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PENSION SIMULATION PROJECT

POLICY BRIEF

How Public Pension Plan Investment Risk Affects Funding and Contribution Risk

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January 2017

Executive Summary

When public pension plan investments do poorly, state and local governments generally make up the difference through increased contributions into the pension fund, often paid for by higher taxes or lower spending on services and infrastructure. When public pension plans do well, the system works in reverse.

Interest rate declines since the 1980s and 1990s have made it harder for public pension plans to achieve assumed investment returns at low levels of risk. Plans faced a choice:

- Maintain investment-return assumptions, perhaps in the belief that the interest-rate decline was temporary, and move into riskier assets to take advantage of the trade-off between investment risk and expected returns. This would allow plans to avoid large increases in government contributions, but would cause investment returns to be more volatile, with larger future swings in plan funding and government contributions.
- Reduce investment-return assumptions and request much higher contributions from governments to make up for lower expected investment income.

For the most part, public pension plans have done the former. We estimate that at today's level of risk, with \$3.7 trillion in public pension fund assets, there is about a one-in-six chance of a single-year shortfall of more than \$425 billion for the United States as a whole.

We examined the implications of the change in investing environment by modeling the finances of a prototypical pension fund under different investment-return scenarios. We ran each scenario 1,000 times for thirty years, with each thirty-year run having a different set of thirty investment returns.

We called our base scenario, before interest rates declined, the *good old days*: It was a golden period with high nominal investment returns and low risk, but unfortunately it is no longer possible. In the good old days our prototypical pension plan had almost no risk of becoming deeply underfunded because its actual investment returns usually were close to assumed returns, and government contributions were stable for the same reason.

Our first alternative scenario was *invest in riskier assets*: The plan still was likely to achieve its assumed returns over the very long run, but with much greater variability, leading to larger swings in plan funding and government contributions. Our prototypical plan had a more than one-in-six chance of becoming deeply underfunded sometime in the thirty-year period, which we defined as having assets that are less than 40 percent of the amount owed — a level that has been associated with crises in several states. Taxpayers and other government stakeholders faced a one-in-six risk that government contributions might have

to increase substantially in a short period, which we defined as a rise of more than 10 percent of payroll in any five-year period.

Our second alternative scenario was *lower assumed returns*: The plan decided not to move into riskier assets, and instead assumed that it would earn less than before but at the same low level of risk. It requested a tripling of contributions from government, and kept those contributions high. As a result, the plan never had any risk of severe underfunding. (In fact, in many runs the plan became overfunded after thirty years because, like the real world, the contributing government was not allowed to withdraw money even if the plan had a long series of very good investment returns, even though it had to increase contributions sharply after a long series of very bad returns.)

We also examined a scenario in which public pension plan investment return assumptions are too optimistic even for the level of risk they are taking, as some professional market forecasts suggest. We simulated a true long-run investment return of 6 percent at today's level of risk, but our prototypical plan assumed 7.5 percent, a common public pension plan assumption. In this scenario, the plan had a more than one-in-three chance of becoming severely underfunded in the next thirty years, which is more than twice as high as when the investment earnings assumption is met. In most simulation runs, employer contributions would rise as a percentage of payroll over time due to investment shortfalls. By the end of thirty years, the median employer contribution was about 50 percent higher than when investment return assumptions are met.

These simulations illustrate the very difficult situation that public pension plans and governments are in. Secure benefit funding requires low risk taking, unless governments are willing to accept large swings in contributions, taxes, and services. Reducing risk remains an option for plans today, but only at the expense of raising employer contributions. As unpalatable as this may be, given the risk of severe underfunding at today's current level of risk taking, moving in this direction may be advisable.

