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The state of public pension funding: Are government employee plans back on track?

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The public-sector pension industry is claiming a comeback from losses suffered during the Great Recession. But this recovery is greatly exaggerated: even years past the end of the recession, most pension sponsors are unable to make their full annual contributions, and pensions are taking as much investment risk as ever. The first step to effective pension reforms is an honest, accurate view of the costs and risks that public plans impose on government budgets and taxpayers.

Pension plans for state and local government employees have been a matter of political debate and policy concern since the Great Recession brought these plans' funding woes to public attention. Policy analysts highlighted their multitrillion-dollar unfunded liabilities, while some financial analysts warned that pension costs could push multiple local—and perhaps even state—governments into default and bankruptcy.

Some cities, such as Detroit, Michigan, and San Bernardino and Stockton, California, have entered bankruptcy, and pension costs played a role in each case. Yet, as strong investment returns have slightly improved pension funding, pension advocates argue that public plans are back on track. The National Conference on Public Employee Retirement Systems declares, "The truth is that the vast majority of public pensions are well funded and are growing stronger as the economy continues to recover" (Kim 2014). The National Association of State Retirement Administrators (NASRA) likewise asserts that "most states have made a reasonably good effort" to fund their plans. "There is a perception that many plans and states have failed," NASRA claims, "when in fact it's only a handful of states" (Brainard and Brown 2014). Such claims are used to push back against efforts to reform public employee pension plans.

In reality, most plan sponsors have failed to make the minimum actuarially calculated requirements for their plans, and the percentage of sponsors making full payments has declined substantially over time. In fiscal year 2013, the most recent for which comprehensive data are available, only 41 percent of plans received their full annual required contribution (ARC), barely half the number as in 2001. Likewise, public employee plans are taking substantially more investment risk than in the past, a practice that increases the volatility of governments' required contributions and destabilizes state and local government budgets.

The true extent of public pension funding shortfalls is hidden by a nearly unique set of accounting rules promulgated by the Governmental Accounting Standards Board (GASB) that allow public plans to discount, or value, guaranteed future pension liabilities using the assumed rate of return on a portfolio of risky assets. Unlike the rules applied to corporate pensions or to public employee plans in other countries, GASB accounting rules ignore the value of the government's liability to pay the plan's promised benefits in the very

likely event that the plan's investments do not achieve the assumed rate of return.

These GASB rules create an incentive for public pensions to invest in risky assets; as a result, US public plans hold more risky assets than do corporate pensions or public plans in other countries. GASB rules also create an incentive for public plans to exaggerate the returns they are likely to receive on their investment portfolios. Public plan investment assumptions are substantially higher than the projections made by investment consultants who advise the plans.

To provide an honest and thorough view of public pension liabilities and to reduce incentives to take excessive investment risk, public employee plans should calculate and disclose plan liabilities using accounting rules that are consistent with economic theory, the practice of financial markets, and the regulations applied to other pension plans. Such an approach would discount plans' liabilities using an interest rate derived from investments whose risk is similar to that of the benefits public plans promise, an approach that is often referred to as "fair market valuation." If we discount public plan benefits using a corporate bond yield, as private pensions are required to do, public pensions nationwide are on average only about 46 percent funded, and unfunded liabilities top $2.6 trillion. Were accrued public pension benefits to be discounted using yields on US Treasury securities, which many analysts believe more accurately reflect the risk of accrued public pension benefits, total unfunded liabilities would top $4 trillion. Moreover, moving to a fair-value approach would eliminate incentives for pension managers to take excessive investment risks.

As the Congressional Budget Office put it, "By accounting for the different risks associated with investment returns and benefit payments, the fair-value approach provides a more complete and transparent measure of the costs of pension obligations" (Congressional Budget Office 2011). Thus, the question is: Should pension stakeholders receive more complete or less complete information regarding the cost of pension obligations? Many in the public pensions industry wish to withhold such information from policymakers and the public. But without it, it may be impossible to gauge the full extent of public pension underfunding and to craft effective, lasting reforms.

The Contribution Record

Each year, a public plan's actuaries calculate what is referred to as an annual required contribution (ARC), which is designed to fund the benefits accruing to employees in that year and to pay off, over some stated future period, any unfunded liabilities the plan may have. The ARC will change depending on the investment return the plan assumes—a higher assumed return results in lower required contributions—and the period over which the plan chooses to pay off its unfunded liabilities. The ARC is often expressed as a percentage of the salaries of plan participants, though the employer pays the ARC, not the employees. Employees usually do contribute toward their pensions, and the ARC is calculated net of such contributions.

In reality, the ARC is not legally required, and plan sponsors commonly fail to make ARC payments. This is one reason why, in recent years, GASB has changed its terminology to refer to such payments as actuarially determined contributions. For these purposes, however, we will refer to such payments as the ARC, as this terminology is better known.

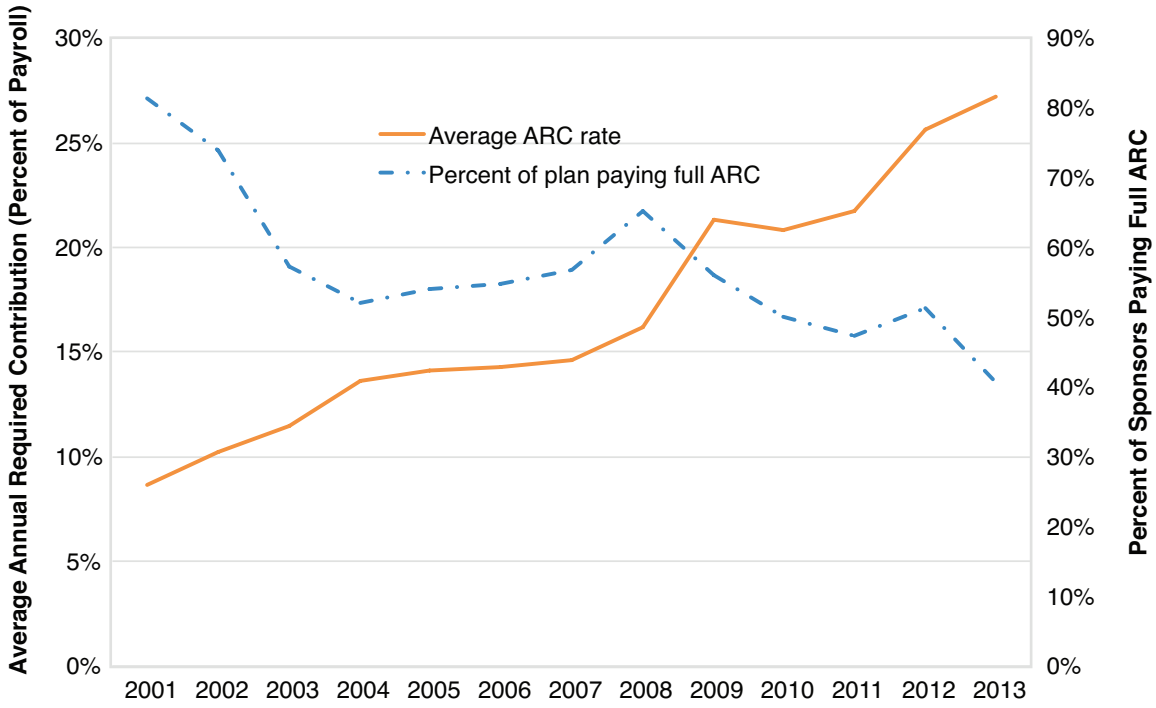
Figure 1 illustrates recent trends in ARC levels and the percentage of plan sponsors making their full ARC payment. This graph, and much of the analysis herein, draws on data from the Public Plans Database (PPD), an invaluable resource which is compiled and maintained by the Center for Retirement Research at Boston College, the Center for State and Local Government Excellence, and the National Association of State Retirement Administrators.[1]

Since 2001, the average plan ARC more than tripled as a percentage of employee payroll, from 8.6 percent of payroll to 27.2 percent. During that time, the percentage of plans making their full contribution fell from 81 percent in 2001, the first year for which comprehensive data are available, to just 41 percent in 2013. Most public plans continued to fall short of making full contributions even four years past the end of the last recession, a period in which plans should be making up for past contribution shortfalls and rebuilding their finances.

Given these results, how does NASRA conclude that "most states have made a reasonably good effort" to fund their plans? The answer is that NASRA lowers the bar on what counts as a "reasonable effort" until a majority of plans are able to achieve it. NASRA defines "a good-faith effort" as "as paying 95 percent or more of the ARC." There is nothing meaningful about this 95 percent threshold other than it being the maximum percentage of the ARC at which a majority of plans can be termed as making a good-faith effort. As NASRA notes, "The median ARC experience is 95.1 percent, meaning that one-half of the plans received at least

1 The PPD is available online at http://crr.bc.edu/data/public-plans-database/.

Figure 1. Annual ARC and Percentage of Plans Receiving Full ARC, Fiscal Years 2001–13



Note: These figures reflect ARCs for the average plan. If plan ARCs and payroll are combined in dollar terms, aggregated ARC levels are slightly lower, but the trends are very similar.
Source: Public Plans Database

95.1 percent of their required contributions." Thus, only the barest majority of the 50 states plus the District of Columbia meet the good-faith effort standard. Indeed, were NASRA analysis to exclude the District of Columbia—which is, after all, a city rather than a state—the median contribution would fall to 94.55 percent of the ARC, and NASRA's "most states" statement would no longer apply.

