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COLLOQUIUM ON TAX POLICY
AND PUBLIC FINANCE

"The Risk to State and Local Budgets Posed by Public Employee Pensions"

Andrew Biggs
American Enterprise Institute

April 1, 2014
NYU Law School
Vanderbilt Hall-208
Time: 4:00-6:00pm
Number 9

SCHEDULE FOR 2014 NYU TAX POLICY COLLOQUIUM

(All sessions meet Thursday 4:00-5:50 p.m., Vanderbilt-208, NYU Law School)

1. January 21 – Saul Levmore, University of Chicago Law School, "From Helmets to Savings and Inheritance Taxes: Regulatory Intensity, Information Revelation, and Internalities." (Main discussion paper); and "Internality Regulation Through Public Choice." (Background paper).

2. January 28 – Fadi Shaheen, Rutgers-School of Law, Newark, "The GAAP Lock-Out Effect and the Investment Behavior of Multinational Firms."; "Evaluating Investments of Locked-Out Earnings (an Outline).

3. February 4 – Nancy Staudt, University of Southern California, Gould School of Law "The Supercharged IPO."

4. February 11 – Thomas J. Brennan, Northwestern University School of Law, "Smooth Retirement Accounts."

5. February 25 – Chris Sanchirico, University of Pennsylvania Law School. "As American as Apple Inc., International Tax and Ownership Nationality."

6. March 4 – James R. Hines, Jr. and Kyle D. Logue, University of Michigan Law School, "Delegating Tax."

7. March 11 – Stephanie Sikes, Wharton School, Accounting Department, University of Pennsylvania. "Cross-Country Evidence on the Relation between Capital Gains Taxes, Risk, and Expected Return."

8. March 25 – Matthew C. Weinzierl, Harvard Business School, "Revisiting the Classical View of Benefit-based Taxation."

9. **April 1 – Andrew Biggs, American Enterprise Institute, "The Risk to State and Local Budgets Posed by Public Employee Pensions."**

10. April 8 – Susannah Camic Tahk, University of Wisconsin Law School, "The Tax War on Poverty"

11. April 15 – Nirupama Rao, NYU Wagner School, "The Price of Liquor is Too Damn High: State Facilitated Collusion and the Implications for Taxes."

12. April 22 – Kimberly Clausing, Reed College, Economics Department, "Lessons for International Tax Reform from the U.S. State Experience under Formulary Apportionment."

13. April 29 – David Gamage, Berkeley Law School, "On Double-Distortion Arguments, Distribution Policy, and the Optimal Choice of Tax Instruments."

14. May 6 – Mitchell Kane, NYU School of Law, "Reflections on the Coherence of Source Rules in International Taxation."

American Enterprise Institute for Public Policy Research

Public Employee Pensions:

Investment Risk and Contribution Risk

Presented to "2013 Conference on Public Pension Underfunding: Closing the Gaps." Federal Reserve Bank of Cleveland. November 21-22, 2013.

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Public Employee Pensions: Investment Risk and Contribution Risk

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Abstract

State and local government employee pension plans fund guaranteed retirement benefit using portfolios of risky assets. Plan sponsors value stable contribution rates and attempt to mitigate volatility of contribution rates using policies including smoothing of investment returns and long amortization periods for unfunded liabilities. These policies, combined with the assumption that investment returns stabilize over the long term, seemingly allow plans to offer generous, guaranteed benefits to participants funded by low, stable contributions from employers. But in many cases, plan stakeholders take this conclusion as an article of faith rather than the result of quantitative analysis. I employ a simple model of financing for a mature pension to analyze how market risk and stabilization policies interact to affect annual required contributions. The model shows that stabilization policies can reduce volatility of employer contributions over the short term. But long-term fluctuations in investment earnings ultimately express themselves in contribution rates that may vary significantly from a deterministic calculation based upon the assumption of constant returns. A plan employing typical smoothing policies has a very low probability of becoming insolvent, so long as it makes required contributions at all times. However, plans could expect that, at least once over a 100-year period, required employer contributions would exceed ten times the baseline rate. If a plan is economically unable or politically unwilling to make any and all contributions as required, then insolvency of the fund becomes a possibility.

1. Introduction

Public employee pensions are a matter of policy concern in states and localities around the country. Rising budgetary costs, coupled with perceptions that these traditional defined benefit (DB) plans offer state and local government more generous retirement benefits than are available to similar private sector employees, have generated both political controversy and policy actions. A number of plans have raised employee contributions, reduced post-retirement benefit increases or made other incremental changes to plan parameters. Many public employees feel that their benefits are under threat, and in a number of cities plans have been proposed or implemented to shift at least newly-hired public employees to defined contribution plans similar to the 401(k)s offered to most private sector employees.

At the same time, many public plan stakeholders view government-run DB pensions as having large efficiencies relative to other modes of pension provision, such that limiting or eliminating them would harm public employees and taxpayers alike. According to this view, the long-run nature of public plans – in terms both of investment holding periods which last from the time an employee is hired until he or she dies, and of the infinitely-lived nature of (most) governments – allows such plans to claim the risk premium built into equities and other investments while shielding plan sponsors from much of that risk. Public plan stakeholders argue that these long term factors, combined with policies designed to exploit the long term, such as smoothed investment returns and long amortization periods, largely negate the market risk embedded in public plans investment portfolios. This article examines the degree to which these beliefs are correct.

Most employees of state and local governments are enrolled in traditional defined benefit pension plans. A DB pension is designed to pay participant a guaranteed (or "defined") retirement benefit based on a formula, which is generally independent of the investment performance of the plan's assets.[1] By contrast, most private sector employees participate in DC pensions to which the employer may provide a

[1] In a number of plans, post-retirement benefit increases or similar supplements are subject to the investment or funding performance of the plan. In very few plans are core benefits subject to alteration.

contribution – the typical employer contribution is around 3 percent of the employee's wages[2] – but makes no commitment regarding the ultimate level of retirement income the pension account may provide.