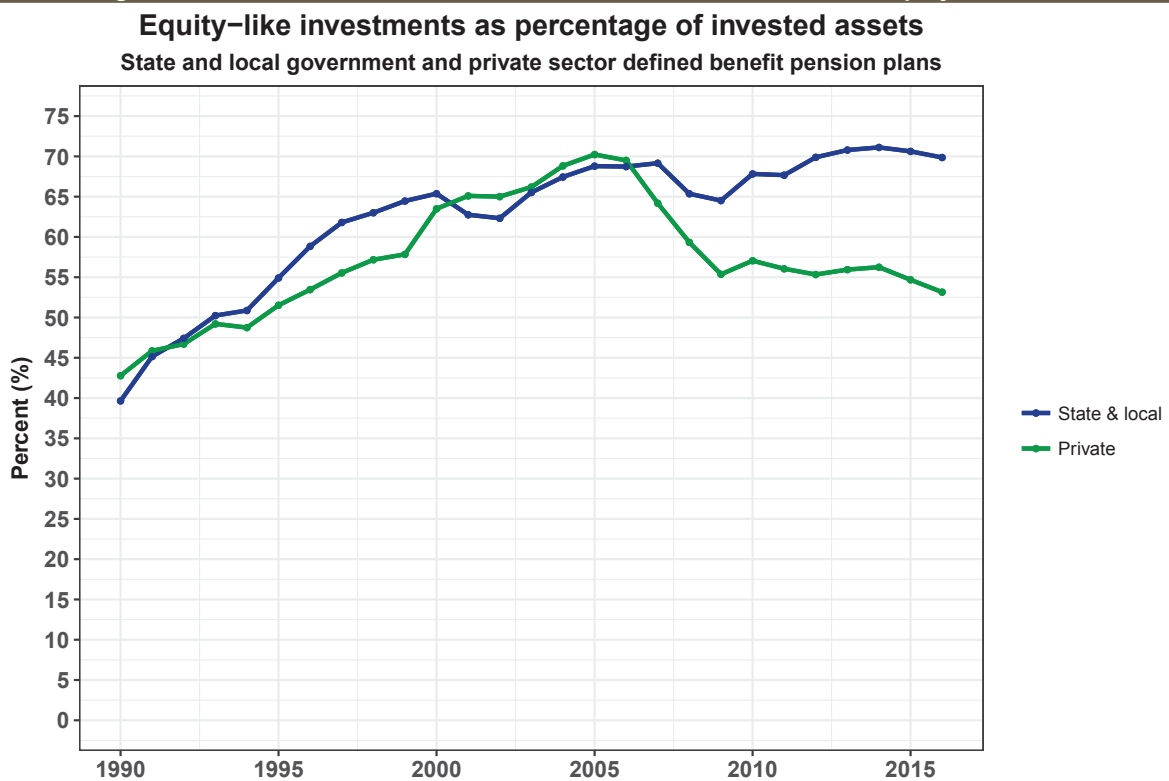
We summarize important elements of our analysis below. For full details, see the companion report on this topic.

Introduction

Public pension funds receive contributions from governments and employees, and invest those funds with the goal of having enough money to pay future benefits when due. Governments and pension funds can't predict the future with certainty, so they adjust contribution requirements to reflect experience — requesting higher contributions if experience hasn't been as good as expected, or reducing requirements if experience has been better than expected.

The biggest uncertainty is how well the pension fund's investments will do. Currently, public pension funds have approximately \$3.7 trillion in assets, about two-thirds of which are invested in stocks, real estate, hedge funds, and other assets subject to investment risk. While public plans once were more conservative investors than private defined benefit plans, they now have a much greater share of their assets invested in equity-like investments than do private plans (see Figure 1¹).

Figure 1. Public Pension Funds Have Increased Their Investments in Equity-Like Assets

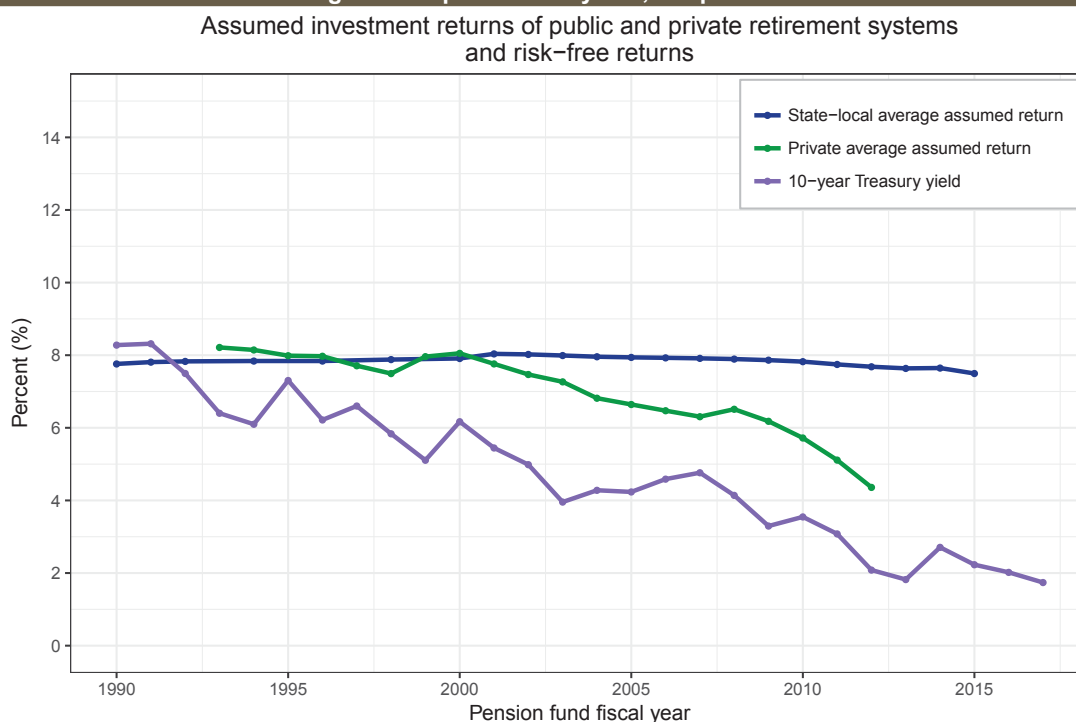


Source: Authors' analysis of Z.1 Financial Accounts of the United States, Federal Reserve Board, Tables L.118.b, L.120.b, and L.122

