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Modeling the Costs of the Pension Benefit Guaranty Corporation's Multiemployer Program

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Abstract

The Pension Benefit Guaranty Corporation (PBGC), a government-owned corporation, insures the pension benefits of more than 10 million participants in multiemployer defined benefit pension plans. Multiemployer plans are typically offered, as part of collective bargaining agreements, by multiple unrelated employers that are jointly responsible for funding the plan. In recent years, many multiemployer plans have experienced underfunding, and some plans now face insolvency. Many beneficiaries of insolvent plans are likely to receive less than their insured benefits, because PBGC cannot pay insurance claims that exceed the accumulated value of the premiums it has collected under the multiemployer program (plus interest earnings on its assets).

This paper describes the simulation model that the Congressional Budget Office uses to inform its baseline budget projections for the multiemployer program. That model is also useful for analyzing the budgetary effects of legislative proposals related to the program and for providing additional information about plans, participants, and PBGC's finances.

Keywords: PBGC, pension guarantees, pension insurance, defined benefit plans, multiemployer plans, insolvency

JEL Classification: G22, G23, G28, J32

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Introduction

The Pension Benefit Guaranty Corporation (PBGC) is a government-owned corporation that insures the pension benefits of more than 10 million participants in multiemployer defined benefit pension plans.[1] Multiemployer plans are typically offered, as part of collective bargaining, by two or more unrelated employers that are jointly responsible for funding the plan. Some multiemployer plans are experiencing shortfalls in funding and have reported that they are likely to face insolvency, at which point they will file claims for financial assistance from PBGC's multiemployer program. The resources available to PBGC to help those plans—which are limited by law to the accumulated value of the premiums it has collected under the multiemployer program (plus interest earnings on its assets)—are projected to be insufficient to meet the large amount of insurance claims on the program. As a result, many beneficiaries of insolvent plans will receive less than their insured benefits.

In August 2016, the Congressional Budget Office published projections of the financial condition of the multiemployer program through 2036.[2] This working paper describes the model that CBO used for those projections.

Cash-Based Estimates for the Multiemployer Program

In its 2016 report, CBO projected that claims for financial assistance filed with the multiemployer program—which represent amounts that PBGC would be obligated to pay insolvent plans to cover the cost of guaranteed benefits—would total $9 billion from fiscal year 2017 through 2026 and $35 billion over the following 10 years. However, if current laws continued without change, the multiemployer program would become insolvent in 2025 for the first time in its history, CBO projected. In that case, PBGC would be unable to pay $3 billion of those claims during the 2017–2026 period and $31 billion during the 2027–2036 period. As a result, projected outlays for the multiemployer program over those two decades would be limited to $11 billion—equal to the value of premiums expected to be collected during that period plus the program's previously accumulated assets.[3]

Fair-Value Estimates for the Multiemployer Program

An alternative measure of PBGC's exposure to losses is the market value—or fair value—of its insurance claims, net of premiums. That accrual measure of PBGC's net position measures the value of PBGC's multiemployer insurance over the life of the insured plans.[4] A fair-value estimate approximates the amount, expressed as a present value, that a private insurer would need to be paid to willingly assume PBGC's obligations to pay all claims from multiemployer plans expected to face insolvency over the next

[1] Defined benefit plans promise retirees a particular benefit amount (generally based on length of service) regardless of how much beneficiaries have contributed toward their pensions. Such plans are less common than defined contribution plans, in which benefit amounts depend on the value of contributions by beneficiaries and their employers. PBGC does not insure defined contribution pensions because, by definition, such pensions are always fully funded.

[2] Congressional Budget Office, *Options to Improve the Financial Condition of the Pension Benefit Guaranty Corporation's Multiemployer Program* (August 2016), www.cbo.gov/publication/51536.

[3] Since the release of those projections, which underlie the analysis in this paper, CBO has revised its 10-year baseline projections to reflect continued deterioration in the outlook for the multiemployer program. CBO's latest baseline projects that the program will become insolvent in 2024 and be unable to pay a total of $10 billion in claims between 2024 and 2027. See Congressional Budget Office, "Baseline Projections for Selected Programs: Pension Benefit Guaranty Corporation" (March 2016 and January 2017), www.cbo.gov/about/products/baseline-projections-selected-programs#13.

[4] In accrual accounting, the gains and losses from transactions are recognized when they are incurred rather than when they are paid, as is the case in cash accounting.

20 years. CBO estimates that on a fair-value basis, total claims for financial assistance net of premiums received over the 2017–2036 period have a present value of $101 billion.

A fair-value estimate is more comprehensive than a cash-based estimate for several reasons: It includes the full lifetime of cash flows associated with claims from plans' insolvencies, and it accounts for the time value of money and the cost of market risk (the compensation that private investors require to assume risks that are correlated with overall economic conditions). PBGC's insurance faces considerable market risk because claims are likely to be largest following unexpected declines in aggregate economic conditions.

Accounting for the cost of market risk results in a higher valuation of claims on PBGC than does a present-value-based estimate that does not account for market risk, such as PBGC's own estimate of its net financial position. In its *FY 2015 Projections Report* (the most recent version available), PBGC estimated that its net deficit for the multiemployer program—which measures lifetime claims for plans projected to become insolvent by 2035—would have a discounted present value of $53 billion in 2015.[5] Although PBGC's accrual estimates differ from CBO's in many ways, the most significant is that PBGC does not include an adjustment for market risk. Instead, it simply calculates the present value of (or discounts) expected claims and premium income using the interest rates on Treasury securities with a range of maturities.

CBO's Model of the Multiemployer Program

To generate both cash-based and fair-value estimates for the multiemployer program, CBO simulates individual plans by calculating thousands of paths for plans' investment returns, benefits, and contributions. The simulation model incorporates the rules that determine how multiemployer plans are funded (including the use of actuarial valuations, which encourage investments in risky assets) and the exemptions that are sometimes made to those funding rules (which have contributed to the severe underfunding of many plans). CBO's projections for the multiemployer program account for how projected claims filed by individual plans will affect PBGC's finances. Many parts of the model, particularly actuarial projections of the benefits accrued under each plan, approximate the more detailed modeling in PBGC's Pension Insurance Modeling System (PIMS). CBO estimated most of the key inputs of its model—particularly those that determine the contributions that employers make to underfunded plans—using information in plans' annual data filings.[6]

CBO uses the simulation model for various purposes: to inform its baseline budget projections for the multiemployer program, to analyze the budgetary effects of legislative proposals relating to that program, and to provide additional information about plans, participants, and PBGC's finances. In many cases, estimates of the effects of alternative policies relative to the baseline are more certain than the baseline projections themselves. The reason is that the baseline projections depend on a large number of model parameters that are estimated with considerable uncertainty, but when CBO estimates how the effects of a legislative proposal would differ from the baseline, the proposed change may affect just a few parameters whose impact can be estimated with more certainty. CBO's model can also project losses to beneficiaries under current and alternative policies, which are an important consideration for policymakers. Losses in benefits stemming from plans' insolvencies, voluntary cuts to benefits before a plan becomes insolvent,

[5] For additional discussion of PBGC's projections, see Pension Benefit Guaranty Corporation, *FY 2015 Projections Report* (2016), www.pbgc.gov/documents/Projections-Report-2015.pdf (1.6 MB).

[6] Other key inputs of the model, such as the rate at which plans will take advantage of certain legal provisions, cannot be based on data and instead can only be estimated with considerable judgment. In certain cases, CBO relied on guidance from outside experts, including some at PBGC, to determine those inputs.

and unpaid insurance claims resulting from the projected insolvency of the multiemployer program vary considerably over time and among plans.

The accrual estimates generated by CBO's model could also be used to provide policymakers with a comprehensive measure of the cost of PBGC's insurance to supplement cash-based budget estimates. Alternatively, some analysts have called for changing the budgetary treatment of long-term federal insurance programs, such as PBGC's, by using accrual estimates of the projected costs of the programs throughout the budget process. This report includes an illustrative example of how PBGC's costs could be recorded in the federal budget on an accrual basis.

Overview of Multiemployer Plans and the Challenges Facing PBGC's Multiemployer Insurance

Multiemployer pension plans are one of many types of retirement plans that receive favorable treatment under the U.S. tax code and that are regulated by the Internal Revenue Service and the Department of Labor under the Employee Retirement Income Security Act of 1974 (ERISA) and other federal laws. Each multiemployer plan is provided by a group of employers, usually in a unionized industry as part of a collective bargaining agreement. Employers share the costs of the plan, and employees can switch between employers in the group without having to change their pension plan. The multiemployer plans insured by PBGC promise defined benefits to each employee that are based on a formula tied to the employee's length of service. Participating employers are jointly obligated to fund those promised benefits, which represent deferred compensation. ERISA regulates the amount of funds that employers must contribute to meet their plan's liabilities and requires all plans to purchase pension insurance by paying premiums to PBGC. (Annual premiums are equal to a fixed amount per plan participant.)[7]

A plan insured by PBGC's multiemployer program becomes eligible for financial assistance from PBGC if it becomes insolvent by having insufficient assets on hand to pay current benefits. Once a plan has been determined by its trustees to be insolvent, it must cut benefits to the maximum level insured by PBGC ($429 for each year of a beneficiary's service, which amounts to about 60 percent of the promised benefit in a typical multiemployer plan). At that point, PBGC will make payments to cover any shortfall between the insured level of benefits and the funds that the plan has available to pay them. However, by law, the total amount of financial assistance claims from insolvent multiemployer plans that PBGC can pay is limited to the total amount of premiums and interest it has collected under the multiemployer program. The program has only about $2 billion in assets on hand, and the additional premiums it is expected to collect in coming years are likely be a small fraction of projected claims.[8]

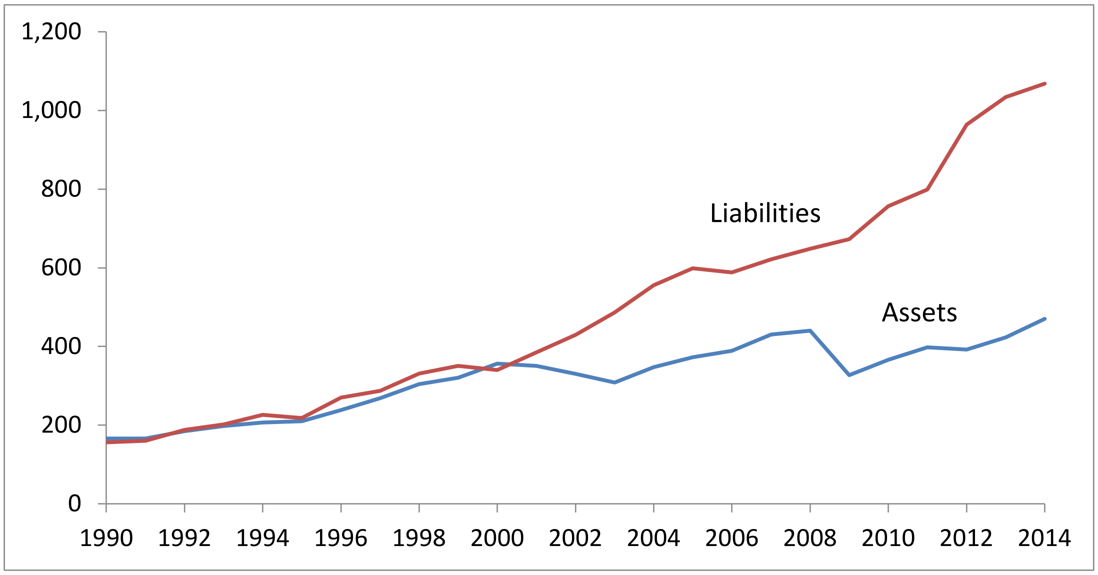
PBGC's looming claims stem from a dramatic rise in the underfunding of many multiemployer plans since 2000, which has put many plans at risk of insolvency as employers struggle to make the additional contributions needed to close the funding gap (see Figure 1). The rise in underfunding resulted from large losses on plans' risky investments following collapses in stock market values during the 2000–2002 and

[7] For more information about multiemployer plans and their history, see Harriet Weinstein and William J. Wiatrowski, "Multiemployer Pensions Plans," *Compensation and Working Conditions*, Bureau of Labor Statistics (Spring 1999), pp. 19–23, www.bls.gov/opub/mlr/cwc/multiemployer-pension-plans.pdf (37 KB).

[8] In its latest five-year report to the Congress on the multiemployer program, PBGC summarized the adequacy of the program's premiums as follows: "After the premium increases legislated under [the Multiemployer Pension Reform Act of 2014], projections of premiums at legislated rates plus current assets and likely returns on those assets appear sufficient to cover PBGC's existing multiemployer program cash flow needs for the next five to nine years, but not for an extended period." See Pension Benefit Guaranty Corporation, *PBGC Insurance of Multiemployer Pension Plans: A Five-Year Report* (March 2016), pp. 7–8, www.pbgc.gov/documents/Five-Year-Report-2016.pdf (1 MB).

2008–2009 periods. Two other important factors have contributed to the gloomy outlook for the multiemployer program: pension accounting rules that create a strong incentive for plans to fund relatively fixed pension benefits with risky assets, and exemptions to the rules governing employers'

Figure 1.
Total Assets and Liabilities of Multiemployer Defined Benefit Pension Plans, 1990-2014
Billions of Dollars



Source: Congressional Budget Office, using information from the Pension Benefit Guaranty Corporation's *2014 Pension Insurance Data Tables* (www.pbgc.gov/sites/default/files/legacy/docs/2014-data-tables-final.pdf) and from plans' filings of Internal Revenue Service Form 5500.

contributions, which have made it more difficult to collect sufficient contributions to improve plans' funding. (For more details on the factors that have led to underfunding, see Appendix A.)

Most multiemployer plans hold a significant share of their assets in risky securities, particularly common stocks. That strategy makes a plan more prone to underfunding as asset values fluctuate over time but promised benefits remain relatively fixed. A plan that instead invested in long-term government and corporate bonds would experience much less fluctuation in funding levels, because changes in the value of promised benefits would largely track with changes in the value of those bonds. However, under current pension accounting rules, the more a plan allocates its asset holdings to risky investments (which have a higher expected return than less risky investments), the lower the value of assets it will need to be considered adequately funded.[9] The reason is that, for funding purposes, a plan uses the expected return on its investments, no matter how risky, to discount the future stream of its promised benefits in order to

[9] Increasing the incentive to hold risky assets contributes significantly to the fair-value cost of PBGC's insurance, because the cost of the insurance for a given plan increases with the riskiness of the assets used to fund the plan and the market value of its underfunding. For a discussion of that issue in the context of PBGC's single-employer program, see Congressional Budget Office, *The Risk Exposure of the Pension Benefit Guaranty Corporation* (September 2005), www.cbo.gov/publication/17160; and Jules H. van Binsbergen, Robert Novy-Marx, and Joshua D. Rauh, *Financial Valuation of PBGC Insurance With Market-Implied Default Probabilities*, Working Paper FR 13-27 (Simon Business School, University of Rochester, January 2014), http:\\dx.doi.org/10.2139/ssrn.2336304.

estimate what is referred to as its actuarial liability.[10] Actuarial liability is generally lower than a market-based measure of a plan's liability—often approximated by the measure known as current liability—because a private-sector provider of the same promised benefits would discount those promises using the yields on long-term bonds, which have risk comparable to that of the promised benefits. If plans were required to fund their current liability rather than their actuarial liability, they would have less incentive to hold a risky portfolio. However, because the current liability would be higher than the actuarial liability computed using higher discount rates, plans would require additional contributions from employers to fund the same level of benefits. That situation could make continuing to participate in a defined benefit plan less attractive to employers.

Some underfunded plans will eventually become insolvent because employers will fail to make the additional contributions that the plan needs to pay benefits as they become due. In the past, insolvency often occurred after all of a plan's employers withdrew from the plan, because the withdrawal payments they agreed to make fell short of the amount needed to cover the plan's benefits. Since the enactment of the Pension Protection Act of 2006 (PPA), however, fewer plans have experienced such mass withdrawals. The reason is that the PPA allows employers in a severely underfunded plan to be exempted from making the minimum required contributions if the plan's administrator certifies that those contributions would place undue hardship on the employers and their employees. (Employees would be affected because when employers increase their contributions to decrease a plan's underfunding, they often do so by reducing their contributions to pay new benefits.) As a result of the PPA's exemption, employers may make contributions that are too low for a plan to pay benefits as they become due.

Besides investment losses and funding exemptions, other factors can contribute to a plan's risk of insolvency.[11] An underfunded plan that has had some of its employers withdraw is more likely than other plans to be in a weakened financial condition, because the departing employers will generally not be liable for any later underfunding, which increases the burden on the remaining employers. In addition, when an entire industry covered by a plan declines, or when the active workforce participating in the plan shrinks, employers' normal-cost contributions (an amount determined by the benefits that active employees accrue for an additional year of service) will be lower, and employers will have a greater incentive to seek funding exemptions when their plan becomes underfunded.

The Multiemployer Pension Reform Act of 2014 (MPRA) created a "critical and declining" designation for plans whose trustees certify that the plans are unable to meet their benefit obligations. The MPRA makes such plans eligible to reduce benefits, including payments to retired participants, if doing so would, in the judgment of the plan's actuary, avert the insolvency of the plan. In its baseline estimates, CBO projects that only a small amount of plans' benefits will be affected by such reductions. The MPRA also allows PBGC to help a plan merge with another plan or be partitioned into a well-funded plan and a PBGC-assisted underfunded plan. Lawmakers did not provide an additional funding source for that assistance, however, so CBO projects that PBGC will not have the necessary resources to implement mergers or partitions for most plans that would benefit from such actions.

[10] Pensions for state and local government employees are funded to a similar standard, and they have also experienced significant underfunding that is attributable to actuarial funding rules. See Congressional Budget Office, *The Underfunding of State and Local Pension Plans* (May 2011), www.cbo.gov/publication/22042.

[11] The factors discussed in this paragraph were also identified in Alicia H. Munnell and Jean-Pierre Aubrey, *Private Sector Multiemployer Plans—A Primer*, Issue Brief 14-13 (Center for Retirement Research, Boston College, August 2014), http:\\crr.bc.edu/briefs/private-sector-multiemployer-pension-plans-a-primer/.

Projecting Cash Flows of Multiemployer Plans

CBO's simulation model of the multiemployer program projects claims, net of premiums, for a representative sample of multiemployer plans insured by PBGC. For each plan, the model produces a probability distribution of potential outcomes for participants' benefits, employers' contributions and decisions about withdrawal, the plan's assets and liabilities, and financial assistance claims to PBGC. Using a simulation model lets CBO capture the asymmetric nature of PBGC's insurance, in which the largest losses follow from large downturns in the overall economy that depress the prices of risky assets. The model also lets CBO test how sensitive its projections are to alternative assumptions about the probability distributions of the economic variables in the model. CBO's model is conceptually similar to PBGC's Pension Insurance Modeling System, but it is simpler because it does not account for many of the intricacies of plans' benefit and contribution rules that are modeled in PIMS.[12] CBO uses a more data-driven approach to model plans' cash inflows and outflows on the basis of historical relationships between those flows and a plan's observable characteristics.

CBO's projections for each plan include the following elements (the key parameters that affect those elements are summarized in Table 1, and the mathematical equations underlying each element are provided in Appendix B):

- **Participants and Benefits.** CBO projects the stream of benefits payable over time for each plan on the basis of the last reported levels of benefits paid and liabilities (which reflect the estimated value of future benefits), information provided to CBO by PBGC about the distribution of the plan's participants by age and years of service, and projections of hiring and separation rates. Additionally, the number of participants varies over time on the basis of projections for the rate of new hiring, separations, retirement, and mortality. The simulation incorporates reductions in benefits that are required by law when a plan becomes insolvent or that a severely underfunded plan is allowed to make if it meets the eligibility requirements in the MPRA. Similarly, the simulation incorporates increases in benefits when a plan becomes overfunded (that is, when the value of its assets exceeds the value of its liabilities).

- **Assets and Liabilities.** The values of the plan's assets and liabilities are computed for each year of the simulation. Assets in the following year are simulated from the previous year's level by adding the simulated amount of investment income and employers' contributions and subtracting the simulated amount of benefits paid for that year. Liabilities are calculated by discounting the value of the future benefits that have been accrued under the plan to date.