Public DB plans have become a source of policy and political controversy over the past decade as their funding health has declined and the annual budgetary contributions required for these plans have risen. While public DB plans were on average fully-funded around the turn of the century, at least using the accounting rules established by the Governmental Accounting Standards Board, they were in 2012 on average around 73 percent funded.[3] Unfunded benefit liabilities for the median state plan rose from about 25 percent of employee payroll in 2002 to about 150 percent of payroll in 2012.[4] Unfunded liabilities for state and local plans in 2012 were roughly $1 trillion.

Using so-called "fair market valuation," which most economists believe provides a fuller view of the economic costs of public plans, state and local plans are on average about half funded and unfunded liabilities top $4 trillion.[5] Fair market valuation discounts benefit liabilities at an interest rate gauged to match the risk of the liabilities; by contrast, GASB rules allow plans to discount liabilities using the expected return on pension assets, whose risk is significantly greater than that of the benefits they fund.

Perhaps more important in this context is that annual contributions from plan sponsors calculated under GASB rules, referred to as the Actuarially Required Contributions (ARC), have roughly doubled over the past decade, putting increased budgetary pressure on state and local governments already squeezed by the economic recession. From 2001 to 2012, average Annual Required Contributions for state plans rose from 6.2 to 15.3 percent of payroll. Rising pension costs, in conjunction with depressed revenues due to the economic downturn, have caused many of these payments to prove unaffordable. While plans on average made 100 percent of their ARC payments in 2001, it is estimated that only 80

[2] Bureau of Labor Statistics (2010).
[3] Munnell, et al. (2013).
[4] Wilshire Consulting (2013).
[5] For discussion see Biggs (2011) and Novy-Marx and Rauh (2010).

percent of ARCs were paid in 2012.[6] Changes in budgetary costs for pensions are perhaps more important in a public policy context than summary measures of the present value of a plan's long-term benefit liabilities, as plan sponsors desire that their annual contributions be both low and stable from year to year.

Despite rising costs, many stakeholders believe that public plans can generate generous, guaranteed benefits for participants while levying on sponsors contributions that are both low and stable. A pressing question for pension sponsors is the degree to which this combination is possible. Ordinary investors face a trade-off between risk and return, which in the context of funding a fixed future liability means that the investor must choose between either low contributions or stable contributions but cannot have both. Public plans, by contrast, are believed to benefit from long time horizons. In discussions of state and local employee pensions, the phrase "long term" comes up often: plans rely on "long term" investment returns, whose risk characteristics are believed to differ substantially from the year-to-year fluctuations observed in financial markets. Likewise, public plans themselves are "long term" institutions that, unlike private pensions, need not consider the possibility of their sponsor becoming insolvent. These beliefs about the "long term" are foundational in explaining why public plans take greater investment risk than private pensions, and why public plan accounting standards pay so little attention to that risk.

For instance, Madland and Bunker (2012) refer to public DB plans' "ability to maximize returns over a long time horizon... When accounts of both older and younger workers are pooled together, the fund manager can shoot for a higher return as the plan has a much longer investment time horizon."[7] Similarly, the AARP states that "because pension plans invest for very long time horizons, they are able to diversify their portfolios across broad time periods, and can better withstand market swings."[8] The National Association of State Budget Officers (2012) states that "Pension plans typically have long time horizons, which allow investment gains or losses to be smoothed out over a period of years and unfunded

[6] Munnell, et al. (2013).
[7] Madland and Bunker (2012).
[8] AARP (undated).

liabilities to be amortized."[9] Gary Findlay (2009), executive director of the Missouri State Employees Retirement System, states that "The objective that is stipulated by law is to have contribution rates that remain relatively level over decades of time because we are a plan with very long time horizons."[10] The National Association of State Retirement Administrators (2012) writes that, "A primary objective for using a long-term approach in setting the return assumption is to promote stability and predictability of cost."[11]

But are these beliefs about the long term justified? Does a long time horizon allow public plans to generate a combination of generous, guaranteed benefits for participants financed by low, stable contributions from plan sponsors? Until recently there has been little solid publicly-available research on the topic, making it difficult for plan stakeholders – participants, trustees, elected official and taxpayers – to truly know.[12] Most pension financial disclosures are expressed in terms of present values of streams of future benefits or investment income, discounted at the expected return on risky investments but with little attention to the risk of those investments.

To the degree that pension disclosures show costs on an annual basis, such as the required contributions from employees or plan sponsors, fluctuations in these costs due to market risk are dampened by policies that smooth investment returns over roughly 5 years and amortize unfunded liabilities by up to 30 years. And since most plans do not project costs over more than the next decade, and in any case publish little sensitivity analysis with regard to plan financing and portfolio returns, it is difficult for plan stakeholders – particularly those outside the direct management of the plan, such as elected officials and citizens – to understand the ultimate level of risk they are shouldering until good or bad outcomes are realized.

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[9] National Association of State Budget Officers (2012).

[10] Keller (2009).

[11] National Association of State Retirement Administrators (2012).

[12] Washington's State Actuary has for a number of years conducted an in-depth analysis of plan financing that includes Monte Carlo simulations and other techniques for analyzing funding risk. The California Public Employees Retirement System (CalPERS) this year added a "Risk Analysis" section to its actuarial valuations, and has for several years published a separate report on funding risk.

This paper constructs a simple model of public pension financing that simulates the effects of investment risk on annual pension contributions, over both the short and the long term. Risk is generated via stochastic investment returns, but the effects of portfolio risk on contributions are muted via stabilization policies that smooth investment returns and amortize unfunded plan liabilities over multiple years. This model generates answers to questions such as: To what degree do investment returns "settle down" over the long term, allowing for a relatively stable contribution rate? And how much do smoothing and amortization policies allow plans to dampen or eliminate the effects on required contributions of shorter-term fluctuations in portfolio returns? Is a plan that makes its full required contributions each year effectively protected against insolvency? How high might those contributions go, and how might they affect state or local government budgets? And what are the implications for plan solvency if sponsors cannot or will not make their required contributions each year?

The results show that investment risk declines over the long term only in ways that are incidental to plan financing. While the risk of investment returns narrows over the holding period, the distribution of realized investment earnings only grows wider as investment horizons lengthen. Stabilization policies can reduce contribution risk in the short term, but wide variations remain. Even using smoothing and amortization policies, variations in investment returns could cause annual contributions in future years to be far above or below those paid at present.