More important than dissecting these definitions, however, is acknowledging that the ARC paid by public-sector pensions is, by the standards of the pension world, a very low bar to meet. Although funding rules differ between public and private plans in a number of respects, the two most important are the interest rate at which liabilities are valued and the period over which unfunded liabilities must be paid off (or "amortized"). Public plans are allowed, under rules issued by the GASB, to discount plan liabilities at the assumed rate of return on plan investments, currently an average of about 7.7 percent. Corporate defined benefit plans, by contrast, must discount plan liabilities using a corporate bond yield. The Mercer Pension Discount Yield Curve is a measure of corporate bond yields used by corporate pensions in valuing their liabilities. As of April 2015, the Mercer Pension Discount Yield Curve for a mature corporate plan with a high ratio of retirees to workers showed a discount rate of 3.8 percent (Mercer 2015).

Moreover, corporate pensions generally must pay off their unfunded liabilities over a period of 7 years, while the average public plan chooses to amortize its unfunded liabilities over around 25 years. Some public plans have used amortization periods as high as 100 years as a means to reduce annual contributions while still appearing to pay what is required. Shorter amortization periods means higher payments up front.

The effects of different discount rates and amortization periods on annual contributions can be substantial. To illustrate, I draw on averages for public plans in 2013 using PPD data. The average plan had a total normal cost of 13.8 percent of payroll and an amortization payment of 16.9 percent of payroll, based on an assumed 7.7 percent investment return and an amortization period of 25.4 years. Employee contributions averaged 6.7 percent of wages, leaving the plan sponsor with an

Table 1. Discount Rates Used by Public-Sector Pensions in Different Countries

Country	Discount Rate (2012)	Reference Rate
Australia	6.0%	Expected return on government bonds over long term
Canada	5–6.5%	Expected return on government bonds over long term, plus markup for risk premium
Switzerland	3.5%	Expected return on portfolio of 2/3 stocks and 1/3 government bonds, minus 0.5%
Netherlands	2.4%*	Public pensions assets managed under private-sector rules; riskless return plus ultimate forward rate for very long-term liabilities
United Kingdom	6.4%	Expected return on investments, calculated as inflation rate plus approximately 3% real return
United States	8.0%	Expected return on assets

Source: Van der Wal (2014)

ARC of 24 percent of payroll.[2] This is a contribution level that most plan sponsors have shown themselves to be unable or unwilling to meet.

Calculating public plan contributions using stricter corporate pension rules raises contributions even higher. Lowering the discount rate from 7.7 percent to a 3.8 percent rate used by corporate defined benefit plans would increase the total normal cost from 13.8 to 38.4 percent of wages. Since employee contributions are set, governments would bear all of this contribution increase, and thus the employer normal cost would rise from 7.1 percent to 31.7 percent of payroll. Likewise, the combination of a lower discount rate and a shorter payoff period would increase the amortization payment from 16.9 to 73.4 percent of payroll. The total ARC under corporate pension rules would increase from 24 to about 105 percent of payroll. [3]

No substantive differences between government and private-sector pensions justify governments' paying so much less toward their pensions than corporate plan sponsors. Some point out that governments are infinitely lived while corporations may go bankrupt. For instance, in a 2006 white paper, GASB argued, "Because governments have the power to tax—a right in perpetuity to impose charges on persons or property—they have the ability to continue operating in perpetuity. . . . The relative longevity of government is reflected in the long-term view applied in governmental financial reporting" (Government Accounting Standards Board 2006).

This assumes that even the smallest municipality has a funding advantage over the largest corporation, which seems dubious. More importantly, however, a government's power to tax merely means that, in the event of a plan's becoming underfunded, future taxpayers will bear that cost through higher taxes rather than future beneficiaries bearing it through lower benefits. It does not change the funding risk involved with the plan, merely the party that will bear that risk. This difference is no reason to ignore funding risk.

Moreover, public-employee plans in other countries—which presumably have the same funding advantages over corporate entities that US state and local governments are purported to have—tend to fund their public-employee retirement plans using more conservative discount assumptions similar to those of US corporate pensions (Andonov, Bauer, and Cremers 2013). Table 1 shows discount rates used by public employee plans in the United States and five developed countries. US public pensions use by far the highest discount rates, outstripping other countries by between 1.5 and 5.6 percentage points (Van der Wal 2014). Even if one believes that government plans are justified in using higher discount rates than corporate pensions, there is no reason to believe that a small US municipality has any advantage over a national government abroad in providing pensions. Nor is there any reason to believe that pension managers in

2 This illustrated figure will differ slightly from the ARC for the average plan, as it is based on aggregated assets and liabilities.

3 I assume, based on an actuarial analysis of seven different plans under the Florida Retirement System, that the normal cost of a plan increases by 30 percent for each 1 percentage point reduction in the discount rate and the amortization cost increases by 25 percent (DuZebe 2011, and Jones, Murphy, and Zorn 2009; also see Office of the State Actuary, 2010a, 2010b).

other countries, who tend to be more financially sophisticated than those in the US, are leaving money on the table by using excessively low discount rates.

The best explanation for these differences is that the US public pension system accounting framework is out of step with how state and local governments invest pension assets, that this misguided accounting framework provides an artificial financial advantage to public-employee plans, and that the public pension industry—state and local plans, employees who benefit from them, actuarial and investment firms that are employed by public plans, and representative groups to whom the plans donate—are loath to give up these advantages.

Public Pension Investment Practices

GASB accounting rules provide an incentive for public pensions to take additional investment risk. That is, the plan may discount its liabilities using the expected return on plan assets; the higher the expected return, the lower the present value of liabilities and the lower the contribution deemed adequate to fund them; and the higher the risk of a portfolio, the higher its expected return will tend to be.

These incentives act in two ways: going into the financial crisis and recession of 2007, US public plans almost surely held more risky assets than they would have in the absence of GASB rules, leading to larger investment losses. Moreover, plans that became underfunded during the recession because of investment losses or a lack of contributions by their sponsors would have an incentive to take greater investment risk to make up the difference.

Table 2 illustrates trends in investment practices over time. Some point out that public plans have moderated their investment return assumptions.[4] These figures support that contention: from fiscal years 2001 through 2013, the average assumed investment return for public plans declined by 0.35 percentage points, from 8.05 percent to 7.68 percent. Those figures, however, are not a measure of the amount of investment risk that public plans are taking because they do not account for the even larger decline in yields on low-risk investments. The yield on 10-year US Treasury securities fell from 5.02 percent in 2001 to 2.35 percent in 2013, a decline of 2.67 percentage points. In other words, riskless returns declined by 7.5 times more than did the returns pensions assumed for their own investments. Similarly, the yield on corporate bonds fell from 6.86 percent in 2001 to 4.46 percent in 2013.

4 For instance, see National Association of State Retirement Administrators (2015).

The only way for plans to compensate for lower riskless returns is to take increasing investment risk, and this is precisely what they have done. In 2001, the average plan held 64 percent of its investments in risky assets, which I categorize as equities, real estate, or alternative investments. By 2013, the average plan held 72 percent risky assets.

Put another way, public pensions have been assuming that their investments will earn a much larger premium over risky assets than in the past. In 2001, the average plan assumed that its investments would return 3.03 percentage points over the Treasury yield. Today, the average plan assumes a risk premium of 5.34 percentage points. Similarly, pensions' assumed earnings premium over corporate bonds rose from 1.19 percent in 2001 to 3.22 percent in 2013.

The increase in risk taking by public plans highlights the problem with the GASB approach of basing liability discount rates on pension's investment rather than their liabilities. In the past, US state and local pensions invested conservatively, holding mostly bonds or bond-like investments. In 1952, for instance, pensions invested 96 percent of their portfolios in low-risk investments such as bonds and cash (Pew Charitable Trusts 2014).

Pensions may have been technically incorrect in discounting their liabilities based on the assumed return on assets rather than the risk of their benefits, but in practical terms the differences were small. Today, however, pensions are discounting the same types of liabilities using the expected return on a portfolio holding nearly three-quarters risky assets. This change in investment practices occurred gradually, such that there was no clear juncture at which the GASB approach to measuring liabilities went from "right" to "wrong." But GASB standards confuse differences in plans' investment strategies—whether a plan makes larger contributions in safer investments to pay costs up front and maintain contribution stability down the road or makes smaller contributions in riskier assets at the price of contribution volatility and costs shifted to future taxpayers—with a difference in liabilities. In this, the GASB approach is simply mistaken.

Can Plans Achieve Projected Investment Returns?