- **Contributions.** CBO estimates employers' contributions to the plan in each year on the basis of the plan's current funding ratio (the value of the plan's assets divided by the value of its liabilities), the change in that funding ratio from the prior year, previous contributions, and the fraction of participants who are "orphans" (people who worked for an employer that has withdrawn from the plan).[13] Estimates of employers' contributions incorporate special rules for plans that become critical and declining. In addition, special rules cover the contributions (called

[12] The PIMS model for PBGC's single-employer program is summarized in Steven Boyce and Richard A. Ippolito, "The Cost of Pension Insurance," *Journal of Risk and Insurance*, vol. 69, vol. 2 (December 2002), pp. 121–170, http:\\papers.ssrn.com/sol3/papers.cfm?abstract_id=314354. The PIMS model for the multiemployer program is similar, but it simplifies many of the components because less detailed information is available about participating employers for the multiemployer program than for the single-employer program.

[13] When an employer withdraws from a plan, the remaining employers assume responsibility for contributing toward the benefits of orphan participants in the event that the plan becomes underfunded.

withdrawal liability payments) that participating employers make when they withdraw from a plan.

- **Critical and Declining Plans.** The model simulates a plan's being designated as critical and declining, which is a probabilistic occurrence based on the plan's funding ratio and whether the plan can take further actions to improve its funding. Some critical and declining plans will probabilistically make benefit cuts, reducing both accrued benefits and new benefit accruals from their prior levels.

Table 1.
Key Parameters in CBO's Simulation Model

Parameter	Effect of the Parameter on Estimates of PBGC's Net Claims	How CBO Estimated the Parameter
Contribution Rate	The more that employers contribute to a plan, the less likely the plan is to become underfunded.	Used regression model based on information from plans' filings of IRS Form 5500
Distribution of Insured Benefits	Variation among participating employees in the amount of benefits accrued under a plan affects the effective percentage of benefits guaranteed by PBGC. The larger the percentage of total benefits that PBGC insures, the higher the cost to PBGC.	Current law limits a participant's insured benefits to a maximum of $429 per year of service. To capture variation in the distribution of benefits for its sensitivity analysis, CBO increased or decreased the maxmium annual insured amount.
Risk Premium Earned on Plans' Risky Assets	The larger the difference between the interest rate earned on a plan's risky assets and the rate used to discount liabilities, the greater the improvement in PBGC's financial position on a cash basis. On a fair-value basis, however, the higher return on risky assets is considered adequate compensation for risk and thus does not change PBGC's financial position.	Used historical data
Mortality Rate	The greater the mortality rate, the fewer years that benefits are paid to plan participants, and the lower the estimated financial assistance claims on PBGC.	Used mortality schedule provided by PBGC
Discount Rate for Calculating Plans' Actuarial Liability	A higher discount rate lowers the value of a plan's actuarial liability and improves the plan's funding ratio. The actuarial discount rate is equal to the expected return on the plan's assets, so the greater the expected return on those assets, the lower the actuarial liability and the required contributions from employers.	Used information from plans' filings of IRS Form 5500
Collection Rate for Withdrawal Liability Payments	The more likely a plan is to receive the withdrawal liability payments assessed on employers that leave the plan, the less likely the plan is to become underfunded.	Used information from discussions with PBGC staff
Annual Probability of Exhausting All Reasonable Measures to Achieve Solvency	The more likely a plan is to have exhausted all reasonable measures to achieve solvency, the greater the estimated financial assistance claims on PBGC.	Analyzed plans' filings of IRS Form 5500 and data received from PBGC

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Growth Rate of the Active Workforce	The higher the growth rate of a plan's active workforce, the higher the level of employers' contributions toward newly accrued benefits, and the more cash the plan will have to pay current benefits. That additional cash improves the outlook for PBGC by shifting potential losses to new beneficiaries. The improvement is more pronounced with cash-based estimates than fair-value estimates because in fair-value estimates, the value of the additional cash is partly offset by the cost of market risk from deferring potential losses to the future.	Evaluated trends in the number of active participants reported in plans' filings of IRS Form 5500
Amount of Benefits Payable	Variation in the amount of benefits payable affects employers' ability to fund a plan at the current level of contributions. A plan whose benefits payable are greater than expected is more likely to become underfunded.	Evaluated the variation in benefits paid as reported in plans' filings of IRS Form 5500
Annual Probability of Employer Withdrawal	The more likely employers are to withdraw from underfunded plans, the greater the estimated financial assistance claims on PBGC. Also, the more likely employers are to withdraw from better-funded plans, the greater PBGC's net claims because PBGC receives less premium revenue.	Used information from discussions with PBGC staff to determine the average rate of employer withdrawal from underfunded plans
Annual Probability of Benefit Reductions Being Approved by the Treasury	The more likely that a critical and declining plan is to have its application for benefit reductions approved by the Secretary of the Treasury, the lower the net claims on PBGC. However, the model's estimates are largely insensitive to this parameter because CBO estimates that few plans will have viable applications for benefit reductions.	Determined that the criteria for approval of benefit reductions were rigorous and that many plans would probably be unable to meet those criteria

Source: Congressional Budget Office.

- **Employer Withdrawal.** Along any simulation path, each plan has a probability that all participating employers will withdraw from the plan. That probability increases with the underfunding of the plan, but plans that are overfunded may also experience mass withdrawal by employers. For the paths in which mass withdrawal occurs, the plan will stop accruing new benefits and receiving employers' contributions and will instead receive withdrawal liability payments from employers.
- **Plan Insolvency.** Plans that enter a critical and declining state or that experience a withdrawal by employers may become insolvent, meaning that all assets have been depleted and the plan is unable to pay the level of promised benefits. On the simulation paths in which a plan becomes insolvent, PBGC receives claims for financial assistance up to the insured level of benefits.

Each simulation path includes aggregate as well as plan-specific shocks (both drawn from a multivariate normal probability distribution) to allow for variation in returns on assets, projected benefits, and rates of employers' contributions from the means of the projected paths. CBO's cash-based projections of financial assistance claims net of premiums are the average across all simulated paths for each plan, including paths in which the plan remains solvent, so no financial assistance is payable.

CBO's fair-value estimates of PBGC's net claims discount that stream of cash flows to a present value using an options-pricing approach that includes an adjustment to the cash flows to capture the cost of market risk. The adjustment for market risk effectively discounts cash flows that are tied to the stock market at the projected rate of return on the stock market and discounts safe nominal cash flows using the yield on safe assets, such as Treasury securities. The adjustment for market risk makes the cost of PBGC's insurance considerably higher than if a Treasury interest rate was used to discount all of the expected cash flows.

Sources of Data and Initial Plan Conditions

CBO used publicly available data from the Internal Revenue Service (IRS) to set initial conditions for each plan in the simulation, such as the starting values of plans' assets and liabilities and the distribution of participants by age and years of service. CBO also used those data to inform the projection of plan-specific parameters, such as how benefits are paid and new benefits are accrued over time, how much employers contribute to a plan, how likely employers are to withdraw from the plan, and how the plan's assets are invested.

Sources of Data. All employer-sponsored retirement plans with more than $250,000 in assets must provide detailed information about their financial status by filing Form 5500, or its short-form version, with the IRS each year. That asset requirement means that all multiemployer plans that are large enough to be a significant concern for PBGC's balance sheet must file. CBO used those filings to create a data set of 1,167 multiemployer plans insured by PBGC, with total reported assets of $405 billion (on a market-value basis) and total current liabilities of $853 billion in 2012 (see Table 2). Plans' filings of Form 5500 are about two years out of date by the time they are released by the IRS. Although data are now available for 2014, the 2012 filings were the most recent ones available when CBO conducted this analysis.[14] For each plan in its PIMS model, PBGC provided CBO with estimates of the distribution of participants in 2012 by age, years of service, and status. CBO also used a mortality table provided by PBGC.[15]

Sample of Plans. The projections were based on a sample of 105 plans—the largest 50 plans (including 14 critical and declining plans) and an additional 55 smaller critical and declining plans. The 50 largest plans accounted for assets worth $213 billion and liabilities worth $462 billion in 2012, and the full 105-plan sample accounted for assets worth $223 billion and liabilities worth $484 billion. CBO weighted the plans in the sample to match the total liabilities reported on the Form 5500 filings for all plans. The weighted sample produced results similar to those obtained when running the model using data for all 1,167 plans, so CBO used the weighted sample in its analysis to reduce the computational burden.

Projections From 2013 to 2016. CBO estimated the values for each plan's assets and liabilities as of 2016 by running the simulation from 2012 through 2016. Values were simulated using observed market returns for 2013 through 2015 and simulated returns for 2016 (because the estimation was completed before the end of 2016). CBO simulated the realized returns on assets for all plans in 2013, 2014, and 2015 as a weighted average of the realized returns on the Standard & Poor's 500 index and on long-term bonds between 2012 and 2015. (Although plans invest in a broader range of assets, CBO used a

[14] CBO downloaded plans' filings for the 2012 plan year on December 5, 2014. The data set initially included 5,747 plans with $418 billion in assets and $871 billion in liabilities. Removing plans that had no listed actuarial liability shrank the set to 1,216 plans with $411 billion in assets and $865 billion in liabilities. Finally, including only plans that indicated in at least one annual filing that they were covered by PBGC brought the data set down to 1,167 plans. For its modeling and analysis, CBO converted the reported values of plans' assets and liabilities for the 2012 plan year to valuations as of the end of fiscal year 2012. (The 2012 plan year, which varies by plan, consists of a 12-month period beginning in any month of calendar year 2012.)

[15] PBGC provided CBO with its projections for the RP-2000 combined healthy participant mortality table. That table includes improvements in mortality for future cohorts that suggest greater life expectancy than presumed in the Social Security Administration's actuarial life table (available at www.ssa.gov/oact/STATS/table4c6.html).

combination of those two asset classes to represent all asset allocations because the data are insufficient to measure asset allocations more precisely.) The weight assigned to the S&P 500 index was higher if a plan reported allocating a greater share of its portfolio to stocks or other risky assets that have historically been correlated with the stock market. The simulated investment returns for 2013 to 2015 include shocks to account for individual plans' variation from the weighted average return on the two asset classes over the period.

The value of a plan's assets in 2016 under each simulation was increased by estimated contributions and decreased by estimated benefit payments between 2013 and 2016. (The methods used to estimate benefits and contributions are discussed below.) Similarly, the value of a plan's liabilities in 2016 under each simulation was increased by CBO's projections of newly accrued benefits and decreased by estimated

Table 2.
Funding of Multiemployer Defined Benefit Pension Plans in 2012

Plan's Actuarial Funding Ratio in 2012[a] (Percent)	Number of Plans in That Category	Actuarial Value[b] (Billions of dollars)			Market Value[b] (Billions of dollars)		
		Assets	Liabilities	Underfunding	Assets	Liabilities	Underfunding
				Plans Filing Internal Revenue Service Form 5500			
0-40	31	1	4	3	1	4	4
40-50	37	6	14	8	6	24	18
50-65	138	58	103	45	57	152	95
65-80	342	132	180	48	121	275	154
80-90	314	156	183	27	144	273	129
90-100	197	56	60	4	51	87	36
100 or More	108	27	25	0	26	37	11
Total	**1,167**	**436**	**569**	**135**	**405**	**853**	**448**
				Plans Included in CBO's Simulation Model			
0-40	6	*	1	1	*	1	1
40-50	11	3	8	5	3	15	12
50-65	29	44	79	35	43	115	72
65-80	33	68	93	25	62	144	82
80-90	16	95	111	16	88	165	78
90-100	4	15	17	1	14	24	10
100 or More	6	14	13	0	13	20	7
Total	**105**	**240**	**322**	**83**	**223**	**484**	**261**

Source: Congressional Budget Office.

* = between zero and $500 million.

a. A plan's actuarial funding ratio is the value of its assets divided by the value of its liabilities. A plan is said to be underfunded if the current value of its assets falls short of the value of its liabilities. At the time of CBO's analysis, data for 2012 were the most recent available from Internal Revenue Service Form 5500.

b. Plans' liabilities are computed as the present value of the remaining obligation to beneficiaries. They are calculated by discounting, to the valuation date, the projected value of cash flows for benefits that have been accrued as of that date. The discount rate used to calculate the actuarial value of liabilities is a plan's expected rate of return on its assets, whereas the discount rate used to calculate the market value of liabilities is CBO's projection for the interest rate on 30-year Treasury bonds. For plans' assets, the market value includes immediate recognition of investment gains and losses, whereas the actuarial value amortizes any gains and losses over five years.

benefit payments between 2013 and 2016. The values reported for 2016 were the averages from those simulations (see Table 3).

Plan Status. In its modeling, CBO did not directly project a plan's transition between the different status categories defined in ERISA (critical, seriously endangered, endangered, and neither critical nor endangered), which are assigned on the basis of a plan's funding ratio and other criteria. Instead, CBO used the plan's funding ratio alone as a proxy for the health of the plan. That funding ratio was used to predict employers' contributions (based on an equation estimated from historical data), their withdrawal decisions (based on a simple equation calibrated to generate reasonable withdrawal rates), and various other decisions and events that affect plans. In cases in which it was useful to report results by the current health of plans, CBO reported projections by plans' funding ratio as of 2016 instead of plans' ERISA status.

Table 3.
Market Value of Multiemployer Plans' Assets and Liabilities in 2012 and 2016

Plan's Actuarial Funding Ratio in 2016[a] (Percent)	Market Value in 2012 (Billions of dollars)		Projected Market Value in 2016 (Billions of dollars)	
	Assets	Liabilities	Assets	Liabilities
0-40	1	4	*	*
40-50	19	53	10	60
50-65	11	28	10	40
65-80	20	57	40	110
80-90	17	42	40	100
90-100	39	86	90	200
100 or More	115	214	290	520
Total	**223**	**484**	**490**	**1,040**

Source: Congressional Budget Office, using plans' filings of Internal Revenue Service Form 5500.

* = between zero and $5 billion (2016 values are rounded to the nearest $10 billion).

a. A plan's actuarial funding ratio is the value of its assets divided by the value of its liabilities.

Insolvent and Terminated Plans. CBO relied on data from PBGC for estimated financial assistance claims by insolvent and terminated plans because those plans no longer file IRS Form 5500. A plan is considered insolvent when it has insufficient assets to pay promised benefits, and it is considered terminated when all employers withdraw. In 2012, 49 insolvent and terminated multiemployer plans received financial assistance payments from PBGC totaling $95 million.[16]

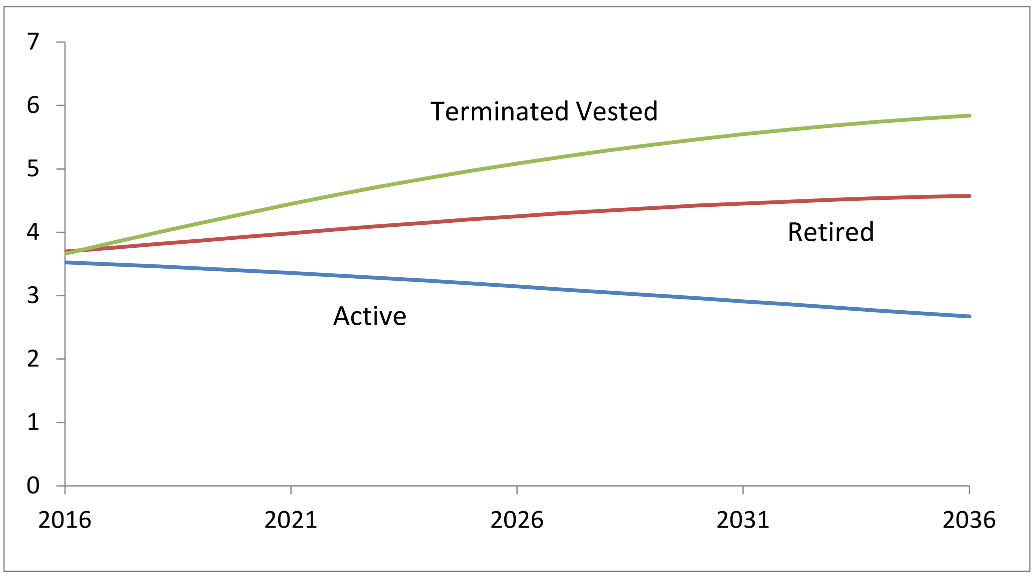
Participants and Benefits

The formulas used to determine how employees earn benefits vary considerably among plans and over time. About 67 percent of plans offer benefits that are primarily pay-related—that is, based on a formula expressed as a percentage of contributions to the plan, with the contributions generally a fixed percentage

[16] See Pension Benefit Guaranty Corporation, *2014 Pension Insurance Data Tables*, Table M-4, www.pbgc.gov/sites/default/files/legacy/docs/2014-data-tables-final.pdf (701 KB).

of total employee compensation.[17] About 21 percent of plans offer benefits that are primarily a flat dollar amount for every year of service. (The other 12 percent of plans either report offering both types of benefits or do not specify how their benefits are calculated.) Those percentage or dollar amounts may vary by job classification, participants' enrollment date, or the date that certain units of work were accrued. (Many plans raised benefit levels during the stock market run-up of the late 1990s but subsequently lowered new benefit accruals in the wake of the two most recent recessions.)[18] Thus,

Figure 2.
Projected Number of Participants in Multiemployer Plans, by Employment Status
Millions



Source: Congressional Budget Office.

Active participants in a multiemployer pension plan are current employees of employers in the plan, terminated vested participants are former employees who worked long enough to qualify for pension benefits but are not yet receiving them, and retired participants are retirees who are receiving benefits.

estimating the benefits accrued under a plan in any given year requires having an estimate of the number of participants who will be eligible to accrue benefits in that year and an estimate of what the representative participant's benefit per year of service will be.

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[17] In contrast, most single-employer pension plans insured by PBGC offer benefits that are based on an employee's salary (often the final salary or an average salary over the last few years of service).

[18] For a discussion of the actions that a plan's trustees may take when the plan has large investment gains, see Randy G. DeFrehn and Joshua Shapiro, *Multiemployer Pension Plans: Main Street's Invisible Victims of the Great Recession of 2008—The Results of the NCCMP 2009 Survey of the Funded Status of Multiemployer Defined Benefit Plans* (National Coordinating Committee for Multiemployer Plans, April 2010), www.nccmp.org/pdfs/publications/booklets/59101_NCCMP_SurveyRpt.pdf (5.2 MB).

CBO simulated the number of participants in a plan by employment status, age, and tenure using procedures similar to those used by PBGC and plans' actuaries.[19] Participants in a plan fall into one of three employment status categories: current employee of an employer in the plan (active participant), former employee who worked long enough to qualify for pension benefits but is not yet receiving them (terminated vested participant), or retiree who is receiving benefits (retired participant). The number of participants in a given category changes over time (see Figure 2) as new participants join the plan and become active, as active participants retire or leave and become terminated vested, and as terminated vested participants retire. (Rates of separation and new enrollment were selected to target a growth rate of the active workforce equal to -1 percent.)[20] In addition, the number of participants in all categories is decreased by participants' mortality.

CBO estimated the average dollar benefit per year of service by dividing the last reported benefit that a plan paid by the number of retired participants. That amount is expected to vary over time as employees who accrued benefits under different formulas become eligible to receive benefits or stop receiving benefits. To capture some of that variation, CBO assumed a static rate of growth in promised benefits, with the value of that rate selected to make the present value of currently accrued benefits equal to the current liability reported by the plan.[21] Furthermore, because many plans have significantly reduced benefit levels for newly accrued benefits in recent years, CBO estimated a separate constant benefit accrual rate for new accruals based on the plan's reported normal cost. The normal cost is a measure of the additional liability to pay benefits that a plan has accrued during the previous year.[22] To adjust for idiosyncrasies in the reporting of plans' normal costs, CBO capped the benefit accrual rate for new accruals at 150 percent of the estimated accrued benefit per participant.[23]

Projections of the number of participants were combined with projections of the rate of benefit accruals to estimate benefit cash flows for each plan and in total for all plans (see Figure 3). CBO used idiosyncratic

[19] For a discussion of actuarial methods used to project pension obligations, see Actuarial Standards Board, *Actuarial Standard of Practice No. 4: Measuring Pension Obligations and Determining Pension Plan Costs or Contributions,* Document 173 (revised December 2013), www.actuarialstandardsboard.org/wp-content/uploads/2013/12/asop004_173-3.pdf (162 KB).

[20] In its *FY 2015 Projections Report*, PBGC discusses the projections of the changes in employment levels that result in a net decrease in the active population of -1.3 percent. See Pension Benefit Guaranty Corporation, *FY 2015 Projections Report* (2016), www.pbgc.gov/documents/Projections-Report-2015.pdf (1.6 MB).

