.

When that kind of "inversion" in bond yields occurs, economists fear it may signal a recession within the coming year. It has happened multiple times so far this year.

Investors have been weighing a mix of encouraging and discouraging economic reports this year as they also keep an eye on unpredictable swings in the escalating trade war between the U.S. and China.

"If the bond market was saying that the economy is on OK footing then you wouldn't see yields fall like they are," said Willie Delwiche, investment strategist at Baird. "In many respects, equities are waking up to what's happening in bonds."

Trading has been choppy over the last several weeks as investors grapple with the possibility of a prolonged trade war between the U.S. and China. They escalated the dispute earlier this month by raising tariffs on each other.

The U.S. went even further and proposed a ban on technology sales to certain Chinese companies. That added even more volatility to technology stocks that are already sensitive to the ups and downs of trade negotiations.

The trade dispute has interrupted a market rally that saw the S&P 500 recoup the fourth quarter's sharp loss and hit a new high. The index is down 4.9% so far in May, though it's still up 11.8% for the year.

In a client note Tuesday, Morgan Stanley warned that the stock market faces a lot more volatility because of weak economic data and the trade war. It also cautioned that those factors are also increasing the risk that the U.S. economy could slide into a recession.

"This isn't just about the U.S. and China," said Brian Nick, chief investment strategist at Nuveen. "It's about everybody sensing there is something to brace for."

The drop in yields accelerated last week, but it has been happening gradually since late last year, when the 10-year Treasury yield peaked at 3.2%.

The slide in bond yields held back gains for banks and other financial companies. Falling yields lead to lower interest rates on loans, which makes lending less profitable. Goldman Sachs Group slid 1.8%.

Health care, consumer staples and industrial stocks also took heavy losses. UnitedHealth Group dropped 2.3%, Procter & Gamble slid 2.1% and United Rentals closed 3% lower.

Communications services stocks bucked the broader market slide. Video game publisher Activision Blizzard led the sector, climbing 2.9%.

Some stocks had a good day.

Traders bid up shares in Total System Services 4.8% higher following the announcement that the payments processor is being bought by Global Payments in a deal valued at $21.5 billion. The move is the third major acquisition in the payment technology sector this year. Global Payments shares lost 3%.

SeaWorld surged 16.6% after it announced a stock buyback and increased investment from a hedge fund.

Fiat Chrysler shares gave up an early gain, sliding 0.9% after the carmaker proposed a merger with France's Renault. A combination between the companies would create the world's third largest automaker and reshape the global industry. It would top General Motors' production and trail Volkswagen and Toyota.

The Fed Gets More Cover for a Cut

BY JUSTIN LAHART – WSJ 06.12.2019

Low inflation reading smooths way for central bank to signal next week

Muted inflation may not count as a reason for the Federal Reserve to cut rates, but it sure makes cutting them an easier thing to do.

Consumer prices edged up in May from April, the Labor Department reported Wednesday, but fell short of expectations. Overall prices were up 1.8% from a year earlier versus the 1.9% economists polled by The Wall Street Journal had penciled in. Core prices, which exclude food and energy prices to better capture inflation's trend, were up 2% on the year versus an expected gain of 2.1%.

The Fed's preferred inflation measure runs a little cooler than the Labor Department gauge, so it likely fell short of the central bank's 2% inflation target last month. Economists at Goldman Sachs, for example, estimate it was up just 1.4% overall, with the core up 1.5%.

That matters because the Fed policy makers lately have been more concerned about inflation falling shy of their target than in the past. They are in the midst of a continuing review of how they set policy. It seems likely to conclude the central bank should be more willing to err on the side of inflation being higher.

Even so, if the Fed wasn't worried that global uncertainty and trade disputes were beginning to eat into U.S. growth, low inflation on its own wouldn't count right now as a reason to cut rates—not with the stock market near record highs and the unemployment rate, even after last week's disappointing jobs report, at its lowest level since 1969.

Off Target
Change in the Federal Reserve's preferred price measure from a year earlier

Source: Commerce Department

So Wednesday's report probably didn't move the needle much on whether the Fed will cut rates when it meets next week. As it stands, there probably hasn't been quite enough evidence that the economy is at risk for it to immediately do so. That could change if, for example, Friday's May retail sales report comes up short.

What low inflation does, however, **is make it easier for the Fed** next week **to signal a possible rate cut at its July policy-setting meeting**. Then, if evidence continues to suggest the economy is indeed facing headwinds, it has **more cover to go ahead and pull the trigger**.

Treasury Yields Fall as Traders Await Fed Decision

BY AKAME OTANI – WSJ 03.20.2019

Analysts expect Fed to **leave short-term interest rates unchanged**.

U.S. government bond prices rose Wednesday ahead of the latest interest-rate decision from the Federal Reserve.

Corporate Borrowing Rates and Yields

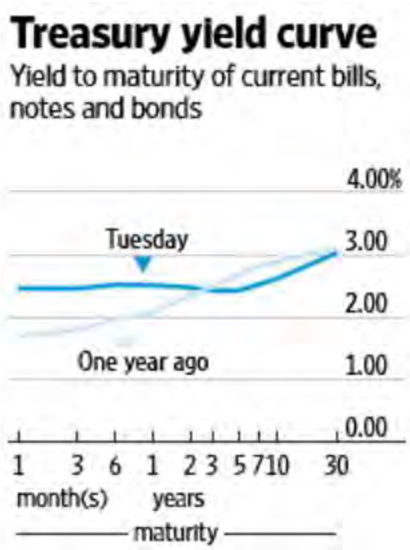
Bond total return index	Close	Yield (%) Last	Yield (%) Week ago	52-Week High	52-Week Low	Total Return (%) 52-wk	Total Return (%) 3-yr
Treasury Ryan ALM	1487.561	**2.579**	2.563	3.154	2.501	**4.329**	0.769
10-yr Treasury, Ryan ALM	1755.640	**2.614**	2.605	3.232	2.557	**5.256**	0.015

The **yield** on the benchmark **10-year U.S. Treasury note** was **last** at **2.592%,** according to Tradeweb, compared with 2.614% Tuesday. **Yields fall as bond prices rise**.

Analysts widely expect the Fed to leave short-term interest rates unchanged at the conclusion of its two-day policy meeting. Given that, many say focus will be on the Fed's statement and rate projections, which will offer clues on how long the central bank intends to hold rates steady.

Left: U.S. Treasury in WA DC.

Investors have become increasingly skeptical the Fed would raise rates this year since the central bank signaled in January that it was comfortable leaving them unchanged for the time being. That's partially because **inflationary pressures haven't ticked up** much, suggesting the Fed faces little risk of the economy overheating.



Federal-funds futures, used by **traders** to place bets on the course of monetary policy, showed Wednesday a **roughly 23% chance** of the **Fed lowering rates by** the **end** of **2019**, according to CME Group. That's **compared** with 15% one month ago.

Confidence that the Fed won't be in a rush to raise rates again has helped keep Treasury yields off of the highs they hit last year. The yield on the two-year Treasury note, which tends to move in line with investors' short-term rate expectations, was at 2.458% Wednesday, compared with 2.471% Tuesday and 2.496% at the end of last year.

Still, some analysts caution that the Fed's rate projections could surprise those who believe that the central bank has finished raising rates for the duration of the economic cycle.

"When it comes to making policy decisions, we interpret the **Fed's preference for patience** as one of timing, indicating the current hiking cycle hasn't ended quite yet," said Charlie Ripley, senior market strategist at Allianz Investment Management, in an email

Government-bond yields remained within 0.1 percentage point of their lows of the year as investors continued to bet that the Fed's next move is more likely to be a reduction of interest rates than a rise.

After a surge in market volatility and concerns that higher interest rates could hasten a recession, **Fed officials** in January stepped back from their own forecasts at their December meeting that they would raise interest rates two times in 2019 and emphasized that they would be more responsive to economic data, including financial conditions, in setting rates this year.

Fed officials have indicated that they see little reason to raise interest rates as long as inflation doesn't present a threat to the economy. Inflation is a threat to the value of government bonds because it erodes the future purchasing power of their fixed interest and principal payments.

"**We think the bond market is sending a pretty accurate signal about expectations for slow inflation and growth**," said **Bob Browne**, **chief investment officer** for **Northern Trust**. In setting rates this year, "the Fed needs to think about what the economy will look like in 2020," he said.

Treasury Yields Feel Downward Pressure

BY AKANE OTANI - WSJ 04.11.2019

U.S. government bond yields fell Wednesday after a moderate report on consumer prices and cautious signals from central bankers. The **yield** on the benchmark **10-year** U.S. Treasury note settled at **2.479%**, compared with 2.497% Tuesday.

Yields, which fall as bond prices rise, slipped after a gauge of consumer prices rose less than 2% in March from a year earlier, suggesting inflation remained contained.

Yields then remained pressured after European Central Bank President Mario Draghi said inflation wasn't picking up as quickly as officials had previously expected after the central bank announced it had left interest rates unchanged.

Inflation tends to weigh on demand for bonds since it chips away at the purchasing power of their fixed payouts.

"**There isn't enough inflation for the [Federal Reserve] to resume its gradual rate hikes and there isn't any deflation worry in the data for the Fed to do a complete about-face and cut interest rates either**," said Chris Rupkey, managing director and chief financial economist at MUFG.

Yields remained **lower** after the **Fed released minutes** from its **March 19-20 meeting** that indicated officials saw little reason for the Fed to resume its rate increases, citing the risks to the economy and signs inflation remained soft.

Investors in the futures markets are betting Fed officials will have to go beyond just holding interest rates steady, pricing in a more than 50% chance of the Fed lowering rates by the end of the year, according to CME Group.

Treasurys Continue to March Higher

BY SAM GOLDFARB – WSJ 03.26.2019

U.S. government-bond prices rose anew Monday, pushing the yield on the 10year Treasury note to a nearly 15-month low, amid continued concerns about the outlook for global economic growth.

The **yield** on the benchmark **10-year U.S. Treasury** note settled at **2.418%, its lowest close since December 2017**, compared with 2.459% Friday. Yields, which drop when bond prices rise, extended declines after falling sharply Friday in response to weak readings from the eurozone manufacturing sector.Yields had actually crept higher overnight as data showed improvement in German business sentiment. But they dropped again near the start of U.S. trading and continued sinking throughout much of the day, with someanalysts blaming technical factors such as buying from holders of mortgage-backed securities who sometimes exacerbate moves in government bonds as they try to maintain a relatively consistent exposure to interest-rate swings.

Though investors this year have generally been optimistic about the outlook for the U.S. economy—leading to gains in stocks and other riskier assets— **the bond market is now flashing warning signs**.

On Friday, the **yield on the 10-year Treasury yield dropped below the yield on the three-month Treasury bill** for the first time since August 2007—**a so-called yield-curve inversion that historically has been a good predictor of recessions**.

Some investors and analysts say there could still be relatively benign explanations for the recent moves in Treasurys. Friday's rally, for example, was led by bonds in Europe, where the yield on the 10-year German bond dropped below 0% for the first time since 2016. As yields fall overseas, that can spark extra demand for Treasurys without necessarily meaning that the U.S. economy itself is in trouble.

Some analysts also have said that the decline in Treasury yields may be partially because of the recent announcement from the Federal Reserve that it will hold more longer-term government bonds than many expected. That decision, analysts said, was largely driven by technical considerations about how the central bank sets short-term interest rates, but it nonetheless could bolster Treasurys by curtailing the supply of government debt. "We sort of went from the world is swimming in bonds to we may have occasional shortages of bonds over the next couple years," said Jim Vogel, an interest-rates strategist at FTN Financial.

Even so, signs of slowing global growth have led to a big increase in bets that the Fed will lower interest rates this year. Federal-funds futures, used by investors to place bets on the course of interest rates set by the Fed, on Monday showed a **73% chance of a rate cut by the end of the year**, according to CME Group data. That was **up from 54% Friday and 13% a month ago**.

Treasurys Extend a Month of Gains

BY SAM GOLDFARB – WSJ 05.31.2019

U.S. government bond prices ticked higher Thursday, extending their monthlong rally after overcoming some selling pressure early in the session.

The yield on the benchmark **10-year U.S. Treasury note** settled at **2.227%**, setting a **20-month low** for the third consecutive session, compared with 2.238% Wednesday.

Yields, which fall when bond prices rise, initially edged up as stocks climbed in Europe and opened higher in early U.S. trading. But they began to slip in the late morning and fell more sharply before the 3 p.m. close, as riskier assets such as oil and stocks also lost ground.

Stocks and bond yields have been falling this month due largely to increased trade tensions between the U.S. and China and a run of downbeat economic data out of Europe and the U.S., all of which have increased fears that developed-market economies may be headed for a rough patch.

Investors often buy Treasurys during times of political and economic uncertainty because they offer a regular stream of income with essentially no risk of nonpayment.

Further increasing concerns, the yield on the 10-year Treasury note has fallen below the yield on the three-month Treasury bill, a so-called yield-curve inversion that has often occurred ahead of recessions.

Recent yield declines have also coincided with a sharp drop in market-based inflation expectations. The 10-year break-even rate—a measure of annual inflation expectations over the next decade derived from the extra yield investors demand to hold 10-year Treasury notes over 10-year Treasury inflation-protected securities—finished Thursday at 1.76%, according to Tradeweb, down from 1.96% at the end of April.

Muted inflation typically bolsters bonds by helping to preserve the purchasing power of their fixed coupon payments.

Treasurys Fall on Mixed Signals

BY AKANE OTANI – WSJ 05.02.2019

U.S. government bond prices swung Wednesday, ultimately ending lower for the day, after seemingly conflicting signals from the Federal Reserve sparked volatility in Treasurys.

Treasury yields, which fall as bond prices rise, initially declined after the Fed held short-term interest rates steady and said that inflation was running under its 2% target. But bond yields then reversed course, jumping to session highs, after Fed Chairman Jerome Powell appeared to play down a recent pullback in inflation pressures.

Mr. Powell said some of the weakness in inflation appeared to be "transitory"—stemming from a drop in prices for apparel, for instance. That likely disappointed traders who have been betting that muted inflation would push the Fed to lower rates by the end of the year, analysts and investors said.

"If the Fed is seeing structural issues in the economy causing below-target inflation, that would augur a Fed that's patient for longer. But if they're viewing it as a little more transitory and are on watch for when it creeps back up, the honeymoon might be shorter," said Jason Ware, chief investment officer at Albion Financial Group. The yield on the benchmark 10-year Treasury note, used as a reference for everything from mortgage rates to student debt, settled at 2.511%, compared with 2.505% Tuesday, climbing from a session low of around 2.453%.

Mr. Powell's comments also jolted federal-funds futures, which traders use to place bets on monetary policy.

Just after the Fed released its policy statement, the futures market showed traders pricing in a roughly 78% chance of the central bank lowering rates at least once by year-end, according to CME Group.

But by the time Mr. Powell finished speaking to reporters, that number dropped to 60%.

Treasurys Gain on U.S.-Iran Worries

BY IRA IOSEBASHVILI – WSJ 06.14.2019

U.S. government-bond prices rose, as fears of a military standoff with Iran sent investors into assets seen as safe.

The yield on the benchmark 10-year Treasury settled at 2.096%, compared with 2.129% Wednesday. **Yields fall as bond prices rise**.

Yields extended early declines after Secretary of State Mike Pompeo said the Trump administration has concluded that Iran is responsible for attacks on two oil tankers in the Gulf of Oman. The attacks stoked concerns over trade disruptions in the Strait of Hormuz and raised demand for Treasurys and other so-called haven assets.

Stronger-than-expected demand at Thursday's auction of 30-year bonds also helped buoy Treasury prices. That is **a sign that demand for long-dated safer assets remains high despite the recent fall in yields. Bond yields frequently rise when the government sells debt because the added supply tends to depress prices**.

Signs of muted inflation, together with worries over **slowing global growth**, have boosted Treasurys in recent months, driving the 10-year yield down from multiyear highs reached late last year. **Muted inflation helps preserve the purchasing power of bonds' fixed payments**.