The figures cited in table 2 raise two questions. First, are the investment portfolios chosen by public plans likely to produce the returns that plans have assumed for them? And, second, how will the increasing risk of public pension investments affect the volatility of

Table 2. Risk Taking, Assumed Returns, and Assumed Premia over Riskless Assets

FY	Percent Risky Assets	Assumed Investment Return	10-year Treasury Yield	Assumed Risk Premium	Corporate Bond Yield	Assumed Risk Premium
2001	64%	8.05%	5.02%	3.03%	6.86%	1.19%
2002	63%	8.04%	4.61%	3.43%	6.08%	1.96%
2003	64%	8.00%	4.01%	3.99%	5.65%	2.35%
2004	68%	7.98%	4.27%	3.71%	5.44%	2.54%
2005	69%	7.96%	4.29%	3.67%	5.40%	2.56%
2006	69%	7.95%	4.80%	3.15%	5.48%	2.48%
2007	70%	7.94%	4.63%	3.31%	5.58%	2.37%
2008	68%	7.95%	3.66%	4.29%	5.56%	2.39%
2009	67%	7.91%	3.26%	4.65%	5.23%	2.68%
2010	68%	7.87%	3.22%	4.65%	4.89%	2.98%
2011	70%	7.78%	2.78%	5.00%	4.06%	3.73%
2012	71%	7.72%	1.80%	5.92%	3.66%	4.06%
2013	72%	7.68%	2.35%	5.33%	4.46%	3.22%

Source: Author's calculations from Public Plans Database

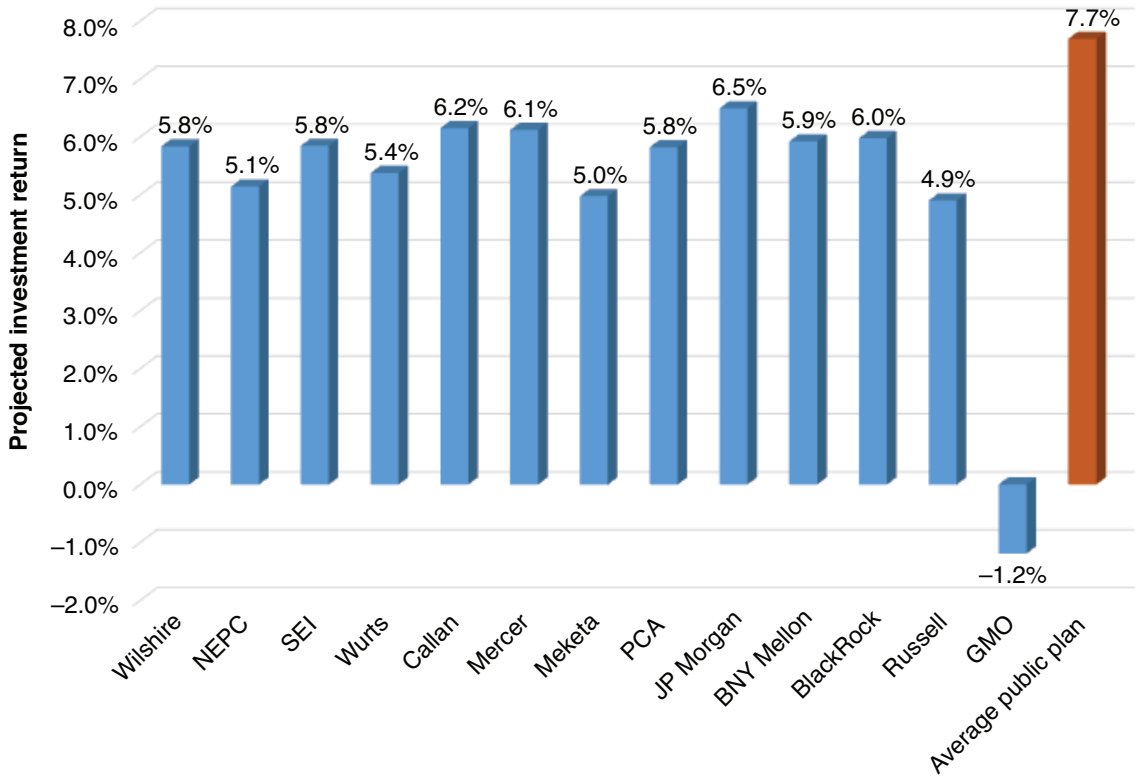
annual contributions that state and local governments must make?

Public plans tend to justify their projected investment returns for the future by looking to historical returns—roughly speaking, "We did it before, so we can do it again." By contrast, the Society of Actuaries Blue Ribbon Panel on Public Pension Funding, on which I served, recommended that in forecasting investment returns plans should use a "building blocks" approach, in which a risk premium is stacked atop the yield on riskless assets. This approach would recognize that the bond returns are likely to be lower in the foreseeable future than in the past. The Society of Actuaries panel's recommended approach would be to apply an investment risk premium of 3.5 to 4.5 percentage points on top of the yield on 10-year Treasury securities. At the Treasury yield of 2.2 percent as of June 1, this would produce a total expected return of 5.7 to 6.7 percent, well short of the 7.7 percent assumed by most plans.

Professional investment advisers appear to agree. In October 2014, the Pension Consulting Alliance (PCA) compiled investment return projections from eight investment consultants and five asset managers, many of whom are employed as expert advisers for public plans. For each consultant's projections of individual asset-class returns, I calculated the expected return on a portfolio composed of 70 percent domestic stocks and 30 percent domestic bonds, designed to approximate public pensions' current division between risky and safe assets. The median projected 10-year return in the PCA survey is 5.2 percent and the mean is 5.8 percent (figure 1). Were these returns to hold over the long term, contribution costs would increase by approximately 40 percent over levels what most plans already are failing to pay.

These investment return projections shed some light on why public pensions have become so heavily invested in hedge funds and private equity, despite misgivings regarding the fees and investment performance of these asset categories. Based on the PCA survey, even if public plans invested 100 percent of their assets in US stocks—a strategy that would be perceived as akin to gambling—their projected return over the next decade would range between 5.9 and 7.5 percent. Alternative investments are the only way that plans can plausibly achieve their investment return targets, albeit at significantly higher risk to the fund and to the taxpayer.

Figure 2. Projected 10-Year Geometric Mean Return on 70–30 Domestic Stock–Bond Portfolio



Source: Pension Consulting Alliance, October 2014

One possible objection to these figures is that the consultants the PCA surveyed are projecting investment returns only over the following 10-year period, while public plan liabilities are spread over many decades. Thus, higher returns after 10 years could potentially compensate for lower returns over the next decade. I examine this question using data on annual benefit liabilities drawn from the Oregon Public Employees Retirement System (Hembree and Larrabee 2014).

Oregon PERS discounts its benefit liabilities based on the assumption of a 7.75 percent annual investment return. To test, I first assume a lower annual return for the first 10 years, then solve for the return in subsequent years that would allow benefits to be paid in full. If we assume the median PCA-projected return of 5.8 percent over 10 years, a 9.1 percent annual compound return would be required in subsequent years for the plan's investments to be sufficient. Even this understates the returns the plan would need because a compound return does not account for the volatility of annual returns.

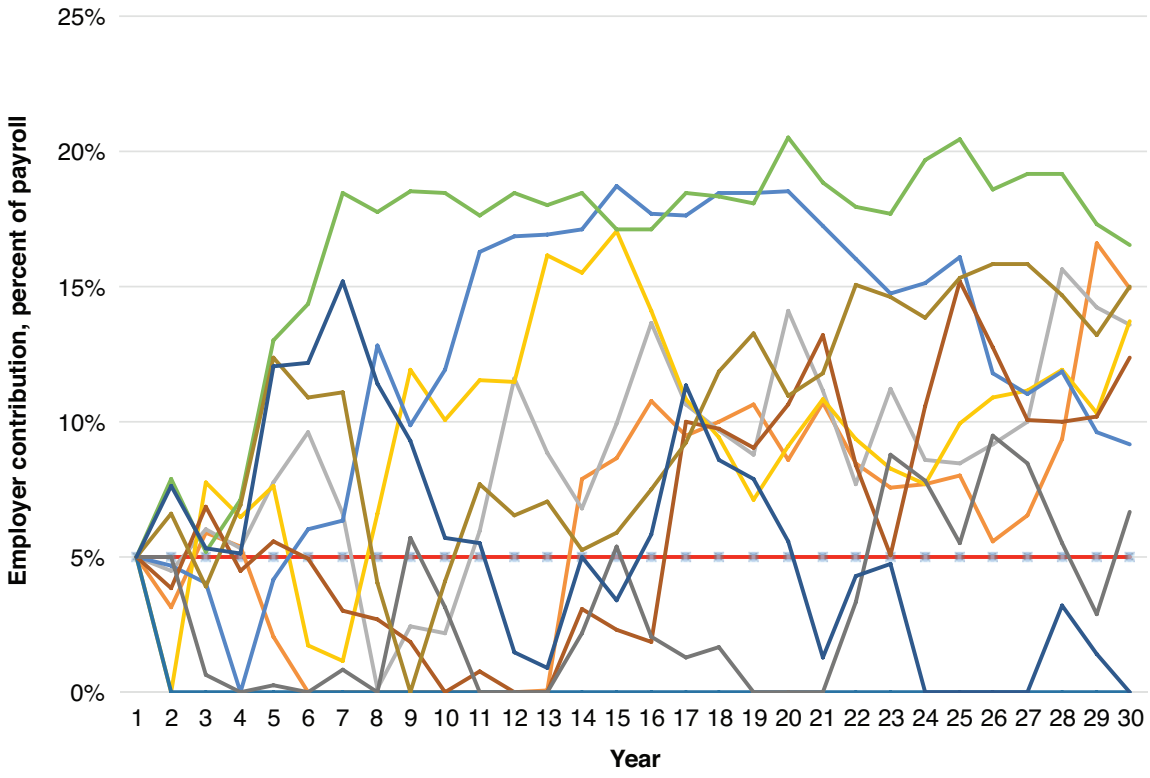
In terms of the arithmetic mean return, which is how most pensions express investment return assumptions, a roughly 9.8 percent annual return would be needed in years 11+ to compensate for a 5.8 percent return over the first decade. This result occurs because most of a public plan's liabilities must be paid within roughly the first 13 years. Low returns even over a single decade can leave a plan's investments far behind where they need to be.