[21] The current liability is sometimes referred to as a proxy for the market value of a plan's liability. The Pension Protection Act of 2006 requires that the interest rate used to compute the current liability be no more than 5 percent above or 10 percent below the weighted average rates of interest on 30-year Treasury securities during the four years before the valuation date. For details, see U.S.C. §431 (2012 & Supp.). However, market discount rates (inferred from the prices of private-sector annuities) are typically lower than the discount rates used to value the current liability. For a discussion about selecting discount rates to value pension liabilities, see Congressional Budget Office, *The Underfunding of State and Local Pension Plans* (May 2011), www.cbo.gov/publication/22042.

[22] Put another way, the normal cost is a measure of the current value of the incremental benefit that an employee has accrued over that period. Plans may choose the method they use to value the normal cost, and they generally select either the entry-age-normal method or the unit-credit method. The entry-age-normal method attempts to create level contributions throughout an employee's career, whereas the unit-credit method attempts to fund benefits as they accrue rather than spreading costs out over time. The unit-credit method results in lower normal costs early in an employee's career and higher normal costs later in an employee's career than the entry-age-normal method does. (In 2012, 42 percent of plans reported using the entry-age-normal method, and 58 percent reported using the unit-cost method. Among plans considered critically underfunded, however, 26 percent used the entry-age-normal method, and 74 percent used the unit-cost method.) For an illustration of the methods used to measure normal cost, see Joseph Newton and Mark Randall, "Funding Policy and Actuarial Cost Methods" (presentation by Gabriel Roeder Smith and Company, March 22, 2013), www.tmrs.com/down/presentations/FundingPolicy_ActuarialCostMethods.pdf (876 KB).

[23] When reporting normal cost, some plans include costs other than the present value of benefits accrued during the year, depending on the funding method used. For more information, see Reasonable Funding Methods, 26 C.F.R. §1.412(c)(3)-1 (2006 & Supp.).

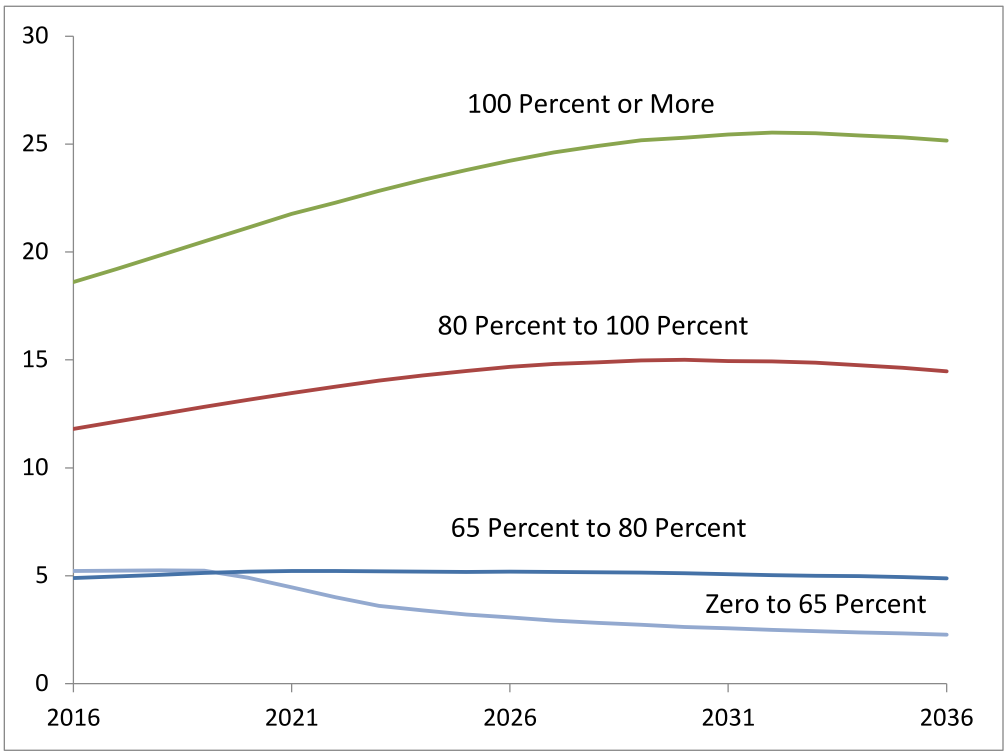
shocks to the overall level of benefits payable to capture unmodeled variation in benefits payable stemming from fluctuations in rates of hiring, separation, retirement, or mortality. CBO's analysis suggests that the results of the model are largely insensitive to changes in those rates (as discussed below in the section on "Analyzing the Sensitivity of the Results to Key Assumptions").

Assets and Liabilities

Plans periodically report the values of their assets and liabilities following actuarial procedures, and those valuations determine employers' contributions. CBO projected plans' assets and liabilities using procedures that mimic those used by the plans' actuaries.

The future value of a pension plan's assets is uncertain because of variations in the returns on those assets, in employers' contributions, and in benefit payments. CBO projected two values for a plan's assets: *market values*, which are used to project when a plan may run out of assets and declare insolvency, and *actuarial values*, which are used in determining the required level of contributions. For both measures, the projected value of assets in the next period is equal to the value in the previous period plus the sum of employers' contributions and a measure of investment gains or losses, minus the sum of benefits paid and the plan's administrative expenses.

Figure 3.
Projected Annual Benefit Payments, by Plans' Actuarial Funding Ratio in 2016
Billions of Dollars



Source: Congressional Budget Office.

A plan's actuarial funding ratio is the value of its assets divided by the value of its liabilities.

For the market value of assets, the investment gain or loss is the change in the market value of the investments held by the plan—primarily stocks, bonds, and other assets. In the simulation, the plan's investment portfolio is rebalanced to maintain the same asset allocation in each period, which is consistent with the relatively static investment allocations of most plans. Market rates of return for each plan's asset portfolios were simulated using a simple model of asset returns in which plans with portfolios whose returns are more strongly correlated with returns on the stock market earn higher but more variable rates of return. (The variability of each plan's investment returns has both market and idiosyncratic components.)

For the actuarial value of assets, CBO smoothed the asset values by amortizing investment gains and losses over five years, which approximates the valuation method used by plans. As a result, the actuarial value tends to lag behind the market value along any path of the simulation, but the average actuarial and market values are close to one another over most of the projection period. (The exception is in the first few years before the start of the projection period, which were affected by the large amount of market volatility that occurred between 2008 and 2012 and that pushed actuarial and market values apart.)

For plans' liabilities, CBO projected *actuarial* and *current* values because both are necessary to determine plans' funding. Both measures are computed as a present value of the remaining obligation to beneficiaries and are calculated by discounting to the valuation date the projected value of benefit cash flows that have been accrued as of that date. That liability calculation includes only cash flows that are due in the future; hence, for a plan that stops accruing new benefits, the liability will tend to decline over time as benefits are paid.[24]

In the model, the present value of liabilities is calculated in each period from CBO's projections of benefit cash flows. When reporting the actuarial value of liabilities, plans' actuaries are directed to choose a discount rate equal to their best estimate of the expected return on the plan's assets. Judging from plans' filings, that discount rate does not appear to change from year to year, so CBO held the rate for each plan constant throughout the simulation. In contrast, CBO calculated the current value of liabilities by discounting the benefit cash flows at a discount rate equal to CBO's estimate of the interest rate on 30-year Treasury bonds, which the agency expects will rise over the next five years. Because the current liability is based on the current market rates of a security with comparable risk, it more closely approximates the price that a private insurer would charge to take responsibility for paying a plan's benefit stream.

CBO projects that the market value of plans' liabilities will gradually decline over the projection period (see Table 4). Plans with a higher initial funding ratio will continue to accrue new benefits for their participants, but employers participating in those plans will also choose to withdraw as the plans become even better funded. In contrast, plans with a lower funding ratio will reduce benefits when possible or become insolvent.[25] Because there is a persistent difference between the actuarial and market discount rates, the actuarial value of liabilities remains significantly lower than the market value of liabilities over the projection period.

Those differences in liability valuations result in similar patterns—but very different values—for actuarial and market funding ratios. Overall, plans' funding ratios look considerably worse on a market-value basis than they do on an actuarial-value basis, mostly because the use of a lower discount rate for the market

[24] An equivalent way to calculate a plan's liabilities in the next year is to use the current year's value, add the gain or loss because of changes in the discount rate and new benefit accruals, and subtract the level of benefits paid for that year.

[25] The average actuarial funding ratio in 2015 was projected to be 93 percent, which is consistent with the estimate for a survey of plans reported in Segal Consulting, *Survey of Plans' Zone Status* (Spring 2015), www.segalco.com/media/1975/spring2015zonestatus.pdf (647 KB).

liability measure means that the market value of liabilities is much larger than the actuarial value of liabilities. Funding ratios are projected to decline for the most severely underfunded plans as those plans approach insolvency. However, funding ratios are projected to improve for plans that are eligible for benefit reductions as employers continue to make contributions to cover a smaller liability.

Contributions

Employers typically negotiate contribution rates for multiemployer plans that exceed the minimum contribution required by law. Thus, CBO determined a simple rule to predict the total contribution rate for a plan (as a percentage of its actuarial liability) based on a linear formula related to the plan's previous contribution rate, its current funding ratio, the change in the funding ratio from the previous period, and the fraction of orphan participants relative to total participants (see Table A-1 in Appendix A). That predictive rule matched historical contribution rates for plans reasonably well, but CBO used an alternative rule for plans that enter a critical and declining state (as discussed in the next section). CBO then set the total contribution at the greater of the predicted contribution amount or the minimum required contribution. Pension funding rules specify the minimum required contribution as the sum of a plan's normal cost and a contribution to reduce underfunding (an amount that the plan projects will eliminate its funding shortfall over several years). In addition, CBO capped the total contribution at 140 percent of the difference between the current value of a plan's liabilities and the actuarial value of the plan's assets to account for the excise tax that puts an effective upper bound on employers' contributions.

Table 4.
Projected Assets, Liabilities, and Funding Ratios of Multiemployer Plans

	Plan's Actuarial Funding Ratio in 2016[a] (Percent)				All Multiemployer Plans
	0-65	65-80	80-100	100 or More	
				Assets (Billions of dollars)	
				Actuarial Value	
2016	30	40	150	320	550
2021	20	50	170	350	590
2026	10	50	190	370	620
2031	10	50	190	370	630
2036	10	60	190	380	640
				Market Value	
2016	30	40	140	290	490
2021	10	40	160	320	540
2026	10	50	180	350	590
2031	10	50	190	350	600
2036	10	50	190	370	620
				Liabilities (Billions of dollars)	
				Actuarial Value	
2016	60	60	170	280	570
2021	60	60	180	310	610
2026	50	60	180	320	610
2031	30	60	180	310	580
2036	20	50	160	290	520
				Market Value	
2016	100	110	300	520	1,040
2021	90	100	260	450	890
2026	70	90	260	450	870
2031	50	90	250	440	820
2036	30	80	220	410	740
				Average Funding Ratio[b] (Percent)	
				Actuarial-Value Basis	
2016	40	72	90	113	74
2021	17	67	96	114	66
2026	11	66	103	117	66
2031	14	80	113	123	73
2036	23	113	136	142	91
				Market-Value Basis	
2016	24	40	46	56	39
2021	12	45	63	72	43
2026	9	47	70	77	45
2031	10	58	79	83	50
2036	17	83	98	100	65

Source: Congressional Budget Office.

Values for assets and liabilities are rounded to the nearest $10 billion.

a. A plan's actuarial funding ratio is the value of its assets divided by the value of its liabilities.
b. The total value of the assets of all plans in a given funding category divided by the total value of those plans' liabilities.

For most plans, contributions will decline gradually over time because of a number of factors. Plans' normal cost will fall as the projected number of active participants—and thus accruals of new benefits—declines. Funding ratios for most plans are expected to improve over time (see Table 4), which will gradually decrease contributions to reduce underfunding. For plans with a funding ratio below 65 percent, contributions to reduce underfunding will also decline because more employers will withdraw as the plans approach insolvency. However, for critical and declining plans, which are eligible for benefit reductions, contributions to reduce underfunding will increase as a share of the total contributions paid by the employers in those plans.

Critical and Declining Plans

Under the Pension Protection Act, specific rules apply to plans that become critically underfunded. A critically underfunded plan is one that faces insolvency in the near term and typically has a funding ratio of less than 65 percent. If such a plan is unable to implement a strategy to improve its funding and emerge from critical status over a specified period—generally 10 to 15 years—it must take actions to emerge from critical status at a later date or at least to forestall insolvency. Those actions can include increasing employers' contributions, reducing future benefit accruals, changing the plan's benefit structure, and cutting the plan's expenditures (including through a merger). If those actions are insufficient for the plan to remain solvent, the plan's trustees must certify that the plan has exhausted all reasonable measures to avoid insolvency and emerge from critical status. Thus, plans that have declared an exhaustion of all reasonable measures will generally expect their funding to deteriorate over time.

Under the Multiemployer Pension Reform Act, critical and declining plans may apply to the Secretary of the Treasury for permission to reduce benefits, provided that the plan's actuary certifies that the plan is projected to avoid insolvency with those reductions, while also providing complete protection for certain beneficiaries (based on age and disability) and partial protection for others.[26] Benefits may not be reduced below 110 percent of the maximum level insured by PBGC.

The MPRA also changed the rules for partitions, in which some of the liabilities of a troubled plan are placed in a new PBGC-supported plan. However, there are likely to be few partitions under current law because PBGC lacks the financial resources necessary to fund partitions for large plans.[27]

In its modeling, CBO captured the MPRA's rules for critical and declining plans by first applying a basic eligibility test that designated any plan whose funding ratio fell below 65 percent for three consecutive years as critical and declining. (Plans identified as being in a critical and declining state in 2016 were treated as starting in that state in the simulation.) Critical and declining plans were reevaluated in each period of the simulation to determine eligibility for benefit reductions. If a plan required more than 15 years to reach full funding at its current level of benefits and contributions to reduce underfunding, CBO estimated the benefit reduction necessary for the plan to be fully funded within 15 years at the plan's current level of contributions to reduce underfunding. However, many plans would be unable to achieve full funding within 15 years without cutting benefits below 110 percent of the maximum insured level, and thus they would be ineligible for benefit reductions under CBO's criteria. Critical and declining plans are projected in the simulation to account for 16 percent of multiemployer plans' total liabilities in 2026 and 22 percent of liabilities in 2036. Of the critical and declining plans that are not terminated because of

[26] Participants can vote against such cuts, but with plans whose insolvency would expose PBGC to $1 billion or more in losses, the Secretary of the Treasury may proceed with cuts irrespective of the vote's outcome. The rules for benefit reductions are specified in Consolidated and Further Continuing Appropriations Act, 2015, P.L. 113–235, 128 Stat. 2794 (2014). What CBO refers to in this paper as benefit *reductions* or *cuts* are referred to in that statute as benefit *suspensions*.

[27] For a discussion of how federal assistance could be used to allow PBGC to increase its use of partitions to resolve troubled plans, see Congressional Budget Office, *Options to Improve the Financial Condition of the Pension Benefit Guaranty Corporation's Multiemployer Program* (August 2016), www.cbo.gov/publication/51536.

mass withdrawal, 7 percent (measured by liabilities) in 2026 and 2036 meet the criteria for benefit reductions.

CBO projected that only a small fraction of the plans eligible for benefit reductions in a given year would implement them, because getting those reductions approved by the Secretary of the Treasury is a lengthy process, including the solicitation of comments from contributing employers and plan participants. To account for the effect of those requirements, CBO assigned a 15 percent probability that an eligible plan's benefit reductions would be approved in any year. That assumption has little effect on CBO's projections of PBGC's finances because only a small number of plans will satisfy the evaluation criteria that CBO applied. For plans that negotiate a benefit cut to return to solvency, the plan stays in that status for the remainder of the simulation, and contributions to reduce underfunding remain fixed until the plan is on a path to solvency.

Plans that do not meet the criteria for benefit reductions are assigned a 10 percent annual probability of declaring that they have exhausted all reasonable measures to avoid insolvency. (CBO's projections are relatively insensitive to significantly higher or lower probabilities than that because, in general, plans that are critical and declining have an increased likelihood of facing insolvency.) For plans that have exhausted all reasonable measures, total contributions remain fixed at the same level as in the recent past, typically causing the plan to follow a slow path toward insolvency.[28] Plans that have not exhausted all reasonable measures and have not cut benefits are simulated using the simple contribution rule described above.

Employer Withdrawal

A participating employer may withdraw from a multiemployer plan for a variety of reasons. An employer in a significantly underfunded plan or in a declining industry may choose to withdraw rather than face rising contribution requirements in future years. Alternatively, an employer in a well-funded plan may determine, as part of its labor negotiations, that continuing to participate in the plan is less desirable than enrolling employees in a defined contribution plan. (Defined contribution plans have less administrative burden, do not require the employer to pay premiums to PBGC, and shift the risk of investment losses to employees.)[29]

An employer that withdraws from an underfunded multiemployer plan is assessed a withdrawal liability. The amount is based on the employer's share of the plan's total liabilities, minus the plan's assets, when the employer leaves.[30] After the withdrawal, the remaining employers in the plan assume responsibility

[28] In practice, many plans that have exhausted all reasonable measures continue to offer future benefit accruals at a reduced level (typically capped at 1 percent of contributions).

[29] In a complete withdrawal, the employer ceases to have an obligation to contribute to the plan (for example, because the employer is no longer covered by a collective bargaining agreement) or ceases all covered operations under the plan (for example, because the employer has gone out of business). Alternatively, an employer may choose to partially withdraw from a plan. In a partial withdrawal, at least one employer either has a reduced obligation to contribute (for example, because the employer has multiple bargaining agreements but no longer has an obligation to contribute under at least one of those agreements) or experiences a decline of at least 70 percent in its contribution base units (the units by which employers' contributions are measured, such as hours worked or units of production). The rules for partial withdrawals are specified in 29 U.S.C. §1385 (2012 & Supp.).

[30] The amount may be calculated using one of several methods (and is often amortized over several years), but generally it is based on the employer's contributions as a percentage of all contributions to the plan multiplied by the plan's unfunded liabilities. An employer's withdrawal liability is considered paid off after the employer pays the assessed amount plus interest or has made payments for 20 years, whichever comes first. Annual withdrawal liability payments are capped at the highest per capita contribution rate to the plan over the past 10 years (the look-back period) multiplied by the largest three-year average annual number of contribution base units (such as number of hours worked). That cap—particularly the look-back period—may make it advantageous for employers in an underfunded plan to withdraw rather than face rising contributions if they continue to participate. Thus, the cap potentially increases PBGC's liability by reducing employers' liability when those employers might

for contributing toward the benefits of participants who worked for the withdrawing employer (orphan participants) in the event that the plan becomes significantly underfunded. Nevertheless, the absence of former employers can exacerbate a plan's underfunding.[31]

CBO's model accounts for plans that had some or all of their employers withdraw in 2012 or earlier. For such a plan, the model incorporates the plan's distribution of active and inactive (including orphan) participants; previous withdrawal liability payments from former employers are reflected in the value of the plan's assets.[32] For plans that had no participating employers in 2012 or earlier (because of a mass withdrawal), CBO used PBGC's projections rather than modeling those plans' costs. However, plans that have already experienced mass withdrawals account for a small share of the total liabilities of multiemployer plans.

For 2017 and later, CBO simulated the effects on plans of mass withdrawals, which have a small probability of occurring in each year, but CBO did not simulate the effects of withdrawals by a subset of employers. (In addition, CBO did not project any mass withdrawals between 2013 and 2016, the period between the year of the latest available data and the start of the simulation model.) One way to approximate the effects on a plan of withdrawal by a subset of employers is to calculate a weighted average of the effects from the plan's experiencing a mass withdrawal and no withdrawal, with the weight applied to mass withdrawal increasing with the fraction of liabilities attributable to the departing employers. Thus, CBO's estimates of future probabilities of mass withdrawal can be interpreted as including an additional adjustment to account for withdrawals by a subset of employers.[33]

In its modeling, CBO assumed that employers' probability of mass withdrawal varies with a plan's funding ratio in the simulated economic path. Historically, there have been few instances in which all employers have withdrawn from a plan, so the data are insufficient to accurately estimate the parameters of a more complicated model of withdrawal. (The provisions in the PPA that require additional action when plans are underfunded and that exempt plans that have exhausted all reasonable measures to avoid insolvency from minimum contribution requirements have probably also reduced the probability that employers will withdraw prior to a plan's insolvency.) CBO expects that employers in severely underfunded plans are more likely to withdraw than employers in less underfunded plans because required contributions, particularly contributions to reduce underfunding, will place a larger financial burden on those employers. At the same time, CBO expects that employers in fully funded plans have a greater probability of withdrawing and switching to other forms of retirement benefits than do employers in underfunded plans that withdraw because of the plans' distress.