The sharp move higher in oil prices also benefited the currencies of some crude exporters. The dollar fell 0.1% against the Canadian dollar, while also losing ground against the Brazilian real and Russian ruble.

Elevated tensions in the Middle East sent the Swiss franc up 0.2% against the dollar. The Japanese yen, another popular destination for nervous investors, also gained.

The WSJ Dollar Index, which measures the U.S. currency against a basket of 16 others rose by 0.1% to 90.39.

Treasurys Get Lift from Muted Inflation Data

BY SAM GOLDFARB – *WSJ 06.13.2019*

Yields on short-term U.S. government bonds fell Wednesday after another set of tame inflation data bolstered investors' expectations that the Federal Reserve will soon move to cut interest rates.

The yield on the two-year U.S. Treasury note, which is particularly sensitive to changes in monetary policy, settled at 1.891%, compared with 1.922% Tuesday. The yield on the 10-year note also slipped, falling to 2.129% from 2.140%.

Yields, which fall when bond prices rise, declined after the Labor Department said **consumer prices excluding volatile food and energy products rose 0.1% in May from the previous month**.

That was below the 0.2% increase anticipated by economists surveyed by The Wall Street Journal and the latest sign that inflation is failing to catch momentum despite a strong labor market and growing economy.

On Tuesday, the department reported a 0.1% increase in the producer-price index, a gauge of prices at the wholesale level.

Inflation is a major threat to government bonds because it erodes the purchasing power of their fixed payments. In theory, muted inflation on its own should provide a bigger boost to longer-term debt than short-term bonds.

Recently, though, investors have been more focused on the possibility that it could push the Fed to lower rates—something that typically has a greater impact on short-term Treasurys.

Federal-funds futures, which investors use to bet on the direction of interest rates, suggested Wednesday that traders think there is a 23% chance that the Fed will cut rates at its meeting next week, according to CME Group data, up from 17% Tuesday.

They also point to an 83% chance of a rate cut by the end of the Fed's July meeting.

Investors are starting to believe "we're really never going to get inflation," said Wen Lu, U.S. rates and derivatives strategist at TD Securities in New York.

Soft inflation, coupled with concerns about the global growth outlook, have generally boosted Treasurys in recent months, causing the 10-year to fall from the roughly 2.6% level it reached in mid-April.

Even with yields around their lowest levels since 2017, demand was solid Wednesday for a $24 billion 10-year note auction, analysts said.

Given growth fears, yields on corporate bonds haven't fallen as quickly as those on Treasurys.

Still, the average extra yield, or spread, that investors demand to hold U.S. investment-grade corporate bonds over Treasurys has edged down in recent days to

1.24 percentage points as of Tuesday, from 1.30 percentage points on June 3, according to Bloomberg Barclays data.

The average spread on speculative-grade corporate bonds has also fallen to 3.89 percentage points from 4.43 percentage points over that span.

The WSJ Dollar Index, which measures the U.S. currency against a basket of 16 others, was up 0.3% in midafternoon trading at 90.35.

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Treasurys Hold Gains as Fed Shows Patience

BY AKANE OTANI – WSJ 05.23.2019

U.S. government-bond prices rose on Wednesday, holding on to gains after the release of minutes from the latest meeting of the Federal Reserve's monetary-policy committee.

The yield on the benchmark 10-year Treasury note settled at 2.393%, compared with 2.428% Tuesday.

Yields, which fall as bond prices rise, retreated early in the day as reports that the White House was considering imposing restrictions on additional Chinese companies sent relatively risky assets like stocks lower.

Worries about trade have kept Treasury yields flitting around the 2.4% mark in recent weeks.

Yields briefly edged up, but then retraced their gains after minutes from the Fed's meet- ing from April 30 to May 1 showed many officials believed weak inflation justifies the central bank's patient stance.

At the meeting, Fed officials opted to hold interest rates steady and signaled they could leave them unchanged for the rest of the year.

The yield on the two-year Treasury note, which tends to track investors' expectations for monetary policy, settled at 2.231%, versus 2.258% on Tuesday.

Because of the Fed's move— as well as uncertainty about the U.S. and China's trade talks and generally muted inflation— analysts say it is unlikely bond yields will move much higher in the coming months.

"Trade, central banks, inflation and Brexit have surprised," said **Bank of America** analysts in a note Wednesday, adding that they cut their year-end forecast for the **10year Treasury yield to 2.60% from 3%.**

Treasurys Jump on Stock Fall, Rate Talk

BY SAM GOLDFARB – WSJ 05.04.2019

U.S. government bond prices climbed again on Monday, benefiting from a decline in technology stocks and a Federal Reserve official opening the door to a near-term interest rate cut. Already nervous about the Trump administration's tariff policies and a recent run of soft economic data, investors found new reasons to buy bonds following reports that U.S. regulators were considering **increasing scrutiny of industry giants such as Facebook and Alphabet**.

Adding to the bid for bonds, Federal Reserve Bank of St. Louis President James Bullard said in remarks prepared for a presentation in Chicago that a reduction in short-term interest rates "may be warranted soon" in light of an expected slowdown in U.S. economic growth and "ongoing global trade regime uncertainty."

After logging its **largest one-session decline in a year on Friday**, the yield on the benchmark **two-year Treasury** note fell an additional 0.089 percentage-point to 1.848%. **The yield on 10-year note settled at 2.085%—its lowest close since September 2017— compared with 2.139% Friday**.

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Treasurys Ride Weak Reports in China, U.S.

BY AKANE OTANI – WSJ 05.16.2019

U.S. government bonds climbed Wednesday as the latest flurry of data pointed to **some weakness in the world's two biggest economies**.

The **benchmark 10-year U.S. Treasury** note yield settled at **2.380%**, compared with 2.421% on Tuesday.

The yield, which moves in the opposite direction of price, slipped early Wednesday after Chinese economic reports indicated a slowdown in the growth of industrial production and retail sales in April. In addition, investment in fixed assets such as infrastructure and property slowed during the first four months of the year.

Treasury yields extended their decrease after U.S. data showed industrial production and retail sales fell in April.

Factory output was down for the third time in four months. The drop in retail sales was driven by declines in electronics, home improvement, motor vehicles, auto parts and online shopping.

Yields fell as reports showed declines in U.S. retail sales and industrial output. The combination of reports helped stoke investors' appetite for Treasurys, whose fixed returns are more attractive when the economic outlook appears to be uncertain.

With its recent drop, the 10year note yield is hovering near its low for the year. Some analysts said the downward trend is likely to continue while trade tensions and uneven economic data keep risky assets under pressure.

Worries about escalations in the U.S.-China trade dispute pushed Treasury yields and stocks down early this week.

“Trade is far and away the more dominant story right now, but sales should not go unnoticed ahead of consumer confidence reads later this week,” said Mike Loewengart, vice president of investment strategy at E*Trade, in an email message. “Many view retail as a key economic bellwether,” so further softness on that front could give pessimistic investors “more to sink their teeth into,” he added.

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Treasurys Rise After Fed Signals Possible Pause to Rate Increases

BY AKANE OTANI – WSJ 01.30.2019

U.S. government bond prices rose Wednesday after the **Federal Reserve held its benchmark interest-rate steady** and **signaled** it will **likely leave rates unchanged for some time**.

The **yield** on the **benchmark 10-year Treasury** note settled at **2.694%, compared with 2.712% Tuesday**.

Yields, which fall as bond prices rise, drifted higher overnight as U.S. stock futures jumped and an ADP report showed better-than-expected private payroll gains for January.

Strong economic data tends to soften demand for Treasurys, whose fixed payments look more attractive to investors when the growth outlook seems shakier.

Bond yields then reversed course after the Fed, which concluded its two-day policy meeting Wednesday, dropped explicit references to future rate increases—a mainstay of policy statements since the bank’s most recent rate-increase campaign began in 2015. Fed Chairman Jerome Powell also said at a news conference following the meeting that “the case for raising rates has weakened somewhat.”

Taken together, traders and analysts said the messaging sent a strong sign that the Fed will take a more gradual approach to monetary policy this year.

“It’s exactly what the market was hoping for,” said Kevin Giddis, head of fixed-income capital markets at Raymond James.

Mr. Giddis noticed short-term rates dropping further as Mr. Powell stressed a “patient” approach to monetary policy in his press conference. “The bias is shifting more towards lower long-term rates, rather than higher,” Mr. Giddis said.

Traders dialed back bets on future rate increases.

Yields on shorter-term debt, which often move in line with investors' expectations for rate increases, retreated. The yield on the two-year Treasury note settled at 2.524%, compared with 2.569% Tuesday.

Federal-funds futures, tools used to place bets on the course of monetary policy, showed the market pricing in a 6.8% chance of at least one rate increase by the end of the year, compared with 21% Tuesday and 24% a week ago, according to CME Group.

Fed officials have hinted in public comments over the past few weeks that they are leaning toward leaving rates unchanged for some time due uncertainty about the outlook for global growth. That has helped ease some of the selling pressure on Treasurys, whose yields had hit multiyear highs in the fall when robust economic data raised fears that the Fed could accelerate its pace of interest-rate increases.

Recent reports have been more mixed. While the labor market has appeared to hold up, housing data in particular have disappointed investors. A report Wednesday showed pending home sales for December fell 2.2% from the month prior, missing economists' expectations for a 0.5% rise.

"You don't see much that'll send economic growth straight higher from here," Mr. Giddis said.

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Treasurys Sag after Rosy Data

BY AKANE OTANI – WSJ 02.28.2019

U.S. government-bond prices fell Wednesday, giving up gains from earlier in the week, after upbeat economic data and a second day of testimony from Federal Reserve Chairman Jerome Powell.

The yield on the benchmark 10-year U.S. Treasury note settled at 2.693%, compared with 2.636% Tuesday. **Bond yields, which rise as prices fall**, wobbled overnight but climbed steadily throughout the morning. Analysts attributed the moves to heavy corporate issuance in the U.S., a wave of selling among futures for German bunds and better-than expected data on pending home sales in January.

Strong economic data tends to damp demand for Treasurys, whose fixed payouts look attractive to investors when they are feeling unsure about the growth outlook.

Still, some analysts cautioned against reading too much into Wednesday's move, noting that bond yields have for the mostpart remained stuck in a holding pattern for the past few weeks. The uptick in yields "doesn't look like anything fundamental," said Jon Hill, vice president on BMO Capital Markets' U.S. rates strategy team.

Bond yields held on to their advance for the day after Mr. Powell delivered two hours of testimony before the Senate Banking Committee. A day earlier, Mr. **Powell** had told lawmakers that a **slowing global economy** and **muted inflation** warranted a **"patient approach" to tweaking monetary policy**.

Dimming optimism about the global economic outlook has kept bond yields around the world off the highs they hit last year. That is a pattern that some analysts say stands at odds to the rebound across stocks and commodities.

The yield on the 10-year Treasury note tends to rise when investors are confident about growth and retreat when they are less sure about the economic outlook.

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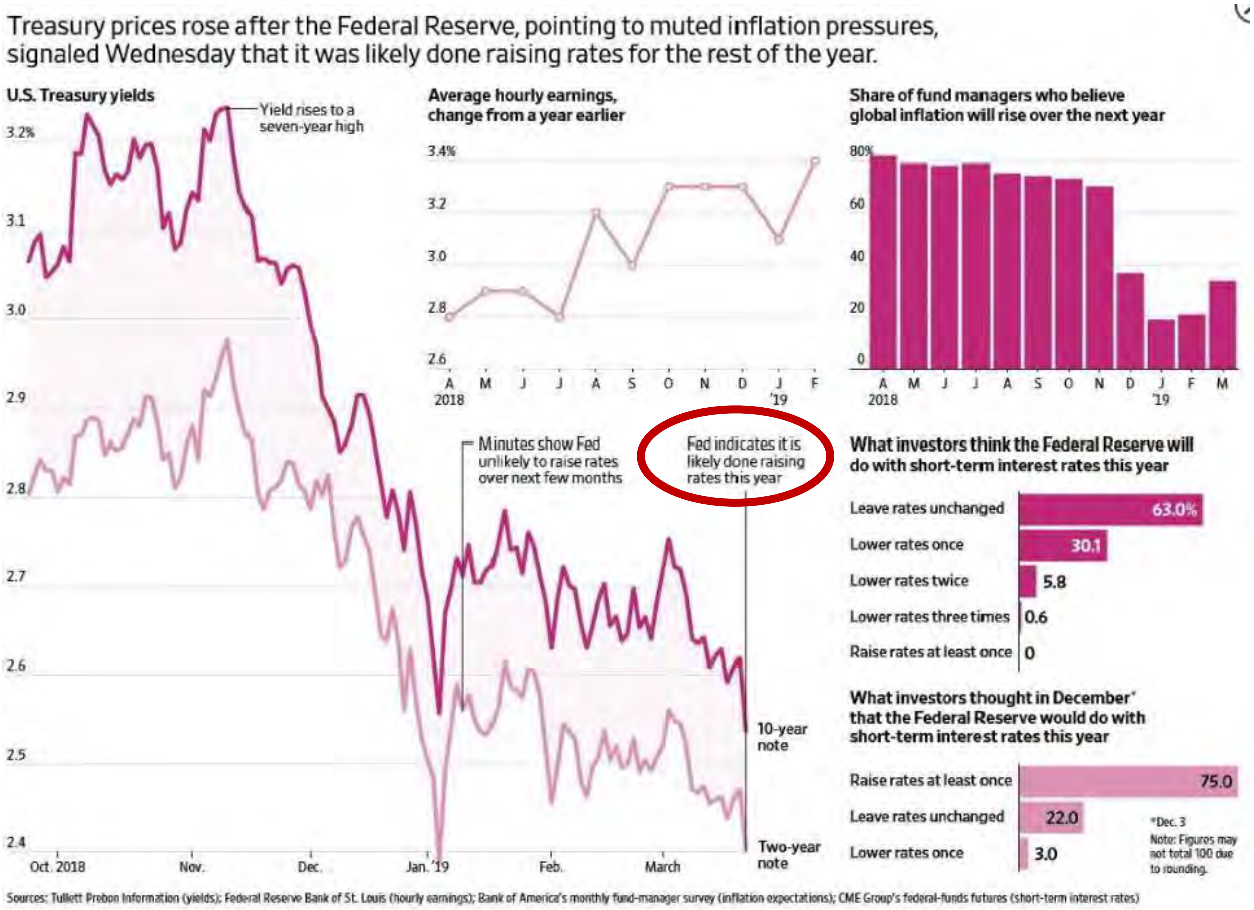
Treasury Yields Tumble After Fed Restraint

BY AKANE OTANI – WSJ 03.21.2019



U.S. government bonds rallied Wednesday, sending the 10year Treasury yield tumbling to its lowest level in more than a year, after the Federal Reserve signaled it was unlikely to raise interest rates at all in 2019.

The yield on the benchmark 10-year note—used as a reference for everything from auto loans to mortgages—settled at 2.537%, compared with 2.614% Tuesday. That marked its lowest close since Jan. 11, 2018.

Yields, which fall as bond prices rise, have generally drifted lower this year as investors have grown increasingly convinced that the Fed would hold rates steady while monitoring a slowdown in global growth. Wednesday's move highlighted the extent to which investors have come to believe that U.S. growth and inflation are likely to stay soft for the foreseeable future.

Treasury yields typically rise when investors are confident about the economic outlook and retreat when growth prospects look more murky.

"Finally, the [Fed's rate projections] are coming down to the reality of what's happening," said Joe Ramos, head of U.S. fixed income at Lazard Asset Management. A slow economic recovery warrants cautious action by the Fed, he added.

The yield on the two-year Treasury note, which tends to move in line with investors' short-term rate expectations, settled at 2.402% Wednesday, compared with 2.471% Tuesday. That marked its biggest one-day slide since the start of the year, according to Dow Jones Market Data.

Traders also added to their bets that the central bank would lower rates by the end of the year.

Federal-funds futures showed the market pricing in a 39% chance of the Fed lowering rates at least once in 2019, up from 23% earlier in the day and just 18% one month ago, according to CME Group.