Second, a plan that makes its required contribution each year has very, very little chance of becoming insolvent. However, those required contributions can often be multiples higher than would be supposed in the absence of market risk. If plan sponsors are politically unwilling or economically unable to make any and all required pension contributions then plan insolvency becomes a possibility worth worrying about.

Third, while smoothing and amortization policies can reduce year-to-year contribution changes, which is of benefit to policymakers who must plan public budgets, these dampening policies can generate longer "peak-and-valley" contribution changes that work against generational equity in pension funding.

The benefits to public pension financing of the "long term" have at times been overstated and misunderstood. While the long term is often discussed in qualitative terms, it rarely is quantified. As a result, plan stakeholders – especially elected officials and the public – have little awareness of the true level of risk they are shouldering and the true value of public pension liabilities.

2. Modeling plan finances

Actuaries who conduct valuations of public plans must model a wide range of variables and simulate the plan population in great detail. This may make such models unwieldy in conducting the type of analysis undertaken here. By contrast, the model presented in Hamilton (2007)[13] makes two major simplifications that allow for more robust analysis of the effects of investment risk on annual contributions. First, the model focuses on a mature pension plan, meaning one which is in a steady state in terms of employees and beneficiaries. This simplifies the modeling of the participant population, as in a mature plan benefits remain constant relative to payroll from year to year. In the absence of market risk, we can calculate the contributions, assets and investment returns necessary for the plan to remain adequately funded in perpetuity.

But plan maturity is important from a policy perspective as well. As a plan matures, its fund increases in size relative to employee payroll or the budget of the sponsoring government. When a large fund generates gains or losses, these will lead into larger changes in contributions relative to payroll or budgets than would a less mature plan. For instance, if a plan's investments are equal to 4 times payroll and the plan loses 10 percent in value, to make up that loss in a single year would require a contribution

[13] Hamilton (2007).

increase equal to 40 percent of employee payroll. Thus, contribution stabilization policies are necessary; the question the model seeks to answer is how effective such policies may be.

Second, the only risk the model analyzes is investment risk. In reality, plans face variations in a number of factors, such as longevity, retirement ages, the incidence of disability, and so forth. Modeling these risks demands a far greater level of detail. But the model presented here is adequate for the task, as variable investment returns are by far the greatest risk facing public plan finances.

Hamilton (2007) models a mature plan to captures plan liabilities, investments, contributions and policies such amortization of unfunded liabilities. We begin with a steady state in which investment returns do not vary (Equation 1). In that case,

$$1. \quad C = PGR - \mathrm{A}\, x \left[\frac{R-g}{1+g}\right]$$

where C represents the contribution rate (as a percent of payroll), PGR is the pay-as-you-go program rate, meaning the ratio of benefits paid in a year to payroll in that year; A is the plan's asset as a percentage of payroll; R is the assumed return on the plan's investments; and g is the growth rate of payroll.

Each plan is different, but for illustration we flesh out Equation 1 using parameters that are reasonably typical of most public plans. Benefits are assumed to be equal to approximately 28 percent of payroll, assets are 4.3 times payroll, nominal investment returns are 8 percent and nominal payroll growth is 4.1 percent.[14] Given these inputs, an annual contribution rate of 11 percent of payroll would be sufficient to maintain the program's funding over a steady state, meaning that benefits could be paid while the plan's assets would neither rise nor fall relative to the wage base.

While not immediately important to the model, we assume that employees pay 6 percent of wages into the plan while the plan sponsor pays 5 percent. Once returns are allowed to vary, the employer also

[14] Payroll growth is composed of price inflation at 2.5 percent and combined individual wage growth and workforce growth of 1.6 percent.

will be responsible for any additional contributions needed to address unfunded liabilities; the plan sponsor and potentially employees may benefit from reduced contributions if the plan becomes overfunded.

Shifting now to a situation in which asset returns can vary, the figures calculated in Equation 1 become targets that the plan will seek to achieve. In Equation 2.,

$$2.\ C_{t+1} = TCR - \gamma(A_t - FT)$$

where C_{t+1} represents the contribution rate at time t+1; TCR the target contribution rate, say, the 11 percent calculated in equation 1; A_t is plan assets relative to payroll at time t; FT is the funding target, or target assets relative to payroll (equal to 4.3 in our stylized plan); and γ (gamma) represents a parameter that determines the speed at the plan moves to restore the program to its target ratio of assets to payroll, meaning, the degree to which it raises or lowers the contribution rate to make up for any unfunded liabilities or spend down unneeded surpluses.