Volatility of Plan Contributions

Even if public plans have accurately forecasted the expected returns on their investments, the increased risk of pension portfolios will create greater instability in the contributions required to maintain funding health over time. This trend is important, as the Academy of Actuaries calls "contribution stability and predictability" one of the "three primary objectives" of pension funding policy (American Academy of Actuaries 2014). Stable contributions allow pension sponsors to plan the substantial budgetary allocations required by pensions as far in advance as possible.

Yet the increased investment risk taken by public pensions will inevitably increase the volatility of the plan's

Figure 3. Employer Contribution Rates Incorporating Investment Volatility



Note: Lines represent various sample employer contribution rates. Horizontal red line illustrates the projected 5 percent contribution rate, assuming constant investment returns over time.
Source: Author's calculations, derived from Biggs (2014).

required contributions from year to year. The increased volatility of pension contributions, coupled with the rising size of pensions relative to the overall budgets of the state and local governments that sponsor them, makes it more difficult for policymakers to plan their budgets and avoid sudden increases in taxes or debt or reductions in other spending priorities (Biggs 2013).

Unfortunately, public pension actuaries place little emphasis on measuring and conveying the link between investment risk and contribution risk, and GASB disclosures ignore investment risk entirely. Under GASB rules, a plan that takes greater investment risk instantly becomes "better funded" and may reduce its annual contributions, even if greater investment risk raises the probability of large shortfalls in future years.

Figure 3 illustrates contribution volatility, drawing on a recent study I authored in the *Journal of Retirement* (Biggs 2014). It begins with a plan that is fully funded with an assumed fixed employee contribution rate of 6 percent of wages and an expected employer contribution rate of 5 percent of wages. The plan's assumed investment return is 7.7 percent, and the standard deviation of annual returns is 12 percent. The plan smooths investment returns over five years and amortizes unfunded liabilities over 25 years, which are the most common methods used by public plans.

The red line running horizontally across the chart illustrates the projected 5 percent contribution rate that actuaries would inform plan sponsors about and that plan reports would disclose. This contribution rate is calculated based on the assumption of constant investment returns over time.

The other lines represent a small sample of the many *actual* contribution rates that could be required of the government sponsoring the plan. These actual contributions can vary significantly, both from year to year and over longer periods. In some instances, the plan receives high returns and can go for extended periods without any employer contribution. In other years, required contributions can rise to three or four times their expected levels.

The *Journal of Retirement* analysis shows that, so long as a plan sponsor makes all required contributions, of whatever size, the chance of the plan becoming insolvent are extremely low. Once a sponsor fails to make full contributions, however, insolvency becomes possible. Risky investment strategies and contribution shortfalls are inextricably linked: riskier investments produce more volatile required contributions, and both common sense and historical data show that times of high required contributions are when those requirements fail to be met. Put another way, the best evidence that public plans are taking excessive investment risk is that so many cannot afford to make their payments.

These types of figures generally are not calculated for pension trustees or elected officials who are responsible for pension funding. And yet they are crucial for understanding the trade-offs between investment risk and return that face all investors, including pension funds. When public pensions take investment risk that is far out of balance with the risk of the benefits they offer, pensions put their own financial health, the budgetary stability of their sponsors, and the broader economy of their state or locality at risk.

Actuarial Liabilities and Economic Liabilities

This volatility of pension contributions illustrates a key shortfall of current pension accounting practices: pension liability measures do not reveal the significant financial and budgetary risk that a plan sponsor takes on when it guarantees future benefits but funds those benefits using risky assets. This no-matter-what, come-what-may promise constitutes a liability whose true value to pension participants and cost to pension sponsors significantly outstrips the pension "liabilities" disclosed in accounting documents.

What is termed a "liability" under GASB accounting differs fundamentally from the legal or economic definition of a liability. A public pension liability is the present value of contributions that, if invested at a stated steady rate of return, would be sufficient to meet benefit payments as they come due. But when a pension plan promises employees some future stream of benefits, it is not buying into the steady contribution rate that, at some steady rate of investment return, would fund those benefits. Rather, it is accepting the need to bear whatever contribution rate is necessary to pay those benefits, on time and in full, regardless of the returns the plan's investments might generate. *That* is a liability. That is, the plan sponsor is liable for promised benefits not in one set of circumstances—in which the plan's investments generate, say, 7.7 percent returns, year in and year out—but in every set of circumstances, including those in which long-term investment returns may be far below projected levels.

Economists and financial markets capture the value of this full set of possible outcomes by discounting a liability at an interest rate commensurate with the risk of that liability. For simplicity, if we assumed that pension liabilities were as safe as Treasury securities, state or local government bonds, or corporate bonds, we would discount those liabilities using those rates. The reality is a bit more complex, and there is some disagreement among economists on the appropriate discount rate to use for pension liabilities (Brown and Pennacchi 2015).

But there is broad agreement that the expected rate of return on a risky portfolio of assets is *not* the appropriate discount rate to use. Indeed, in a 2014 survey of economists conducted by the University of Chicago Business School, 98 percent agreed with the statement, "By discounting pension liabilities at high interest rates under government accounting standards, many U.S. state and local governments understate their pension liabilities and the costs of providing pensions to public-sector workers" (Chicago Booth IGM Forum 2014).

Some observers confuse the issue by stating that discounting pension liabilities using a risk-adjusted interest rate assumes that the plan itself will invest in such a low-risk asset. For instance, Girard Miller—at the time, a columnist for *Governing* magazine and now the chief investment officer of the Orange County Employees Retirement System—stated, "Pension funds are not going to invest their entire portfolio in 3 percent Treasury bonds right now—or ever—so the risk-free model is not even descriptive of reality and has little normative value" (Miller 2012).

An example illustrates why that is not the case. Imagine that a pension plan owes a single lump-sum payment of $1 million in 15 years' time. The plan assumes a 7.7 percent return on investment, meaning that a lump-sum contribution of about $315,058 today would make the plan "fully funded" in GASB accounting terms. In reality, though, there is a less than 50 percent chance that a $315,058 investment today will end up reaching $1 million 15 years from now.[5] So a liability that is called "fully funded" is at best only 50-50 funded.

To protect against a potential shortfall, the plan could

5 The reason is that the mean, or average, stock return is several percentage points higher than the median return. Thus, even if the average return is assumed to be 7.7 percent, less than 50 percent of outcomes will exceed that average.

purchase a "put option," which is a financial product that would make up any difference between the fund's actual value and its goal of $1 million. A put option is, in effect, an insurance policy whose cost depends upon the "strike price" at which the insurance policy kicks in, the risk of the assets being insured, and the rate of return available on riskless investment.

That put option would cost about $386,424 but would ensure with 100 percent certainty – not the 50 percent under GASB rules—that the full $1 million benefit could be paid without returning to future taxpayers for a bailout. This *true* full funding helps maintain intergenerational equity, which means, in GASB's terms, that "taxpayers of today pay for the services that they receive and the burden of payment for services today is not shifted to taxpayers of the future" (GASB 2009). GASB illustrates intergenerational equity using terms such as "living within our means" and "fairness." Similarly, the American Academy of Actuaries calls intergenerational equity one of the "three primary objectives [that] need to be balanced" by pension policymakers (American Academy of Actuaries 2014).

Of course, the chance also exists that the plan's investments would end up being worth *more* than $1 million. In that case, intergenerational equity would be violated in the other direction, in the sense that today's taxpayers would overpay and tomorrow's taxpayers would reap the benefits. To address this, the plan could sell a "call option" that would give away any fund surplus over $1 million. The sale of the call option, which would reap about $3,805, would reduce costs to current taxpayers while ensuring that future taxpayers do not reap a bonus.

So here is what we have: $1 million that must and can be paid in full, without overcharging or undercharging either current or future generations. How much does it cost? This is the important part for the pension valuation debate: the sum of the initial $315,058 contribution to risky assets and the $386,424 purchase of the put option protecting against funding shortfalls, minus the $3,805 sale of the call option giving away any funding surpluses, comes to $697,676. That figure is precisely equal to present value of the $1 million future liability if discounted at the government bond yield.

In other words, discounting pension liabilities using low-risk bond yields does not assume that the pension plan may invest only in low-risk bonds. This result will be the same regardless of how the plan chooses to invest. A plan that makes smaller contributions in riskier investments has a lower initial contribution and, in the process, shifts larger net costs onto future generations. A plan that makes larger contributions but takes less investment risk bears more of the cost upfront. But the cost does not change.