Employers in plans that accounted for 5 percent of total liabilities in 2016 will withdraw by 2026, CBO projects, and employers in plans that accounted for 11 percent of total liabilities in 2016 will withdraw by 2036. Of the plans that experience mass withdrawals by 2036, 79 percent (measured by liabilities) will be

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otherwise have been able to pay their full assessment. The rules for the amount of annual withdrawal liability assessments are specified in 29 U.S.C. §1399 (2012 & Supp.).

[31] Even if the withdrawing employers make withdrawal liability payments to cover the entire liabilities of orphan participants, the existence of those participants' benefits increases the risk of future underfunding because withdrawing employers have no obligation to make the plan whole for any investment losses on their withdrawal liability payments. (That additional risk could be eliminated if the withdrawal liability payments were used to purchase an annuity.) Such losses would raise the total contribution that the remaining employers would need to make to meet the shortfall and therefore would increase the incentive for all employers to withdraw from the plan.

[32] Data are not available that indicate the amount of ongoing withdrawal liability payments to plans that have experienced employer withdrawals. As a result, CBO's projections of the value of plans' assets may be understated for plans that previously had one or more employers withdraw without having paid their full withdrawal liability.

[33] CBO plans to explore how to explicitly model such partial withdrawals in future revisions of the model.

plans that become overfunded, and the remaining 21 percent will be plans that become underfunded. Only mass withdrawals from underfunded plans are expected to pose a significant risk of plans' insolvency, however, because the overfunded plans are assumed to purchase annuities from insurers to cover their benefits and thus no longer require PBGC insurance.

In the simulations, if a plan experiences withdrawal by all of its employers, pension benefits no longer accrue and employers make no further contributions, although they do make withdrawal liability payments. The plan continues to pay vested benefits as promised based on funding from its assets and amortized withdrawal liability payments. For underfunded plans, CBO projects that the withdrawing employers will make withdrawal liability payments that are amortized over a maximum of 20 years and that have a present value equal to 40 percent of the actuarial value of the funding shortfall. The 40 percent figure, which is based on private discussions with industry experts, is intended to capture various events, such as the probability that former employers will remain financially sound enough to make scheduled payments. For plans that are not underfunded, CBO projects that no withdrawal liability payments will be made.

Plan Insolvency

Even with the MPRA's options for benefit reductions and partitions, most plans that have experienced mass withdrawal, and many critical and declining plans, may eventually become insolvent. Plans in either of those states will continue to receive contributions and withdrawal liability payments from current and former employers and will continue to pay benefits to participants—until they have too few assets to pay all promised benefits that come due and thus are declared insolvent. Once that happens, a plan's benefits are reduced to no less than the maximum level insured by PBGC, and if necessary, PBGC gives the plan enough financial assistance to allow it to pay that level of benefits.[34] Many years may elapse between the time that all employers withdraw and the point at which the plan becomes insolvent. For some critical and declining plans, employers may remain active in the plan even after insolvency occurs.

CBO captures those features of insolvency in its modeling of withdrawal events and critical and declining plans. In the simulations, the liabilities of insolvent plans are projected to make up $64 billion (7 percent) of all liabilities in 2026, on average, and increase to $96 billion (13 percent) of all liabilities by 2036. Plans that have a funding ratio below 65 percent represent PBGC's largest exposure to risk from 2017 to 2026—accounting for $42 billion (65 percent) of all insolvent liabilities in 2026 (see Figure 4)—as very little can be done to help those plans improve their funding status. Many of those plans will become insolvent after many years in which projected benefit payments significantly exceed employers' contributions.

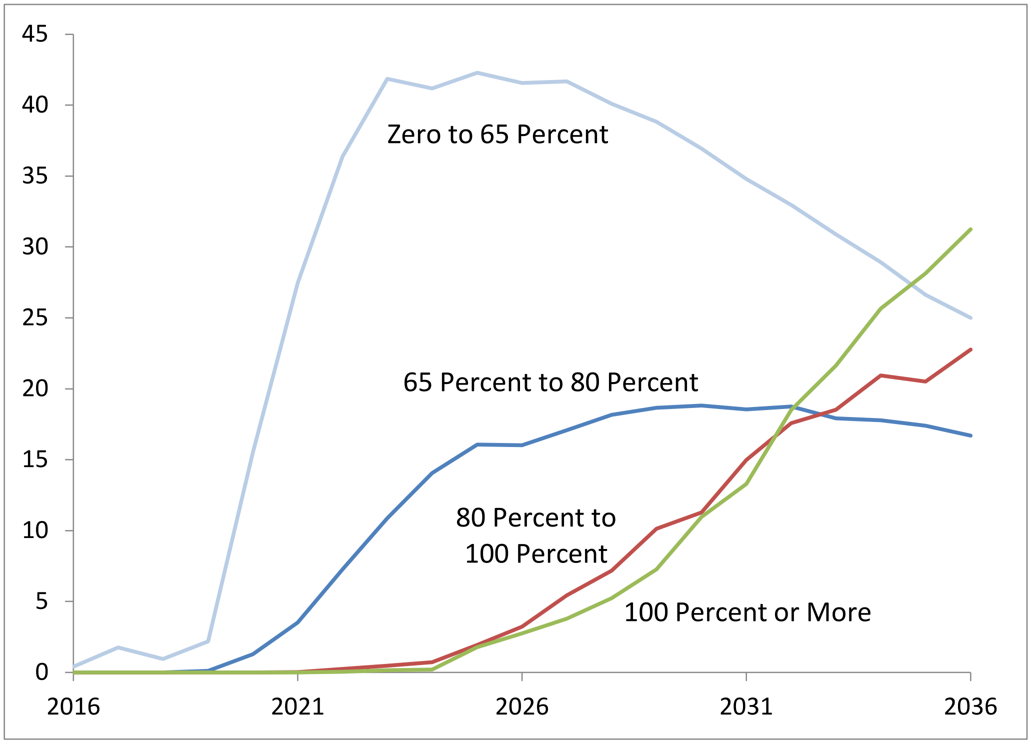
CBO's Projections of Claims on PBGC and Losses to Beneficiaries

The cost of PBGC's insurance is measured in the federal budget on a cash basis. The financial assistance payments that PBGC makes to plans and the costs of administering the multiemployer program are recorded in the budget as federal outlays in the year they are paid. Similarly, the premium payments that PBGC receives from plans are recorded as offsetting receipts (that is, negative outlays) in the year they are received. The multiemployer program does not receive any funding from general tax revenues; its operations are funded from premium payments and interest earned on its invested assets.

[34] Pension law is ambiguous about whether PBGC has the authority to compel a plan to cut benefits to the maximum insured level before the plan is declared insolvent. PBGC believes it does not have that authority, and CBO follows PBGC's interpretation in producing its current-law estimates. For details, see 29 U.S.C. §§1341a, 1342 (2012 & Supp.).

In the 10-year baseline budget projections published in March 2016, CBO projected that if current laws did not change, the multiemployer program would receive claims for financial assistance totaling

Figure 4.
Projected Liabilities of Insolvent Plans, by Plans' Actuarial Funding Ratio in 2016
Billions of Dollars



Source: Congressional Budget Office.

A plan's actuarial funding ratio is the value of its assets divided by the value of its liabilities.

$9 billion from 2017 through 2026, while collecting premiums of $4 billion and earning interest of $1 billion on its assets. With that expected pattern of cash flows, the program would exhaust the assets it has previously accumulated (estimated to total $2 billion in 2016) and become insolvent for the first time in its history in 2025, CBO projected. As a result, a total of $3 billion in claims for financial assistance made in 2025 and 2026 would not be paid under current law.[35]

Claims for financial assistance are projected to be considerably larger in the following decade (2027 to 2036): a total of $35 billion. The multiemployer program is expected to receive only $5 billion in premiums during that period (and not earn any interest, having exhausted its assets). Thus, under current law, financial assistance payments would be limited to about $5 billion over that decade.

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[35] Because the outlook for the multiemployer program has continued to worsen, CBO's latest baseline projects that the program will become insolvent in 2024 and be unable to pay a total of $10 billion in claims between 2024 and 2027. See Congressional Budget Office, "Baseline Projections for Selected Programs: Pension Benefit Guaranty Corporation" (January 2017), www.cbo.gov/about/products/baseline-projections-selected-programs#13.

An alternative way to measure the costs of PBGC's insurance is on a fair-value basis, which approximates the current market value of claims on the multiemployer program, net of premiums received, without regard to the fact that the amount of financial assistance that PBGC can pay is limited under current law to the amount of assets it has available.[36] On a fair-value basis, the value of PBGC's insurance is significantly larger than cash-based estimates indicate: $101 billion in financial assistance obligations, net of premium income, for plans that are expected to become insolvent over the next 20 years, CBO estimates.

Fair-value estimates are more comprehensive than cash-based estimates because they include the full lifetime of cash flows associated with claims from plans' insolvencies and because they account for the time value of money and the cost of market risk. Including the lifetime costs of plans' insolvencies is important because the structure of PBGC's insurance defers financial assistance payments until all other sources of funding have been exhausted—it may take more than 20 years for the full costs to PBGC of a distressed plan to be realized. By accounting for the time value of money, present-value estimates indicate the lump-sum amount today that would need to be set aside in an interest-bearing account to cover the shortfall between premiums and claims in the future. Claims also have a significant element of market risk—they are likely to be largest following unexpected declines in economic conditions that generally depress the values of risky assets that plans hold, making it more likely that plans will become insolvent in the future.[37] The more market risk that the assets of an insured plan are subject to, the larger the value of PBGC's exposure to claims from that plan.

Claims for Financial Assistance From Severely Underfunded Versus Better-Funded Plans

CBO estimates that plans that had a funding ratio below 65 percent in 2016 will file claims for financial assistance totaling $5 billion on a cash basis from 2017 through 2026, accounting for more than half of estimated claims during that period (see Table 5). The cash outflow for claims by such plans is expected to more than triple in the following decade, to $16 billion. However, fair-value estimates of claims by plans with a funding ratio below 65 percent indicate that most claims will be attributable to insolvencies in the first decade: $26 billion because of insolvencies between 2017 and 2026, compared with $3 billion because of insolvencies between 2027 and 2036.

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[36] One way to think about the value of PBGC's insurance, which is consistent with the fair-value approach, is as a financial derivative contract called a "put option." A put option gives the buyer the right to sell an asset at a prenegotiated price (called the "strike price") at some date in the future. PBGC's insurance gives employers rights similar to those of the buyer of a put option. By withdrawing from a plan, employers can effectively sell the plan's assets and make withdrawal liability payments to PBGC in exchange for the current liability of the plan, which represents the strike price. The put option is more beneficial to employers the more underfunded the plan is and the lower the withdrawal liability obligations are. The losses from exercising the put option are borne by PBGC and plan participants, whose benefits are cut to the maximum level insured by PBGC when the plan becomes insolvent. The concept of PBGC's insurance as a put option has been the focus of several academic papers, most recently Jules H. van Binsbergen, Robert Novy-Marx, and Joshua D. Rauh, *Financial Valuation of PBGC Insurance With Market-Implied Default Probabilities*, Working Paper FR 13-27 (Simon Business School, University of Rochester, January 2014), http://dx.doi.org/10.2139/ssrn.2336304.

[37] Market risk is that part of the risk of an investment that cannot be eliminated through diversification. It occurs because most investments (including the assets of defined benefit plans) tend to perform relatively poorly when the economy is weak and relatively well when the economy is strong. People value income from investments more when the economy is weak and income is relatively low, so they assign a higher cost to losses that occur during economic downturns. The cost of market risk captures the higher cost of losses in bad times (and the lower cost in good times). To bear market risk, investors require compensation (known as a risk premium), which typically equals the difference between the higher expected rate of return on risky securities and the rate that can be earned on safe securities, such as federal debt. Thus, one way to account for the cost of market risk is to adjust the cash flow of an investment that has such risk by removing the component of the cash flow that is attributable to the risk premium. For a related discussion, see Congressional Budget Office, *Fair-Value Accounting for Federal Credit Programs* (March 2012), www.cbo.gov/publication/43027.

In addition, plans with a funding ratio of 65 percent or above will file financial assistance claims totaling $2 billion on a cash basis between 2017 and 2026, CBO estimates. The cash outflow for claims by such plans is expected to soar to $18 billion in the following decade. Fair-value estimates help to explain the finding of large claims attributable to better-funded plans. Only a few of those plans are expected to

Table 5.
Cash-Based and Fair-Value Estimates of Financial Assistance Claims and Premiums for PBGC's Multiemployer Program

Billions of Dollars

	Cash-Based Estimates			Fair-Value Estimates		
Actuarial Funding Ratio in 2016[a] (Percent)	Financial Assistance Claims	Premiums	Interest	Financial Assistance Claims	Premiums	Market Value of Liabilities in 2016[b]
			2017 to 2026			
0-65	5	*	*	26	*	100
65-80	2	*	*	12	*	110
80-100	*	1	*	5	1	300
100 or More	*	2	*	3	2	520
Terminated and Insolvent Plans	2	n.a.	n.a.	3	n.a.	n.a.
Total	**9**	**4**	**1**	**49**	**3**	**1,040**
			2027 to 2036			
0-65	16	*	0	3	*	100
65-80	8	*	0	7	*	110
80-100	6	2	0	22	1	300
100 or More	4	2	0	25	2	520
Terminated and Insolvent Plans	1	n.a.	n.a.	0	n.a.	n.a.
Total	**35**	**5**	**0**	**58**	**3**	**1,040**

Source: Congressional Budget Office, using data from the Pension Benefit Guaranty Corporation and from plans' filings of Internal Revenue Service Form 5500.

PBGC = Pension Benefit Guaranty Corporation; * = between zero and $500 billion; n.a. = not available.

a. A plan's actuarial funding ratio is the value of its assets divided by the value of its liabilities.

b. Values for liabilities are rounded to the nearest $10 billion.

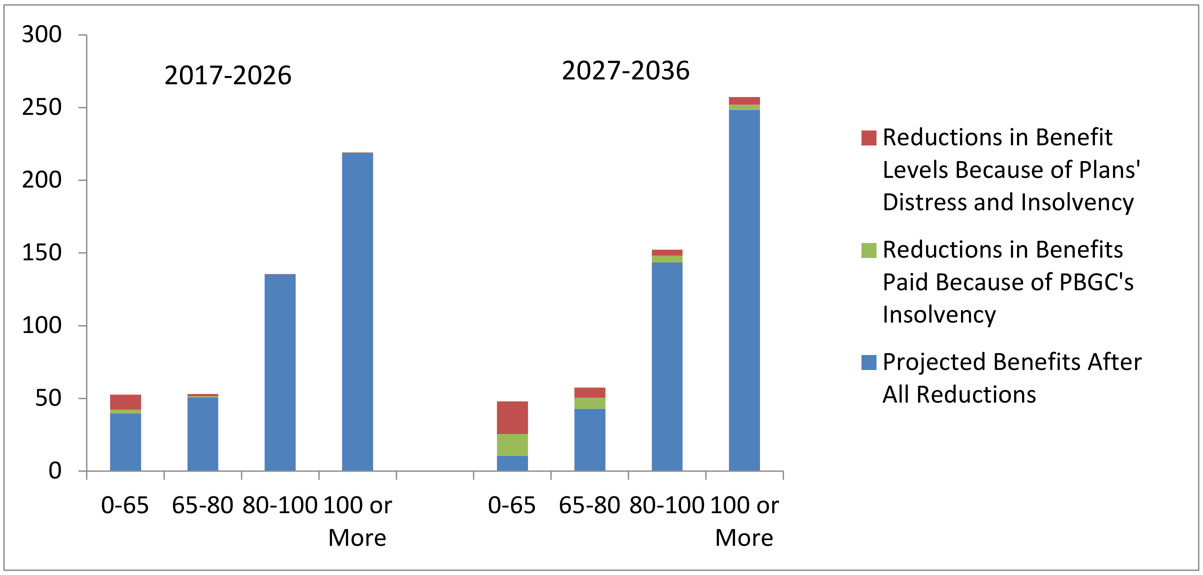
become insolvent between 2017 and 2026; the fair value of lifetime claims from those insolvencies totals $20 billion. However, many more plans with a funding ratio of 65 percent or above are likely to face insolvency in the second decade, accounting for $55 billion of the $58 billion in lifetime claims attributable to plans' insolvencies during that period.

The primary factor that makes insolvency probable for better-funded plans is the weakness of the rules that govern plans' funding. Because plans often must sell assets at a time when asset values are low to pay benefits currently due, a significant drop in asset values may permanently reduce the growth potential of the plans' assets. Plans' funding is further weakened because liabilities continue to grow without employers increasing contributions significantly to make up current shortfalls. Those effects are more pronounced in simulations that include multiple years of economic weakness, making it even more difficult for plans to recover completely.

PBGC premiums are equal to a fixed amount per plan participant and are not tied to a plan's riskiness. Premiums currently equal $27 per participant and are indexed to increase at the same rate as average wages in the economy in future years. Although CBO projects that premiums will rise to $36 per participant by 2026, premium revenue is likely to be insufficient to cover financial assistance claims on

Figure 5.
Projected Benefits Paid by Multiemployer Plans After Benefit Reductions, 2017-2036, by Plans' Actuarial Funding Ratio in 2016

Billions of Dollars



Source: Congressional Budget Office.

A plan's actuarial funding ratio is the value of its assets divided by the value of its liabilities.

The total height of each bar represents the benefits currently promised by those plans over the relevant decade. The blue portion of each bar represents the benefits projected to be paid by those plans given reductions stemming from plans' insolvencies, plans' negotiated benefit cuts, and the projected insolvency of PBGC's multiemployer program.

PBGC = Pension Benefit Guaranty Corporation.

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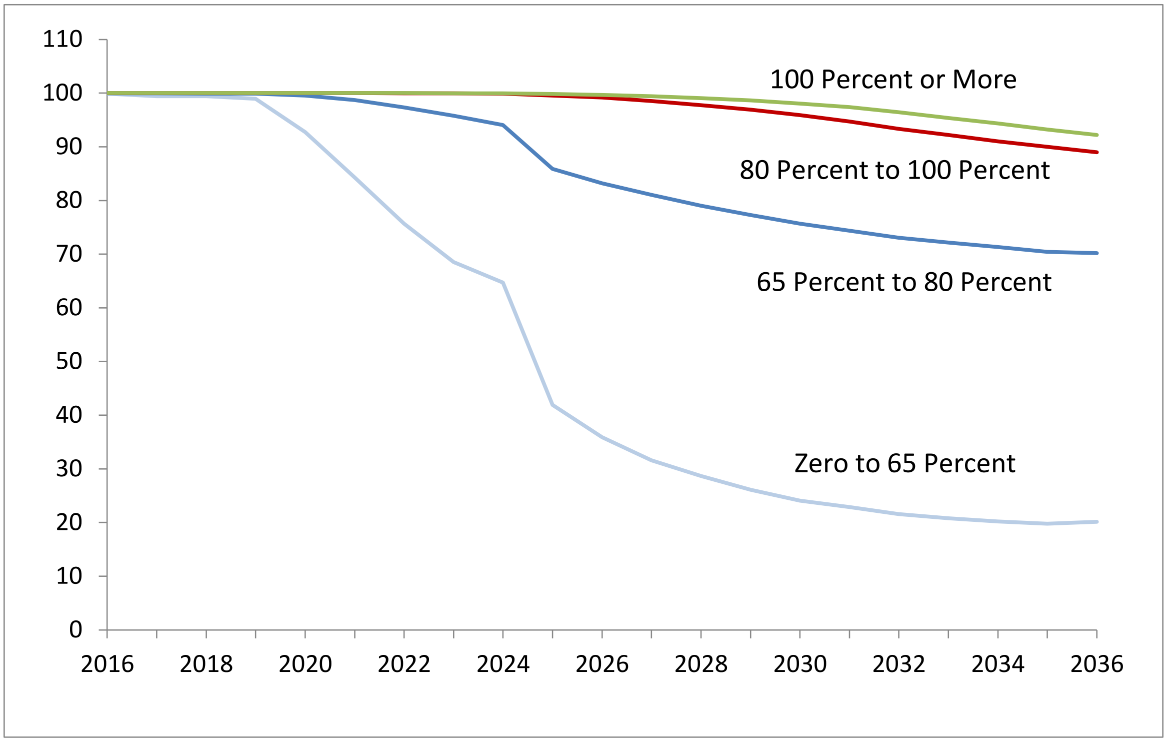
both a cash basis and a fair-value basis. As a result, the multiemployer program will become insolvent in 2025, CBO projects, and its financial assistance payments will be limited, under current law, to the amount of premium revenue it collects. In 2025 and 2026, PBGC will be unable to pay claims totaling $3 billion, but that amount is projected to increase to a total of $31 billion between 2027 and 2036.