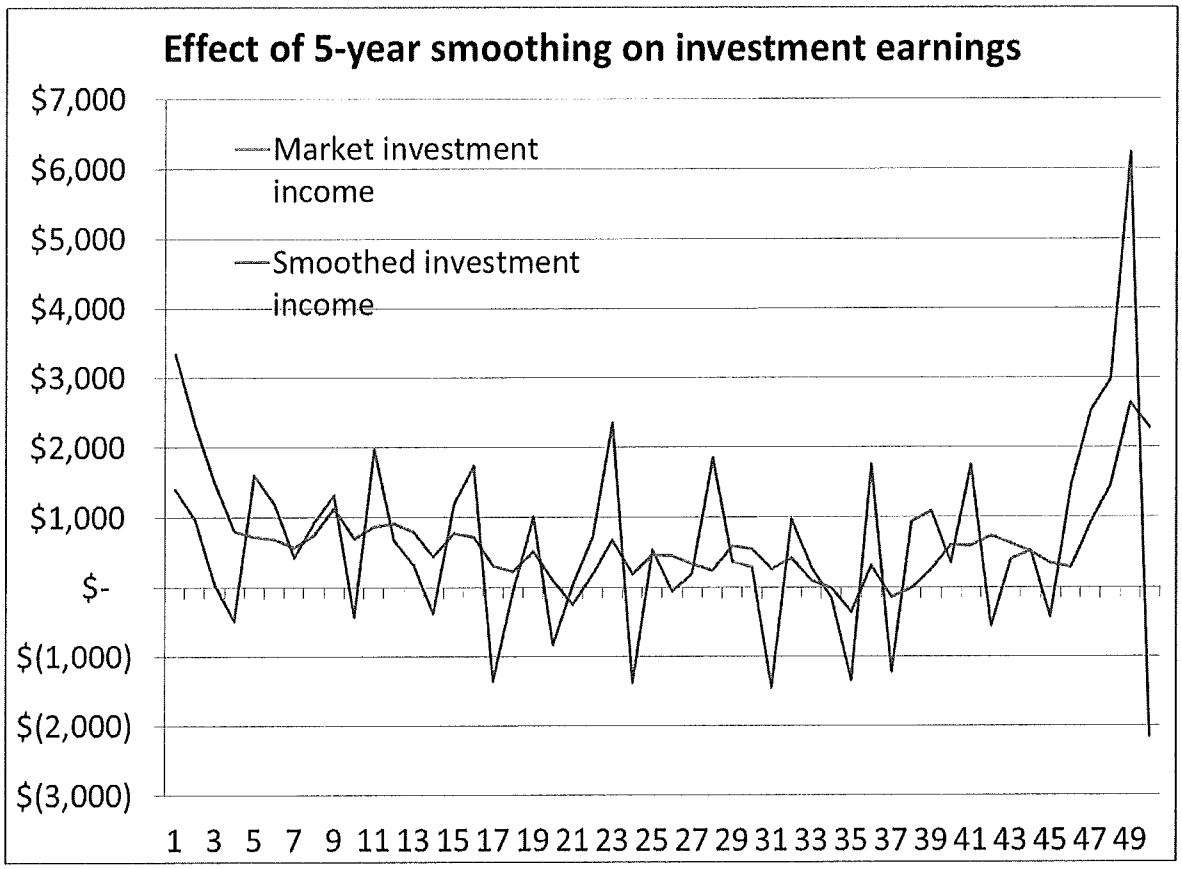
$A_t - FT$ represents the difference between the plan's actual assets and its target steady-state asset level, and γ represents the percentage of that difference that the plan attempts to make up each year through changes in the contribution rate.[15] In the pension world, the gamma parameter is akin to the rate at which the plan "amortizes" – meaning pays off – unfunded liabilities.

In this model, over- or under-funding is amortized on a rolling basis, meaning that the amount to amortized and the period over which it is amortized are recalculated each year. Rolling amortization is a more forgiving policy than fixed amortization, which requires that over- or underfunding present as of a given year be resolved over a fixed time frame that is not continually recalculated. In addition, amortization is calculated on a "level percent of payroll" basis, meaning that amortization payments rise

[15] This does not mean that a plan facing an unfunded liability in a given year will be restored to full funding in $1/\gamma$ years, as γ interacts with the investment return and with payroll growth. Assumed amortization periods in years are translated into γ values using a trial-and-error process in which an unfunded liability is introduced in year 1 and reconciled over following years as γ values change.

each year at the rate of payroll growth. Both of these policies are considered forgiving with regarding to amortization and allow for longer amortization schedules than a fixed-period and/or level-dollar amortization approach.

To Hamilton's model I add "smoothing" of investment earnings, which is common among public plans. Smoothing creates a distinction between the market value of the plan's investments and an "actuarial value" that is used to determine contribution rates. Investment income attributed to the plan's actuarial investments is a function of average investment returns over a number of prior years, generally five but sometimes as many as fifteen.[16] Figure 1 below illustrates how smoothing can reduce the volatility of actuarial relative to market assets. Since contributions are based upon actuarial assets, this approach serves to smooth contribution rates as well.



[16] Discussion of various smoothing methods is available in Winklevoss (1993).

The model can be extended over any desired period, depending upon what the investigator considers to be the "long term." As a default the model runs over 500 years, though in most cases we report results over a 100 year period for ease of understandability.

The model simulates investment returns using a "Monte Carlo" approach in which the computer generates investment returns that are individually random but which collectively are illustrative of the portfolio held by a public plan. In most cases, the plan's average investment return will be 8 percent and the standard deviation of investment returns is 12 percent. This latter figure determines the distribution, or risk, of the plan's investments. Both the mean return and investment risk are broadly typical of assumptions made by U.S. public plans. [17] While each individual investment outcome is random, the distribution of investment returns – and the effects on plan funding and contribution rates that such differences imply – provide information regarding the level of contribution risk faced by plan stakeholders. Typically the model is run 1,000 times.

3. Illustrating model results

For each simulation, we provide a number of summary statistics derived from the 1,000 runs of the model. These statistics include:

- *Annual contribution delta* (ACD): measures the average absolute value change in required contribution rates from one year to the next. Thus, for instance, an increase in contributions from 11 to 12 percent would have an ACD value of 1, as would a reduction in contributions from 11 to 10 percent. A low ACD is generally desired by policymakers as it allows for stable contributions from year to year. In general the ACD is measured as an average over a 100-year period.
- *Standard deviation of contributions* (SDC): measures variation in annual contribution requirements over a 100-year period. Unlike the ACD, the SDC is not concerned with year-to-

[17] However, a number of outside analysts believe that plans would need to take additional investment risk, on the order of a standard deviation of returns of around 14 percent, to generate an 8 percent return in expectation.

year variations but rather the spread of contribution rates throughout the sample. If the ACD is high then the SDC also will be high, but a high SDC can co-exist with a low ACD.

- *Mean contribution rate*: the average of annual contribution rates over 100-year periods. If the model is run 1,000 times, this value equals the mean value of the 100,000 individual years modeled. In general, the mean contribution rate will be close to the deterministic rate calculated under the assumption of steady investment returns.
- *Standard deviation of 100-year mean contribution rates*: measures the variation in average contribution rates over 100-year periods, indicating how variations in investment returns may alter the average cost of the plan over long periods.
- *Insolvent 100/500 years*: measures whether plan assets ever fall to zero over a 100- or 500-year period.