Meanwhile, futures implied a 0% chance of any rate increase in 2019.

To many investors, the Fed's decision to leave rates unchanged seemed justified, given that data have suggested growth around the world is slowing and that inflationary pressures remain in check.

While the U.S. economy has remained resilient, the outlook has dimmed significantly elsewhere around the world, pushing central banks from the Fed to the European Central Bank to signal a more cautious approach to monetary policy.

That has in turn supported both stocks and bonds, keeping yields off the multiyear highs they hit in November.

Still, some analysts caution that the Fed isn't necessarily done with raising rates for the duration of the economic cycle.

Corporate earnings, while expected to drop off in the first quarter, are still projected to grow overall this year. The labor market is on a record streak of job creation, and measures of consumer confidence have rebounded since losing ground during the government shutdown.

"While the Fed continues with the wait-and-see policy stance, we think it would require a material deterioration in growth or some exogenous shock to the markets for the Fed to be completely done raising rates in the current cycle," said Charlie Ripley, senior market strategist at Allianz Investment Management, in an email.

He added that he expected inflation to firm somewhat over the rest of the year.

Inflation poses a threat to the value of government bonds because it erodes the purchasing power of their fixed payments.

Others believe that the strength of the U.S. economy compared with its counterparts around the world could keep bond yields from falling much further.

"I don't believe this move is sustainable," Lazard's Mr. Ramos said. "It doesn't look like there's anything visible that will kill this low, sustainable growth we're seeing."

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U.S. Data Spur Rate-Cut Expectations

BY PAUL KIERNAN – WSJ 03.23.2019

Fresh data suggesting the global slowdown may be intensifying caused a widely watched bond-market indicator to flash its first recession warning since 2007 on Friday, raising expectations the Federal Reserve may cut interest rates by year's end to counter the economic headwinds.

The developments represent a stark turnaround from December, when Fed officials raised rates amid strong growth, tight labor markets and steady inflation. Since then, the picture has been muddied by choppy U.S. economic data, a record-length government shutdown, global trade tensions and the U.K.'s unresolved Brexit plan.

The latest signs of trouble came Friday when a report showed factory output in the eurozone fell in March at the fastest pace in six years, while a measure of U.S. manufacturing activity slid to its lowest level in almost two years. Those data followed a Thursday report showing U.S. services-sector revenues slowed more than previously thought in the fourth quarter, prompting several economists to lower their growth estimates.

The drumbeat of unsettling news Friday drove the yield on 10-year Treasury notes below that of three-month bills for the first time since 2007.

That situation, known as an "inverted" yield curve, has preceded every U.S. recession since 1975 and is viewed by many investors as a reliable predictor of downturns.

Traders in futures markets by the end of the day Friday had put a 58% chance of at least one Fed rate cut by the end of this year, up from 11% a month ago, according to CME Group.

"It's very clear that the economy at this point is losing momentum," said Lindsey Piegza, chief economist at Stifel. "I think the risk of turning negative is rapidly rising."

Many economists still think the economy is on solid footing, as does the Fed. On Wednesday, policy makers at the central bank projected U.S. gross domestic product would expand 2.1% this year and 1.9% in 2020, down from 3.1% last year but slightly faster than its long-term potential.

Chairman Jerome Powell said at a press conference Wednesday that the Fed has "a positive outlook for this year, a favorable outlook for this year," underpinned by rising wages, low unemployment and high household confidence.

But Mr. Powell also pointed to a number of risks, such as slowing growth in Europe and China and uncertainty surrounding U.S. trade policy. While fiscal-stimulus measures shielded the U.S. economy last year from such headwinds, the effects of 2017 tax cuts and 2018 spending increases are fading.

Further clouding the outlook, the U.S. government shutdown in December and January delayed the release of most official data, making it hard to gauge how much steam the economy has lost.

“The limited data that we have do show a slowdown,” Mr. Powell said Wednesday.

But he stressed it wasn’t clear which direction the Fed’s next interest-rate move should be. “We’re going to watch carefully and patiently as we allow events to evolve, and when they do clarify, we will act appropriately.”

An additional risk is that the Fed’s four interest-rate increases in 2018—the last of which occurred in December— may not yet have been fully felt. It can take many months for such policy changes to work their way through financial markets and the broader economy.

Given the latest data and signals from the bond market, some said the Fed should look to reduce interest rates to keep the U.S. from following its trading partners into slowdown.

Purchasing managers see slowing U.S. momentum among manufacturers as activity contracts overseas, raising pressure on the Federal Reserve to cut interest rates this year.

Sources: IHS Markit (PMI); CME Group (rate cut)

"To prevent recession next year, the Fed should cut rates this year by enough to keep the yield curve" from inverting, Marc Sumerlin of Evenflow Macro, a policy analysis firm, wrote to clients Friday. "Right now, one rate cut is justified, but a growing global downturn would justify more."

After a blockbuster year for U.S. companies, analysts are expecting corporate earnings to moderate in 2019. FedEx Corp., whose shipping business is often seen as a bellwether for the broader economy, cut its outlook this week for the second consecutive quarter, citing weaker macroeconomic conditions and global trade trends.

A yield-curve inversion is considered a warning sign because it implies bond investors think a weakening economy will require interest rates to be lower in the future than where the Fed currently has set them. While the yield curve has inverted before every recession in recent decades, it has also inverted without a recession following until several years later, and economists think some changes—in particular central bank bond-buying— may have muted its signal.

St. Louis Fed President James Bullard said in an interview Friday that the inversion was "mildly concerning," adding, "I'm hopeful this is just temporary." A sustained inversion, he said, would worry him considerably.

U.S. Economy Slowed Heading Into 2019

BY HARRIET TORRY – WSJ 03.29.2019

The U.S. economy finished the year on a softer note than previously estimated, and new data showed corporate-profit growth stalled, pointing to weak momentum at the start of 2019.

Businesses faced slower consumer spending and rising labor costs, which could signal more moderate growth this year despite a strong labor market.

Gross domestic product, a broad measure of goods and services produced across the economy, **rose at a 2.2% annual rate in the fourth quarter**, adjusted for seasonality and inflation, down from an earlier estimate of 2.6%.

A measure of U.S. company earnings, corporate profits after tax with inventory valuation and capital-consumption adjustments, posted no growth in the fourth quarter compared with the prior three months, the Commerce Department reported Thursday.

That marked a slowdown from a 3.5% quarter-over- quarter increase in the third quarter, 2.1% in the second, and 8.2% in the first. Measured from a year earlier, after- tax profits rose 14.3%, which was the slowest year-over year increase of any quarter in 2018 but nonetheless robust by historical standards.

Earnings had a strong run earlier in 2018 due at least in part to a cut in the federal corporate-tax rate to 21% from 35% starting in January 2018. That impact eased toward the end of the year, when concerns about trade negotiations with China, a slowing global economy and the start of a partial government shutdown resulted in steep stock selloffs.

Per-share profits rose 16.9% year-over-year in the fourth quarter for the biggest U.S. publicly traded companies, according to financial-data firm Refinitiv. That was the slowest growth rate of the year, but the fifth straight quarter of double-digit earnings growth for companies in the S& P 500.

“Companies did not produce the cash flow as much as they did in [the third quarter],” said Howard Silverblatt, senior index analyst at S& P Dow Jones Indices, citing higher costs for companies.

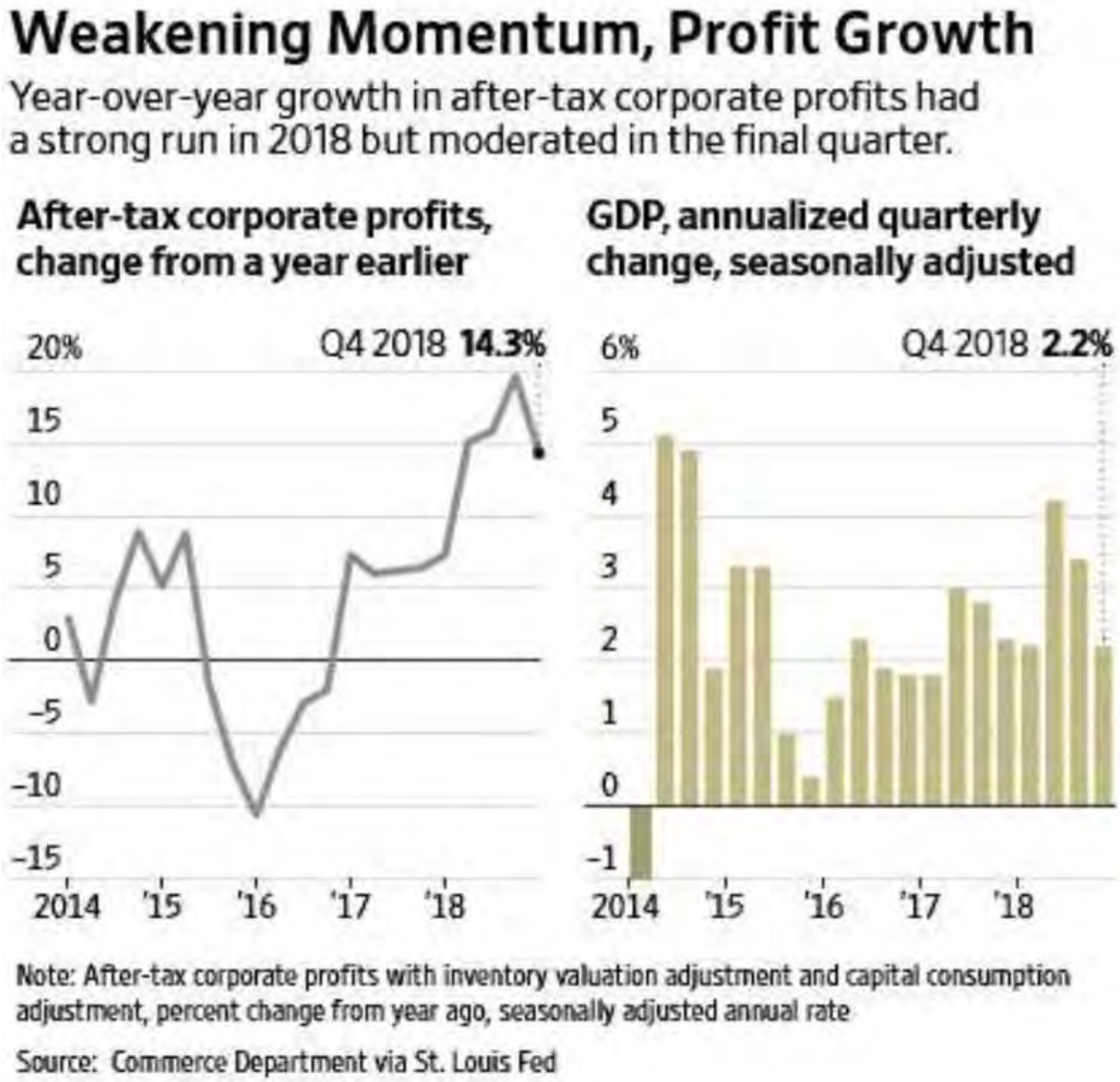
In the broader economy, spending by consumers, state and local governments and businesses was revised lower in the fourth quarter, while foreign trade exerted a smaller drag on growth compared with last month’s estimate.

In the recreational-vehicle industry, both manufacturer Winnebago Industries Inc. and dealership company Lazydays Holdings Inc. reported lower revenues in their most recent quarters. Winnebago Chief Executive Michael Happe said this week that the sector has come under pressure from higher product prices due to increased tariff and material costs, rising short-term interest rates in the second half of 2018 and volatility.

Rick Collins, president of Elkhart, Ind.-based Cleer Vision Windows Inc., which makes windows for recreational vehicles, said that demand weakened in the fourth quarter in its recreational-vehicle segment “and we’re still seeing some softness carrying through." As a whole, he said, 2018 was extremely strong for the first three quarters but "the fourth quarter tempered the year as a whole."

In the GDP report, fixed nonresidential investment, a measure of capital expenditures, was revised lower for the fourth quarter from the Commerce Department's initial estimate, due to a downward revision to spending on intellectual- property products like software.

Business investment still helped to drive overall GDP growth in late 2018, contributing 0.73 percentage point to the fourth quarter's 2.2% growth rate. In another positive sign for the U.S. economy, growth in exports was revised slightly higher from last month's estimate, to a 1.8% annual pace. Foreign trade exerted a mild 0.08 point drag on growth, smaller than initially thought, due to a downward revision to the rate of fourth-quarter imports.



By one measure of the nation's total output for 2018 compared with total output for 2017—which offers a look at broader trends—the economy grew 2.9% last year, unchanged from the prior reading. By a separate measure, output in the fourth quarter of 2018 versus the fourth quarter of 2017—which gives a look at more recent trends—the economy grew 3.0% last year. That was slightly below the initial estimate of 3.1% growth.

For 2019, many economists and businesses say they expect growth to moderate as the effects of the 2017 tax cuts wane, but they say the economy remains supported by low unemployment and rising incomes.

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U.S. Government Bonds Gain Amid Global Growth Concerns

BY DANIEL KRUGER – WSJ FEB. 19, 2019

U.S. government bond prices rose Tuesday as investors are becoming increasingly concerned about signs of a slowdown in global economic growth.

The **yield** on the benchmark 10-year Treasury note **fell** to 2.645%, its lowest level in more than a week, down from 2.666% Friday. It is **0.088 percentage point above its low for the year**.

Yields, which fall when prices climb, declined as investors focused on signs of slowing growth in Europe and Asia. Sentiment about current conditions in Germany fell in January, the ZEW Institute said Tuesday. Economists at **Deutsche Bank now forecast Germany's economic growth at just 0.5% this year**. If that prediction comes true, it would be the weakest expansion rate since 2013.

In China, where growth and consumer sentiment have eroded amid a bruising trade dispute with the U.S., auto sales declined again last month, with passenger-vehicle deals off 18% from a year earlier, China's Association of Automobile Manufacturers said Monday.

The rise in demand for safe assets such as U.S. Treasury debt shows "there's a full recognition of how bad the global economy is right now," said Andrew Brenner, head of global fixed income at NatAlliance Securities.

Investors have begun to **expect** that the **next move by the Federal Reserve on interest rates** from its current range of 2.25% to 2.5% will be to **lower them rather than increase them**, Mr. Brenner said.

Fed-funds futures, which investors use to bet on the path of central bank rate policy, shows the **probability of a rate increase by year-end is 2% versus 12% odds for a rate cut**, according to CME Group data late Tuesday. One month ago, the likelihood of a rate increase in 2019 was 31% compared with 3% for a reduction.

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U.S. Government Bonds Pull Back After Powell Comments

BY DANIEL KRUGER – WSJ 06.04.2019

Yields rise after Fed chairman said poli**cy makers 'will act as appropriate to sustain the expansion'.** Left: Federal Reserve Chairman Jerome Powell speaking at a conference on Tuesday.

U.S. government-bond prices fell Tuesday, as investors reassessed the balance of risks to the economy after Federal Reserve Chairman Jerome Powell said policy makers "will act as appropriate to sustain the expansion."

In recent trading, the **yield** on the **benchmark 10-year Treasury note** was **2.123%,** according to Tradeweb, **compared with 2.085% Monday**. It dropped from as high as 2.133% earlier in the session after the text of Mr. Powell's speech Tuesday at a Fed conference in Chicago was published.

Yields, which **rise as bond prices fall**, had increased overnight as some investors scaled back their holdings of U.S. Treasurys following several sessions of large price increases.

Investors have **piled into government bonds in recent months** amid rising **concerns** that **economic growth** in the **U.S. and world-wide is decelerating**. **Bonds** become **more attractive** in **periods** of **slower growth** because investors value their predictable interest and principal payments.

Treasury notes maturing in five years or less currently yield less than 2% – below the Fed's benchmark rate, which is currently set at a range of between 2.25% and 2.5%. That is a sign that **investors** are **pricing in** more than one **central-bank rate cut this year**, analysts said.

Fed-funds futures, which investors use to bet on the direction of central-bank policy, show **odds** of **97%** that **policy makers will cut rates at least once by** the **end** of the **year**, **according to CME** Group **data**.