One likely reason for public pension plans increasing the allocation of assets to equities is that nominal risk-free returns have declined substantially, but public pension funds' earnings assumptions have been "sticky," barely falling at all (see Figure 2²). In contrast, private sector plans have been reducing earnings assumptions along with the decline of risk-free returns. Several

economists have argued that assumed returns have not followed risk-free returns downward, in part because pension fund boards and sponsors prefer high discount rates, which keep the reported actuarial value of pension liabilities and actuarially determined contributions lower, all else equal. Their research suggests that the move toward riskier assets reflects the unique nature of the regulatory and standards-setting environment for public pension funds, particularly the accounting standards and actuarial practices that value liabilities with discount rates equal to earnings assumptions generally selected by the plans themselves. These standards and practices used by public plans in the United States are different than the standards, practices, and rules for private plans and for public plans in other countries.³

Figure 2. Public Pension Fund Earnings Assumptions Barely Fell, Despite Substantial Declines in Risk-Free Rates



Sources:
 State-local assumed return from Public Plans Database
 Private assumed returns provided by Andonov, Bauer, and Cremers
 10-Year Treasury yield from Federal Reserve Bank of St. Louis (FRED)

The decline in risk-free interest rates since the 1980s and 1990s has created a very difficult investing environment for public pension plans. Before the decline, the typical plan could have achieved its investment-return assumptions while taking very little risk. As rates declined, public plans faced a choice: either reduce investment-return assumptions and request much higher contributions from governments, or maintain assumptions, avoid increasing contributions from governments, and take on much greater risk.

For the most part, public pension funds have maintained their investment-return assumptions, perhaps in the belief that interest

rate declines were temporary and that in the longer run high investment returns could again be obtained at low levels of risk. But maintaining their assumptions implicitly required them to invest in riskier assets.

Our Analysis and Results

We modeled the implications of a sustained reduction in risk-free interest rates by examining a prototypical pension plan under three scenarios:

- *The good old days*: The pension plan can expect to earn a 7.5 percent return with very little investment-return volatility, or risk. This is similar to what plans might have been able to achieve two or three decades ago. As the name implies, pension plans no longer have this beneficial choice available.
- *Invest in riskier assets*: In response to declining risk-free rates, the pension plan maintains a 7.5 percent earnings assumption but invests in riskier assets. Even though it can expect a long-run compound return of 7.5 percent, some years will be much higher and some will be much lower. Our measure of investment-return volatility, the standard deviation, is 12 percent in this scenario. This is similar to what many public pension plans did as risk-free rates fell.
- *Lower assumed return*: In this scenario, instead of investing in riskier assets in response to declining risk-free rates, the pension plan lowers its earnings assumption to 3.5 percent and remains invested in relatively low-risk assets, with a standard deviation of 1.8 percent. This forces the plan to raise contributions from governments. For the most part, public pension plans have not done this (although they have raised contributions in response to investment shortfalls). Lowering risk and raising contributions remains an option.

Pension plans were not limited to one response or the other — they could have chosen to be in-between.

We modeled the finances of our prototypical pension fund over thirty years, assuming that employers pay full actuarially determined contributions. Our analysis shows that plans faced a fundamental trade-off, shown in Table 1: If they moved into riskier assets, the risk to the pension fund would increase significantly but government contributions would remain low. The riskier-assets scenario resulted in a 16.9 percent probability for our prototypical plan that plan funding would fall below 40 percent sometime during the thirty years — a level that has been associated with crises in several states.

If instead of moving into riskier assets the plan lowered assumed investment returns, the risk to the pension fund would remain minimal, but employer contributions would have to triple, and would remain high for all thirty years of the simulation period. This dramatic increase in required contributions may go a long way toward explaining why plans have taken on increased investment risk.