Losses to Beneficiaries

Beneficiaries of plans that had a funding ratio below 65 percent in 2016 will face significant cuts in benefits from the amounts they expect to receive. CBO projects that the total benefits paid by those plans over the 2017–2026 period will be lower than promised by $10 billion (or 19 percent) because of plans' insolvencies and other benefit reductions allowable by law (see Figure 5). In addition, with the multiemployer program expected to become insolvent in 2025, PBGC will be unable to pay a total of $2 billion in claims from such plans, CBO projects. With that effect included, the amount of benefits paid by such plans between 2017 and 2026 will be $12 billion (or 24 percent) lower than the amount promised to beneficiaries.

The impact on beneficiaries will be even more significant in the following decade. Benefit cuts and plans' insolvencies are projected to reduce the benefits paid by plans that had a funding ratio below 65 percent in 2016 by $22 billion (or 47 percent) between 2027 and 2036. The insolvency of the multiemployer

Figure 6.
Projected Percentage of Promised Benefits Paid, by Plans' Actuarial Funding Ratio in 2016
Percent



Source: Congressional Budget Office.

A plan's actuarial funding ratio is the value of its assets divided by the value of its liabilities.

program will prevent PBGC from paying a total of $15 billion in claims from those plans, CBO projects; thus, the amount of benefits paid by such plans over the 2027–2036 period will be $37 billion (or 78 percent) lower than the amount promised to beneficiaries. By 2036, plans that had a funding ratio below 65 percent in 2016 will be paying just 20 percent of the currently promised level of benefits, CBO projects (see Figure 6).

Using CBO's Model for Policy Analysis

Besides helping to produce baseline budget projections, CBO's model of the multiemployer program can serve several other functions. It provides a disciplined framework for analyzing how alternative policies would affect the multiemployer program. Also, because it is a rigorous quantitative model, it can be run with different sets of parameters to establish how uncertain the projections of current and alternative policies are. In addition, the model could be used to provide estimates of plans' tax-deductible contribution rates, which would underlie estimates of how legislation affecting the multiemployer program would alter federal revenues. (However, the Congress's Joint Committee on Taxation is responsible for producing revenue estimates of legislation.) Finally, the model can be used to produce budget estimates of the multiemployer program on an accrual basis, which some policymakers have suggested as an alternative to the cash basis currently used in the federal budget.

Estimating the Effects of Policy Changes

CBO has used its model to analyze various options to improve the financial condition of the multiemployer program. The options examined to date included changing the terms of PBGC's insurance (such as premium levels or the maximum insured level of benefits), changing the rules that govern plans' funding requirements, and providing federal financial assistance to PBGC.[38] CBO projected that significant increases in premiums would be necessary for the multiemployer program to remain solvent over the next 20 years and that large cuts in the maximum insured benefit or stringent changes to funding rules would delay the program's insolvency by only a few years. However, such changes might hasten the demise of multiemployer defined benefit plans because employers in better-funded plans would probably close their plans and offer defined contribution plans instead. Alternatively, a combination of federal assistance and cuts in benefits for the worst-funded plans would reduce the burden that would need to be placed on better-funded plans to shore up PBGC's financial condition.

To estimate the effects of policy changes, CBO runs the model using the insurance terms and funding rules of the alternative policy and computes the difference between those projections and projections run under current law. Running the model with a change in insurance terms (such as a higher premium level) or a more restrictive funding rule (such as a shorter amortization period to determine employers' minimum contributions) is relatively straightforward. However, such changes would probably trigger behavioral responses by employers, which also need to be accounted for. CBO identified three related sets of behavioral responses that are likely to have a significant impact on its policy projections: changes in employers' contributions in response to changes in minimum funding requirements, withdrawal by employers in response to changes in insurance terms or minimum funding requirements, and the willingness of employers and plan participants to agree to benefit cuts (as required under current law and some policy proposals) in response to a change in insurance terms.

In general, CBO models such behavioral responses by estimating three rates: a rate of change in annual contribution rates, a rate of employer withdrawal, and a rate of agreement in response to a change in policy parameters of a given size. A guiding principal in that modeling is that as PBGC's insurance is made less generous through premium increases, cuts in the maximum insured level of benefits, or more stringent funding rules, the change in employers' contributions will be more muted and their withdrawal rate will tend to increase. For the third set of responses, the willingness of employers and employees to accept benefit cuts depends on the relative attractiveness of accepting a cut versus rejecting it (accounting for the variation in employers' and employees' incentives within and among plans). Very little information exists to use for estimating the three behavioral response parameters, so CBO made judgments by consulting with outside experts and using the limited data that are available.[39]

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[38] See Congressional Budget Office, *Options to Improve the Financial Condition of the Pension Benefit Guaranty Corporation's Multiemployer Program* (August 2016), www.cbo.gov/publication/51536.

[39] CBO examined historical trends in employers' contribution rates to determine how plans have responded to past legislative changes, such as the PPA's more stringent funding requirements and annual premium increases.

Analyzing the Sensitivity of the Results to Key Assumptions

The model allows CBO to evaluate the sensitivity of each of its parameters to alternative values. To quantify the sensitivity of its assumptions, CBO estimated net financial assistance claims using parameter estimates that represent the ends of the ranges of probable values for each parameter (see Table 6). CBO found that the model's results are most sensitive to assumptions about employers' contribution rates, the

Table 6.
Sensitivity of Base-Case Estimates of Net Claims to Alternative Parameters

Billions of Dollars

	Financial Assistance Claims, Net of Premiums, 2017-2036	
	Cash-Based Estimates[a]	Fair-Value Estimates
	Central Estimate	
CBO's Projections for the Multiemployer Program With Base-Case Parameters	36	101
	Range of Estimates	
CBO's Projections for the Multiemployer Program With Combined Sensitivity to Alternative Parameters	10 to 44	31 to 157
	Difference From Central Estimate	
Multiply or Divide Contribution Rate by 1.1	-6 to 5	-19 to 19
Multiply or Divide the Distribution of Insured Benefits by 1.1	-5 to 3	-9 to 10
Increase or Decrease the Risk Premium Earned on Plans' Risky Assets by 1 Percent	-5 to 3	0 to 0
Multiply or Divide the Mortality Rate by 1.1	-4 to 1	-5 to 3
Increase or Decrease the Discount Rate for Calculating Plans' Actuarial Liability by 1 Percent	-4 to -2	-6 to 1
Multiply or Divide the Collection Rate for Withdrawal Liability Payments by 1.5	-2 to 0	-4 to 3
Multiply or Divide the Annual Probability of Exhausting All Reasonable Measures to Achieve Solvency by 1.5	-2 to 0	-3 to 3
Increase or Decrease the Growth Rate of the Active Workforce by 1 Percent	-2 to 0	-1 to 1
Increase or Decrease the Amount of Benefits Payable by 1 Percent	-2 to -1	-1 to 1
Multiply or Divide the Annual Probability of Employer Withdrawal From Better-Funded Plans by 1.5	-2 to -1	-1 to 0
Multiply or Divide the Annual Probability of Employer Withdrawal From Underfunded Plans by 1.5	-1 to 0	-1 to 4
Multiply or Divide the Annual Probability of Benefit Reductions Being Approved by the Treasury by 1.5	-1 to -1	-1 to 0
Combined Sensitivity of Base Case to All Parameters	**-26 to 8**	**-69 to 57**

Source: Congressional Budget Office

a. The cash-based estimates of net claims include interest earned on the multiemployer program's assets.

distribution of a plan's insured benefits, and the risk premium on plans' risky assets.[40] However, using alternative values for any one of those parameters changes CBO's estimates of net financial assistance claims by no more than about 20 percent, which is small given the 20-year time frame of the analysis and the amount of variation that exists among the characteristics of individual plans.

Although a change in any single parameter has a small effect on the projections, the projections are much more sensitive to changes in all of the parameters combined. To illustrate the uncertainty of its base-case projections, CBO produced 100 sets of values for each of the key parameters in Table 6, taken from each parameter's distribution of probable values. For each set of parameter values, CBO reran the model to generate a projection of average net claims on a cash basis and a fair-value basis. From those runs, CBO found that the middle two-thirds of the range of average estimates of net claims over the 2017–2036 period spanned $10 billion to $44 billion on a cash basis and $31 billion to $157 billion on a fair-value basis (compared with CBO's central estimates of $36 billion on a cash basis and $101 billion on a fair-value basis). The high degree of sensitivity of those estimates stems from the interaction between parameters. For instance, net financial assistance claims will be much larger when the probability of employer withdrawal is higher than the central estimate and the collection rate for withdrawal liability payments is lower than the central estimate.

Estimates of the difference between alternative policies and current law may be more or less sensitive to uncertainty than the base-case projections themselves. For example, because estimates of premiums are largely insensitive to market conditions, and thus have much less variation than estimates of financial assistance claims, projections of how policy alternatives involving higher or lower premiums would affect PBGC's finances are less uncertain than the baseline projections of PBGC's net claims. Projections of the effects of other policies, such as policies that depend on employers' and employees' willingness to accept benefit cuts, are much more uncertain.

Accounting for Effects on Federal Revenues

Multiemployer plans and all other qualified pension plans are eligible for various types of favorable tax treatment. For example, accrued benefits are not treated as income under the individual income tax until they are paid. Furthermore, employers may deduct contributions and withdrawal liability payments from their income when figuring their taxable business income.

Some policy options would affect employers' contributions—and thus tax revenues—because of a change in the rules for minimum contributions or an increase in the likelihood of employer withdrawal. Policies that would increase required contributions would result in lower tax revenues in the short term (as plans improved their funding ratio) but higher tax revenues in the long run (as plans reached full funding). Policies that would increase the likelihood of employer withdrawal would have less clear effects. Projected tax revenues would rise if employers' expected withdrawal liability payments were lower than the contributions they would otherwise have been expected to make. But revenues would fall if the withdrawing employers were also expected to contribute to another defined benefit or defined contribution plan.

In principle, CBO's model could be used to inform revenue estimates. But in practice, such effects are challenging to estimate because they are spread among multiple sources—including corporate and individual taxes—and because they can interact with other federal spending and revenues. In any case, for

[40] The distribution of benefits refers to variation among participating workers in the amount of benefits accrued under a plan, which affects the effective percentage of benefits insured by PBGC. A plan whose benefit levels vary widely among participants will have a smaller percentage of its total benefits insured than a plan with the same average benefits but less variation among participants. The larger the percentage of total benefits that PBGC insures, the higher the cost to PBGC.

legislation proposed in the Congress, the staff of the Joint Committee on Taxation is responsible for providing estimates of effects on revenues.

Demonstrating an Alternative Budgetary Treatment for PBGC's Insurance Programs

The Congress uses budget estimates for information about the cost of current and alternative policies. The federal budget accounts for credit programs—including direct loans and loan guarantees—on an accrual basis. Over the years, the Congress has considered extending the use of accrual accounting to federal insurance programs, including PBGC's, so the budget would more fully recognize insurance liabilities as they are created.

Pros and Cons of Accrual Measures. Under the accrual approach used for federal credit programs, the lifetime cost of a new direct loan or loan guarantee is recorded in the budget as a present-value amount at the time the loan or loan guarantee is made. Loan guarantees are similar in structure to PBGC's insurance. Thus, recording the cost of insurance programs on an accrual basis would be consistent with the treatment of federal credit programs and would provide a more up-front and comprehensive measure of the longer-run cost of such programs.

Accrual measures have some disadvantages, however, compared with cash-based estimates. They are more complex methodologically, obscure the cash flow pattern of expenditures and receipts, pose significant implementation challenges, and would probably be more changeable from year to year and harder for policymakers and the public to understand.[41] Present-value estimates of costs depend on several assumptions, particularly about discount rates. The resulting sensitivity of the estimates to those assumptions and their potential lack of transparency may make them more prone to manipulation than cash-based estimates.[42] Policymakers would need to decide the estimating basis for accrual estimates—in particular, whether to use market-based discount rates (as CBO did to compute the fair value of PBGC's insurance in this analysis) or some other discount rate to calculate the present value of the accrued amounts.

An Example of Accrual Budgeting for PBGC. The federal budget currently includes two types of cash flows for PBGC's multiemployer program: outlays for financial assistance payments to insolvent and terminated plans, and receipts from premiums and interest. Suppose, for example, that the trust fund for the multiemployer program had assets equal to $2 billion at the beginning of 2017. During the year, the fund earns interest of $40 million (assuming an interest rate of 2 percent), receives premiums equal to $300 million, and pays claims equal to $200 million, leaving it with $2.1 billion at the end of 2017. Under the current cash-based budgeting, those transactions would reduce the federal deficit by $140 million, equal to net federal outlays (premiums received minus financial assistance paid) plus interest (see Table 7).

Under accrual accounting, by comparison, those cash flows would still be tracked, but expenses would be recognized when insurance was provided rather than when cash was paid or received. That treatment is consistent with the accrual-accounting approach of recognizing the full costs of transactions when the

[41] For a discussion of the challenges involved in an accrual budgeting system, see Marc Robinson, *Accrual Budgeting and Fiscal Policy*, Working Paper WP/09/84 (International Monetary Fund, April 2009), www.imf.org/external/pubs/ft/wp/2009/wp0984.pdf.

[42] Some analysts contend that state and local governments have artificially lowered their budget outlays by manipulating the assumptions that determine their required contributions to pension plans. See, for example, Robert Novy-Marx and Joshua D. Rauh, "The Liabilities and Risks of State-Sponsored Pension Plans," *Journal of Economic Perspectives*, vol. 23, no. 4 (Fall 2009), pp. 191–210, http://dx.doi.org/10.1257/jep.23.4.191; and Jeffrey R. Brown and Richard F. Dye, *Illinois Pensions in a Fiscal Context: A (Basket) Case Study*, Working Paper 21293 (National Bureau of Economic Research, June 2015), www.nber.org/papers/w21293.

Table 7.
Illustrative Example of Cash Accounting With a Trust Fund for PBGC's Multiemployer Program
Millions of Dollars

		2017
	Budget Accounts	
1	Value of Multiemployer Trust Fund (Start of Year)[a]	2,000
2	Interest Earned	40
3	Premiums Received	300
4	Financial Assistance Paid	-200
5	Value of Multiemployer Trust Fund (End of Year)	2,140
	Effect on Budget Totals	
6	Federal Outlays[b]	-100
7	Federal Net Interest Cost[c]	-40
8	Federal Deficit[d]	-140

Source: Congressional Budget Office.

PBGC = Pension Benefit Guaranty Corporation.

a. The value of the multiemployer trust fund tracks the premiums received (net of PBGC's operating costs), the financial assistance paid to plans, and the interest earned on the fund's balance. The fund is invested in Treasury securities.

b. Zero minus line 4 minus line 3.

c. Minus line 2.

d. A negative number indicates a decrease in the deficit.

transactions occur. Thus, one way to implement accrual accounting would be to recognize an expense for each new multiemployer plan insured by PBGC—in the year the insurance was provided—equal to the expected cost of all future claims by the plan minus its expected future premium payments.[43] In the transition to an accrual system, the budget would instead record a one-time outlay to recognize the current value of PBGC's net obligation to all preexisting plans. After recording those initial charges, in subsequent years the budget would also show a change in outlays for any revision to the projected or realized costs of existing plans. Legislative proposals to alter the multiemployer program would affect the current value of PBGC's net obligation, and the change in that obligation—expressed as a single lump-sum amount—could be reported in a cost estimate as the proposal's budgetary effect.

As an illustration of an accrual approach, the budget could show two asset accounts (the current trust fund and an account representing the value of projected future premiums) and two liability accounts (one representing total future projected claims and the other representing only the future claims that would be payable given the program's projected income). All accounts could be reported at fair market value. At the end of 2017, the trust fund would show a balance of $2.1 billion, and the value of future premiums would be $6.3 billion (see Table 8). The total projected liability at the end of 2017 would be $103 billion,

[43] The expected cost of PBGC's insurance includes accruals for new benefits and additional years of service. If the insurance obligation could somehow be limited to the amount of benefits insured at a point in time (for example, if PBGC had the ability to terminate a plan at will), the expected cost on that basis would be less than a measure that includes all future claims.

Table 8.
Illustrative Example of Accrual Accounting on a Fair-Value Basis for PBGC's Multiemployer Program

Millions of Dollars

		2017
	Budget Accounts	
1	Asset: Value of Multiemployer Trust Fund (Start of Year)[a]	2,000
2	Interest Earned	40
3	Premiums Received	300
4	Financial Assistance Paid	-200
5	Value of Multiemployer Trust Fund (End of Year)	2,140
6	Asset: Value of Future Premiums (Start of Year)[b]	6,500
7	Premiums Received (Transferred to Trust Fund)	-300
8	Reestimated Premiums	0
9	Premiums From New Plans	5
10	Net Interest on Asset Value	130
11	Asset: Value of Future Premiums (End of Year)	6,335
12	Notional Liability: Value of PBGC's Projected and Unpaid Financial Assistance (Start of Year)[c]	105,000
13	Reestimated Obligations to Existing Plans	0
14	Financial Assistance Paid	-200
15	New Insurance Obligations	20
16	Net Interest on Liability Value	-2,100
17	Notional Liability: Value of PBGC's Financial Assistance (End of Year)	102,720
18	Liability: Value of Financial Assistance Payable Under Current Law (Start of Year)[d]	8,500
19	Net Interest on Liability Value	170
20	Financial Assistance Paid (Transferred to Trust Fund)	-200
21	Increase or Decrease in Financial Assistance Payable	5
22	Liability: Value of Financial Assistance Payable Under Current Law (End of Year)	8,475
	Effect on Budget Totals	
23	Federal Outlays[e]	0
24	Federal Net Interest Cost[f]	0
25	Federal Deficit	0
26	Other Means of Financing[g]	-140
27	Federal Debt[h]	-140

Source: Congressional Budget Office

PBGC = Pension Benefit Guaranty Corporation.

a. The value of the multiemployer trust fund tracks the premiums received (net of PBGC's operating costs), the financial assistance paid to plans, and the interest earned on the fund's balance. The fund is invested in Treasury securities.

(continued)

(continued)

b. In an accrual accounting system, the present value of future premiums to be collected from insured plans would be tracked as an asset. The value of the asset would be adjusted for changes in expected future premiums (the reestimate), would increase by the present value of premiums projected to be collected from new plans, and would accrue interest at the discount rate used in the present-value calculation. The asset value is reduced each period for premiums received because those amounts appear in the trust fund.

c. The notional liability tracks the present value of projected financial assistance claims, not all of which can be paid under current law because PBGC is projected to lack the premium income needed to pay all claims. The notional amount would increase with estimated increases in claims for insured plans, with the amount of projected claims for newly insured plans, and with accumulated interest. (Under fair-value accounting of the present value, interest is negative in most years, reducing the liability.) The notional amount would decrease with the amount of financial assistance paid (which is deducted from the value of the trust fund).

d. The value of the liability payable under current law is the lesser of the notional liability and the sum of the value of the trust fund and the value of future premiums. The interest credited to that liability tracks the interest earned on the trust fund and is used to discount the value of future premiums. The liability increases with any noninterest reestimates of the value of future premiums and decreases with the amount of financial assistance paid (which is deducted from the value of the trust fund).

e. Line 21 minus lines 8 and 9.

f. Line 19 minus lines 2 and 10.

g. (Line 11 minus line 6) minus (line 22 minus line 18).

h. Line 25 plus line 26.

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but the payable liability would be limited to the sum of the trust fund and the value of future premiums, or $8.5 billion.

After the initial transition to an accrual approach, which would include the previously unrecorded liabilities in the deficit, the multiemployer program would have only a modest effect on the deficit in later years. One reason is that changes in total liabilities from their projected high level would be unlikely to affect the amount payable under current law. Another reason is that an increase in the deficit from a rise in the value of assets would be matched by a rise in the value of payable claims. Changes in the value of assets and liabilities that stemmed from receipt of future premiums or payment of future claims—which would not affect the deficit under an accrual approach but would add to or reduce federal debt held by the public—would be tracked in the budget as “other means of financing.”

The use of accrual accounting would also require a set of supporting accounts to track the accrued costs and future premiums that had yet to be paid or received, as well as to handle the transfers of interest that would result from expressing costs in present-value terms. The account structure of federal credit programs could provide a model for how such an approach could be applied to PBGC. With credit programs, a program’s lifetime cost is recorded up-front as a present value, and interest is transferred between the program’s financing account and the Treasury to reconcile the difference between the present-value amount and the actual amounts paid in the future.