Yields pared their gains Tuesday after Mr. Powell said the central bank is closely monitoring the recent escalation in trade tensions and that it would respond if needed to keep the economy growing steadily.

"We do not know how or when these **trade issues** will be resolved," Mr. Powell said in remarks prepared for delivery Tuesday morning. "We are closely monitoring the implications of these developments for the U.S. economic outlook and, as always, we will act as appropriate to sustain the expansion."

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U.S. Government Bonds Rally as Europe's Economy Weakens

BY SAM GOLDFARB – WSJ 02.07.2019

U.S. government bonds strengthened Thursday as investors favored safer assets amid growing concerns about Europe's economy.

The **yield** on the **benchmark 10-year U.S. Treasury** note settled at **2.652%, compared with 2.702%** Wednesday.

Yields, which fall when bond prices rise, dropped along with stocks after the European Union cut its forecast for eurozone economic growth to 1.3% in 2019 from its earlier estimate of 1.9%. The forecast came shortly after new data showed that German industrial production unexpectedly dropped in December—falling 0.4% from a month earlier, while economists had predicted a 0.8% gain.

Disappointing European economic data is "weighing on Treasury yields," particularly as Federal Reserve officials appear increasingly worried that slowing growth abroad could drag on the U.S., said Brian Daingerfield, macro strategist at NatWest Markets.

Helping pull U.S. Treasury yields lower, the yield on the benchmark 10-year German bond fell to 0.115% from 0.165% Wednesday, according to Tradeweb.

Persistently low bond yields in Europe and Japan have helped prevent Treasury yields from rising far off of historic lows in recent years, creating demand for Treasurys from yield-starved foreign investors.

After the Fed signaled last week that it was done for now with steady interest-rate increases, there has been some speculation among investors and analysts that long-term Treasury yields could rise as the central bank provides room for faster inflation.

At the same time, some analysts have noted that global growth concerns could outweigh that dynamic, keeping inflation expectations, and Treasury yields, in check.

The **10-year break-even rate**, a market-based measure of annual **inflation expectations** based on the **yield differential between the 10-year Treasury note and 10-year Treasury inflation-protected security**, stood at **around 1.840% Thursday** afternoon, according to Tradeweb—up slightly from a month ago but still comfortably below the Fed's 2% inflation target.

Rising consumer prices are a major threat to long-term government bonds because they erode the purchasing power of bonds' fixed payments.

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Volatility Unlikely To Derail Buybacks

BY JESSICA MENTON – WSJ 05.17.2019

U.S. companies have been buying back their own shares at a blistering pace for more than a year, and market turbulence isn't likely to stop them now.

The roughly 86% of firms in the **S&P 500** that have reported results for the first quarter repurchased **$188 billion worth of their own stock** during that time, according to S& P Dow Jones Indices, on pace to be the second-highest amount on record based on data going back to 1998.

While data isn't yet available for the second quarter, companies ramped up buying during the two previous market pullbacks.

An escalation in trade tensions between the U.S. and China has recently revived global-growth worries, and the S& P 500 is off to its worst start to May since 2012.

Source: Ned Davis Research analysis of S&P Global Market Intelligence data

Stocks have rebounded this week following Monday's selloff. The Dow Jones Industrial

Average rallied more than 200 points Thursday—its largest one-day point gain since April 12.

But signaling anxiety, investors yanked $14 billion from U.S. mutual and exchange-traded funds during the week that ended May 8, the largest weekly outflow since Jan. 30, according to a Bank of America Merrill Lynch analysis of data from fund tracker EPFR Global.

Buybacks are helping companies **boost** their **earnings per share significantly**. In the first quarter, 25% of S& P 500 companies added a tailwind of at least 4% to their earnings per share because of repurchases, according to S& P Dow Jones Indices. That is up from 14% of companies that increased their earnings per share by at least 4% a year ago.

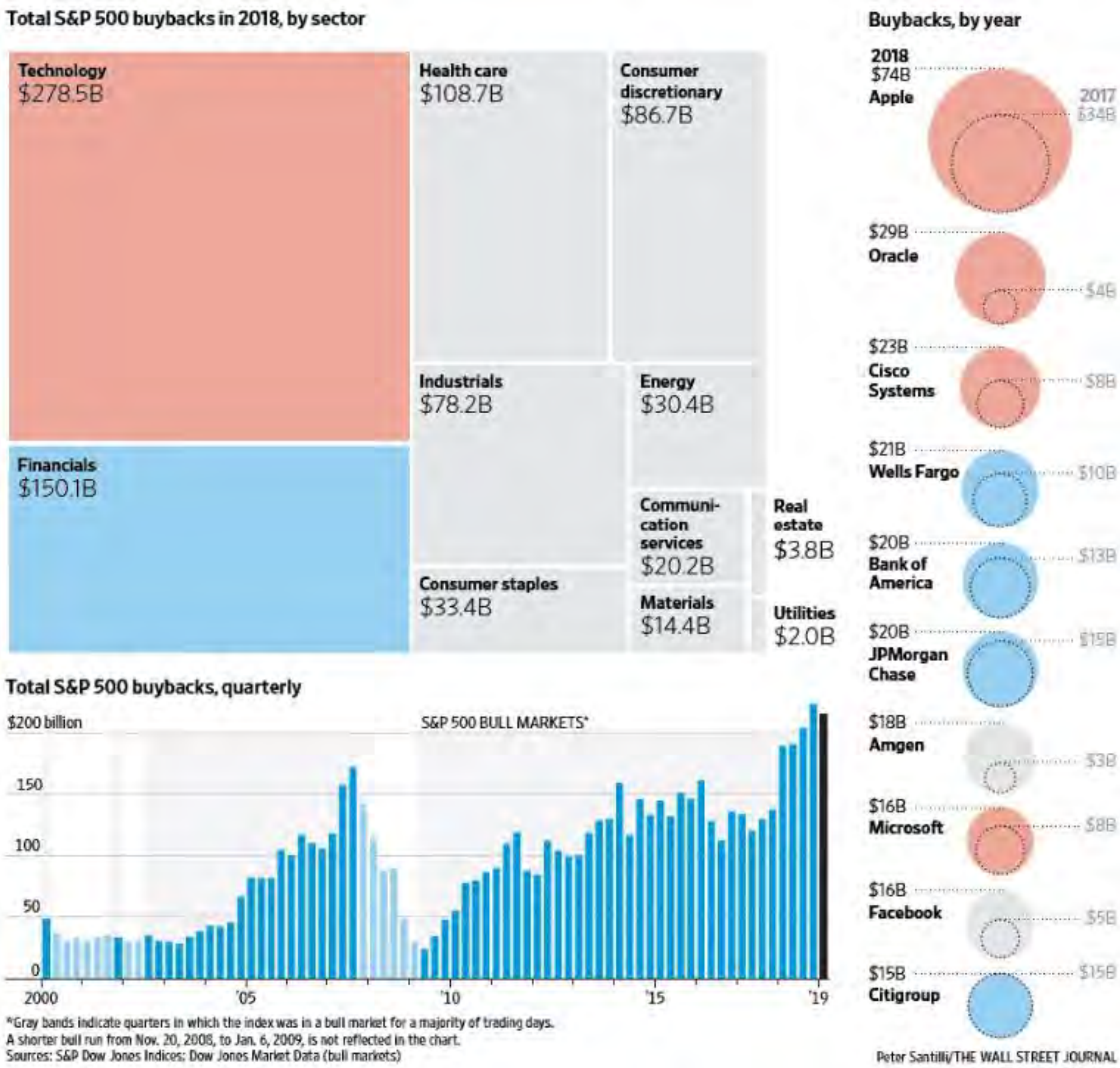
When markets decline sharply, it presents a dilemma: On one hand, if things get bad, companies may want more cash on hand.

On the other, a downtrend in markets generally means a company's stock gets cheaper, so its dollar goes farther in buying back shares.

Every quarter in 2018 marked a new high for buybacks, as companies were bolstered with money they saved because of corporate tax cuts.

The most buybacks in one quarter, a staggering $223 billion, came in the last three months of last year when broader markets spiraled. Buybacks also hit a record in the first quarter of 2018 when markets sold off.

Companies repurchasing blockbuster amounts of stock during two recent big pullbacks could be a sign the firms didn't see those market declines as worrying, even as concerns about global growth mounted.



Ed Clissold, chief U.S. strategist at Ned Davis Research Group, said firms would be suspending their buyback programs if the current pickup in volatility were part of a broader economic concern. "Companies will do a lot to avoid cutting or suspending a dividend, so if prospects deteriorate, buybacks are the first thing they take away."

Companies spend billions repurchasing shares because less stock outstanding helps make their profits appear stronger by boosting per-share earnings—a gauge investors typically use to justify a company's stock price.

Some investors counter that buybacks don't actually add to a company's net profit, and the **capital could be used on other things**.

Apple Inc., Oracle Corp. and Cisco Systems Inc. were the biggest buyers of their own stock in 2018, repurchasing a total of $126 billion of shares, according to S& P Dow Jones Indices.

In April, the iPhone maker said it would add $75 billion to its buyback program.

"We're in the fortunate position of generating more cash than we need to run our business and invest confidently in our future," Apple Chief Executive Tim Cook said during the company's earnings call last month.

Some analysts say companies' willingness to buy back shares has been among the factors driving the latest stages of the 10-year bull market. And companies repurchasing shares during a downturn could help buoy markets.

"It takes capital from companies that are buying back their own equity and then moves that capital back to an investor so it can be redeployed into a company that's growing," said Scott Colyer, chief executive and chief investment officer at Advisors Asset Management.

"Companies tend to amp up their buybacks when their stock price drops, which provides some support in the marketplace."

Some analysts are concerned that technology companies accounted for too big a slice of the buyback pie.

Last year, the top 20 companies repurchasing stock in the S& P 500—many of which were tech firms—accounted for 42% of all buybacks, compared with a 32% share in 2017, data from S& P Dow Jones Indices showed.

"The presumption is that 2020 will be a good year for buybacks, but that's based on expectations that the economy remains strong and we don't have a trade war," said Howard Silverblatt, senior index analyst at S& P Dow Jones Indices. "Even though next year is supposed to be a great year for earnings and cash flow, we're not there yet."

Washington presents one potential hurdle for companies repurchasing stock.

Democratic presidential candidates have signaled that they want to restrict how much stock U.S. companies can buy back, arguing that buybacks enrich shareholders at the expense of workers.

Democrats aren't alone. Republican Senator Marco Rubio of Florida has also criticized stock repurchases. In February, Mr. Rubio unveiled a proposal to change how investors are taxed when companies buy back shares.

Weaker Inflation Views Stir Fed Fears

BY MICHAEL S. DERBY – WSJ 05.14.2019

Inflation expectations retreated in April, in a development that could worry U.S. central bank officials.

The Federal Reserve Bank of New York reported Monday in its April Survey of Consumer Expectations that the public's expectation of future price rises hit their lowest level since late 2017. **One year from now, the public expects to see inflation rise by 2.6% and three years from now by 2.7%. Both of those readings are down from 2.8% and 2.9% respectively in March**.

The New York Fed report also found expectations of future income growth a year from now moderated to a 2.4% increase, from 2.6%.

The decline in inflation expectations comes at a particularly unwelcome time for the Fed. The **central bank** has struggled for years to get **inflation** sustainably to its **2% target** since formally adopting the goal in 2012. Recent inflation readings also have been growing weaker, despite solid growth and a historically strong labor market.

The Fed's preferred inflation gauge, the personal-consumption expenditures **price index**, rose by a mere **1.5% in March relative to the 2% goal**. Officials have largely dismissed the recent weakness, tying it to temporary factors.

But the **newfound softening of expectations** could question that. Fed officials generally agree that what the public thinks future inflation will do is a powerful driver of actual inflation.

It is "important" for inflation to stand sustainably around 2%, because if it doesn't, "inflation expectations over time could be pulled down and that could put downward pressure on inflation and make it harder for us to react to downturns," Fed Chairman Jerome Powell said on May 1.

The weakness of inflation has reopened a debate as to whether the Fed may need to consider lowering its short-term rate target at some point. Markets have been predicting just such a move for a while, and some economists are coming around to that view, though no Fed officials have predicted such an action yet.

*"**Fed officials believe public expectations of inflation are a driver of actual inflation**".*

Yield Dive Catches Forecasters Off-Guard

BY AVANTIKA CHILKOTI AND DANIEL KRUGER – WSJ 06.10.2019

Almost nobody saw the nose-dive in bond yields coming, but a few players were positioned well enough to profit. Some observers think there is more room for yields to fall further.

The drop in 10-year Treasury yields in recent months has been rapid and in many quarters completely unexpected.

The **yield** on the **10-year Treasury settled on Friday at 2.085%, down from 3.23% in early November**. That is the biggest decline over a similar stretch since early 2012.

Yields on 10-year debt in Germany, Japan, Denmark and the Netherlands have fallen into negative territory, and as much as 20% of the $55 trillion in global debt has yields less than zero, according to Deutsche Bank Securities. Investors who purchase such debt are effectively paying borrowers to hold their money.

Investors holding bonds before yields plunged have made money because bond prices rise when yields fall.

Mark Lindbloom, a portfolio manager at Western Asset Management, is one of the few who got it right. Last year, the firm loaded up on long-dated Treasury debt relative to the benchmarks it uses to track performance.

The firm held that position even as the Federal Reserve— and most economists— were forecasting rate increases this year and for U.S. government-bond yields to be well north of 3%. His unconstrained fund has outpaced its benchmark index, according to Morningstar.

"We find ourselves worrying about the same issues yet again," Mr. Lindbloom said, referring to low inflation, slow long-term growth and the reliance on central banks to boost economic expansion.

Few analysts anticipated the rush into government debt. In October, when yields on the 10-year Treasury were near their peak of around 3.2%, none of the more than 50 respondents in The Wall Street Journal's monthly survey of economists predicted yields would fall below 2.75% by June 2019. The average forecast was 3.39%.

Steven Major, global head of fixed-income research at HSBC, was on the right side of the yield-prediction game, even if he didn't catch it completely.

He has long predicted that the Fed would maintain a "low-for-longer" stance given that higher levels of debt have left the U.S. economy more sensitive to changes in monetary policy.

In the middle of December, Mr. Major predicted the yield on 10-year Treasurys would stand at 2.80% by June.

"It is still too early to conclude for sure that the Fed has over-tightened but the facts are pointing in that direction," Mr. Major wrote in a March note, before bond yields took their latest leg down. “The global economy has become far more leveraged and therefore sensitive to rates,” he wrote.

The bond rally has led several banks to revise forecasts. Early in June, JPMorgan Chase revised its year-end prediction for the 10-year Treasury yield to 1.75% from 2.9% in March. Bank of America, UBS, Goldman Sachs and HSBC also have cut forecasts.

Pacific Investment Management Co. added more longer-term U.S. Treasurys after the Fed indicated earlier this year that it would stop raising rates, said Scott Mather, the firm’s chief investment officer for U.S. core strategies.

The move paid off, with a number of Pimco funds, including its flagship Pimco Total Return Fund, showing strong gains in recent months. Since September, the firm has two of the top three taxable bond funds, according to Morningstar.

Pimco believes it is possible that the U.S. economy will slip into a recession over the next few years, though the fears aren’t necessarily what is pushing Treasury yields lower now.

The Fed could move to cut rates, given the current uncertainty, Mr. Mather said. “This is not the market pricing in a high probability of recession,” Mr. Mather said. “If it was, credit spreads would be a heck of a lot wider,” he said, referring to the higher yields riskier corporate borrowers pay for debt compared with government bonds.

Mr. Mather said he believes yields will fall further over the next several years but doesn’t expect big moves in coming months, he said.

The stampede into bonds in Europe has been particularly dramatic, with yields hitting all-time lows.

The yield on benchmark 10year German government bonds, also known as bunds, fell to a record minus-0.259% on Friday.