Nor is it necessary to assume that pension plans actually buy put or call options. Instead, the public is unknowingly providing what economists call an "implicit put option," a contingent liability placed on future taxpayers to make good on promises taxpayers make today. In other words, the prices of the options used in my calculations illustrate the value that the public places on risk. Not purchasing options does not make the risk disappear; it merely shifts it onto the general public in a nontransparent way. In the Congressional Budget Office's terms, the fair-value approach reflects "the cost of the risk to taxpayers that the rate of return on risky pension assets may not meet expectations" (Congressional Budget Office 2011). Discounting pension liabilities using an interest rate commensurate with the risk of those liabilities captures the full value of the pension promises being made.

The GASB accounting approach, by contrast, assumes either that pension investments have no risk over the long run or that the cost of this risk is inconsequential. The former view appears to be widely shared among pension stakeholders, but among experts it is generally held to be incorrect (Pastor and Stambaugh, 2009; Bodie, 1994). The latter view is inconsistent with the notion of generational equity, in which each generation should pay its own fair share of pension liabilities. Pension trustees, elected officials, and voters need and deserve the information the fair-value approach provides to make informed choices regarding pension policy.

Pension Funding while Controlling for Risk

In this section, I report pension funding on a plan-by-plan and state-by-state basis using data from the Public Plans Database. The Public Plans Database does not include complete data for 2014, so where necessary I turn to 2013 data and supplement with data drawn directly from plan actuarial valuations. I report each plan's funding figures as calculated under GASB rules. I also calculate plan funding on a fair-value basis, which compares the market value of plan assets to the market value of liabilities.

The important choice to make in calculating pension liabilities on a fair-value basis is deciding the discount rate. The discount rate for public pension benefits should be derived from investments with risk similar to that of the benefits being offered. Many analysts have argued that, because pensions advertise a

no-matter-what, come-what-may benefit and because benefits have generally been paid even when plan sponsors were in significant financial distress, pension liabilities should be discounted using the yield on guaranteed US Treasury securities. For instance, the Society of Actuaries Blue Ribbon Panel recommended that, as a supplement to existing measures, plan sponsors calculate plan liabilities using the Treasury yield curve. Public pension liabilities measured using Treasury yields might be considered an upward reasonable bound on their value.

Others have argued for valuing pension liabilities using corporate bond yields, as private-sector pensions are required to do. This approach could be appropriate if we wished to value public and private pension liabilities on a uniform basis, a reason the federal government's Bureau of Economic Analysis cites in using corporate bond yields to value pension liabilities for the National Income and Product Accounts. This choice implicitly assumes that accrued public pension benefits carry the same average level of risk as corporate bonds, which likely overstates their risk. Thus, liabilities calculated using a corporate bond yield might be considered a reasonable lower bound.

Until 2012, Moody's accepted pension liabilities as reported under GASB accounting rules. In that year, however, Moody's outlined plans for calculating pension liabilities using a common discount rate whose risk more closely matched that of pension benefit liabilities (Moody's Investment Services 2013). Moody's discounts pension liabilities using a high-grade corporate bond yield derived from Citibank's Pension Discount Curve, which is based on corporate bonds rated Aa or better.

Moody's assumes that pensions have an average duration of liabilities of 13 years, so I utilize the Citibank yield for pensions with a "short" duration of liabilities, averaging 12.24 years. For the period of July 1, 2013, to June 31, 2014, the Citibank Pension Discount Curve averaged 4.26 percent.[6] The assumption of an average duration of 13 years allows for a recalculation of pension liabilities by first compounding reported liabilities forward at the plan's assumed investment return for 13 years, then discounting back to the present using the corporate bond yield. Thus, what these figures roughly reflect is how public pension funding would look if it were judged on the same terms as corporate pensions.

Funding ratios and unfunded liabilities on a fair-value basis are calculated by comparing the market value of assets to the market value of liabilities. This differs from GASB accounting, where the "actuarial value" of assets is used. The actuarial value of assets is generally calculated by smoothing investment returns over a given period, usually about five years, though a wide variety of methods are used. In certain cases the market value of assets is not available, in which case the actuarial value of assets is used.

Ideally, plans would perform such calculations themselves, using plan-specific data or assumptions regarding the duration of plan liabilities and the risk that accrued benefits may be reduced. However, these assumptions are reasonable approximations.

Appendix table A1 contains funding information on a plan-by-plan basis. It begins with actuarial assets and liability values, from which GASB funding ratios and unfunded liabilities are derived. It then reports assets and liabilities on a fair-market-value basis along with fair-value funding ratios and unfunded liabilities.

The best-funded plan in our data set on a fair-value basis is the Pennsylvania Municipal Employees Plan at 83 percent, though it should be noted that this is a collection of separate plans with varying, though on average quite high, funding ratios. Next is the District of Columbia's Police and Fire (81 percent), which benefits in a fair-value context from making its payments based on an assumed investment return of 6.5 percent, among the lowest in the public pension world. Following are the Missouri Local and North Carolina Local plans at 74 percent funded.

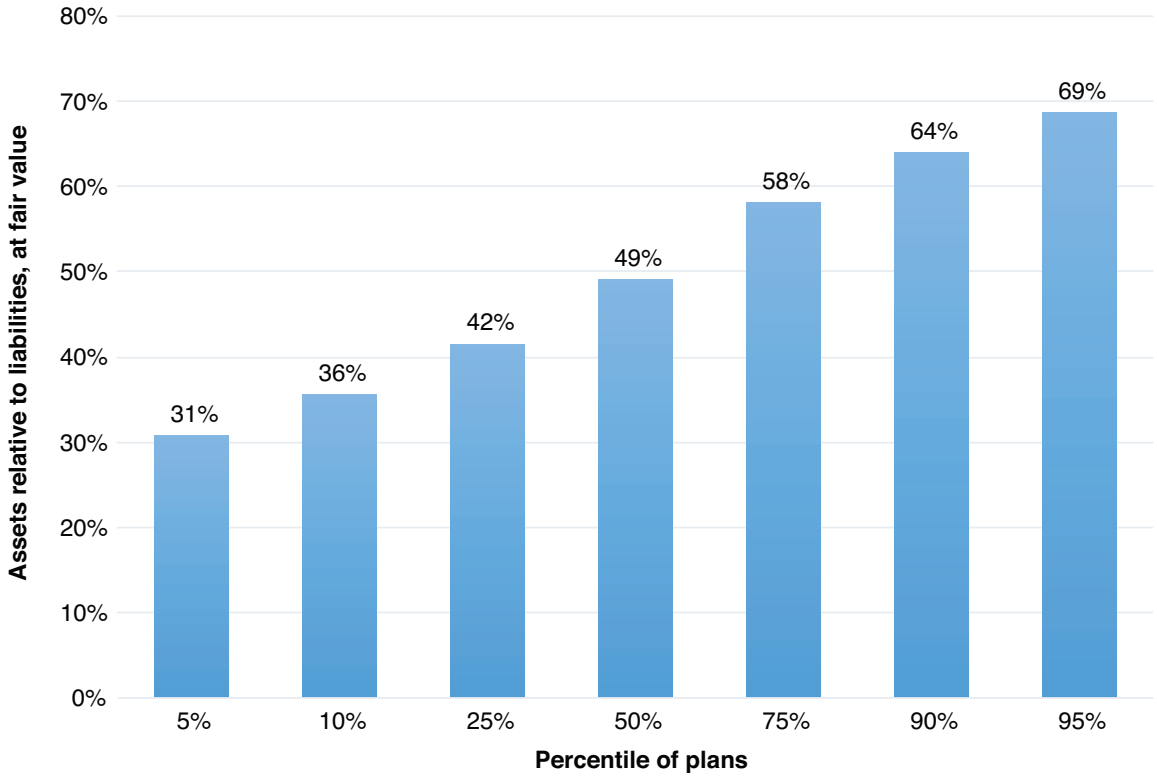
The largest unfunded liabilities on a dollar basis are the two main California plans, CalPERS and CalSTRS, with combined unfunded liabilities on a fair-value basis exceeding $460 billion. Both plans are about half-funded on a fair-value basis, and their large size leads to large unfunded liabilities in dollar terms. Following are Texas Teachers, Illinois Teachers, and the Florida Retirement System.

The lowest funding ratio, which is a better indicator of the overall financial health of a plan, is for the Kentucky Employee Retirement System, with a fair-value funding ratio of 17 percent. Following Kentucky are the Chicago Police plan (21 percent), and Illinois SERS, Connecticut SERS, and Chicago Municipal Employees (all at 26 percent).

Figure 4 illustrates the distribution of fair-value funding ratios among the 150 plans analyzed. The median funding ratio under fair market valuation is 49 percent, meaning that half of plans are less than 49 percent funded and half are greater than 49 percent funded. Twenty-five percent of plans are less than 42

6 Citibank also offers yield curves for liabilities averaging 15.04 and 18.92 years.

Figure 4. Distribution of Funding Ratios, 2013–14



Source: Author's calculations from Public Plans Database

percent funded, 10 percent are less than 36 percent funded, and 5 percent are less than 31 percent funded. Likewise, 25 percent of plans are more than 58 percent funded on a fair-value basis, 10 percent are more than 64 percent funded, and the highest 5 percent of plans are at least 69 percent funded.