Each run of the model is unique, based upon randomly drawn investment returns. For that reason, studies relying on Monte Carlo analysis generally do *not* show the results of a single run of the model. In the case of pension funding, however, single runs can provide visual illustrations of the degree to which pension contributions vary on a year-to-year or generation-to-generation basis. For that reason, for each policy simulation we provide a single figure illustrating contribution rates over a single 50-year period. The annual returns are from a single run of the model and are generally the same across policy options; the goal is to illustrate how smoothing and amortization policies may dampen the effects of portfolio risk on annual contributions. The goal of these figures is not rigor, which is provided through the summary measures, but a more intuitive view of the interaction of market risk and policies to dampen contribution volatility.

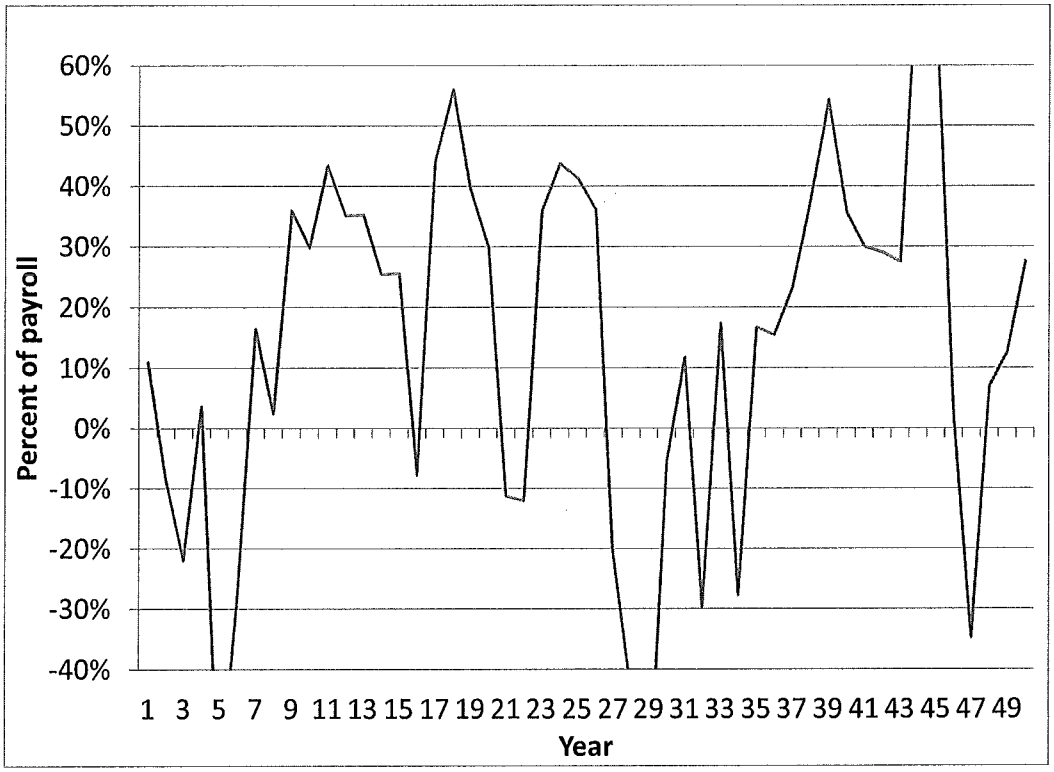
Policy 1. 10-year amortization; no smoothing; no minimum or maximum contribution rate

Policy 1 is the most restrictive case in which the plan must quickly – over only 10 years – address any under- or overfunding due to fluctuations in investment returns. There is no smoothing of investment

income. Contributions rise to whatever level necessary to address underfunding, but also may fall quickly when the plan becomes overfunded.

For Policy 1, 100-year average ACD is 22.5 percent, indicating very large year-to-year changes in required contributions. The SDC is a similarly large 30.0 percent. While the mean contribution rate is 11.1 percent of wages, right around the forecast rate of 11 percent, the standard deviation of average 100-year contribution rates is 5.5 percent. This would indicates, for instance, that even over a 100-year period the average contribution rate could be significantly higher or lower than the deterministic forecast. However, if these contributions are made there is virtually no chance of the plan becoming insolvent: in none of the 1,000 simulation does the fund become insolvent either over 100 years or over a longer 500-year duration.

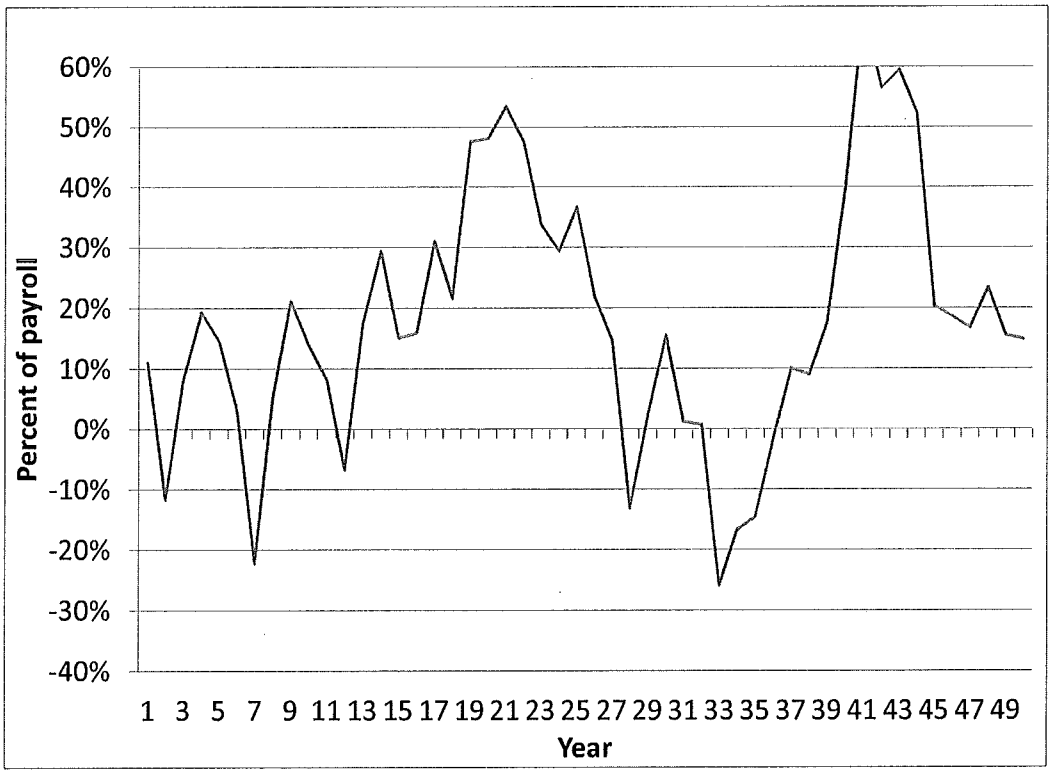
Example of Policy 1



Policy 2. 20-year amortization; no smoothing; no minimum or maximum contribution rate