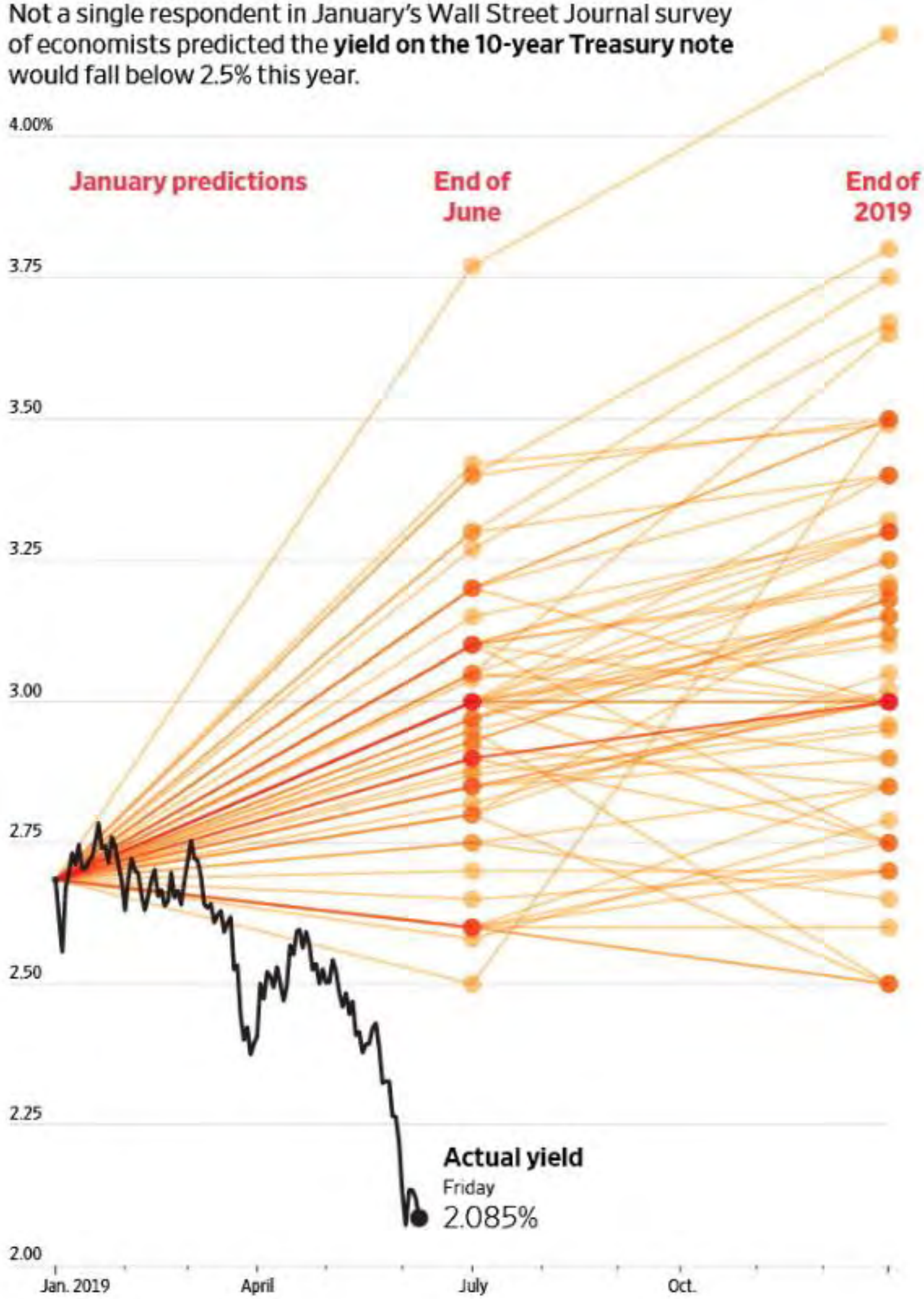
That has investors moving relatively higher yields in peripheral European countries such as Portugal and Spain, where the rates are still positive.

“Everyone is trapped in the same position, everyone is trying to capture some level of income,” said Dickie Hodges, head of unconstrained fixed income at Nomura.

Mr. Hodges began buying up Portuguese government bonds early this year until about 15% of his $375 million fund was in 30-year Portuguese government debt. Rates on those bonds have fallen to 1.6425% from 2.9% at the start of the year Nick Maroutsos, co-head of global bonds at Janus Henderson Investors, is among the winners from the recent drop in government bond yields. For the past three or four months, Mr. Maroutsos has been indirectly increasing his exposure to shorter-dated U.S. government bonds through interest- rate swaps and futures, betting that markets were wrong late last year in believing the Fed was preparing to raise rates.

His Janus Henderson Absolute Return Income Fund produced a 2.9% return in the year through March 31, compared with 2.1% for a benchmark index. “Central banks, and the Fed is no different, they overpromise and under deliver,” Mr. Maroutsos said, adding that he would use any selloff to increase his exposure to the bonds.

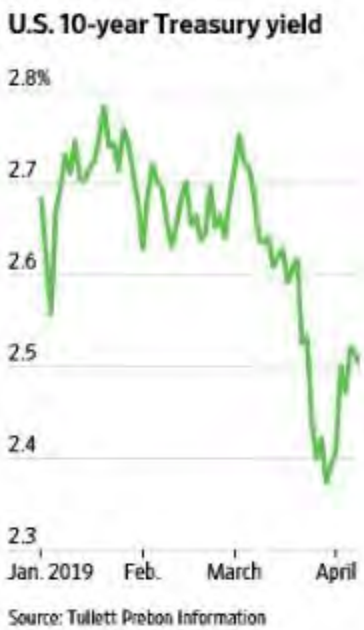
Not a single respondent in January's Wall Street Journal survey of economists predicted the **yield on the 10-year Treasury note** would fall below 2.5% this year.



Note: Bond yields fall as prices rise.
Sources: WSJ Survey of Economists (predictions); Tullett Prebon (actual)

Yield Forecasts Cut on Treasury Bonds

BY DANIEL KRUGER – WSJ 04.08.2019



Wall Street firms are lowering their forecasts for U.S. government-bond yields, the latest sign of investors' mounting worries about slowing economic growth.

Firms including HSBC Holdings PLC, JPMorgan Chase & Co., Goldman Sachs Group Inc., and UBS Group AG predict Treasury prices will hold firmer than many initially expected. HSBC predicts the yield on the benchmark 10year Treasury note will end the year at 2.1%, down from an earlier forecast of 2.5%.

Some other firms' forecasts are lower than before, while still predicting the 10-year yield will rise by year-end. UBS last week lowered its forecast to 2.8% from 3.2%. Goldman Sachs recently predicted the yield will end the year at 2.8%, while JPMorgan expects it to finish 2019 at 2.75%. Those forecasts are down from 3% and 2.9%, respectively.

Tepid reports on the economy "have left investors relatively skeptical about the notion that growth will rebound later this year," JPMorgan analysts wrote in a note published March 29. While investor concerns about a slowdown are increasing, the analysts said they expect the economy will return to a faster pace of growth as the year progresses. The 10-year note yield fell Friday, settling at 2.503% after the Labor Department said that the pace of wage gains slowed in March, signaling that a tight labor market isn't leading to faster inflation.

The yield on the benchmark 10-year Treasury note late last month hit 2.356%, its lowest intraday mark since December 2017, after falling from multi-year highs reached in November. During the rally in longer-term U.S. government debt, longer-term yields fell below those of shorter-term debt, a shift economists and investors consider a warning of recession.

Few investors and analysts anticipate an imminent recession, but many expect the expansion to slow. One major reason behind bonds' recent rally is the Fed early this year began signaling a shift away from its attempts to raise interest rates as officials became increasingly concerned that higher borrowing costs would lead to slower growth and tighter financial conditions.

Those lowering their target for the 10-year yield also cited **slowdowns in Europe and China**, which could pull down yields in the U.S. The yield on Germany's 10-year government debt recently fell into negative territory for the first time since 2016. **Slower growth can lead central banks to hold down interest rates, which can lead to lower bond yields**.

Yield Gap Isn't a Recession Guarantee

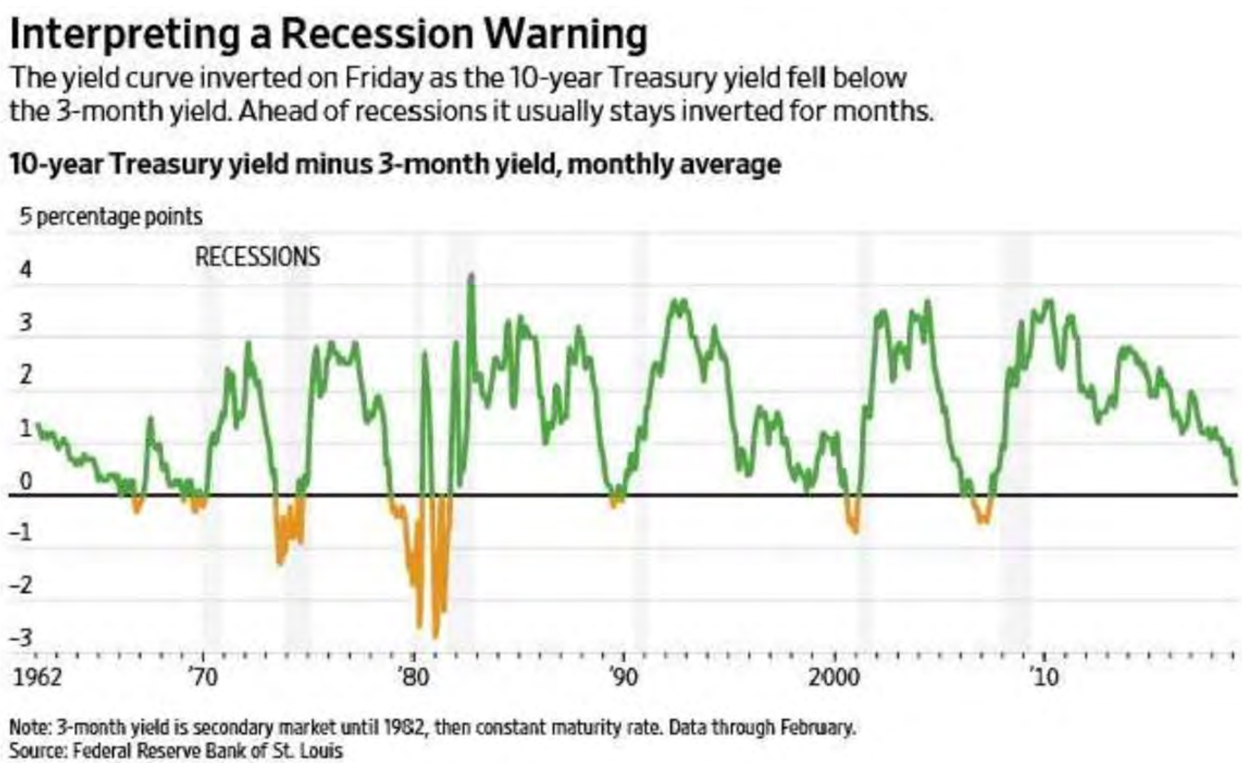
BY JAMES MACKINTOSH – WSJ 03.25.2019

The **market's most reliable recession indicator is finally flashing red**. With the Treasury yield curve inverting on Friday— the 10-year yield fell sharply to be lower than the three-month for the first time since 2007—is it finally time to prepare for an economic downturn?

The answer is nuanced. It is true that **the yield curve is the best forecasting tool for recessions**, having **inverted before each of the last seven recessions** as measured by the National Bureau of Economic Research.

But the idea that the gap between short- and long-dated Treasury yields is a rock-solid predictor you can use for your portfolio positioning is mistaken in several ways.

Start with **what the inversion tells us. It means investors think that the Federal Reserve is going to cut rates, so the current short-dated yield isn't going to be sustained over the full 10 years**. Since the 10-year discounts the average short rate over the period, that should mean the 10-year falls.



That isn't quite the same thing as predicting recession, since the Fed can cut rates without recession. Indeed, **the two times that yield curves inverted on most measures without recession were in 1998 and 1965-66, both times when the Fed slashed rates and the economy continued to grow**.

The futures market on Friday intensified its bets on rate cuts after more weak economic data. Federal funds futures put a 60% chance on rate cuts by December, with a 20% chance of two or more cuts.

In precrisis times such small rate cuts would merely flatten the yield curve a bit. But the bond market has changed with quantitative easing, making inversion much easier. Before QE **there was usually some extra yield, known as the term premium, built into 10-year Treasurys as compensation for locking your money up for so long**. That meant that to get to an inversion, investors had to expect really significant cuts, which rarely happen without recession.

But **in recent years the term premium has been nonexistent or negative**, so the gap between the 10-year and three-month yield was lower to start with. Even anticipation of quite small cuts can make the curve invert.

There are other reasons to be cautious, too.

Even when the yield curve provides a correct warning of recession, it doesn't say how far away it is. Sometimes it follows the inversion within months. Last time it took almost two years.

The yield curve might be less reliable than its recent U.S. history suggests. **It has a terrible record internationally**, for instance. It flat-out hasn't worked in Japan, also has a poor record in the U.K. and in Germany provided no advance warning of the 2008 recession, the worst since reunification. At the moment the curve isn't inverted in any of them thanks to super low or negative interest rates, even though all are struggling with greater economic troubles than the U.S.

Which part of the curve you look at matters, too, and how long an inversion lasts matters. Friday brought the inversion of the three-month and 10-year for the first time since 2007.

Prof. Campbell Harvey of Duke University analyzed inversions in the 1980s and concluded that the 10-year/ three-month was the best part of the curve to use. He also concluded **it needs to be inverted on average over a quarter to provide a solid signal, not just for a few days**—let alone just part of a day, like on Friday. Otherwise it is **merely predicting a slowdown**, something **everyone already believes is on the way** after last year's tax-cut sugar rush. Since the time of the study, **the only time the curve inverted without recession was in 1998, but then only for a few days, not the full quarter**.

Even this isn't enough. There are **different ways to measure the three-month yield**, and the one the market uses isn't the best, according to Prof. Harvey. He prefers the Fed's constant maturity yields, which are a few hundredths of a percentage point higher.

Recession might be on the way, but so far the yield curve is just telling us that the economy is weakening. And you already knew that.

Yields Fall to Lowest in Over Two Weeks

BY DANIEL KRUGER – WSJ 02.27.2019

U.S. government-bond prices rose as Federal Reserve Chairman Jerome Powell told lawmakers that the **central bank** is assessing the path of economic growth and is **in "no rush" to raise interest rates**.

The yield on the benchmark Treasury 10-year note settled at 2.636%, the lowest in more than two weeks. It closed at 2.673% Monday.

Yields, which drop when bond prices rise, declined after Mr. Powell said Fed officials are assessing the impact of **slower global growth** and **financial-market turbulence** on the U.S. economy.

Weaker global economic momentum and **financial conditions** that are **less supportive of growth**, together with "muted" inflation pressures, "warranted taking a patient approach with regard to future policy changes," Mr.

Powell said in his testimony before the Senate Banking Committee on Tuesday.

Fed officials at their meeting in December had **forecast two interest-rate increases this year** after raising rates four times last year, most recently in December. As **markets** became **increasingly volatile at year-end**, policy makers reconsidered their approach and have since signaled that **further increases are on hold**.

Fed officials' adoption of a **more patient approach** to achieving their goal of **realigning monetary policy more closely with precrisis norms** has coincided with signs that **growth is decelerating in the U.S., Europe and China**.

Yields' Tumble Could Have Further to Go

BY JUSTIN LAHART – WSJ 03.25.2019

When Treasury yields fall sharply, it is usually because something bad is happening, but the latest drop seems to be mostly about the Federal Reserve. That doesn't mean it can't go on for a while.

The yield on the 10-year Treasury has fallen to 2.46% from 2.61% before **the Fed** on Wednesday **delivered a remarkably dovish policy statement** and **dramatically ratcheted down its rate expectations**. Back in December the median projection among the central banks' policy makers was for two rate increases this year. Now they **expect to stand pat and raise rates just once in 2020**.