Two measures of financial assistance could be useful to report in the budget: the full amount due to beneficiaries and the amount payable under current law. CBO projects that under current law, the multiemployer program would receive claims for financial assistance totaling $45 billion from 2017 through 2036 and would become insolvent for the first time in its history in 2025. The federal government is not legally obligated to provide funds if PBGC has a financial shortfall and is unable to fulfill its insurance commitments. In that case, pension beneficiaries would face a severe reduction in benefits because financial assistance payments from PBGC would be limited to any premiums collected. The projected insolvency of the multiemployer program would cost beneficiaries $34 billion over the 2025–

2036 period in insured benefits that could not be paid, CBO estimates. Many observers believe that the government would take action to protect pension beneficiaries from such severe losses, which provides one rationale for reporting the full amount of PBGC's insurance obligation to beneficiaries as well as the amount payable under current law.

Appendix A: Factors That Influence the Underfunding and Insolvency of Multiemployer Plans

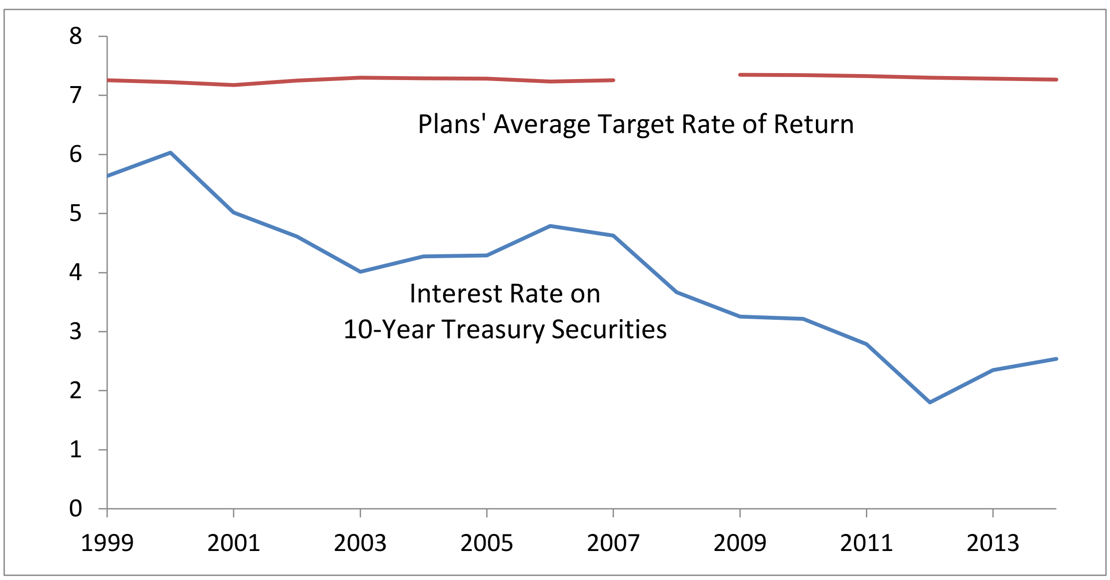
The Congressional Budget Office based its modeling decisions on its analysis of trends in the data for multiemployer defined benefit pension plans. That analysis suggests that plans' investments in risky assets have created persistent underfunding as plans have been unable to fully recover from declines in asset values during market downturns. Plans' funding has been further stressed because benefit payments have greatly exceeded employers' contributions. In some cases, significant numbers of orphan participants, combined with declining numbers of active participants, have caused employers' contributions to be inadequate to cover the promised level of benefits. Together, those factors have pushed underfunded plans toward insolvency.

The Role of Risky Investments in Making Plans' Funding Volatile

Like most public- and private-sector pension plans, multiemployer defined benefit plans must fund benefits as they accrue with contributions from employers. Most multiemployer plans invest those contributions in a broad portfolio of risky assets—such as stocks, real estate, and corporate bonds—that are selected to meet a target rate of return. Those target rates are very similar among plans and over time, averaging about 7.2 percent to 7.4 percent per year between 1999 and 2014 (see Figure A-1). Such similarity largely reflects the fact that plans select their target on the basis of relatively uniform investment advice by pension actuaries. Although plans' average target rate of return has remained about

Figure A-1.
Comparison of Plans' Target Rates of Return With Interest Rates on 10-Year Treasury Securities, 1999-2014

Percent



Source: Congressional Budget Office, using information from the FRED database maintained by the Federal Reserve Bank of St. Louis (https://fred.stlouisfed.org) and from plans' filings of Internal Revenue Service Form 5500.

Plans' target rate of return for a given year is the average of the rates reported by all multiemployer plans for that year. Data are not available for 2008. The interest rate on 10-year Treasury securities for a given year is the average of the monthly values in that year.

the same, the difference between that rate and the interest rate on 10-year Treasury securities, which are considered low-risk, has increased significantly since 1999.

A plan uses the target rate of return on its risky investments as the discount rate to compute the present value of its accrued benefits. Thus, the target rate of return determines how much employers must contribute to fund the plan's benefits. That target rate generally understates the plan's liabilities relative to what a private insurer would charge to provide annuities to cover such benefits. The discount rate that would more appropriately reflect the market value of a plan's liabilities is a lower rate, such as the yield on investment-grade debt, because a plan's accrued benefits are relatively fixed commitments.[44] Although multiemployer plans do report a market-based measure of their liabilities, it is not used to determine employers' minimum contributions. If the market-based measure were used, the value of liabilities would be much higher (see Figure A-2), and employers would have to increase their contributions significantly.

Using risky investments to fund benefit obligations under the current funding and valuation rules for multiemployer plans has two primary consequences. First, plans with riskier investments experience more volatility: They are more likely to become overfunded when investment returns exceed the target rate of return or underfunded when investment returns fall short. Even if those ups and downs in the market cancel out over time and a plan achieves its target rate of return on average, the effect of that volatility will tend to worsen the plan's funding.[45] In addition, during periods with higher returns, employers have tended to increase benefits rather than hold more assets than required by law.[46]

Second, the current rules give plans little incentive to hold a less risky portfolio that would be more certain to fund their promised benefits. The reason is that doing so would increase the contributions that employers would be required to make to fund a given level of new benefits or to cover a funding shortfall.

The deterioration in plans' funding that occurred because of stock market declines in the 2000–2002 and 2008–2009 periods was particularly severe when measured on a market-value basis. If plans had been required to fund their benefit liabilities—at the time those liabilities were accrued—with safer investments, such as Treasury bonds, the underfunding of multiemployer plans would have been far less significant and would pose less risk now to the Pension Benefit Guaranty Corporation and to plan beneficiaries. The declines in funding that occurred during those periods have not deterred plans from investing in risky assets: On average, the percentage of plans' investments held in risky assets has increased since 2000 (see Figure A-3). By 2012, two-thirds of plans had between 67 percent and

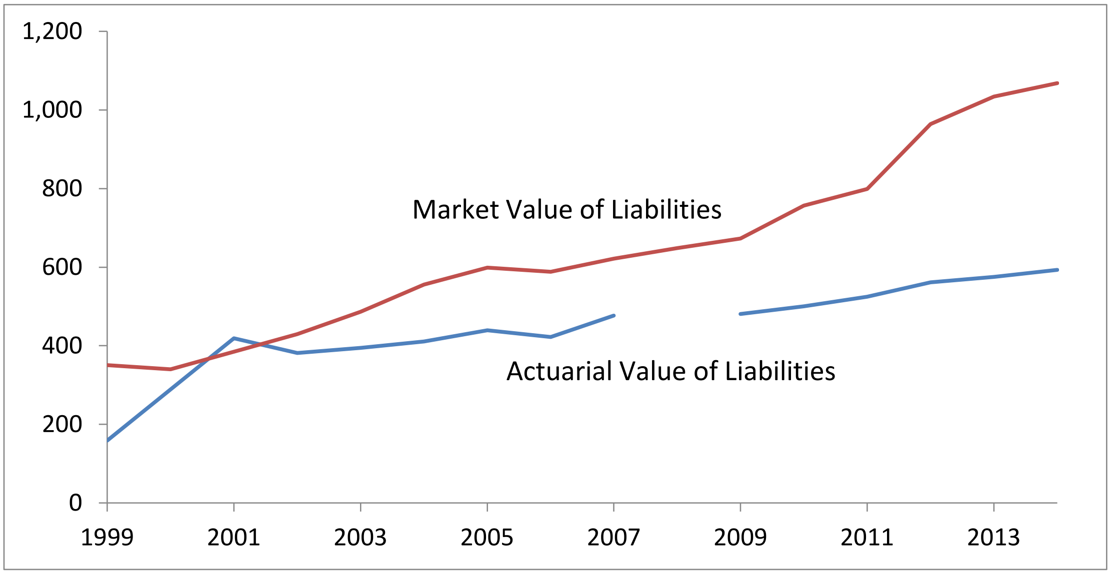
[44] For a discussion of that issue, see Jeffrey Brown and George Pennacchi, *Discounting Pension Liabilities: Funding Versus Value,* Working Paper 21276 (National Bureau of Economic Research, 2015), www.nber.org/papers/w21276.

[45] Data for plan years 1999 through 2012 show that investment returns fell short of plans' target rates by an average of 12.9 percentage points during periods with lower-than-expected returns but exceeded target rates by an average of 10.6 percentage points during periods with higher-than-expected returns, CBO estimates. Plans that are significantly underfunded or whose net outflows are a large percentage of the plans' assets are less likely to recover from market declines—even ones followed by multiple years of positive investment returns—than are plans whose funding is in better shape or whose net outflows are a smaller percentage of the plans' assets. As an example, assume that the market declines by 12.9 percent in the first year and then increases by 10.6 percent a year for the next four years, so the total market return over the five-year period is 33 percent. In that case, a plan that has assets equal to $60 million in the first year, liabilities equal to $100 million in the first year, and annual net outflows of $5 million will see its funding ratio increase to 61 percent by the end of the fifth year. Alternatively, if the market registers a 33 percent return over five years by growing by 5.4 percent each year, the same plan's funding ratio will rise steadily to 65 percent. That effect is more pronounced the greater the plan's net outflows.

[46] For example, a large number of plans raised benefits during the stock market boom of the 1990s, as documented in Judith Mazo and Eli Greenblum, "Multiemployer Pension Plans Respond to the Financial Crisis," in Raimond Maurer, Olivia S. Mitchell, and Mark J. Warshawsky, eds., *Reshaping Retirement Security: Lessons From the Global Financial Crisis* (Oxford University Press, 2012), http://dx.doi.org/10.1093/acprof:oso/9780199660698.003.0010.

98 percent of their assets in risky investments, and one-sixth of plans had 98 percent or more of their assets in risky investments.

Figure A-2.
Liabilities of Multiemployer Defined Benefit Pension Plans, 1999-2014
Billions of Dollars



Source: Congressional Budget Office, using information from the Pension Benefit Guaranty Corporation's *2014 Pension Insurance Data Tables* (www.pbgc.gov/sites/default/files/legacy/docs/2014-data-tables-final.pdf) and from plans' filings of Internal Revenue Service Form 5500.

The market value of liabilities is the Pension Benefit Guaranty Corporation's estimate using a discount rate that reflects the cost to purchase an annuity at the beginning of the relevant year.

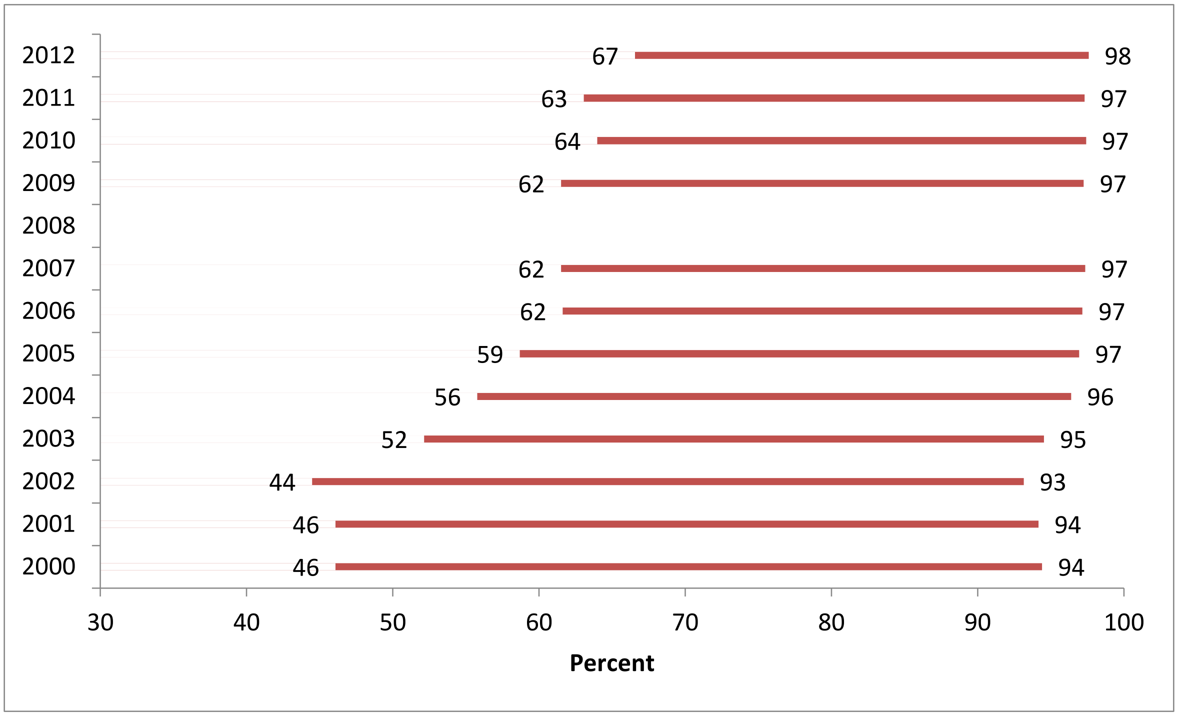
Data for the actuarial value of liabilities are not available for 2008.

Causes of Insolvency for Underfunded Plans

Employers are jointly obligated to make contributions to offset unexpected shortfalls in a plan's funding, but those requirements may be insufficient to prevent the plan's insolvency, for at least three reasons. First, the rules governing required contributions include exemptions that allow employers participating in some underfunded plans to make much lower contributions than the amounts necessary to shore up the plans' funding. Second, some employers may withdraw from a plan, potentially exposing the employers remaining in the plan to greater risk of future underfunding and insolvency. Third, when an entire industry covered by a plan declines or when the active workforce participating in the plan shrinks, normal-cost contributions (determined by the amount of benefits that active employees accrue for an additional year of service) will be lower, and the incentive for employers to seek out funding exemptions once the plan becomes underfunded will be greater.

Exemptions for Some Critically Underfunded Plans. Under the Pension Protection Act of 2006 and the Multiemployer Pension Reform Act of 2014, an employer whose plan is facing insolvency in the near term can contribute less than the minimum required amount as long as the pension plan is following an approved rehabilitation plan. When a multiemployer plan officially reaches critical status, it is required to develop a rehabilitation plan that includes all reasonable measures to put it on a path to solvency, or at

Figure A-3.
Two-Thirds Range of the Percentage of Pension Plans' Portfolios Invested in Risky Assets, 2000-2012



Source: Congressional Budget Office, using compilations of data from Internal Revenue Service Form 5500.

Data are not available for 2008.

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least to forestall insolvency. Such measures may include reductions in benefits and gradual increases in contributions, but those contributions are allowed to be lower than the minimum required level while the pension plan remains in critical status, provided it is adhering to its rehabilitation plan. Some of those critically underfunded plans have declared that they have exhausted all reasonable measures to avoid or forestall insolvency. Such plans had a total of $109 billion in liabilities and $33 billion in assets (both measured on a market-value basis) in 2016, CBO estimates.

The effect of the exemption from minimum-contribution rules is apparent in the total amount of employers' contributions to plans in critical status, all of which are following rehabilitation plans. CBO estimates that employers in a total of 79 critically underfunded plans were allowed to contribute $4.7 billion less than the minimum funding requirement in 2012 and a total of $7.7 billion less than the minimum funding requirements over the 2009–2012 period (see Table A-1). The percentage of plans in critical status that received less than the minimum required contributions rose from 8 percent in 2009 to 27 percent in 2012.

Withdrawals by Employers. Historically, withdrawal by one or more large employers from multiemployer plans has resulted in a significant percentage of orphan participants—especially in the mining, manufacturing, transportation, and public utilities industries (see Table A-2). Although the withdrawal of one or more large employers from a plan may precipitate a mass withdrawal by all employers, particularly in a declining industry, those events have been infrequent.

Table A-1.
Employers' Minimum Required Contributions and Total Contributions to Multiemployer Plans in Critical Status

	Billions of Dollars			
	Minimum Required Contributions	Total Contributions	Amount Waived From Excise Tax[a]	Number of Plans
	Plans Receiving Lower Contributions Than Otherwise Required			
2009	0.3	0.1	0.2	28
2010	0.9	0.6	0.3	37
2011	3.3	0.9	2.4	53
2012	6.1	1.4	4.7	79
Total, 2009-2012	**10.7**	**3.0**	**7.7**	**n.a.**
	Plans Receiving Higher Contributions Than Otherwise Required			
2009	0.1	5.0	n.a.	334
2010	0.2	4.1	n.a.	289
2011	0.3	3.5	n.a.	224
2012	0.2	3.8	n.a.	213
Total, 2009-2012	0.8	16.4	n.a.	n.a.

Source: Congressional Budget Office, using compilations of data from Internal Revenue Service Form 5500.

n.a. = not applicable.

a. Under current funding rules, employers participating in critically underfunded plans are allowed to make contributions below the otherwise-required minimum level without incurring an excise tax. (A critically underfunded plan is one that faces insolvency in the near term and typically has a funding ratio of less than 65 percent.)

Withdrawals burden the remaining employers because the departing employers often pay less than their share of the plan's funding shortfall. For example, employers that withdraw because of bankruptcy typically make withdrawal liability payments that are less than the amounts assessed, because those payments receive lower priority in bankruptcy proceedings than other obligations do. In addition, a withdrawing employer is not obligated to reimburse the plan for any investment losses on its withdrawal liability payments. Such losses raise the total contribution that remaining employers would need to make to cover the shortfall and therefore increase the likelihood that the plan will become insolvent. (That additional risk could be eliminated if a withdrawing employer was required to purchase an annuity to cover its share of the plan's unfunded benefits.)

Before the enactment of the Pension Protection Act, many analysts feared that mass withdrawals from severely underfunded plans would increase sharply. Because that law allows employers in critically underfunded plans to make less than the minimum required contributions, many of those plans have been able to avoid mass withdrawals. However, their funding ratios have worsened, and they remain likely to become insolvent.

Industry and Demographic Factors. Industry employment trends and demographic factors have shrunk the percentage of people who are continuing to accrue benefits in multiemployer defined benefit plans. Some of the industries that offer such plans, particularly in the manufacturing and construction sectors, have shrinking workforces. Moreover, union membership has steadily decreased in many industries, and employers have increasingly switched to offering defined contribution plans. As a result, the population

Table A-2.
Participants in Multiemployer Plans, by Industry, 2012

	Thousands				Percent	
Industry	**Active Participants**	**Orphan Participants**	**Inactive Participants (Excluding Orphans)**	**Total Participants**	**Active Participants as a Share of Total Participants**	**Orphan Participants as a Share of Total Participants**
Mining	13	74	34	120	10	61
Manufacturing	248	297	424	969	26	31
Transportation and Public Utilities	425	381	689	1,495	28	25
Agriculture	3	0	6	10	33	2
Wholesale Trade	15	2	24	41	36	4
Construction	1,326	265	1,791	3,383	39	8
Retail Trade	551	152	661	1,363	40	11
Services	731	47	996	1,774	41	3
Information	106	5	112	222	48	2
Unspecified	113	26	145	284	40	9
Total	**3,530**	**1,247**	**4,882**	**9,659**	**37**	**13**

Source: Congressional Budget Office, using compilations of data from IRS Form 5500 and data received from the Pension Benefit Guaranty Corporation.

of active participants as a share of total participants in multiemployer defined benefit plans has fallen from 76 percent in 1980 to 52 percent in 1995 and 37 percent in 2012. That decline has reduced the ability of underfunded plans to avoid insolvency, because with fewer active participants, plans have less cash coming in from normal-cost contributions that could be used to pay current benefits.