Policy 2 amortizes unfunded liabilities over 20 years, which in combination with a floating amortization period and level-payroll payments is roughly consistent with typical policy for U.S. public plans. Longer amortization reduces required changes in contribution rates, which is reflected in a lower ACD of 13.6 percentage points. The SDC of contributions also falls, to 23.4 percent. The mean contribution rate is slightly lower than Policy 1 at 10.6 percent, but the standard deviation of *average* contribution rates over the 100 years creeps up, from 5.5 percentage points to 5.9 percentage points. Insolvency remains a remote risk.

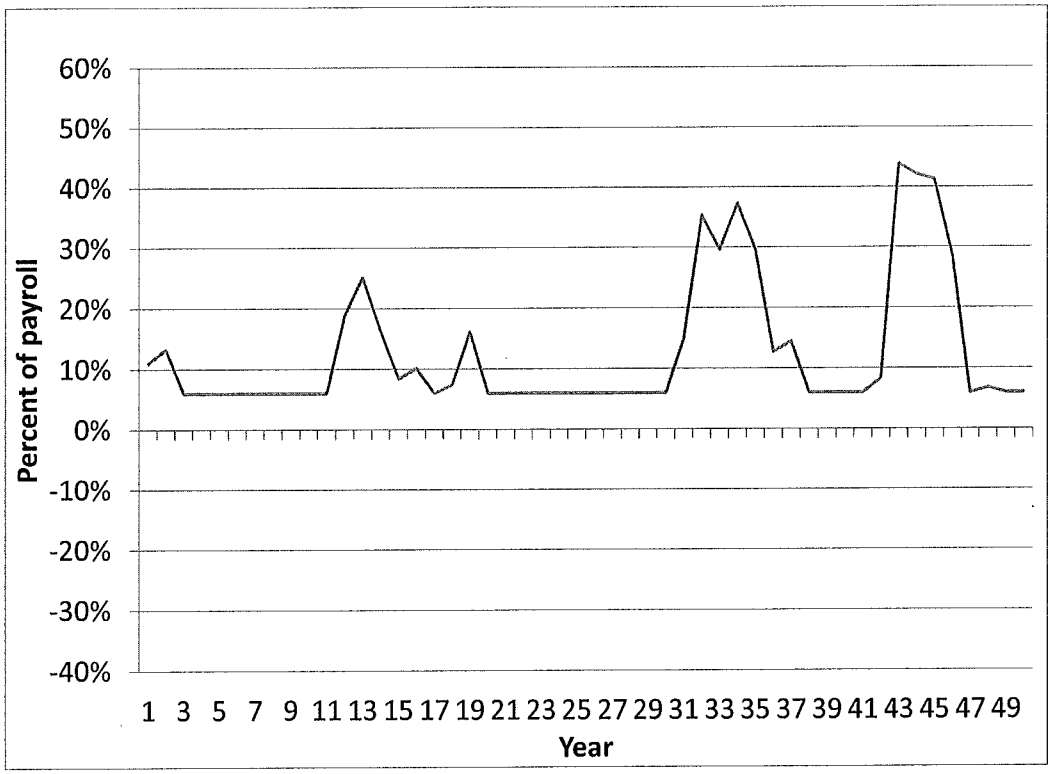
Example of Policy 2



Policy 3. 20-year amortization; no smoothing; 6% minimum contribution; no maximum contribution rate

Policy 3 introduces a minimum contribution of 6 percent, equal to the employee share of the typical normal cost of around 11 percent of wages. In this policy, employer contributions may rise and fall but the employee contribution is made regardless of how well-funded the plan becomes. This minimum contribution lowers the ACD significantly, from 13.7 to 4.0 percent over the full 100-year period. The SDC also falls, from 23.4 percent in Policy 2 to 6.4 percent in Policy 3. Policy 3 also reduces the standard deviation of average 100-year contributions, from 5.9 percent to 4.6 percent. Insolvency of the fund remains extremely unlikely, with no incidence in the 1,000 trial runs. However, the average total contribution rate increases from 10.6 to 12.3 percent: while contributions can never fall below 6 percent, they have no upper bound.