At the end of 2018, economists surveyed by The **Wall Street Journal forecast the 10-year yield would finish this year at 3.38%**.

What is remarkable is that the current 10-year yield is barely higher than the midpoint of 2.375% on the Fed's current target range for overnight rates. The yield on the two-year note, at 2.33%, is lower than that midpoint.

That implies an **expectation that the Fed's next move will be lower**—something it typically does to forestall recession. Indeed, **interest-rate futures now put the probability of a cut this year at better than 50-50**.

Although first-quarter growth is looking weak, beset by temporary factors such as the government shutdown, we already knew that. The same is true of weakness overseas and of the European Central Bank's new stimulus plans announced two weeks ago.

Moreover, points out RBC Capital Markets rates strategist Michael Cloherty, credit-market indicators of default risk suggest the odds of the economy slumping are low. True, the economy seems unlikely to grow as quickly as it did in 2018 with stimulus fading, but it still seems robust enough to drive unemployment even lower.

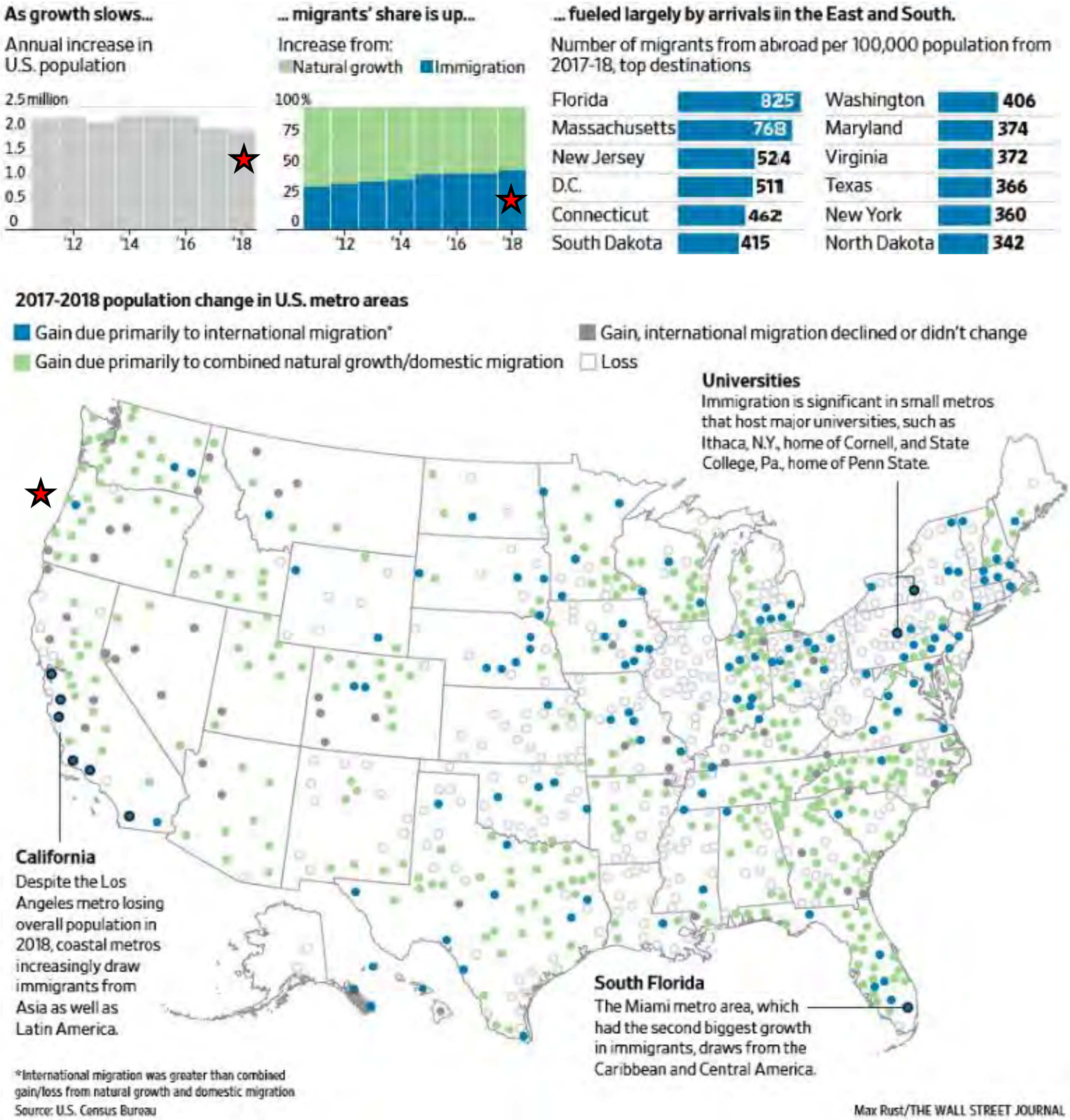
Yet the yield collapse feeds into a narrative of economic weakness that financial markets may find hard to shake. It appears to have infected the stock market and, when stocks fall, investors naturally flock to the safety of Treasurys. It doesn't help matters that it is near the end of the quarter—a time when companies issue profit warnings, using economic weakness as a fall guy.

Things could get worse before they get better.

Immigration's Impact on Nation Grows

by Janet Adamy and Paul Overberg – WSJ – Apr. 17, 2019
Louise Radnofsky contributed to this article.

The U.S. is relying more on newcomers, who now propel population gains in 10% of counties.



About one in 10 U.S. counties grew in the fiscal year that ended last June primarily because of immigration – a significant increase from 2011 – showing how new arrivals are shaping the nation **as** the **population ages and** the **birthrate slows**, new census figures show.

The **share** of **U.S. population growth** that comes **from immigration** has **risen steadily since** the **start** of the **decade**, **when** the **fallout** from the **financial crisis prompted many people** to **delay having children**.

That **fertility lull** has **lasted longer than expected**, and it **overlaps with** a large cohort of **baby boomers** facing **retirement and rising death rates**.

The **share of U.S. population growth** attributable to **immigrants** hit **48% for** the fiscal year ended June 30, **2018**, **up from 35%** in fiscal **2011**.

The result is a **country** that is becoming **increasingly dependent** on **immigrants** to **fill jobs** and **fund programs like Social Security and Medicare**, economists said.

“We have a situation where U.**S. fertility rates are really low** and we’re **not actively adding** to the **workforce through natural increase**,” said Aparna Mathur, a resident scholar of economic policy at the American Enterprise Institute, a conservative think tank in Washington. “We **cannot afford** to **talk about immigrants as bad for** the **U.S. economy**.”

Separate federal statistics released last year suggest that a **number of women who put off having babies after** the **2007-09 recession are forgoing them altogether**. The general **fertility rate** in **2017** for **women age 15 to 44** was **60.2 births per 1,000 women** – the **lowest since** the **government began tracking** it **more than** a **century ago**, **according to** the **National Center for Health Statistics**.

Kenneth M. Johnson, a senior demographer at the University of New Hampshire, estimated that lower teen fertility accounts for about one-third of the overall decline in births among U.S. women.

The increase in women attending college is another force behind the birth decline, researchers say, because women with more skills face a greater financial trade-off if they pause their careers for children.

Still, the continued decline has flummoxed demographers, who expected a greater recovery in birthrates as effects of the recession faded. For the last fiscal year, 298 of the nation’s 3,142 counties grew primarily because of immigration instead of a surplus of births over deaths and from people moving around the country, according to the new Census Bureau figures. That is up from 247 counties in 2011, the earliest data in the figures released Thursday.

These counties include parts of large metro areas, such as most of the San Francisco Bay and the counties that contain San Diego, Houston, Dallas, Miami and Boston, as well as some of their suburban counties.

Fourteen states and the District of Columbia drew on immigration for more than half of their growth last fiscal year, including Florida, Kansas, Michigan, Ohio, Pennsylvania and Virginia.

Since 2010, the biggest share of immigrants – 41% – has come from Asia, according to separate census figures. A fifth, or 21%, has come from Mexico and Central America, a flow of migrants that President Trump has sought to stem.

President Trump has made securing the southern U.S. border a top priority, saying earlier this month that the country couldn't take more immigrants because it's full.

Demographers said that maintaining a flow of **immigrants**, who are **typically younger**, is **key** to **preventing** the **U.S. from becoming an older society where spending on** the **elderly absorbs** an **outsize share** of the **federal budget**. The census numbers don't distinguish between legal and illegal immigrants.

The White House didn't respond to a request for comment Wednesday.

Advocates of immigration restrictions said that immigrants alone can't make up for an aging workforce or sufficiently fund entitlement shortfalls. "The bottom line is that it would take a ridiculous level of immigration to come close to maintaining even the current ratio of workers to non-workers," said Steven Camarota, demographer and director of research at the Center for Immigration Studies. "Immigration isn't going to fix Social Security.

Almost one million people came to the U.S. last year, according to the census estimates. **Though** that is **up 3% from 2017** and **5% from** the **average since** the **2010 census**, it is **in line with longer-term averages**.

Growth from immigration is spreading beyond traditional immigrant gateways. **More than half** of **U.S. metropolitan areas gained more residents from abroad than** they did **from** the **rest of** the **country last fiscal year**, the **new census figures show**.

The Washington Post

Consumers around the World are Spending Less on Almost Everything.

by Abha Bhattarai – The Washington Post – April 16, 2019
Reprinted in part in the Oregonian – April 21, 2019

Consumers around the world are likely to spend more cautiously in the coming months amid **political and economic uncertainty**, according to a new report that surveyed shoppers in 64 countries.

Shoppers said they **have cut back** on **clothing and entertainment** costs in the past year, and have **taken measures to save on gas and electricity**, according to the Conference Board Global Consumer Confidence Survey, conducted in collaboration with Nielsen. Consumers in Europe and Latin America are **buying cheaper alcohol and groceries**, while Asian shoppers are **scaling back** their annual **vacations**.

“There’s a **wait-and-see attitude**," said Denise Dahlhoff, senior researcher for consumer research at The Conference Board, which surveyed 32,000 online shoppers worldwide. “**Consumers** are taking note of what’s happening around them and are adjusting their attitudes and behaviors. They’re **playing it safe**.

Consumers in more than half of the 64 countries surveyed said they expect economic conditions to worsen in the coming year, the survey found. Uncertainty over international trade negotiations, as well as Brexit and whatever President Trump might do or say next have taken a toll on how much people plan to spend, particularly in North America and Europe, Dahlhoff said. Overall, the Global Consumer Confidence Index slipped one point to 106 in the first quarter of 2019.

“Despite the high levels of confidence globally, consumers in different markets have different views about where the economy is heading in 2019,” said Bart van Ark, global chief executive of The Conference Board. “The majority of global consumers do not expect conditions to become more favorable over the next twelve months."

But, Dahlhoff said, a pullback in consumer spending could be an opportunity for certain types of businesses to win over new shoppers. Retailers like TJ Maxx and Burlington Coat Factory flourished during the last economic downturn, and have continued to draw consumers who want to feel good about scoring bargains.

The $24 billion second-hand clothing market, meanwhile, is expected to double in the next five years, as younger shoppers look for ways to save money and reduce waste, according to retail analytics firm GlobalData.

“People are not averse to spending if they see value and benefits," she said. “The second-hand clothing market is growing tremendously. Private-label brands are gaining acceptance. There is room for companies to play around with new ideas.”

According to the survey, consumer confidence in the United States remained unchanged during the first quarter. In Europe, confidence levels declined after peaking in late 2017. Consumer confidence levels were the lowest in South Korea, Russia and Italy.

There were, however, some bright spots, particularly in emerging economies. Consumer confidence in the Asia-Pacific region remained at a historic high, driven by strength in India, Indonesia and Philippines. “Spending intentions have moderated in North America and Europe, but increased in Asia-Pacific,” the report said.

And even though consumers said they planned to spend less in the coming year, they remained largely optimistic about job prospects and personal finances in the coming year. Nearly 60 percent of those surveyed said they felt “excellent” or “good” about their employment situation, while 63 percent said they had a positive view of their personal finances.

“The picture is mixed,” Dahlhoff said. "**Consumers** may be feeling good about their personal financial situation, but they are **not quite sure what’s on** the **horizon**.”

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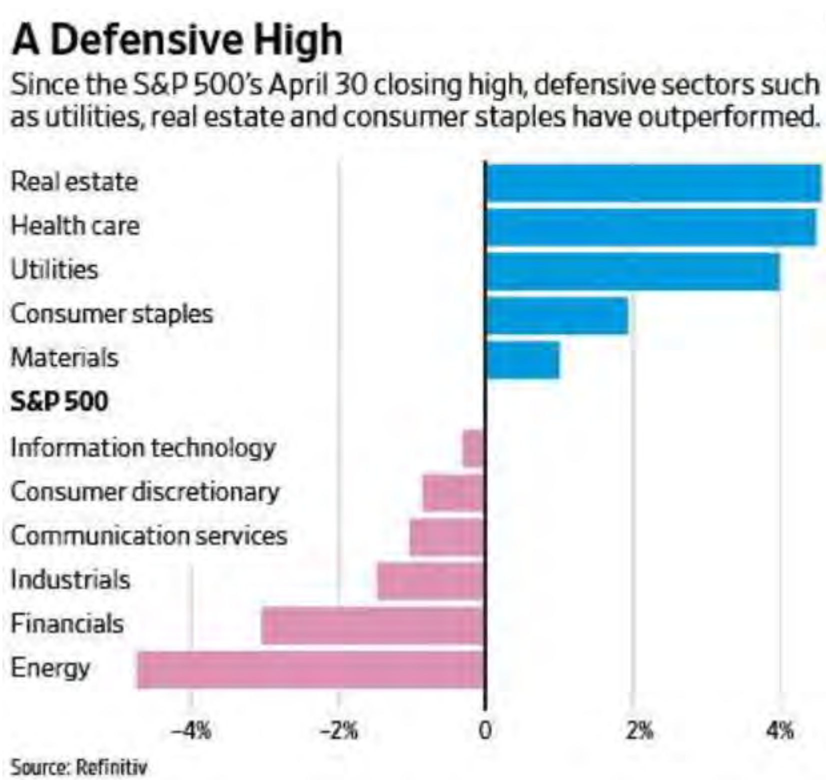
Stocks Keep Gaining Based On Caution, Not Exuberance

by James Mackintosh – Streetwise Column – WSJ – Jun. 25, 2019



With the S& P 500 making a new high again last week the obvious worry is that investors are getting overenthusiastic, as cheap money shields them from the real-world problems of a weaker economy, increasingly dangerous global politics and a poor profits outlook.

But glance at the stocks that are leading the market and there are **no obvious signs of exuberance**. **Instead**, **investors are cautious**, confident only that the Federal Reserve will provide enough help to protect them from recession.

The problem is so familiar it has its own acronym: **TINA**, or **There Is No Alternative to stocks**. With 10year Treasury yields again testing 2% and futures priced for at least two and probably more U.S. rate cuts this year, where else can you go but stocks?

The obvious answer for anyone deeply bearish is to buy bonds despite the low yield, because 2% is great if share prices crash. Cash is another alternative, adding the flexibility to buy back in if the stock market tumbles.

But it is **hard to be confident that recession is imminent**, and investors are dispirited rather than depressed. The **U.S. economy** might have **slowed**, **but** all the signs are that it is **still growing**. The oft-cited recession indicator of an inverted yield curve – that is, a 10year yield lower indicator of an **inverted yield curve** – that is, a 10year yield lower than the three-month yield – has had long and unpredictable lags when it has worked in the past, and there are reasons to think its predictive powers may be lower now.

"We don't see ourselves in a recessionary environment yet, so we've got to stay invested," says Fiona Frick, chief executive of Swiss fund manager Unigestion.

It is also very hard to be excited by the prospect of piling on risk. So the search is on for **nice safe stocks that won't suffer too much if everything goes pear-shaped**, **but** will **still do better than bonds if** the "meh" **economy keeps stumbling along**.

That has pushed **defensive strategies** to the fore. **Over the past 12 months** investors would have been better off in Procter & Gamble, Johnson & Johnson or Walmart than any of the FANGs of Facebook , Amazon, Netflix and Google, now Alphabet, although Microsoft has done well.