A comparison to corporate pension funding standards helps put public plans' fair-value funding ratios in context. For corporate pensions, the Pension Protection Act of 2006 designated colored "zones" based on the funding ratio of a plan. A plan in the "green zone" is one with an 80 percent or greater funding ratio. Note that this does not mean that an 80 percent funding ratio is adequate, as some in the public pension world imply (American Academy of Actuaries 2012). Rather, it merely denotes that a corporate plan with a greater than 80 percent funding ratio is not required to take immediate remedial action to rapidly increase its funding.

A corporate plan is in the "yellow zone," denoted "endangered," if it has a funding ratio of less than 80 percent or an accumulated funding deficiency (AFD) in the current year or is forecast to have one over the following six years. An AFD exists when a plan has failed to make its minimum annual contribution, which in the public pension context is the ARC. Note that nearly 60 percent of public plans failed to make their ARC in 2013. If the public-sector ARC were calculated using corporate pension assumptions for discount rates and amortization periods for unfunded liabilities, all public plans would have an AFD.

A corporate plan is in the orange, or "seriously endangered," zone if it has both a funding ratio below 80 percent and an AFD. Finally, a corporate plan is the red, or "critical zone," if it has a funding ratio below 65 percent and an AFD or meets several other related criteria.

By these standards, only two public plans—Pennsylvania Municipal and DC Police and Fire—would be in the green zone. Thirteen public plans out of 150 would be in the "seriously endangered" zone by virtue of a funding ratio between 65 and 80 percent, while the remaining 135 plans would be in the "critical" zone.

At best, public plans make their contributions to the standards that are applicable to them, so one should not expect many public plans to appear well funded when held to the far higher standards applied to

corporate plans. But that is precisely the point: if US public plans were held to a higher funding standard, one similar to corporate pensions or to public employee plans in other countries, plan sponsors likely would do a much better job of funding these plans' liabilities.

Appendix table A2 contains fair-value figures aggregated by state. These figures include total pension unfunded liabilities in dollar terms, unfunded liabilities as a percentage of state GDP, and the average funding ratio of plans included in the Public Plans Database. Each figure tells a slightly different story and has pros and cons.

Unfunded pension liabilities in dollar terms are easily understandable and useful to state residents because a dollar figure may be compared to other state economic or budgetary figures. However, dollar figures also strongly correlate to the size of the state. California has by far the largest shortfalls at $621 billion, followed by New York at $295 billion and Illinois at $265 billion. The smallest unfunded liabilities in dollar terms are in Delaware ($4.2 billion), Vermont ($4.3 billion), and North Dakota ($5.2 billion).

Expressing unfunded liabilities relative to state GDP may be a better measure of the manageability of pension liabilities, as it compares unfunded pension costs to the economy that must support them. Illinois is the leader with unfunded liabilities equal to 37 percent of GDP, followed by Alaska (33 percent); Mississippi (32 percent); and Kentucky, Ohio, and New Mexico, all at 30 percent. The lowest liabilities relative to state GDP are Washington at 5 percent, Delaware and Nebraska at 7 percent, and North Carolina at 8 percent. However, the Public Plans Database does not contain information on all public plans. Thus, states with a large number of plans that are not included in the database may have lower unfunded liabilities relative to state GDP than a state with a small number of large plans in which both state and local government employees participate.

Average funding ratios of plans within a state may be seen as a measure of a state's stewardship of its plans. States that make larger contributions and take less risk with their investments will tend to have higher funding ratios on a fair-value basis. Wisconsin leads in this measure, with plans funded at an average of 73 percent where assets and liabilities are valued on a market basis. North Carolina (70 percent) and Delaware (67 percent) follow.[7]

7 Note that these figures are not the average of fair-value funding ratios for plans in a given state. Rather, they are a weighted average in which a state's summed pension assets are compared to the state's summed pension liabilities.

Even the best-funded state and local government plans are poorly funded when compared to corporate pensions. In April 2015, the average corporate pension funding ratio was 90.1 percent, versus an average among state and local plans of 49.6 percent when measured on a comparable basis (BenefitsPro 2015). This fact should be troubling to elected officials who make public pension policy and citizens who must bear the costs of pension plans.

Aggregate Funding Trends

Trends in pension funding over time also interest policymakers and the public. The decline in pension funding levels and increase in unfunded liabilities, as measured using GASB actuarial methods, is well known: in 2001, the average public plan was slightly overfunded, with a funding ratio of 102 percent (table 3). Since that time, however, GASB funding levels have followed a slow but steady decline, such that as of 2013 the average plan was only 71 percent funded. The Public Plans Database does not contain sufficient data to produce full figures for 2014, but GASB funding levels have improved somewhat as strong investment returns have increased asset levels.

On a fair-value basis, the change in risk-appropriate interest rates must also be considered, as these interest rates measure the cost of providing a future benefit of a given level of risk. The Citibank pension yield series does not date back far enough to be used in this context, so instead I use AAA corporate bond yields compiled by the Federal Reserve. In general, these will be similar to the Citibank series and are useful in illustrating trends over time.

On a fair-value basis, funding levels will almost always be lower and unfunded liabilities larger than using GASB rules because the yields on risk-appropriate investments are lower than the assumed returns on plan assets. However, that gap increased from 2001 to the present because bond yields fell further than did the investment returns plans assumed under GASB rules. The market funding ratio fell from 89 percent in 2001 to a low of 42 percent in 2012, with an upswing to 46 percent in 2013 as bond yields increased and pension assets received strong investment returns. Figures for 2014 are incomplete, but higher bond yields make it likely that overall funding levels have improved.

On a fair-value basis, pension funding levels will change from year to year based on the level of contributions, the investment return on plan assets, and the discount rate applied to future benefit liabilities. The effect of discount rate changes in a fair-value approach

Table 3. Aggregated GASB and Fair-Value Funding Ratios and Unfunded Liabilities, FY 2001–13

Year	GASB Funding Ratio	GASB Unfunded Liability	Assumed Investment Return	Corporate Bond Yield	Market Funding Ratio	Fair-Value Unfunded Liabilities
2001	102%	(46,762,446)	8.05%	6.86%	89%	267,153,688
2002	95%	116,350,161	8.04%	6.08%	75%	721,077,231
2003	89%	268,636,170	8.00%	5.65%	67%	1,079,119,495
2004	87%	333,093,854	7.98%	5.44%	64%	1,289,246,694
2005	86%	395,289,761	7.96%	5.40%	62%	1,416,080,514
2006	85%	427,910,463	7.95%	5.48%	63%	1,478,272,748
2007	86%	423,368,288	7.94%	5.58%	64%	1,496,347,806
2008	85%	511,575,021	7.95%	5.56%	63%	1,656,221,057
2009	78%	752,999,333	7.91%	5.23%	56%	2,151,982,109
2010	76%	882,683,817	7.87%	4.89%	52%	2,567,963,832
2011	74%	975,327,683	7.78%	4.06%	46%	3,342,017,825
2012	72%	1,088,667,386	7.72%	3.66%	42%	3,870,005,237
2013	71%	922,063,194*	7.68%	4.46%	46%*	2,637,758,929*

Note: * Reflects incomplete data.
Source: Author's calculations from Public Plans Database.

can be substantial. In fact, much of the decline in fair-value pension funding levels from 2001 to 2013 is due to the fall in yields on low-risk investments. Some in the public pension community treat such funding-level changes as an artificial and undesirable result of accounting rules that ignores the reality of actually funding future benefits.

That view is mistaken, for two reasons. First, a change in the yield on low-risk assets today produces a real change in the cost of funding a low-risk liability payable in the future, even if the plan does not invest in these low-risk assets. If the return on low-risk assets falls, pension sponsors must taking greater investment risk to meet any given target investment return, and risk imposes costs on plan sponsors and taxpayers.

Second, plans that view interest rate volatility as undesirable can offset that risk by holding low-risk assets in their investment portfolios. If interest rates decline on newly issued bonds, thereby increasing the value of the plan's liabilities, a portfolio of existing bonds would rise in value because of their higher yields, helping to offset the rise in liabilities. Public plans could hedge their interest rate risk but choose not to, as they focus instead on shifting portfolios toward risky investments.

Conclusions

Public employee pensions are an increasingly important issue for state and local governments to address. Pensions have grown substantially larger relative to the governments that sponsor them and take on a great deal more investment risk than in previous years and decades. Fluctuation in pension assets thus have a greater impact on state and local budget today than in the past. And recent experience shows that most plan sponsors are finding the budgetary burdens of pensions to be excessive, in that sponsors either cannot or will not make full required contributions.

Pension accounting practices have contributed to these outcomes. Calculating a plan's liabilities using the expected return on a risky portfolio of assets both understates the cost of the plan and encourages pensions to take excessive investment risk. This results in plans making excessive benefit promises in good economic times, such as the numerous benefit

enhancements that took place in the late 1990s, while rendering plan contributions unaffordable in bad economic times.

Shifting public employees to defined contribution (DC) plans does not make unfunded liabilities from an existing defined benefit (DB) plan disappear. State and local governments have promised benefits well in excess of the assets they have accumulated to pay for them. In some cases and to some degrees, governments will be able to renege on the benefits they have promised. For instance, some states have been able to reduce annual cost of living adjustments, which can have a substantial effect on pension liabilities. In other states, however, such cuts have been rejected by the courts as the breach of an implicit or explicit contract with public employees. In at least one state, even raising employee contribution rates has been deemed impermissible. Overall, however, most state and local government will have to honor the vast majority of accrued benefits and will need to raise revenues or reduce other spending programs to do so.