Example of Policy 3

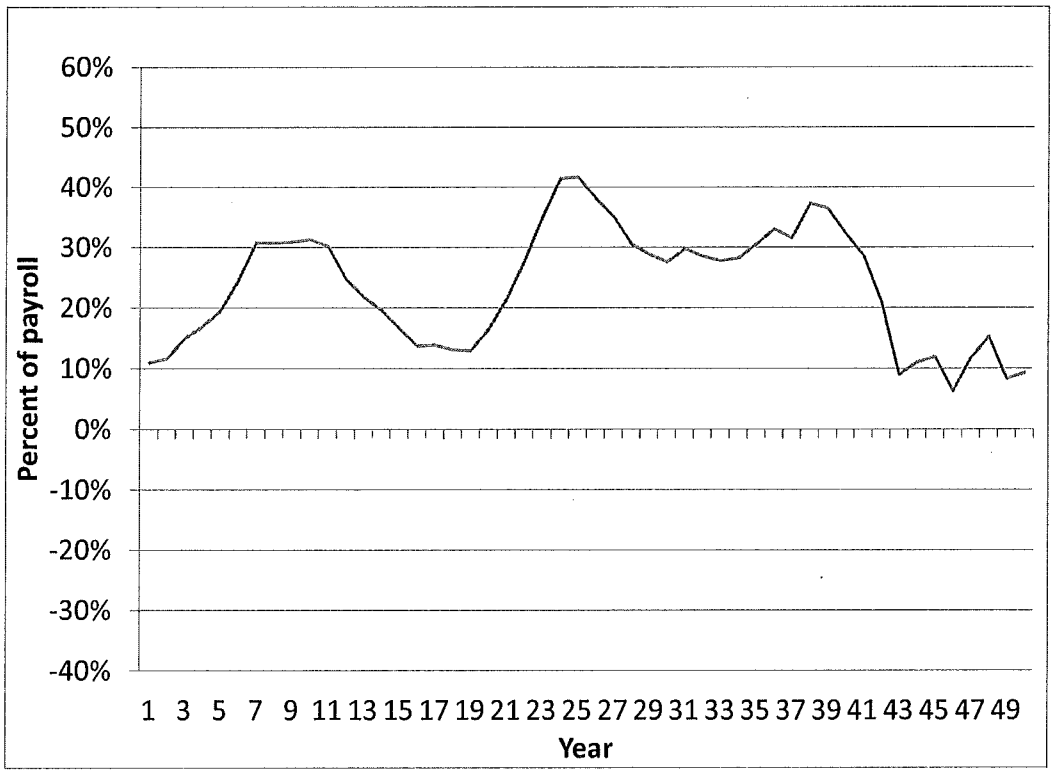


Policy 4. 20-year amortization; 5-year smoothing; 6% minimum contribution; no maximum contribution rate

Policy 4 introduces smoothing of investment returns over a 5 year period, which is common among public funds. Relative to Policy 3 it reduces the ACD significantly, from 4.0 percent to 1.6 percent. The SDC also falls, from 6.4 to 5.7 percent. Average contributions over 100 years rise slightly, from 12.3 to 12.6 percent, and the standard deviation of average 100-year contribution rates rises slightly from 4.6 to 4.7 percent. Despite smoothing of returns, which allows the market value of the plan fund to vary more widely before triggering contribution changes, no simulation among the 1,000 run results in insolvency.

Policy 4 is, at least on paper, the closest approximation of actual pension funding parameters at present: funding shortfalls are amortized over 20 years and investment returns over 5 years, and the employee contribution must be made regardless of how well funded the plan is. Obviously, though, there remains a great deal of heterogeneity with regard to funding policies. Policy 4 may be less realistic in assuming that required contributions will be made regardless of size. Over an average 100-year period in the model, the average maximum annual contribution reaches 37 percent of wages, versus a baseline employer contribution of only 5 percent of wages. Over a 100-year period, the plan could expect at least 10 years with contribution rates in excess of 17 percent. Similarly, Policy 4 assumes that benefit enhancements will not be enacted, no matter how over-funded the plan may become.

Example of Policy 4



Policy 5. 20-year amortization; 5-year smoothing; 6% minimum contribution; 22% maximum contribution rate

Policy 5 replicates Policy 4 with the addition of maximum annual contribution rate, set at 22 percent of wages, or twice the total baseline rate. Since employee contributions are fixed at 6 percent, this means that employer contribution rate of 5 percent is allowed to rise to a maximum of 16 percent of wages, or 3.2 times the base rate.

This maximum is arbitrary, but is not inconsistent with recent experience. Table 1 is based upon data from the Public Plans Database for 2010 (the most recent year for which complete data were available), detailing how the size of plan ARCs relative to plan payroll corresponds with the plan sponsor making the full ARC. Due to the economic downturn, many plans with modest ARCs relative to payroll

Table 1. Payment of Actuarially Required Contribution, 2010

ARC as % payroll	Percentage paying full ARC	Average percent of ARC paid
10%	62%	95%
20%	44%	81%
30%	24%	81%
40%	33%	88%
All	46%	84%

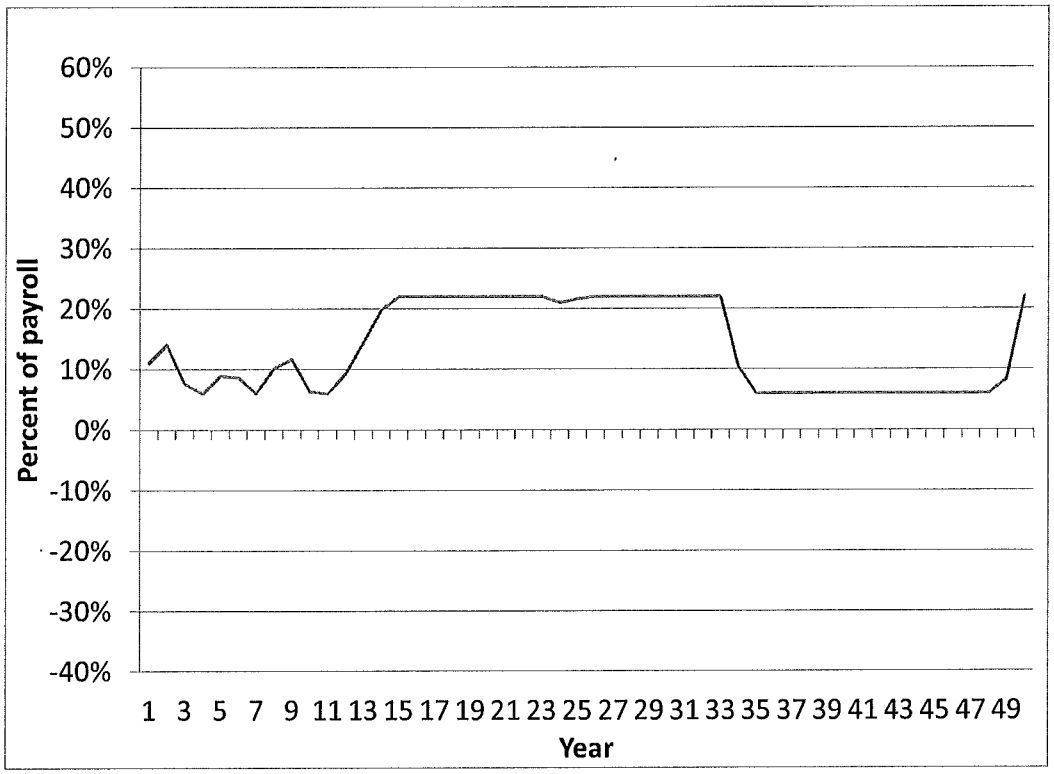
Source: Author's calculations, from Public Plans Database.

often failed to make the full payment; even for plans with ARCs equal to less than 10 percent of salaries, only 62 percent of plans made the full payment. On average, however, payments were close to – and in a number of cases, greater than – the ARC. As the ARC rose in size relative to payroll, however, progressively fewer plan sponsors made the full payment. For plans with ARCs equal to between 20 and 30 percent of wages, for instance, only 24 percent of plans made the full payment and on average paid around 81 percent of the full ARC.