The same goes for sectors. From the last S& P 500 closing high at the end of April, four of the five sectors to beat the wider market were defensive: real estate, **utilities**, health care and consumer staples. The fifth, materials, is usually sensitive to economic cycles but was helped a lot by including a big gold miner, whose stock jumped along with the gold price. Bigger stocks are doing better than their smaller, riskier, brethren. **Stocks with stronger balance sheets and better earnings are ahead of their more leveraged, more speculative rivals**. And **stocks that swing around less are doing better, too**, rare in a rising market.

The natural pushback is to say that these measures are distorted, because so many of the big technology stocks are flush with cash. The five most valuable companies in the U.S. are Microsoft, Amazon, Apple, Alphabet and Facebook. Yet, only one of those has passed last year's high, and the latter three are still more than 10% below their highs. It is good news that investors aren't wildly optimistic, because a boom-time mindset tends to be a precursor of poor returns. But valuations are on the high side, and there is plenty of scope for genuinely bad news – conflict with Iran, further trade disappointment, a no-deal Brexit, tighter tech regulation – to hit stocks, even though these are risks investors are well aware of.

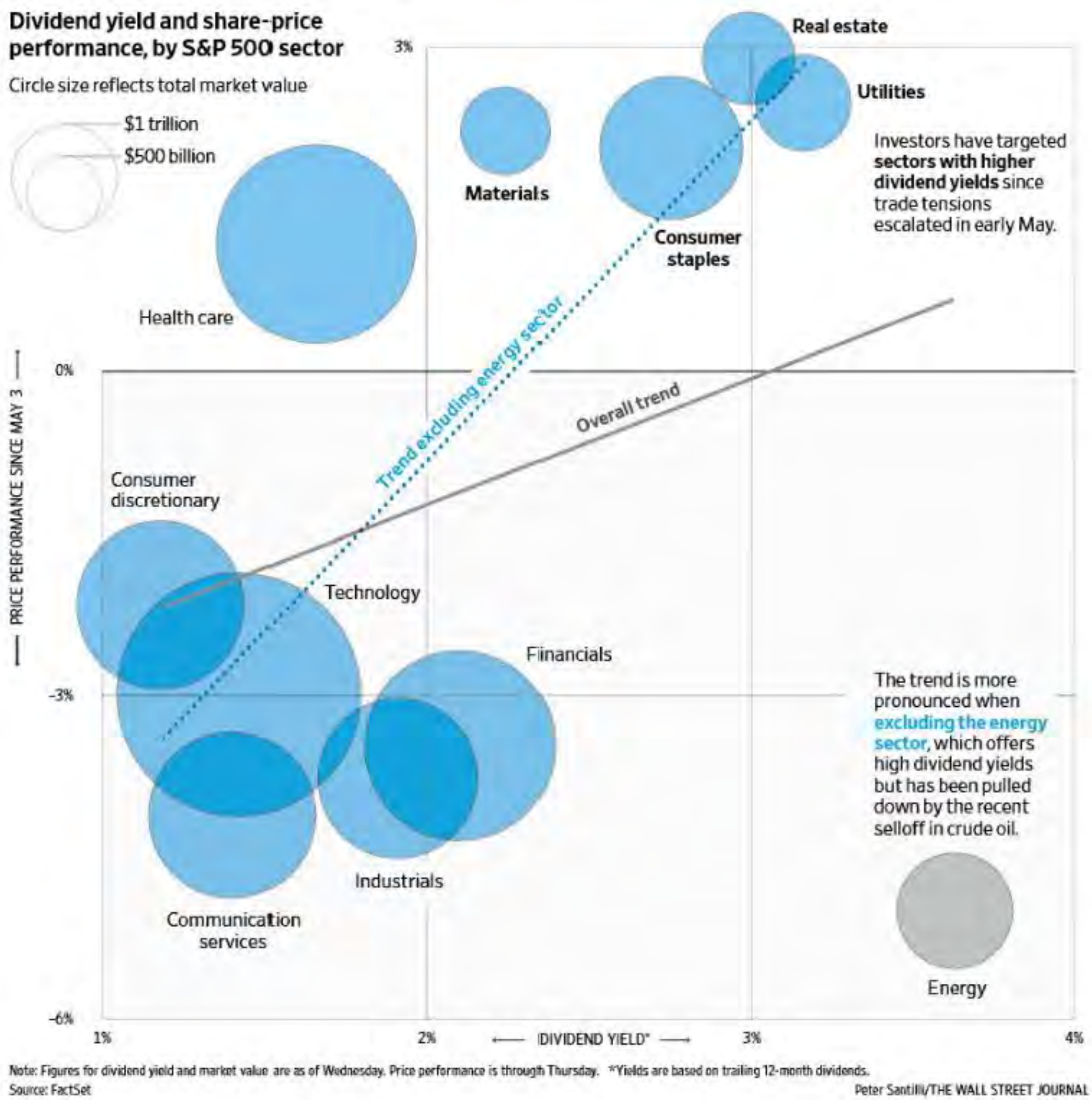
Perhaps as bad for stocks would be if the one thing investors are relying on didn't appear, and the Fed chose not to cut rates. Worse than a central bank papering over the widening cracks in the global economy is one that lets investors think the cracks might be a sign of deeper structural flaws.

Utilities, Other Safety Stocks Thrive

by Jessica Mento – WSJ – Jun 14, 2019
Gunjan Banerji contributed to this article.

The latest rise in the stock market has been helped along by safety stocks, signaling a shift among investors toward seeking certainty as trade tensions and central-bank policy push and pull markets.

Recently, more **companies in S&P 500 sectors perceived as safer**—such as **utilities**, consumer staples and real estate— have been **outperforming** the **broader market**. The shift to safer stocks is a reversal from earlier this year, when cyclical sectors tied to the health of the economy propelled major U.S. stock indexes to records.



Trade tensions rattled investors last month, with indexes posting their worst May since 2010. But stocks have rebounded recently, and the Dow Jones Industrial Average and S& P 500 both sit within 2.7% of their records. Signs have emerged that the Federal Reserve might cut interest rates to boost the U.S. economy, and Friday's weaker-than-expected employment report for May added to growing expectations of a rate cut.

The move into safer stocks "really demonstrates how **risk-averse investors** have become in recent months," said Eric Marshall, portfolio manager at Hodges Capital Management. "A lot of it has to do with what effect the tariffs may have on the economy and uncertainty over how the Fed will or will not respond to that."

As bond yields have fallen, **safety stocks with steady dividend payouts** have **become more attractive**. Those types of companies also are considered some of the most reliable and least volatile in the stock market. Shares of Coca-Cola Co., cellular-tower company American Tower Corp. and power firm NextEra Energy Inc. have each climbed at least 6.1% since the broader market came under pressure on May 13 on renewed trade concerns. The S& P 500 has ticked up 0.4% over that time span.

At least **70%** of the **companies** in the **utilities**, **consumer**-**staples** and **real-estate sectors** are trading **above their 50-day moving average**, a closely watched trend line that some investors use to track momentum.

Safety Stocks Get A Boost

The yield on the benchmark 10-year U.S. Treasury note settled at 2.096% on Thursday, well below November's seven-year high of 3.232% as the Fed has scaled back its rate projections amid fears of slowing global growth. **Yields fall as bond prices rise**, which typically happens when investors flock toward safer assets than stocks.

The **10-year yield** is **below** the **3.2% dividend yield offered by utilities stocks in** the **S&P 500**, which is among the highest in the index and exceeds the broader S&P 500's 1.9% yield.

The **Fed's dovish tilt this year** has also boosted real-estate shares that had been pressured by the threat of higher rates.

Real-estate stocks in the S&P 500 have advanced 20% in 2019, outpacing the S& P 500's 15% rise, after the group slumped 5.6% last year. The sector is the second-best-performing group behind technology, which has climbed by 23% in 2019.

Meanwhile, the Consumer Staples Select Sector SPDR Fund, which holds companies like Procter & Gamble Co. and Walmart Inc., has risen for nine consecutive days and is up 6.2% over that period, hit- ting a record on Thursday. That marks its best nine-day stretch since August 2011, according to Dow Jones Market Data.

Investors also have recently piled into exchange-traded funds that are supposed to offer low turbulence even as U.S. stocks have risen this month. Investors have pushed money into the Invesco S& P 500 Low Volatility ETF, which has recorded $1.9 billion in inflows this year, FactSet data show. The iShares Edge MSCI Min Vol U.S.A. ETF has also drawn fresh cash.

Some investors are still scooping up stocks in other corners of the market. **Michael Sheldon**, chief investment officer at RDM Financial Group at HighTower, said his firm is adding exposure to health-care stocks for their growth and defensive nature.

"We're **not chasing high valuations in** the **defensive part of the market**," Mr. Sheldon said.

"While we do own a few of the slower-growth, higher-yielding names within the market, we're generally **wary of paying up for stocks that** have **made** a **run recently**, **like** the **utilities** sector," he said..

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U.S. Factory Activity Slips Again

by Paul Kiernan – WSJ – Jul. 2, 2019

The **U.S. factory sector lost momentum again last month**, the latest sign that **anemic global growth** and **trade tensions** are contributing to a domestic slowdown.

The Institute for Supply Management said its **manufacturing index** slipped to 51.7 in June from 52.1 in May. Readings above 50 indicate activity is expanding, while those below 50 signal contraction.

"It's at a **relatively weak** level," said Timothy Fiore, chairman of the ISM's Manufacturing Business Survey Committee, in an interview. "The disappointing thing is that there have been **three straight months of decline**."

Monday's data, compiled from a monthly survey of purchasing and supply executives across the U.S., came as part of a broader picture of softening activity in global manufacturing. Survey-based indexes from IHS Markit, another data provider, have indicated the European and Japanese factory sectors are contracting.

The ISM data also highlighted another feature of the world economic landscape: The U.S. has weathered the 2019 slowdown better than most other developed economies.

American consumers have steadily increased spending this year amid low unemployment and rising wages. **Most forecasters expect** the **U.S. economy to grow around 2% this year**.

While forward-looking aspects of the ISM data deteriorated in June, actual manufacturing production and employment rose from the previous month. Monday's overall reading came in slightly higher than the 51.3 level expected by economists, according to a survey by The Wall Street Journal.

Some economists had been bracing for a sharper decline after a number of less-comprehensive manufacturing indexes saw "blood-curdling drops" in June, Pantheon Macroeconomics' Ian Shepherdson said in a note to clients. He added the earlier surveys may have been affected by President Trump's May 30 threat to impose tariffs on Mexico. The administration scrapped that plan on June 7.

Economists said the U.S. and China agreeing to cease fire on trade over the weekend could help to stabilize the manufacturing outlook. Executives say trade disputes have caused uncertainty in recent months, with companies postponing investments and rejiggering supply chains to reduce exposure to tariffs.

For the Federal Reserve – which is weighing whether to lower interest rates later this month to offset a sharper-than expected slowdown – Monday's data aren't likely to move the needle much, said Andrew Hunter, a senior U.S. economist at Capital Economics.

"At face value it wasn't quite as bad as most people had been expecting," Mr. Hunter said. "The picture has been that **manufacturing** has been **struggling** for **several months now**, so this is really just a **continuation of that**."

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ECONOMIC RESEARCH
FEDERAL RESERVE BANK of ST. LOUIS

Factors Behind the Decline in the U.S. Natural Rate of Interest

by Sungki Hong and Hannah G. Shell

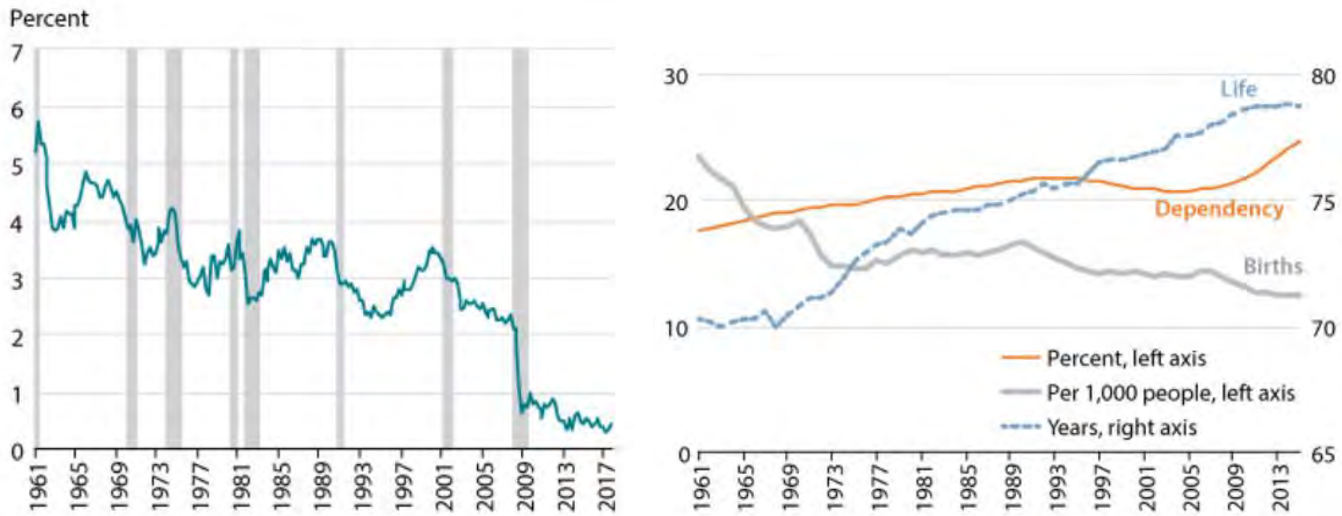
Federal Reserve Bank of St. Louis (FRED) – Apr. 19, 2019

https://research.stlouisfed.org/publications/economic-synopses/2019/04/19/factors-behind-the-decline-in-the-u-s-natural-rate-of-interest?utm_medium=email&utm_campaign=201905A%20Research%20Newsletter&utm_content=201905A%20Research%20Newsletter+CID_b62ae8271abe2d148172544082fa156d&utm_source=Research%20newsletter&utm_term=lower%20natural%20rate%20of%20interest

Americans are living longer but having fewer children, which means **more retirees and fewer workers**, which means **lower potential output**, which means a **lower natural rate of interest**, which affects monetary policy.

The **natural rate of interest** is the **real short-term rate that supports** an **economy operating at** its **potential output without increasing inflation**. It is an essential benchmark rate for policymakers who determine the policy rate. **If potential output declines, the natural rate declines with it**. However, **we do not directly observe** the **natural rate**. **Instead**, we have to rely on **quantitative models** that describe the policy and economic activity of the government, households, and firms to uncover the underlying natural rate of interest.

The Natural Rate of Interest and Demographics in the United States



NOTE: Life, average life expectancy. Dependency, old-age dependency ratio. Gray bars indicate recessions as determined by the National Bureau of Economic Research.
SOURCE: FRED®, Federal Reserve Bank of St. Louis; World Bank, UN Population Database; Natural rate of interest estimated by Holston, Laubach, and Williams (2017).

The left panel above plots the **U.S. natural rate of interest**, as estimated by Holston, Laubach, and Williams (2017). The rate starts out slightly below 6 percent in the early 1960s and tends to **trend downward** during the period, **generally increasing during expansions** and **decreasing during recessions**. **In** the **2007-09 recession**, **however**, the **rate drops quickly and does not increase** at all **during** the **following expansion**.

What could be driving the long-run decline in the natural rate of interest? Over the past 30 years, demographics have changed in most developed countries as their populations have aged. This essay describes how **changing demographics** in the United States **contribute** to a **decline** in its **natural rate**.

Changing Demographics

The right panel of the figure shows three measures of U.S. demographic change: average life expectancy at birth (blue), the birth rate per 1,000 people (gray), and the **old-age dependency** ratio (orange), which is the **population over age 65 divided by** the **population between ages 20 and 65**. Since the 1960s, life expectancy in the United States has increased by more than eight years. At the same time, the **birth rate per 1,000 people has declined drastically**, from 23.4 births in 1961 to 12.4 in 2015. **Longer lives and slower population growth mean an aging population**.