The collective bargaining process can limit employers' ability to address funding deficiencies in multiemployer plans in the short term. Most bargaining agreements are multiyear contracts that deal with a wide range of employment conditions and benefits. Negotiations typically cover total compensation costs, with the agreed-upon compensation levels allocated among wages and pension contributions, health care, and other benefits. In the case of pension benefits, it is common for a plan to be allocated a fixed percentage of compensation that is used both to fund new benefits and to cover increases in employers' contributions for any shortfalls that occur. Thus, the cost of meeting shortfalls is often passed on to employees in the form of a reduction in new benefits. Moreover, if increases in required contributions for a funding shortfall exceed the amount allocated to a plan under a bargaining agreement, coordinating the increase in contributions among multiple employers outside the collective bargaining process may be difficult.

Analysis of the Determinants of Underfunding

To what extent can changes in a plan's funding ratio over a period of time be explained by the plan's characteristics at the start of the period, such as its initial funding ratio, share of active participants, holdings of low-risk investments, and employers' contributions as a share of the plan's liabilities? To address that question, CBO used multiple regression analysis to examine factors that influenced plans' funding from 2007 through 2012. That period included considerable variation in the financial condition of multiemployer plans. By the start of the period, some plans had fully recovered from the downturn in asset values in the early 2000s, but others had not. More large declines in asset values occurred during the 2007–2009 recession, and plans showed differing rates of recovery in their funding levels by 2012.

Table A-3.
Summary Statistics for Regression Variables

Percent

Variable	Number of Observations	Mean	Standard Deviation	Minimum	Percentile 25th	Percentile 50th	Percentile 75th	Maximum
Actuarial Funding Ratio in 2012[a]	1,055	78	17	3	68	79	89	169
Actuarial Funding Ratio in 2007[a]	1,055	84	15	0	75	84	93	180
Active Participants as a Share of Total Participants in 2007	1,055	44	15	0	35	46	54	94
Share of Plans' Assets Invested in Low-Risk Securities in 2007	1,055	13	12	0	2	11	20	69
Employers' Contribution Rate in 2007[b]	1,055	4	2	0	3	4	6	17
Benefits Paid as a Percentage of Liabilities in 2007	1,055	6	2	1	5	6	7	15

Source: Congressional Budget Office, using compilations of data from Internal Revenue Service Form 5500.

a. A plan's actuarial funding ratio is the value of its assets divided by the value of its liabilities.

b. The employers' contribution rate is equal to total employer contributions divided by the actuarial value of a plan's liabilities.

Multiple regression analysis is a useful way to estimate statistically the extent to which such plan-specific factors explain variation in later funding ratios. With that technique, the change in a plan's actuarial funding ratio between 2007 and 2012 can be expressed as a linear function of various observable characteristics of the plan in 2007: the actuarial funding ratio, the percentage of plan participants who are actively accruing benefits, the percentage of assets invested in low-risk securities, the rate of employers' contributions, and benefits paid as a percentage of liabilities.

CBO estimated two versions of regressions, one that included controls for the industry associated with the plan and one that did not. To estimate the regression coefficients, CBO used publicly available financial data from more than 1,000 plans (see Table A-3 for summary statistics for each variable). In both versions of the equations, the amount of variation in 2012 funding ratios that is explained by the plan-specific and industry variables is low (as measured by the R-squared statistics in Table A-4). Nonetheless, most of the variables have coefficients that are economically and statistically significant, meaning that the signs and magnitudes of the coefficients are consistent with expected economic relationships and that the relationship between the variables is likely to be caused by something other than chance.

CBO found that:

- **Industry demographics did not have a significant effect on a plan's funding ratio.** Including a plan's industry did not add significant explanatory value to the regression equation. CBO also found very little correlation between the change in plans' funding ratios by industry and the change in the industry's employment over the same period. One reason is that the effects of industry demographics are probably more localized than can be captured by CBO's approach of using the North American Industry Classification System's two-digit codes to define industries.

Table A-4.
Determinants of Plans' Funding Ratios in 2012

	Regression Coefficients	
	Excluding Industry	Including Industry[a]
Dependent Variable		
Change in Funding Ratio Between 2007 and 2012	n.a.	n.a.
Independent Variables		
Constant	0.16*	variable[b]
Actuarial Funding Ratio in 2007[c]	-0.20*	-0.20*
Active Participants as a Share of Total Participants in 2007	0.06*	0.05
Share of Plans' Assets Invested in Low-Risk Securities in 2007	0.08*	0.08*
Employers' Contribution Rate in 2007[d]	1.26*	1.17*
Benefits Paid as a Percentage of Liabilities in 2007	-2.35*	-2.51*
Adjusted R-squared	0.28	0.31

Source: Congressional Budget Office, using compilations of data from Internal Revenue Service Form 5500 and data received from the Pension Benefit Guaranty Corporation.

* = statistically significant with 95 percent confidence.

a. A plan's industry was accounted for using a set of indicator variables for each of the two-digit North American Industry Classification System industry codes; those variables have a value of 1 if the plan is in that industry and 0 otherwise.

b. The constant term varies by industry and ranges from -0.03 for plans in the agriculture industry to 0.27 for plans in the mining industry.

c. A plan's actuarial funding ratio is the value of its assets divided by the value of its liabilities.

d. The employers' contribution rate is equal to total employer contributions divided by the actuarial value of a plan's liabilities.

- **Plans with a relatively low funding ratio in 2007 were more likely than other plans to see an improvement in their funding.** However, the most underfunded plans are unlikely to be able to improve their funding ratio without significant changes, such as benefit reductions or other financial assistance.

- **Plans with a smaller share of active participants in 2007 were more likely to see a decline in their funding.** Plans that have fewer active workers are more likely to be underfunded because a significant portion of their employers' contributions—negotiated as an amount per active worker—go toward benefits attributable to a large number of orphan or retired participants.

- **Plans with more risky investments in 2007 were more likely to see their funding worsen.** The regression analysis predicted higher funding ratios in 2012 for plans that held fewer risky investments in 2007. Over the 2007–2012 period, the return on the Standard & Poor's 500 index was 15 percent while the return on 10-year Treasury securities was 59 percent, suggesting that plans that held risky investments experienced large declines in their funding ratio. The coefficient in the regression is surprisingly small, suggesting only a modest effect from riskier investments. However, that result probably occurred because the asset categories that plans report on Internal Revenue Service Form 5500 do not adequately distinguish investment risks.

- **Plans with a higher contribution rate were more likely to see their funding improve.** Employers' contribution rates are negotiated during the collective bargaining process and tend to remain the same throughout the period of the contract. Although employers may be able to increase contributions, plans that have a higher contribution rate at the beginning of a period are likely be have a better funding ratio at the end of the period.

- **Plans that pay higher benefits relative to their liabilities were more likely to see their funding worsen.** Higher benefit payments create near-term pressure on plans' funding, particularly for the most underfunded plans, because plans have less time to make up any funding shortfall before benefit payments fall due.

Appendix B: Details of the Simulation Model and Its Calibration

To estimate claims net of premiums for the Pension Benefit Guaranty Corporation's (PBGC's) multiemployer program, the Congressional Budget Office individually simulated the 50 largest multiemployer plans—including 14 plans that had exhausted all reasonable measures to avoid insolvency (known as ERM plans)—as well as 55 smaller ERM plans. Claims and premiums for the 36 non-ERM plans were scaled up to represent the universe of such plans. CBO did the scaling by grouping the non-ERM plans into categories according to their funding ratio in 2016 and then weighting each plan by multiplying its claims and premiums by the plan's share of the total liabilities of all non-ERM plans in the same funding category. The 69 ERM plans in CBO's simulation, by contrast, consisted of the entire population of ERM multiemployer plans insured by PBGC in 2016, so those plans were each assigned a weight of 1.

The simulation model uses a nonstochastic projection of interest rates and many simulated paths of stock market returns (the primary source of volatility in plans' funding). It then projects outcomes for an individual plan along each path on the basis of a variety of plan-specific parameters, which were calibrated using information from the plan's filings of Internal Revenue Service (IRS) Form 5500. (A version of the model that uses stochastic interest rates produces projections of PBGC's finances that are very similar to the projections from this version of the model, in part because shocks to interest rates generate similar changes in a plan's assets and liabilities in the model.) PBGC's premium revenues and claims for financial assistance are simulated along each path, and the paths are averaged to produce cash-based estimates of net claims for the multiemployer program. To produce fair-value estimates, the model is rerun using a risk-neutral transformation of the cash flows in the model, and PBGC's cash flows from that simulation are discounted to the present using the initial yield curve in the model.[47]

This appendix describes various elements of CBO's model and how it was calibrated. In the descriptions, f is used to denote fractions, g to denote growth rates, r to denote discount rates, y to denote yields, R to denote rates of return, ε to denote randomly drawn variables, σ to denote the standard deviation of random variables, π to denote risk premiums, j to denote simulation paths, and n, k, t, and T to denote time periods or time intervals.

Interest Rates, Returns on Assets, and Fair-Value Estimates

The single path of interest rates and 500 paths of stock market returns were generated from CBO's extended baseline projections for the macroeconomy and cover the period from 2012 to 2036. (For 2012 through 2015, CBO used observed interest rates and returns rather than projections.) Those paths are common to all plans and are used to calculate plans' asset returns and discount rates as well as the discount rates used to compute the fair value of PBGC's insurance.

To model interest rates and bond returns, CBO used its projections for rates on zero-coupon Treasury bonds with maturities ranging from 1 to 30 years between 2016 and 2026, which CBO makes as part of its routine budget projections. For years after 2026, CBO retained the shape of the yield curve in 2026 but adjusted interest rates upward on the basis of the difference between CBO's projection for the 10-year bond rate in 2025 and its projections for that rate in subsequent years, as published in the agency's *2015 Long-Term Budget Outlook.*[48]

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[47] That approach is widely used in the financial valuation literature. For examples, see John Hull, *Options, Futures, and Other Derivatives* (Prentice Hall, 2012).

[48] See Congressional Budget Office, *The 2015 Long-Term Budget Outlook* (June 2015), www.cbo.gov/publication/50250.

If the continuously compounded yield on a zero-coupon Treasury bond issued at date *t* with maturity *n* is $y_{n,t}$, then its price is given by:

(1) $$P_{n,t} = e^{-ny_{n,t}}$$

The rate of return from holding a zero-coupon bond with maturity *n* between dates *t*–1 and *t* is:

(2) $$R_{n,t} = \ln\left(\frac{P_{n-1,t}}{P_{n,t-1}}\right) = ny_{n,t-1} - (n-1)y_{n-1,t}$$

with the special case that the rate of return on a one-year bond is simply the previous period's yield on a one-year zero-coupon bond (that is, $R_{1,t} = y_{1,t-1}$), which is referred to hereafter as the "short rate."

CBO's projection for the term structure of interest rates implies that expected returns from holding bonds of different maturities can differ. In CBO's projections, holding long-term bonds earns a lower expected return than holding a series of short-term bonds over the next few years. That pattern, which is historically atypical, is partly a by-product of the current low-interest-rate environment. In the latter part of the projection period, that pattern reverses, with longer-term bonds projected to earn higher returns than short-term bonds as interest rates return to the levels seen historically.

For the stock market, CBO assumed that stocks would earn a continuously compounded return, $R_{S,t}$, equal to the rate of return on 10-year Treasury notes plus a fixed risk premium, π_S, and a normally distributed shock, $\varepsilon_{S,t}$:

(3) $$R_{S,t} = R_{10,t} + \pi_S + \sigma_S\varepsilon_{S,t} - \sigma_S^2/2$$

CBO's estimate of the risk premium is 4.3 percent, and the standard deviation of the return shock, σ_S, is 20 percent. Those estimates are consistent with the ones underlying the projections in CBO's *2015 Long-Term Budget Outlook*.

The fair-value estimates are computed using a contingent-claims-valuation approach in which PBGC's insurance is valued as a dynamic portfolio of the stock and bond returns in the model to account for the market risk inherent in PBGC's insurance obligations. The present value of PBGC's insurance is equal to the current value of the dynamic portfolio that replicates the stream of PBGC's financial assistance claims. (Implicitly, all other risks that affect cash flows are treated as having no market risk.) A standard procedure for implementing contingent claims valuation is to perform a risk-neutral transformation of the asset returns in the model, which changes the distribution of cash flows outcomes, and then to discount those cash flows to the present using the sequence of risk-free short rates. That transformation is done by setting the future yields on all longer-term securities equal to the forward rates of the initial yield curve, denoted $\tilde{y}_{n,t}$:

(4) $$\tilde{y}_{n,t} = \frac{(t+n)y_{t+n,0} - ty_{t,0}}{n}$$

which implies that the risk-neutral return on a zero-coupon bond with any maturity *n* in period *t* is equal to the short (maturing in one year) forward rate in period *t*:

(5) $$\tilde{R}_{n,t} = \tilde{y}_{1,\mathrm{t}}$$

In other words, the risk-neutral return on any bond is equal to the same short forward rate regardless of maturity (that is, the transformation makes all assets pay the same risk-free expected rate of return as if they were being held by a risk-neutral investor, hence the term risk-neutral). Risk-neutral stock market returns, $\tilde{R}_{S,t}$, are computed as the sum of the short forward rate and the idiosyncratic shock:

(6) $$\tilde{R}_{S,t} = \tilde{y}_{1,\mathrm{t}} + \sigma_S\varepsilon_{S,t} - \sigma_S^2/2$$

Thus, when computing fair-value estimates, the simulation is simply rerun by replacing projected yields and returns (y's and R's) with their risk-neutral equivalents ($\tilde{y}$'s and $\tilde{R}$'s) when generating PBGC's cash flows. PBGC's simulated premiums and cash flows of financial assistance payments are discounted to the present using the sequence of short forward rates, $\tilde{y}_{1,t}$.

Participants and Benefits

At the start of the simulation, a plan's total number of participants is divided into groups by active (A), terminated vested (V), or retired (R) status. The number of participants in period t of a given age a and service level s in a plan that is actively enrolling new participants and accruing benefits until period k is denoted by $N_t^A(a,s;k)$, $N_t^V(a,s;k)$, and $N_t^R(a,s;k)$ for those statuses, respectively. The total number of participants is denoted by $N_t(a,s;k) = N_t^A(a,s;k) + N_t^V(a,s;k) + N_t^R(a,s;k)$. Given initial counts of $N_0^A(a,s)$, $N_0^V(a,s)$, and $N_0^R(a,s)$, the number of participants in each group in each subsequent period evolves as follows:

$$(7) \quad N_{t+1}^A(a,s;k) = \begin{cases} N_t^A(a-1,s-1;k)\left(1-f_{m,t+1}(a)\right)\left(1-f_{r,t+1}(a,s)\right) \\ \quad \times\left(1-f_{u,t+1}(a,s;k)\right) & \text{for } a>0, s>0 \\ \left(1+g_{e,t}(a;k)\right)\sum_{s=1}^{S} N_t^A(a,s;k) & \text{for } a\geq 0, s=0 \\ 0 & \text{for } a=0, s>0 \end{cases}$$

$$(8) \quad N_{t+1}^V(a,s;k) = \begin{cases} \left[N_t^V(a-1,s;k) + N_t^A(a-1,s;k)\, f_{u,t+1}(a,s;k)\, f_{v,t+1}(a,s)\right] \\ \quad \times\left(1-f_{m,t+1}(a)\right)\left(1-f_{r,t+1}(a,s)\right) & \text{for } a>0, s\geq 0 \\ 0 & \text{for } a=0, s\geq 0 \end{cases}$$

$$(9) \quad N_{t+1}^R(a,s;k) = \begin{cases} \left[\begin{array}{c} N_t^R(a-1,s;k) \\ +\left(N_t^A(a-1,s;k) f_{v,t+1}(a,s) + N_t^V(a-1,s;k)\right) f_{r,t+1}(a,s) \end{array}\right] \\ \quad \times\left(1-f_{m,t+1}(a)\right) & \text{for } a>0, s\geq 0 \\ 0 & \text{for } a=0, s\geq 0 \end{cases}$$

where

- $f_{m,t}(a)$ is the mortality rate between t–1 and t of participants moving between age a–1 and a.
- $f_{r,t}(a,s)$ is the probability of retirement between t–1 and t for participants who will be age a and have service s in period t.
- $f_{u,t}(a,s;k)$ is the fraction of employees of age a and service s who terminate (by ceasing to work for an employer participating in the plan). For a plan that becomes inactive in period k, all active participants are treated as terminating—that is, $f_{u,t}(a,s;k) = 1$ for $t > k$.
- $f_{v,t}(a,s)$ is the fraction of separating employees of age a and service s who are vested in their benefits.
- $g_{e,t}(a;k)$ is the growth rate of enrollments for participants age a. All new enrollments start with service 0. For a plan that becomes inactive in period k, new enrollments cease—that is, $g_{e,t}(a;k) = 0$ for $t > k$.

Note that there is no variation in outcomes in the participant simulation. These equations also imply the simplifying assumptions that the participants in each status group are treated as full-time employees with uninterrupted service, accumulate the same benefits for their level of service, and have the same transition rates (f_m, f_r, f_u, and f_v). In addition, new enrollments are assumed to increase the active population in each age group by the same rate (g_e). In principle, all of those rates could vary over time and among paths; however, they are kept static, except for changes to f_u and g_e to value currently accrued benefits or when plans are closed to new participants.

The benefits payable by a plan in a given year consist of initially accrued benefits at the start of the simulation plus newly accrued benefits in each subsequent year that the plan remains active. $\hat{B}_{k,t}$ is used to represent the total unscaled benefits accrued as of period k that are payable at date t. Benefits accrued at the start of the simulation are assumed to grow geometrically with the accumulated service of retired employees:

$$\widehat{B}_{0,t} = b_0(1+g_b)^t \sum_a \sum_s sN^R_{0,t}(a,s) \tag{10}$$

To track the additional benefits accrued in period k that are payable at some later period t, it is necessary to project the retirement transitions of active participants in period k. Define $X^A_{k,t}$, $X^V_{k,t}$, and $X^R_{k,t}$ as the projected number of participants who are active, terminated vested, or retired, respectively, in period t who were active in period k (assuming the plan is active until period k and then becomes inactive between periods k+1 and t). Those counts are initialized for period k as follows:

$$X^A_{k,k}(a,s) = N^A_k(a,s;k), X^V_{k,k}(a,s) = 0, \text{and } X^R_{k,k}(a,s) = 0 \tag{11}$$

Then, for period $t \geq k$, the counts evolve as follows:

$$X^A_{k,t+1}(a,s) = 0 \tag{12}$$

$$X^V_{k,t+1}(a,s) = \begin{cases} \begin{matrix}\left[X^V_{k,t}(a-1,s) + X^A_{k,t}(a-1,s)\, f_{v,t+1}(a,s)\right] \\ \times \left(1-f_{m,t+1}(a)\right)\left(1-f_{r,t+1}(a,s)\right)\end{matrix} & \text{for } a>0, s\geq 0 \\ 0 & \text{for } a=0, s\geq 0 \end{cases} \tag{13}$$

$$X^R_{k,t+1}(a,s) = \begin{cases} \begin{matrix}\left[\begin{matrix} X^R_{k,t}(a-1,s) \\ +\left(X^A_{k,t}(a-1,s) f_{v,t+1}(a,s) + X^V_{k,t}(a-1,s)\right) f_{r,t+1}(a,s)\end{matrix}\right] \\ \times\left(1-f_{m,t+1}(a)\right)\end{matrix} & \text{for } a>0, s\geq 0 \\ 0 & \text{for } a=0, s\geq 0 \end{cases} \tag{14}$$

In each subsequent period k, the active participants during that period accumulate additional benefits, b_N, that will be payable when they retire:

$$\hat{B}_{k,t} = \hat{B}_{k-1,t} + b_N \sum_a \sum_s X^R_{k,t}(a,s) \tag{15}$$

Finally, to account for unexpected variation in benefits, a benefit scaling factor was defined as follows:

$$\theta_k = \theta_{k-1} e^{-\varepsilon_{k,B} - \sigma_B^2/2} \tag{16}$$

where $\varepsilon_{k,B}$ is normally distributed with a mean of zero and a standard deviation, σ_B, of 2 percent and is uncorrelated across time periods and plans, and where $\theta_0 = 1$. Then, scaled benefits are:

$$B_{k,t} = \theta_k \widehat{B}_{k,t} \text{ for all } t \geq k \tag{17}$$

In the later exposition, B_t denotes benefits payable at t with the subscript k omitted.