Table 1. Plans Faced a Trade-Off When Risk-Free Rates Fell: Increase Risk to the Pension Fund, or Lower Return Assumptions and Increase Government Contributions

	Plan funding and employer contributions under three investment-return scenarios					
	Funded-ratio measures			Employer contribution measures		
	Probability (percent) of falling below 40% at any time within 30 years	Median funded ratio:		Probability of rising by more than 10% of payroll in any 5-year period (within first 30 years)	Median % of payroll:	
Year 1		Year 30	Year 1		Year 30	
Good old days (7.5% expected return, low volatility)	0	75.0	84.8	0	13.4	11.7
Invest in riskier assets (7.5% expected return, high volatility)	16.9	75.0	86.6	16.5	13.4	11.3
Lower assumed return (3.5% expected return, low volatility)	0	75.0	128.1	0	46.2	36.2

We also examined what would happen if plan earnings assumptions, which are in the range of 7 to 8 percent for most plans, are too optimistic, as some professional market forecasts suggest. We simulated a scenario in which the true expected compound return is 1.5 percentage points lower than the assumed return of 7.5 percent. In that scenario the plan has a more than one-in-three chance of experiencing severe underfunding at some point over the next thirty years, which is more than twice as high as when the investment earnings assumption is met. Employer contributions as a percentage of payroll would be expected to rise substantially over time; by the end of thirty years, the median employer contributions in this scenario are about 50 percent higher than when investment return assumptions are met. Whereas if the return assumption is met they would fall over time.

Conclusion

The decline in risk-free interest rates since the 1980s and 1990s has created a very difficult investing environment for public pension plans. Before the decline, the typical plan could have achieved its investment-return assumptions while taking very little risk. As rates declined, public plans faced a choice: Either reduce investment-return assumptions and request much higher contributions from governments, or maintain assumptions, avoid increasing contributions from governments, and take on much greater risk.

These simulations illustrate the very difficult situation that public pension plans and governments are in. Secure benefit funding requires low risk-taking, unless governments are willing to accept large swings in contributions, taxes, and services. Reducing risk remains an option for plans today, but only at the expense of raising employer contributions. As unpalatable as this may be, given the risk of severe underfunding at today's current level of risk taking, moving in this direction may be advisable.

Endnotes

- 1 The source is the Financial Accounts of the United States from the Federal Reserve Board, March 10, 2016 release. We define equity-like investments to include corporate equities, directly owned real property, and an allocated share of mutual funds and certain other assets (Financial Accounts code FL223093043); we allocated the latter using the share that corporate equities are of mutual fund assets for the economy as a whole. We do not include cash and short-term assets such as time deposits, money market funds, checkable deposits, or repurchase agreements, and we do not include debt securities or mortgage loans. Calculations by other analysts sometimes result in higher equity shares than we report here, and can vary depending on the definitions used and on data sources and methods.
- 2 In the figure, the Treasury yield is the ten-year constant maturity yield, averaged over the typical public pension plan fiscal year (ending in June) from the daily rate available as variable DGS10 from the Federal Reserve Economic Data (FRED) website of the Federal Reserve Bank of St. Louis (<https://research.stlouisfed.org/fred2/>). The assumed investment returns are from several sources: (1) 2001-14 values are the unweighted mean of assumed returns, computed by the authors from Public Plans Data website, 2001-14, Center for Retirement Research at Boston College, Center for State and Local Government Excellence, and National Association of State Retirement Administrators, (<http://publicplansdata.org/>); and (2) 1990-92, 1994, 1996, 1998, and 2000 are from Paul Zorn, "Surveys of State and Local Government Employee Retirement Systems," *Government Finance Review* 9 (August 1993), <https://www.questia.com/magazine/1G1-14379961/surveys-of-state-and-local-government-employee-retirement>.
- 3 For example, see Aleksandar Andonov, Rob Bauer, and Martijn Cremers, "Pension Fund Asset Allocation and Liability Discount Rates: Camouflage and Reckless Risk Taking by U.S. Public Plans?," Unpublished Paper, May 2012, <https://fisher.osu.edu/supplements/10/12706/Andonov%20Bauer%20and%20Cremers%20-%20Pension%20Fund%20Asset%20Allocation%20and%20Liability%20Discount%20Rates%20-%202012%2024%2005.pdf>. The longer term move toward riskier assets also reflected responses to laws allowing "prudent person" approaches to investing and laws explicitly allowing investments in a broader range of assets.

ACKNOWLEDGMENTS

This is the third policy brief of the Pension Simulation Project at the Rockefeller Institute of Government. In addition to the authors the project team includes Lucy Dadayan, senior researcher, and Kathleen Tempel, project manager. The project is supported by the Laura and John Arnold Foundation and The Pew Charitable Trusts. The authors solicited and received comments on an early draft from several public pension experts, and made revisions in response to many, but not all, comments. We appreciate this advice. The views and analysis in this report, as well as any errors, are the responsibility of the authors alone and do not necessarily reflect views of the sponsors or any reviewers.

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