However, DC plans can form a path forward. Even if state and local governments choose to offer plans that are generous by private-sector standards—for instance, 90 percent of private employers contribute less than 6 percent of employee pay to DC plans, versus the typical DB pension ARC of about 25 percent of wages—these costs would be substantially lower than what sponsors currently pay toward DB pensions (Bureau of Labor Statistics 2010).

Moreover, DC plans offer state and local governments the prospects of contribution stability and intergenerational equity. When a state or local government promises fixed benefits but funds those benefits with risky assets, the government's contributions will be volatile. Contributions will be volatile from year to year, destabilizing budgets, and from generation to generation, meaning that some generations of taxpayers could pay far more than others for the services they receive from public employees (Biggs 2014).

There is no avoiding this problem, only mitigating it by taking less investment risk. Yet even a DB system holding riskless assets suffers from interest rate risk with regard to the normal cost of benefits accruing in that year. A DC plan allows the employer to set contributions as a level percentage of employee payroll and maintain that stable contribution rate indefinitely.

A DC plan for the public sector does not make risk go away. Instead, it shifts risk from the government (and taxpayers) to employees, and, as I have stressed throughout this paper, risk is a cost. That said, public employees have an avenue of risk mitigation—altering the date of their retirement—that the government does not have. Delaying retirement (or moving it up, if asset returns are unusually strong) is a very effective way of matching retirement saving to retirement income needs, as delaying retirement both increases assets and reduces the number of retirement years over which those assets must provide income.

At the very least, policymakers at the state and local levels must come to realize that, like any other investor, they must balance risk and return. The fact that state and local governments can pass on investment risks to taxpayers, present and future, does not mean that such risks do not exist or that they do not have costs. To assess these trade-offs, however, pension policymakers and stakeholders need improved measures of pension funding that better capture the costs and benefits of the benefits they have promised and the funding strategies they have adopted to pay those benefits.

About the Author

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Appendix

Table A1. Actuarial and Fair-Market-Value Unfunded Liabilities and Funding Ratios, by Plan for Fiscal Years 2013 or 2014

State	Plan Name	Fiscal Year	Actuarial Unfunded Liability ($)	Actuarial Funding Ratio	Market Unfunded Liability ($)	Market Funding Ratio
Alabama	Alabama ERS	2013	4,990,141	66%	12,892,889	44%
Alabama	Alabama Teachers	2013	1,003,627	66%	26,086,357	44%
Alaska	Alaska PERS	2013	5,435,132	55%	12,193,981	35%
Alaska	Alaska Teachers	2013	3,419,240	48%	7,140,039	31%
Arizona	Arizona Public Safety Personnel	2014	6,214,033	49%	13,060,608	31%
Arizona	Arizona SRS	2014	9,801,000	76%	31,686,076	52%
Arizona	Arizona State Corrections Officers	2014	1,126,333	57%	2,916,006	29%
Arizona	Phoenix ERS	2014	1,494,084	59%	3,158,746	41%
Arkansas	Arkansas PERS	2014	1,969,000	78%	6,068,344	55%
Arkansas	Arkansas Teachers	2014	3,935,000	77%	13,995,045	49%
California	Alameda County Employee's Retirement Association (ACERA)	2013	1,650,743	76%	5,380,238	49%
California	California PERF	2013	93,091,000	75%	296,265,536	47%
California	California Teachers	2013	73,667,000	67%	164,539,844	50%
California	Contra Costa County	2013	1,823,681	76%	4,707,118	58%
California	Kern County Employees Retirement Association	2014	2,150,318	61%	4,599,966	44%
California	LA County ERS	2014	11,287,991	80%	34,065,372	58%
California	Los Angeles City Employees Retirement System (LACERS)	2014	5,304,102	67%	10,252,363	58%
California	Los Angeles Fire and Police	2014	2,435,749	87%	9,963,285	63%
California	Los Angeles Water and Power	2014	2,097,956	81%	6,634,951	59%
California	Orange County ERS	2013	5,367,917	66%	11,975,817	47%
California	Sacramento County ERS	2014	1,267,935	85%	4,963,618	61%
California	San Diego City ERS	2014	2,030,110	74%	4,577,636	60%
California	San Diego County	2014	2,316,718	81%	8,446,783	55%
California	San Francisco City & County	2014	3,110,479	85%	13,736,644	57%
California	University of California	2013	13,808,608	76%	40,076,897	53%
Colorado	Colorado Municipal	2013	1,210,984	73%	3,193,811	52%
Colorado	Colorado School	2013	14,067,932	60%	30,012,181	43%
Colorado	Colorado State	2013	9,714,265	57%	20,024,838	41%
Colorado	Denver Employees	2013	636,680	76%	2,237,038	48%
Colorado	Denver Schools	2013	709,977	81%	2,363,232	58%
Connecticut	Connecticut Municipal	2013	283,353	88%	1,643,202	54%
Connecticut	Connecticut SERS	2014	14,920,815	41%	29,856,127	26%
Connecticut	Connecticut Teachers	2014	10,802,700	59%	28,694,371	35%
Delaware	Delaware State Employees	2014	673,039	92%	4,156,567	67%
District of Columbia	DC Police & Fire	2014	(290,190)	107%	982,548	81%
District of Columbia	DC Teachers	2014	210,647	89%	799,258	67%
Florida	Florida RS	2014	21,509,300	87%	92,717,201	62%
Georgia	Georgia ERS	2013	4,852,645	71%	13,052,355	48%
Georgia	Georgia Teachers	2013	13,626,028	81%	48,913,555	55%
Hawaii	Hawaii ERS	2014	8,578,300	61%	19,888,027	42%
Idaho	Idaho PERS	2013	2,074,100	85%	9,017,967	57%
Illinois	Chicago Municipal Employees	2013	8,714,712	37%	15,164,133	26%
Illinois	Chicago Police	2013	7,228,457	30%	12,510,410	21%
Illinois	Chicago Teachers	2014	9,458,351	52%	19,108,026	36%

Illinois	Cook County Employees	2013	6,430,644	57%	13,121,992	40%
Illinois	Illinois Municipal	2013	4,273,533	88%	17,859,818	65%
Illinois	Illinois SERS	2014	26,211,232	34%	42,504,047	26%
Illinois	Illinois Teachers	2014	61,589,612	41%	108,604,133	30%
Illinois	Illinois Universities	2014	21,584,800	42%	36,665,278	32%
Indiana	Indiana PERF	2014	2,940,962	82%	8,636,514	62%
Indiana	Indiana Teachers	2014	11,198,626	48%	18,654,713	36%
Iowa	Iowa Municipal Fire and Police	2014	586,111	78%	1,652,884	58%
Iowa	Iowa PERS	2014	5,544,028	83%	19,603,466	59%
Kansas	Kansas PERS	2013	9,765,906	60%	24,077,516	37%
Kentucky	Kentucky County	2014	4,976,575	62%	11,424,138	43%
Kentucky	Kentucky ERS	2014	9,415,106	24%	15,834,153	17%
Kentucky	Kentucky Teachers	2014	14,010,205	54%	26,840,106	40%
Louisiana	Louisiana Municipal Police	2014	801,359	68%	1,853,293	50%
Louisiana	Louisiana Schools	2014	806,633	67%	1,772,228	51%
Louisiana	Louisiana SERS	2014	7,271,270	59%	15,803,958	42%
Louisiana	Louisiana State Parochial Employees	2013	241,250	93%	1,365,795	71%
Louisiana	Louisiana Teachers	2014	11,973,764	57%	25,242,176	41%
Maine	Maine Local	2014	234,186	91%	1,411,114	63%
Maine	Maine State and Teacher	2014	2,298,518	81%	7,476,756	58%
Maryland	Maryland PERS	2014	7,512,375	66%	18,073,959	46%
Maryland	Maryland Teachers	2014	10,815,010	71%	28,416,880	49%
Massachusetts	Boston Retirement Board	2013	3,670,839	59%	8,400,963	40%
Massachusetts	Massachusetts SERS	2014	10,958,990	68%	29,512,961	45%
Massachusetts	Massachusetts Teachers	2014	17,801,500	56%	41,479,333	36%
Michigan	Michigan Municipal	2013	3,096,000	72%	9,648,859	44%
Michigan	Michigan Public Schools	2013	25,796,224	60%	60,925,894	40%
Michigan	Michigan SERS	2013	6,210,091	60%	14,819,179	40%
Minnesota	Duluth Teachers	2014	153,608	57%	337,588	40%
Minnesota	Minneapolis ERF	2014	204,974	82%	868,042	52%
Minnesota	Minnesota PERF	2014	5,637,964	74%	18,328,957	49%
Minnesota	Minnesota Police and Fire Retirement Fund	2014	1,626,309	80%	5,615,532	56%
Minnesota	Minnesota State Employees	2013	2,052,861	82%	8,037,120	56%
Minnesota	Minnesota Teachers	2014	6,346,574	74%	18,490,043	52%
Minnesota	St. Paul Teachers	2014	585,631	62%	1,476,914	39%
Mississippi	Mississippi PERS	2014	14,445,348	61%	33,650,326	43%
Missouri	Missouri DOT and Highway Patrol	2014	1,854,978	49%	3,642,903	35%
Missouri	Missouri Local	2014	485,712	92%	2,173,290	74%
Missouri	Missouri PEERS	2013	730,419	82%	2,956,966	53%
Missouri	Missouri State Employees	2014	2,856,813	75%	9,038,085	50%
Missouri	Missouri Teachers	2013	7,315,018	80%	27,745,474	52%
Missouri	St. Louis School Employees	2013	170,472	84%	766,125	56%
Montana	Montana PERS	2014	1,581,700	74%	4,881,991	48%
Montana	Montana Teachers	2014	1,793,633	65%	4,312,143	46%
Nebraska	Nebraska Schools	2014	1,804,089	83%	7,863,428	52%
Nevada	Nevada Police Officer and Firefighter	2013	2,544,033	71%	7,699,706	45%
Nevada	Nevada Regular Employees	2013	10,331,907	69%	29,850,224	43%
New Hampshire	New Hampshire Retirement System	2013	4,638,087	57%	10,024,873	39%
New Jersey	New Jersey PERS	2013	17,832,716	62%	45,504,953	38%
New Jersey	New Jersey Police & Fire	2013	8,869,518	73%	29,049,410	44%
New Jersey	New Jersey Teachers	2013	23,039,504	57%	57,747,868	31%
New Mexico	New Mexico PERF	2013	4,619,228	73%	12,994,754	50%
New Mexico	New Mexico Teachers	2014	6,256,326	63%	14,692,062	44%
New York	New York City ERS	2013	21,832,232	68%	49,640,238	49%
New York	New York City Fire	2013	7,694,738	54%	14,465,820	39%
New York	New York City Police	2013	14,442,758	67%	32,001,360	48%