PBGC-Insured Benefits

The average annual benefit, $b_{k,t}$, earned per participant per year of service in period t for a plan that became insolvent in period k is the ratio of total benefits to total service years:

$$b_{k,t} = \sum_a \sum_s B_{k,t}(a,s) \,/\, \sum_a \sum_s sN_t^R(a,s;k) \tag{18}$$

Then the statutorily determined amount of annual benefits per year of service that a retired employee is entitled to under PBGC's insurance (expressed as annual payments) can be defined as:[49]

$$i(b_{k,t}) = \min(132, b_{k,t}) + 0.75 \min(396, \max(b_{k,t} - 132, 0)) \tag{19}$$

Thus, an approximation for the annual value of guaranteed payments, $\hat{B}_{k,t}^I$, for a plan that becomes insolvent in period k will be:

$$B_{k,t}^I = i(b_{k,t}) \sum_a \sum_s sN_t^R(a,s;k) \tag{20}$$

Liability Valuation and Benefit Calibration

At any point in time, the value of a plan's current (C) and actuarial (A) liabilities in period k for simulation path j is computed as a present value of the accrued benefit stream:

$$L_k^j = \sum_{t=k}^{T} \frac{B_{k,t}}{\left(1+r_k^{Lj}\right)^{t-k}} \text{ for } j \in \{A, C\} \tag{21}$$

The PBGC-insured liability, denoted $L_{I,k}^j$, can be calculated similarly using $B_{k,t}^I$ in place of $B_{k,t}$. The discount rate used to calculate the current liability, r_t^{LC}, is the yield on 30-year Treasury bonds:

$$r_k^{LC} = y_{30,k} \tag{22}$$

The discount rate used to calculate the actuarial liability, r_k^{LA}, is reported by plans and does not change much from year to year. It is intended to match the rate of return that a plan's actuaries expect the plan's assets to earn. CBO's estimate of a plan's expected return on assets is set to equal the plan's reported liability discount rate (see below).

The new benefits accrued under the plan in period k —the so-called normal cost, or NC_k—is the present value of the difference between the total benefits accrued in the previous period and the total benefits accrued in this period:

$$NC_k = \sum_{t=k}^{T} (B_{k,t} - B_{k-1,t}) e^{-(t-k) r_k^{LA}} \tag{23}$$

where r_k^{LA} is the actuarial discount rate for liabilities in period k.

To calibrate the model to reproduce the initial values reported by plans, CBO set the levels of the parameters b_0, g_b, and b_N so that the initial values of benefits payable, actuarial liability, and normal cost simulated in equations (17), (21), and (23) would match the most recently reported values.

Assets and Asset Valuation

Each plan has assets with a market value, A_t^M, that depends on the sum of previously accumulated contributions and the investment returns earned on them. Given assets in period t, assets in period t+1 depend on the investment return over that period plus that period's contributions minus benefits paid:

[49] In statute, the maximum amount insured by PBGC is expressed as a monthly formula, equal to 100 percent of the first \$11 in monthly benefits plus 75 percent of the next \$33 in monthly benefits.

$$A^M_{t+1} = (A^M_t + C_{t+1} - B_{t+1}) exp(R_{M,t+1}) \quad (24)$$

The plan's return on assets, R_t, is assumed to be a weighted average of 10-year bond returns and stock market returns minus the investments' administrative costs, c_a, plus a plan-specific idiosyncratic shock:

$$R_{M,t} = (1-w)R_{10,t} + wR_{S,t} - c_a + \sigma_P \varepsilon_{P,t} - \sigma_P^2/2 \quad (25)$$

The discount rate used to calculate the actuarial liability equals the discount rate reported by plans, which generally varies between 7 percent and 8 percent.

Plans also report an actuarial value of assets, which smooths out fluctuations in value:

$$A^A_{t+1} = A^A_t exp(R_{A,t+1}) + C_{t+1} - B_{t+1} \quad (26)$$

The smoothing is implemented by setting the actuarial return on assets equal to the liability discount rate plus the average of the last five years of excess market returns over the discount rates for those years:

$$R_{A,t} = r^{LA}_{L,t} + \frac{\sum_{h=0}^{4} R_{M,t-h} - r^{LA}_{L,t-h}}{5} \quad (27)$$

Employers' Contributions

For all nondistressed plans, CBO posited a simple predictive relationship for the current rate of employers' contributions that is a function of a plan's actuarial funding ratio, the lagged contribution rate, the change in the actuarial funding ratio from its average over the previous two years, and the most recent observed ratio of orphan participants to total participants, N_0^O/N_0, plus a lognormally distributed shock, ε_C, whose variance, σ_C, decreases with the plan's funding ratio:

$$\frac{C_t}{L^A_t} = H\left[\frac{A^A_{t-1}}{L^A_{t-1}}, \frac{C_{t-1}}{L^A_{t-1}}, \left(\frac{A^A_{t-1}}{\mathrm{L}_{t-1}} - \left(\frac{A^A_{t-2}}{L^A_{t-2}} + \frac{A^A_{t-3}}{L^A_{t-3}}\right)\Big/2\right), N_0^O/N_0\right] + \sigma_C\left(\frac{A^A_{t-1}}{L^A_{t-1}}\right)\varepsilon_C \quad (28)$$

CBO estimated the function H as a multifactor linear regression of the parameters (see Table B-1) using a historical sample of IRS Form 5500 filings for 4,804 plans over the 2010–2012 period. On the left-hand side of the regression equation is the total contribution made to each plan as a fraction of the plan's total beginning-of-year liability. The prior year's funding ratio was discretized into six categorical variables (zero to 40 percent, 40 to 50 percent, 50 to 65 percent, 65 to 80 percent, 80 to 90 percent, and 90 to 100 percent). The categorical variables were interacted with each of the other values. In the regression, the contemporaneous value of the orphan-participants ratio is used instead of the most recent observed value.

Along each path, the regression model was used to generate a predicted contribution amount, C_t^*, for each period using the estimated regression coefficients, the previous period's contribution rate, previous funding ratios, and a randomly drawn shock (drawn from a normal distribution with a mean of zero and a standard deviation equal to the standard deviation of the regression error). The predicted contribution rate was then restricted by minimum and maximum contribution levels to prevent levels that would never be observed in the data:

$$C_t = \min(\max(C_t^*, \underline{C_t}), \overline{C}_t) \quad (29)$$

The minimum contribution is determined by the plan's normal cost plus a contribution to reduce any funding shortfall (assumed to be 1/20th of the shortfall):

$$\underline{C_t} = \max(0, NC_t - \max(0, A^M_t - L^C_t)) + \max(0, (L^A_t - A^A_t)/20) \quad (30)$$

Table B-1.
Contribution Regression Estimates

Explanatory Variable	Coefficient	Standard Error
Pre-PPA x (0.00 ≤ AAL < 0.40)	0.018	0.064
Pre-PPA x (0.40 ≤ AAL < 0.50)	0.076	0.007
Pre-PPA x (0.50 ≤ AAL < 0.65)	0.018	0.003
Pre-PPA x (0.65 ≤ AAL < 0.80)	0.032	0.001
Pre-PPA x (0.80 ≤ AAL < 0.90)	0.042	0.001
Pre-PPA x (0.90 ≤ AAL < 1.00)	0.009	0.001
Post-PPA x (0.00 ≤ AAL < 0.40)	0.034	0.061
Post-PPA x (0.40 ≤ AAL < 0.50)	0.065	0.007
Post-PPA x (0.50 ≤ AAL < 0.65)	0.018	0.003
Post-PPA x (0.65 ≤ AAL < 0.80)	0.032	0.001
Post-PPA x (0.80 ≤ AAL < 0.90)	0.046	0.001
Post-PPA x (0.90 ≤ AAL < 1.00)	0.011	0.002
C/L x (0.00 ≤ AAL < 0.40)	0.681	0.698
C/L x (0.40 ≤ AAL < 0.50)	0.006	0.042
C/L x (0.50 ≤ AAL < 0.65)	0.762	0.040
C/L x (0.65 ≤ AAL < 0.80)	0.368	0.017
C/L x (0.80 ≤ AAL < 0.90)	0.000	0.000
C/L x (0.90 ≤ AAL < 1.00)	0.691	0.029
(0.00 ≤ AAL < 0.40) x (AALDiff2 < -0.10)	-0.023	0.058
(0.00 ≤ AAL < 0.40) x (-0.10 ≤ AALDiff2 < -0.05)	-0.022	0.049
(0.00 ≤ AAL < 0.40) x (-0.05 ≤ AALDiff2 < 0.00)	0.003	0.022
(0.00 ≤ AAL < 0.40) x (0.00 ≤ AALDiff2 < 0.05)	0.000	0.000
(0.00 ≤ AAL < 0.40) x (0.05 ≤ AALDiff2 < 0.10)	0.017	0.027
(0.00 ≤ AAL < 0.40) x (0.10 ≤ AALDiff2)	0.000	0.000
(0.40 ≤ AAL < 0.50) x (AALDiff2 < -0.10)	-0.030	0.008
(0.40 ≤ AAL < 0.50) x (-0.10 ≤ AALDiff2 < -0.05)	-0.024	0.007
(0.40 ≤ AAL < 0.50) x (-0.05 ≤ AALDiff2 < 0.00)	0.001	0.007
(0.40 ≤ AAL < 0.50) x (0.00 ≤ AALDiff2 < 0.05)	0.000	0.000
(0.40 ≤ AAL < 0.50) x (0.05 ≤ AALDiff2 < 0.10)	0.022	0.011
(0.40 ≤ AAL < 0.50) x (0.10 ≤ AALDiff2)	0.000	0.000
(0.50 ≤ AAL < 0.65) x (AALDiff2 < -0.10)	-0.007	0.004
(0.50 ≤ AAL < 0.65) x (-0.10 ≤ AALDiff2 < -0.05)	-0.004	0.003
(0.50 ≤ AAL < 0.65) x (-0.05 ≤ AALDiff2 < 0.00)	0.000	0.002
(0.50 ≤ AAL < 0.65) x (0.00 ≤ AALDiff2 < 0.05)	0.000	0.000
(0.50 ≤ AAL < 0.65) x (0.05 ≤ AALDiff2 < 0.10)	-0.003	0.004
(0.50 ≤ AAL < 0.65) x (0.10 ≤ AALDiff2)	0.002	0.009
(0.65 ≤ AAL < 0.80) x (AALDiff2 < -0.10)	-0.014	0.002
(0.65 ≤ AAL < 0.80) x (-0.10 ≤ AALDiff2 < -0.05)	-0.010	0.001
(0.65 ≤ AAL < 0.80) x (-0.05 ≤ AALDiff2 < 0.00)	-0.004	0.001
(0.65 ≤ AAL < 0.80) x (0.00 ≤ AALDiff2 < 0.05)	0.000	0.000
(0.65 ≤ AAL < 0.80) x (0.05 ≤ AALDiff2 < 0.10)	0.002	0.002
(0.65 ≤ AAL < 0.80) x (0.10 ≤ AALDiff2)	0.004	0.003
(0.80 ≤ AAL < 0.90) x (AALDiff2 < -0.10)	-0.013	0.002
(0.80 ≤ AAL < 0.90) x (-0.10 ≤ AALDiff2 < -0.05)	-0.009	0.001
(0.80 ≤ AAL < 0.90) x (-0.05 ≤ AALDiff2 < 0.00)	-0.006	0.001
(0.80 ≤ AAL < 0.90) x (0.00 ≤ AALDiff2 < 0.05)	0.000	0.000

(continued)

		(continued)
(0.80 ≤ AAL < 0.90) x (0.05 ≤ AALDiff2 < 0.10)	-0.004	0.002
(0.80 ≤ AAL < 0.90) x (0.10 ≤ AALDiff2)	0.000	0.002
(0.90 ≤ AAL < 1.00) x (AALDiff2 < -0.10)	-0.001	0.004
(0.90 ≤ AAL < 1.00) x (-0.10 ≤ AALDiff2 < -0.05)	-0.001	0.002
(0.90 ≤ AAL < 1.00) x (-0.05 ≤ AALDiff2 < 0.00)	0.000	0.001
(0.90 ≤ AAL < 1.00) x (0.00 ≤ AALDiff2 < 0.05)	0.000	0.000
(0.90 ≤ AAL < 1.00) x (0.05 ≤ AALDiff2 < 0.10)	0.001	0.002
(0.90 ≤ AAL < 1.00) x (0.10 ≤ AALDiff2)	0.006	0.003
Orphan Participants as a Share of Total Participants in 2012 (Percent)	-0.017	0.003
Number of Observations	4,804	
Adjusted R-squared	0.8445	

Source: Congressional Budget Office, using data from plans' filings of Internal Revenue Service Form 5500.

AAL = actuarial assets divided by actuarial liabilities; AALDiff2 = difference between beginning-of-year AAL and average AAL of prior two years; C/L = prior-year contributions divided by prior-year beginning-of-year liabilities; PPA = Pension Protection Act of 2006.

The maximum contribution is the amount that would make the actuarial value of the plan's assets equal to 140 percent of the plan's current liability:

$$\overline{C}_t = \max\left(0, 1.4L^C_{t-1} - A^A_{t-1}\right) \tag{31}$$

Note that the shortfall amortization rules defined in the Employee Retirement Income Security Act of 1974 (ERISA) are implicit in the regression model's estimates and were not modeled explicitly.

Modeling States of Plans' Distress

Rather than the rules described above, special rules apply in CBO's model to plans that have entered one of the following states of financial distress:

- Exhaustion of reasonable measures (E)—for plans that declare that they have exhausted all reasonable measures to improve funding, existing benefits and new accruals are left unchanged, and total contributions remain fixed until the plan's funding ratio increases to 80 percent.
- Benefit cut (B)—when a plan's application for benefit reductions is approved, benefits are cut to a fraction of their previous value, and shortfall contributions remain fixed at their level as of the date of the cut until the plan's funding ratio reaches 80 percent, subject to a maximum of 15 years.
- Withdrawal (W)—when all employers participating in a plan have withdrawn, the plan receives withdrawal liability payments instead of contributions, and all new benefit accruals cease.
- Insolvency (I)—a plan that has insufficient assets to pay benefits has its benefits cut to the maximum level insured by PBGC.

Plans that have not entered one of those distressed states are considered to be in a Normal (N) state. The conditional probabilities of transition to each state (summarized in Table B-2) are defined as follows:

- p_I is the conditional probability of insolvency at period t if the plan is not already insolvent. $p_I = 1$ if scheduled benefits exceed the market value of assets; $p_I = 0$ otherwise.

Table B-2.
Probabilities of Transition Between Different States of Financial Distress for a Multiemployer Plan

	Probability of Next Year's State Being:				
Current State	**Normal (N)**	**ERM (E)**	**Benfit Cut (B)**	**Withdrawal (W)**	**Insolvency (I)**
Normal (N)	$(1 - p_W)(1 - p_I)$ x $(1 - p_B)(1 - p_E)$	$(1 - p_W)(1 - p_I)$ x $(1 - p_B)\ p_E$	$(1 - p_W)\ (1 - p_I)$ x p_B	$(1 - p_I)\ p_W$	p_I
ERM (E)	0	$(1 - p_W)(1 - p_I)$ x $(1- p_B)$	$(1 - p_W)\ (1 - p_I)$ x p_B	$(1 - p_I)\ p_W$	p_I
Benfit Cut (B)	0	0	$(1 - p_W)\ (1 - p_I)$	$(1 - p_I)\ p_W$	p_I
Withdrawal (W)	0	0	0	$(1 - p_I)$	p_I
Insolvency (I)	0	0	0	0	1

Source: Congressional Budget Office.

ERM = exhausted all reasonable measures to avoid insolvency; *p* = probability.

- p_W is the probability of withdrawal, if the plan has not transitioned to an insolvent state, defined as a function of the plan's funding ratio (the actuarial value of assets divided by current liability), as shown in Table B-3.
- p_B is the probability of a benefit cut if the plan has not transitioned to a withdrawn or insolvent state. $p_B = 0.15$ if the plan's actuarial funding ratio over each of the past three years was less than 0.65 and if the plan could achieve full funding at its current contribution rate with the benefit cut; $p_B = 0$ otherwise.
- p_E is the probability of being in an ERM state if the plan has not transitioned to a benefit cut or to a withdrawn or insolvent state. $p_E = 0.1$ if the plan's actuarial funding ratio over each of the past three years was less than 0.65; $p_E = 0$ otherwise.

The probability of a benefit cut depends on a test of the viability of the benefit cut. A benefit cut is said to be viable if it meets two conditions. First, the plan's current contribution rate must be insufficient to fund the shortfall between the actuarial value of the plan's assets and liabilities in 15 years:

$$C_t < (L_t^A - A_t^A)/15 \qquad (32)$$

Second, the reduced benefit cannot be less than 110 percent of the PBGC-insured benefit.

Exhaustion of Reasonable Measures. Any plan that is in the ERM state has its total contribution level fixed at the level observed when it first entered that state. New accruals in the plan are assumed to continue.

Benefit Cut. When a plan enters the benefit cut state, it reduces accrued and new benefits by the fixed fraction that will ensure that fixed payments (given the current level of shortfall contributions) are sufficient to amortize the plan's actuarial funding shortfall over 15 years. The required benefit reduction fraction is found by solving for x in the following equation:

$$C_t - \mathrm{NC}_t = \frac{\left((1-x)L_t^A - A_t\right)}{15} \qquad (33)$$

Table B-3.
Annual Conditional Probability of Employer Withdrawal
Percent

Actuarial Funding Ratio in Year of Simulation[a]	Probability of Employer Withdrawal
0-40	2.0
40-50	1.0
50-65	0.5
65-80	0.2
80-105	0.1
105 or More	5.0

Source: Congressional Budget Office.

a. A plan's actuarial funding ratio is the value of its assets divided by the value of its liabilities.

Shortfall contributions to the plan will be locked at the most recent observed level for the next 15 years or until the plan's funding ratio increases to 80 percent, whichever comes first. Afterward, those contributions revert to the normal contribution rate rules.

Note that to be eligible to make a benefit cut in period *t*, the plan cannot cut its liability below 110 percent of its insured liability:

$$(1 - x)L_t^A \geq 1.1L_{I,t}^A \qquad (34)$$

Withdrawal. In a withdrawal event, all employers stop participating in a plan. Each employer is assessed a withdrawal liability based on the plan's shortfall; however, only 40 percent of the withdrawal liability is assumed to be recovered, and it is assumed to be paid as an annuity over 20 years.[50] Thus, employers' annual contribution (from withdrawal liability payments) in year *t* after the insolvency date *k* becomes:

$$C_t = 0.4 \times \left(L_k^A - A_k\right) \times \frac{r_k^{LA}}{\left(1-(1+r_k^{LA})^{-20}\right)} \text{ for k<t≤k+20, 0 otherwise.} \qquad (35)$$

Withdrawal also stops new benefits from accruing—that is, $f_u(a, s) = 1$ and $g_e(a, s) = 0$.

Insolvency. For modeling purposes, an insolvent plan is one whose assets have fallen below its current benefits. The first time that happens, benefits are cut to the maximum level insured by PBGC (see equations 18 to 20). Thereafter, the plan receives a stream of assistance payments from PBGC at PBGC's insurance level to the extent that there are unpaid benefits. At the insolvency date, remaining employers are assumed to make the same level of contributions that they would if they had withdrawn (see equation 35). New benefit accruals in the plan cease—that is, $f_u(a, s) = 1$ and $g_e(a, s) = 0$.

[50] In reality, a mass withdrawal depends on more factors than the financial health of the plan. An employer weighs its potential withdrawal liability assessment against the cost of continuing to participate in the plan—including the additional exposure to market risk. But an employer's decision to withdraw is likely to be influenced by other factors as well, such as its industry's profitability and employment growth, the financial condition of individual employers, and previous withdrawals by one or more employers from the plan. The plan's funding ratio is an observable measure of the plan's distress and is a primary legal basis for determining whether a plan is deemed critical or endangered, as defined in ERISA.

PBGC's Fee Income and Financial Assistance Payments

PBGC assesses a flat fee, f_t, per participant in a multiemployer plan, making total fees in period *t*:

$$\text{Fee Income}_t = f_t N_t \tag{36}$$

PBGC's financial assistance payments begin only if a plan is insolvent and has insufficient assets to pay benefits:

$$\text{Financial\_Assistance}_t = I_{\mathrm{A}_t<\mathrm{B}_t}(B_t^G - A_t) \tag{37}$$

where $I_{\mathrm{A}_t<\mathrm{B}_t}$ = 1 if $\mathrm{A}_t < \mathrm{B}_t$ and 0 otherwise.

The projections of financial assistance claims and premiums that CBO reports are the averages of all paths. The fair-value estimate of PBGC's cash flows is calculated by running the simulation using the risk-neutral transformations of the yields and rate of return variables as described above, then discounting those cash flows using the initial yield curve:

(38) Fair-value estimate = $\frac{1}{J}\sum_j \sum_{t=0}^{T}\left(\widetilde{Fee\ Income}_{j,t} - \widetilde{Financial\ Assistance}_{j,t}\right)e^{-t\tilde{y}_{t,0}}$

where J is the total number of simulation paths.