An aging population can present challenges. The last metric in the right panel, the old-age dependency ratio, increased from 17 percent to just shy of 25 percent between 1961 and 2013. This increase puts a **greater burden on** the **working-age population to support retirees**. For example, the U.S. government supports retired individuals through payments such as Social Security. As the population ages, more individuals receive these payments than contribute toward them.

Impact on the Natural Rate of Interest

Demographics can affect the natural rate of interest through several channels. Remember, if potential output declines, the natural rate declines with it. An **aging population and slowing population growth limit** the **supply of available workers** in an economy. Therefore, **holding labor productivity constant**, a **decrease** in **workers** – a higher old-age dependency ratio – **reduces** the **output generated by an economy**. A smaller working-age population means fewer people with a lot of disposable income to consume. These factors **decrease** an **economy's productive capacity** and **thereby lower the natural rate**. U.S. labor force participation is up compared with the 1960s, despite a long decline since the mid-1990s. By itself, this rising labor force participation would tend to raise the natural rate by increasing productive capacity and, in turn, the natural rate of interest.

An aging population also impacts the natural rate of interest through the savings rate. A higher savings rate increases the supply of loanable funds that banks can lend out, therefore decreasing interest rates. As life expectancy increases, the time individuals spend in retirement increases as does the amount of money they will need to last through retirement. If working-age individuals believe social safety nets will fail, they are likely to save more to offset the risk[2]. The U.S. savings rate did increase somewhat from 2005 to 2008; however, for the most part, U.S. household savings has declined since the 1970s.

Conclusion

Changing **U.S. demographics** can **decrease** the **productive capacity** of the **economy through slowing labor force participation and population growth**. Holding labor productivity constant, **slowing participation and population growth lower potential gross domestic product** (**GDP**) **and** the **natural rate of interest**. The natural rate could also be lower because of increased saving; however, **Americans are saving less than** they did **30 years ago**. **Most likely,** changing **U.S. demographics** are **reducing** the **U.S. natural rate of interest by decreasing potential output**.

Notes

1 U.S. Bureau of Labor Statistics, Civilian Labor Force Participation Rate [CIVPART], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/CIVPART, accessed March 8, 2019.

2 See Carvalho, Ferrero, and Nechio (2017).

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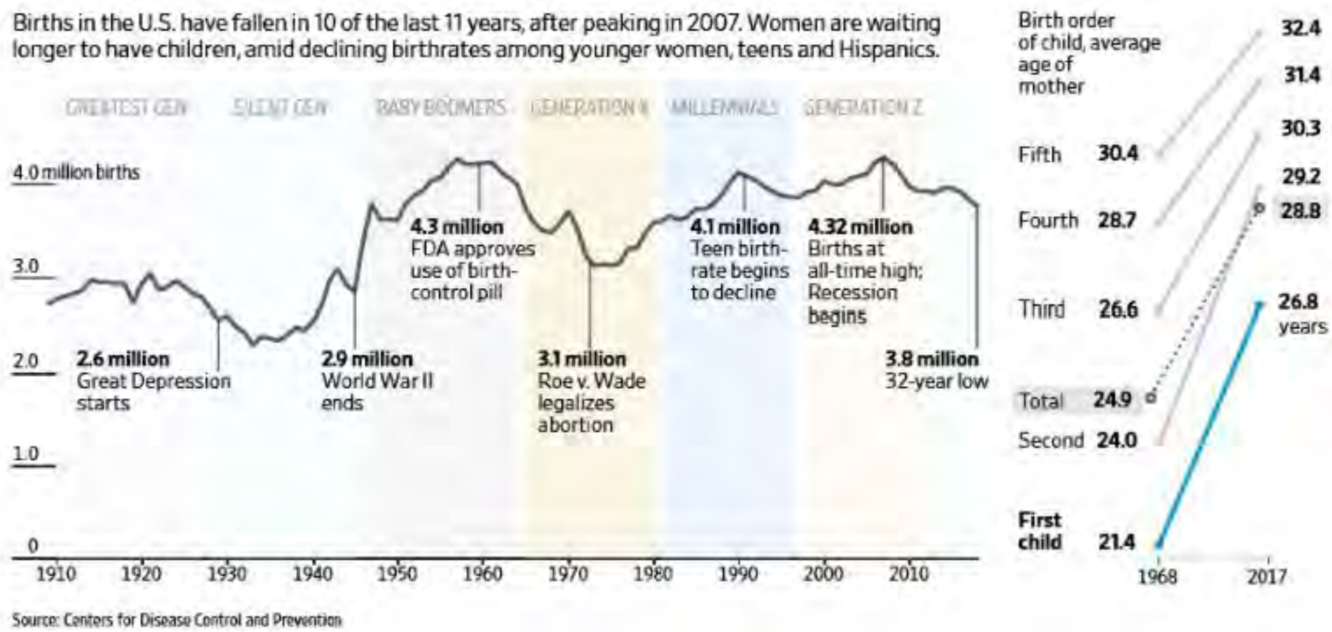
U.S. Births in 2018 Hit 32-Year Low

by Anthony Debarros and Janet Adamy – WSJ – May 15, 2019



Fertility decline has big implications for nation's economy and workforce

The **number of babies born in** the **U.S. last year fell to** a **32-year low**, deepening a fertility slump that is reshaping America's future workforce.

About 3.79 million babies were born in the U.S. in 2018, according to provisional data from the Centers for Disease Control and Prevention's National Center for Health Statistics. That was a 2% decline from the previous year and marked the fourth year in a row that the number fell. The general **fertility rate** – the number of **births per 1,000 women ages 15 to 44**—fell to 59.0, the **lowest since** the **start** of federal record-**keeping**.

With the latest decline, births in the U.S. have fallen in 10 of the last 11 years since peaking in 2007, just before the recession. **Many demographers believed** that **births would rebound as the economy recovered**, **but that trend hasn't materialized**.

Instead, experts say the **continuing declines** appear to be rooted in several trends, including teenagers and unmarried women having fewer babies, lower Hispanic fertility rates and the rise in women obtaining college degrees.

The decline has important implications for the U.S. economy and workforce. The total fertility rate—an estimate of the number of babies a woman would have over her lifetime— has generally remained below the "replacement" level of 2.1 since 1971. A **fertility rate falling** further below replacement level means that, **without enough immigrants**, the **U.S. could see population declines and** a **workforce too small to support** a **growing segment of retirees**.

Last year, it fell to 1.7, a record low. Still, that figure remains higher than the rate in parts of Asia and Europe.

Birthrates by age

Younger and unmarried women have seen the largest fertility declines in recent years, while rates for those in their 30s or who are married have generally increased. The drop has been particularly dramatic among teens ages 15-19, where the birthrate fell 7% last year to 17.4 births per thousand women. That figure is down 72% from a peak of 61.8 in 1991.

In 2018, only women ages 35 to 44 saw an increase in birthrates, while rates for all other age groups declined or remained the same.

The trends suggest that a decline in unplanned pregnancies is a big part of America's lower fertility. Research led by Kasey Buckles, an associate professor of economics at the University of Notre Dame, found that about 35% of the fertility decline from 2007 to 2016 is because of declines in pregnancies that were likely unintended.

Some of that comes from the fact that women are simply waiting longer to have children. Demographers hope that as the large millennial cohort, which this year will be between age 23 and 38, moves through their 30s, the birthrate will begin rising again.

But they also caution that when women delay babies, they end up having fewer of them.

Hispanic birthrates

Another factor is that Hispanic women are having fewer children. Last year, the number of births to Hispanic women fell 1% to total about 886,000. That is partly because the recession and subsequent tightening of immigration rules have slowed the flow of Hispanics into the country. It is also because the share of America's Latino population that was born in the U.S. has grown – about two-thirds of U.S. Hispanics were born here, according to the Pew Research Center.

American-born Hispanics have lower fertility rates than those born in Latin America.

Contraceptive use

The expanded use of long-acting contraceptives is another force driving down births. The 2010 Affordable Care Act, which extended health insurance to millions of Americans and mandated contraception coverage in plans, is one factor behind that uptick.

Education

Women with high levels of education have always had fewer children than those with just a high-school diploma, and researchers have pointed to the increased number of women getting bachelor's degrees as one force weighing on fertility. According to the Boston College paper, 40% of women had a college education in 2016.

Many economists say that because educated women earn more money, they are less likely to want to delay or interrupt their careers to have children since doing so is a greater economic sacrifice.

Recent fertility research suggests a more complicated picture. Although college-educated women still have fewer children than those with just a high-school diploma, fewer of them are childless and their fertility rates have inched up since the recession, said Melanie Guldi, associate professor of economics at the University of Central Florida.

Prof. Guldi said that the stronger economic security of highly educated women may have had the opposite effect after the economic downturn and put these women in a better position to have their desired number of children.

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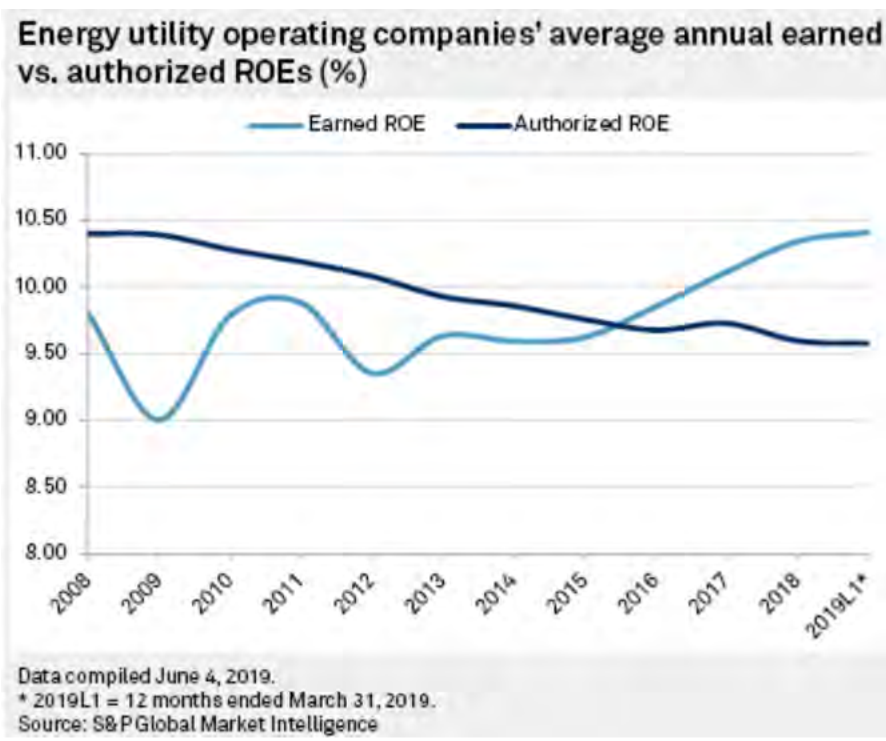
Utility-Earned ROEs Exceeded Authorized Since 2016, But 2019 May Not Match 2018

by Dennis Sperduto – Regulatory Research Associates (RRA)
An Affiliate of **S&P Global Market Intelligence** – – Jun. 10, 2019
Charlotte Cox contributed to this article.

The average annual earned return on equity for the Financial Focus energy coverage universe of utility operating companies has exceeded the average authorized ROE in each year since 2016. Over the period 2016 through the first quarter of 2019, energy utilities' average annual earned ROE was 53 basis points above the authorized average annual equity return. We have utilized the average annual authorized ROE as a proxy for the average required equity return in each annual period.



Regarding **2019**, one significant **uncertainty** is the upcoming summer weather, especially since **most utilities**, in particular **electrics**, **do not have weather normalization clauses or sales adjustment mechanisms**. As noted in an Oct. 8, 2018, Financial Focus report, the third quarter of 2018 was quite warm in the U.S., with cooling degree days nationwide 15% higher than in the third quarter of 2017 and 26% above the norm. Monthly cooling degree days nationwide exceeded the respective monthly total in 2017 and the monthly norm every month of summer, June through September 2018, suggesting that meaningful weather-related earnings growth likely will be challenging in summer 2019. On a positive note, reasonably supportive industry ratemaking practices in many regulatory jurisdictions and a projected continuation of robust utility capital spending in 2019 should bode well for EPS growth. From another perspective, given the consensus view that climate change, including global warming, is occurring, the **possibility** of a **cool summer relative to** the **norm** may not be significant.

Examining the period 2008 through first quarter 2019, however, we find modestly different results. From 2008 through 2015, utilities' average annual earned ROEs were modestly below the authorized equity returns. The largest variance was in 2009, when earned ROEs fell short of authorized ROEs by 139 basis points. We note that the economy was in the depths of a sharp recession in 2009 and gross domestic product declined by 2.5%. The largest calendar-year positive variance occurred in 2018, when utilities' earned ROE was 74 basis points higher than the authorized equity return. GDP grew by 2.9% in 2018, matching the highest level of the period that occurred in 2015.

Over the same period, **energy utilities' average annual earned ROE** was 18 basis points below the authorized average annual equity return. **Removing 2009 data** from the calculation, the average annual earned versus **authorized shortfall** was **seven basis points**.

Energy utility operating companies' average annual earned vs. authorized ROEs, 2008-2019L1

Year	Average annual earned ROE (%)	Average annual authorized ROE (%)	Number of ROE authorizations	Difference, earned vs. authorized ROE (%)
2008	9.80	10.40	69	-0.60
2009	9.00	10.39	70	-1.39
2010	9.78	10.28	100	-0.50
2011	9.88	10.19	58	-0.31
2012	9.35	10.08	93	-0.73
2013	9.63	9.93	70	-0.30
2014	9.59	9.86	64	-0.27
2015	9.62	9.76	46	-0.14
2016	9.85	9.68	68	0.17
2017	10.11	9.73	77	0.38
2018	10.34	9.60	88	0.74
2019L1*	10.41	9.58	85	0.83
Averages	**9.8**	**10.0**	**74**	**-0.18**

Data as of March 31, 2019.
* 2019L1 = 12 months ended March 31, 2019.
Source: S&P Global Market Intelligence

Comments on methodology

Interestingly, the earned annual ROE has generally increased from 2008 through the first quarter of 2019 and especially so since 2015, while the average annual authorized ROE has generally declined.

Another interesting issue is whether the authorized equity return accurately represents the **utility's cost of equity capital**. **Unlike the cost of debt**, **which can be observed**, the **cost of equity cannot be directly observed/measured as it is an investor expectation,** and **expectations**, as a psychological concept, **do not lend themselves to measurement**. **Regulators utilize various models and analyses to estimate the required ROE**. **Because the required ROE is not directly observable**, it **cannot be conclusively demonstrated** that the **authorized ROE** as estimated by regulators is the **company's actual cost of equity capital**, **which may be higher or lower.**

The earned ROE data used in this analysis was taken from a June 5, 2019, Financial Focus report that discusses energy utility operating company financial quality metrics, while the authorized ROE data is derived from an April 11, 2019, Regulatory Focus report, Major Rate Case Decisions – January-March 2019.

The earned ROE data represents the simple average of the energy utility operating companies in the Financial Focus coverage universe, and the authorized ROE is the simple average of the equity returns adopted by regulators in the specified 12-month period. As noted previously, we have utilized the average annual authorized ROE as a proxy for the average required equity return in each annual period.

We emphasize that this analysis is an **overall industry study** and **not one of individual companies**. For some companies, determining the authorized ROE is difficult, if not impossible, since, among other factors, company **rates at times are set by stipulations that do not specify** an **authorized ROE**. In addition, **some utilities operate** in **more than one regulatory jurisdiction**, and the **authorized ROE** is **different** for the different jurisdictions, leading to the **question** as to the **proper weighting** to utilize. Different jurisdictional equity returns for a given company can be weighted by rate base, but rate base may not be specified if the rate case was settled. **Also**, for multi-jurisdictional companies the rate and **ROE determinations** in the various states **may have taken place** in **different years**.