New York	New York City Teachers	2013	25,770,850	58%	48,548,241	43%
New York	New York State Teachers	2013	11,796,300	88%	54,114,848	64%
New York	NY State & Local ERS	2013	17,142,000	100%	82,473,547	63%
New York	NY State & Local Police & Fire	2013	2,703,000	89%	14,005,618	64%
North Carolina	North Carolina Local Government	2014	39,666	100%	8,177,840	74%
North Carolina	North Carolina Teachers and State Employees	2014	3,441,748	95%	29,422,182	69%
North Dakota	North Dakota PERS	2014	1,028,608	64%	2,365,083	49%
North Dakota	North Dakota Teachers	2014	1,198,326	62%	2,871,998	42%
Ohio	Ohio PERS	2013	15,233,000	82%	62,369,254	54%
Ohio	Ohio Police & Fire	2013	5,514,557	67%	15,091,573	44%
Ohio	Ohio School Employees	2014	5,575,000	68%	14,120,511	47%
Ohio	Ohio Teachers	2014	29,509,882	69%	76,555,015	48%
Oklahoma	Oklahoma PERS	2014	994,411	89%	4,460,657	66%
Oklahoma	Oklahoma Police Pension and Retirement System	2014	118,500	95%	1,043,608	68%
Oklahoma	Oklahoma Teachers	2014	7,206,591	63%	16,722,786	46%
Oregon	Oregon PERS	2013	5,621,100	91%	34,197,367	63%
Pennsylvania	Pennsylvania Municipal Retirement System	2014	32,948	98%	387,128	83%
Pennsylvania	Pennsylvania School Employees	2014	35,121,184	62%	84,497,064	39%
Pennsylvania	Pennsylvania State ERS	2013	17,899,396	59%	37,917,795	42%
Pennsylvania	Philadelphia Municipal Retirement System	2013	5,326,900	47%	10,925,245	31%
Rhode Island	Rhode Island ERS	2014	4,351,667	59%	9,298,104	41%
Rhode Island	Rhode Island Municipal	2014	252,728	84%	978,781	59%
South Carolina	South Carolina Police	2013	1,741,715	69%	4,904,652	42%
South Carolina	South Carolina RS	2013	15,442,994	63%	38,533,374	37%
South Dakota	South Dakota PERS	2014	1,389,604	88%	5,678,524	65%
Tennessee	TN Political Subdivisions	2013	391,590	95%	4,515,152	61%
Tennessee	TN State and Teachers	2013	2,664,100	94%	23,143,227	63%
Texas	City of Austin ERS	2013	862,000	70%	2,333,870	48%
Texas	Dallas Police and Fire	2013	1,252,000	76%	5,276,441	39%
Texas	Houston Firefighters	2013	532,645	87%	3,223,663	52%
Texas	Texas County & District	2013	2,602,100	89%	15,616,099	60%
Texas	Texas ERS	2014	7,492,815	77%	27,009,477	48%
Texas	Texas LECOS	2014	323,175	73%	1,038,230	46%
Texas	Texas Municipal	2013	4,027,145	84%	13,006,560	63%
Texas	Texas Teachers	2014	31,638,000	80%	120,264,811	52%
Utah	Utah Noncontributory	2013	4,061,140	82%	13,583,553	59%
Utah	Utah Public Safety	2013	660,247	79%	2,043,576	57%
Vermont	Vermont State Employees	2014	444,014	78%	1,629,850	50%
Vermont	Vermont Teachers	2014	1,076,764	60%	2,694,039	39%
Virginia	Fairfax County Schools	2013	630,836	75%	1,863,180	51%
Virginia	Virginia Retirement System	2013	26,953,010	66%	55,820,227	50%
Washington	Washington LEOFF Plan 2	2013	(1,003,000)	115%	2,949,648	72%
Washington	Washington PERS 2/3	2013	(537,000)	102%	13,273,739	64%
Washington	Washington School Employees Plan 2/3	2013	(62,000)	102%	1,840,056	64%
Washington	Washington Teachers Plan 2/3	2013	(390,000)	105%	4,263,669	66%
West Virginia	West Virginia PERS	2013	120,733	80%	3,799,907	57%
West Virginia	West Virginia Teachers	2013	4,179,234	58%	9,031,252	39%
Wisconsin	Milwaukee City ERS	2013	250,960	95%	3,161,039	61%
Wisconsin	Wisconsin Retirement System	2013	52,600	100%	32,564,224	73%
Wyoming	Wyoming Public Employees	2013	1,800,545	78%	6,195,937	51%

Source: Author's calculations from Public Plans Database.

Table A2. Fair-Value Funding Measures and Rankings, by State

State	Market Unfunded Liability ($ Billions)	Market Funding Ratio	Unfunded Liability/GDP	Rank ($)	Rank (Funding Ratio)	Rank (Percent GDP)
Alabama	38.98	44%	20%	29	33	35
Alaska	19.33	34%	33%	14	49	49
Arizona	50.82	46%	18%	34	29	31
Arkansas	20.06	51%	16%	16	21	23
California	620.19	50%	28%	50	22	43
Colorado	57.83	44%	20%	38	34	33
Connecticut	60.19	32%	24%	39	50	40
Delaware	4.16	67%	7%	1	3	2
Florida	92.72	62%	12%	43	8	9
Georgia	61.97	53%	14%	40	14	17
Hawaii	19.89	42%	26%	15	39	42
Idaho	9.02	57%	14%	8	12	19
Illinois	265.54	34%	37%	48	48	50
Indiana	27.29	48%	9%	21	26	5
Iowa	21.26	59%	13%	17	11	15
Kansas	24.08	37%	17%	20	45	25
Kentucky	54.10	36%	30%	36	47	45
Louisiana	46.04	44%	18%	31	32	30
Maine	8.89	59%	16%	7	10	24
Maryland	46.49	48%	14%	33	25	16
Massachusetts	79.39	40%	18%	41	41	29
Michigan	85.39	40%	20%	42	40	34
Minnesota	53.15	52%	17%	35	19	27
Mississippi	33.65	43%	32%	24	38	48
Missouri	46.32	53%	17%	32	17	26
Montana	9.19	47%	21%	9	27	37
Nebraska	7.86	52%	7%	6	18	3
Nevada	37.55	43%	28%	27	36	44
New Hampshire	10.02	39%	15%	10	43	21
New Jersey	132.30	37%	24%	44	46	41
New Mexico	27.69	47%	30%	23	28	47
New York	295.25	56%	23%	49	13	38
North Carolina	37.60	70%	8%	28	2	4
North Dakota	5.24	46%	9%	3	31	6
Ohio	168.14	50%	30%	46	23	46
Oklahoma	22.23	53%	12%	18	16	11
Oregon	34.20	63%	16%	25	6	22
Pennsylvania	133.73	39%	21%	45	42	36
Rhode Island	10.28	43%	19%	11	37	32
South Carolina	43.44	38%	24%	30	44	39
South Dakota	5.68	65%	12%	4	5	10
Tennessee	27.66	63%	10%	22	7	7
Texas	187.77	53%	12%	47	15	12
Utah	15.63	59%	11%	13	9	8
Vermont	4.32	44%	15%	2	35	20
Virginia	57.68	50%	13%	37	24	14
Washington	22.33	66%	5%	19	4	1
West Virginia	12.83	46%	17%	12	30	28
Wisconsin	35.73	73%	13%	26	1	13
Wyoming	6.20	51%	14%	5	20	18

Note: Rankings are calculated such that, for each category, number 1 denotes the best-funded state and number 50 the poorest-funded state.
Source: Author's calculations from Public Plans Database.