Relative to Policy 4, the 100-year average ACD in Policy 5 falls from 1.6 to 0.7 percent while the SDC falls from 5.7 to 3.9 percent, both presumably because the contribution cap restricts contribution increases. The mean contribution rate rises slightly, from 12.6 to 13.0 percent, despite the 22 percent cap on contributions. The standard deviation of average 100-year contributions rises from 4.7 to 5.0 percent.

The most important change regards the risk of fund insolvency. In Policy 4 there were no instances of insolvency over either 100 or 500 years. In Policy 5, there is a 8.6 percent chance of insolvency over 100 years and a 27.4 percent chance of insolvency over 500 years. These results demonstrate first, that there is a significant probability of very high annual contributions being required and second, that the solvency of the fund depends upon these contributions being made. If the plan sponsor is economically unable or politically unwilling to make very high contributions when necessary, insolvency of the fund becomes a real possibility.

Example of Policy 5



Policy 6. 20-year amortization; 5-year smoothing; 6% minimum contribution; 22% maximum contribution rate; 6.8% arithmetic mean return

Policy 6 incorporates lower average investment returns into the simulation, reducing the mean return from 8.0 to 6.8 percent. This latter figure is the arithmetic mean of projections made by eight national investment consulting firms for returns on public plan portfolios over the next 15 years,[18] and is consistent with other relatively pessimistic projections of pension investment returns in coming years.[19] The ACD is very similar to Policy 5, as the risk of investments is assumed to remain unchanged. However, the mean contribution rate rises from 13.0 percent to 16.9 percent of wages due to the lower average investment return. The standard deviation of both annual contributions and average contributions

[18] See Rizzo and Krekora (2013).

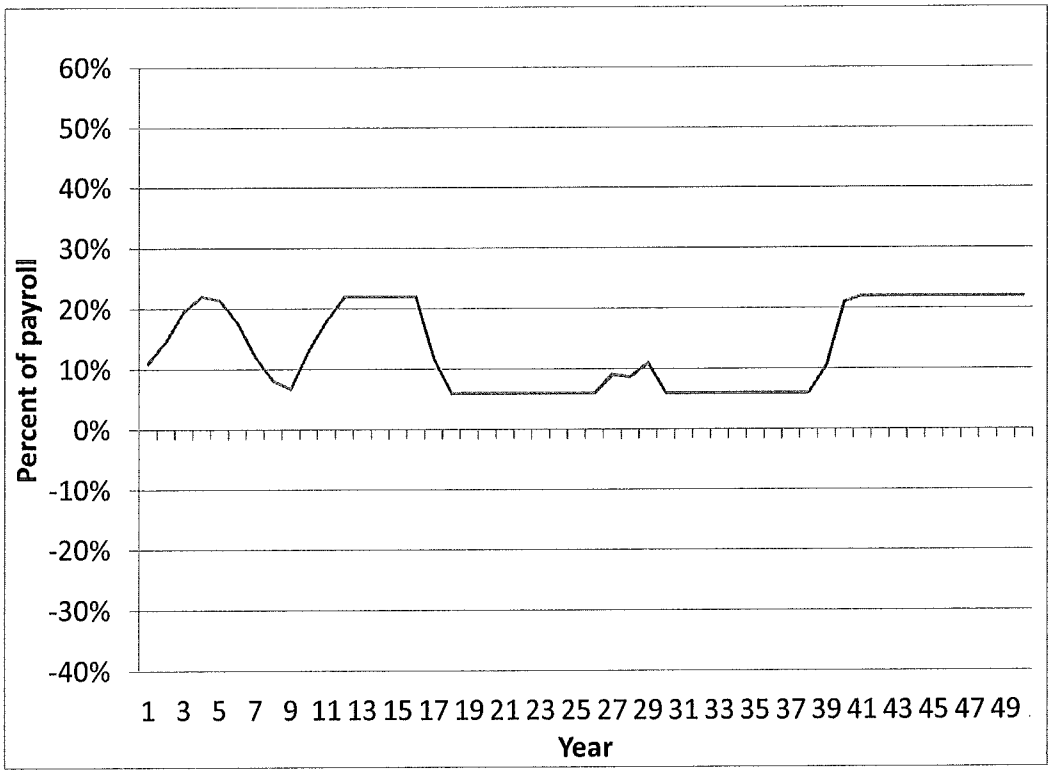
[19] For instance, Wilshire Consulting (2013) projects a median investment return for pensions over the next 10 years of 6.9 percent.

over 100 years declines. This is attributable to the higher average contribution rate combined with the 22 percent cap on total contributions, which allows for less upward contribution volatility.

However, prospects for fund insolvency are worrying under this scenario: the fund has a 31 percent chance of insolvency over 100 years and an 82 percent chance of insolvency over 500 years. This highlights an additional risk facing public plans: not merely the risk embodied in the variation of returns from year to year, but the risk that the plan incorrectly forecasts average returns over the long term.

However, if we re-run the 1,000 simulations while increasing the maximum contribution rate from 22 percent to 30 percent of wages, the plan never becomes insolvent over either 100 or 500 years. Again, this reiterates the importance of the plan sponsor's willingness and ability to make very high contributions when needed.

Example of Policy 6



Policy 7. 20-year amortization; 5-year smoothing; 11% minimum contribution; no maximum contribution rate

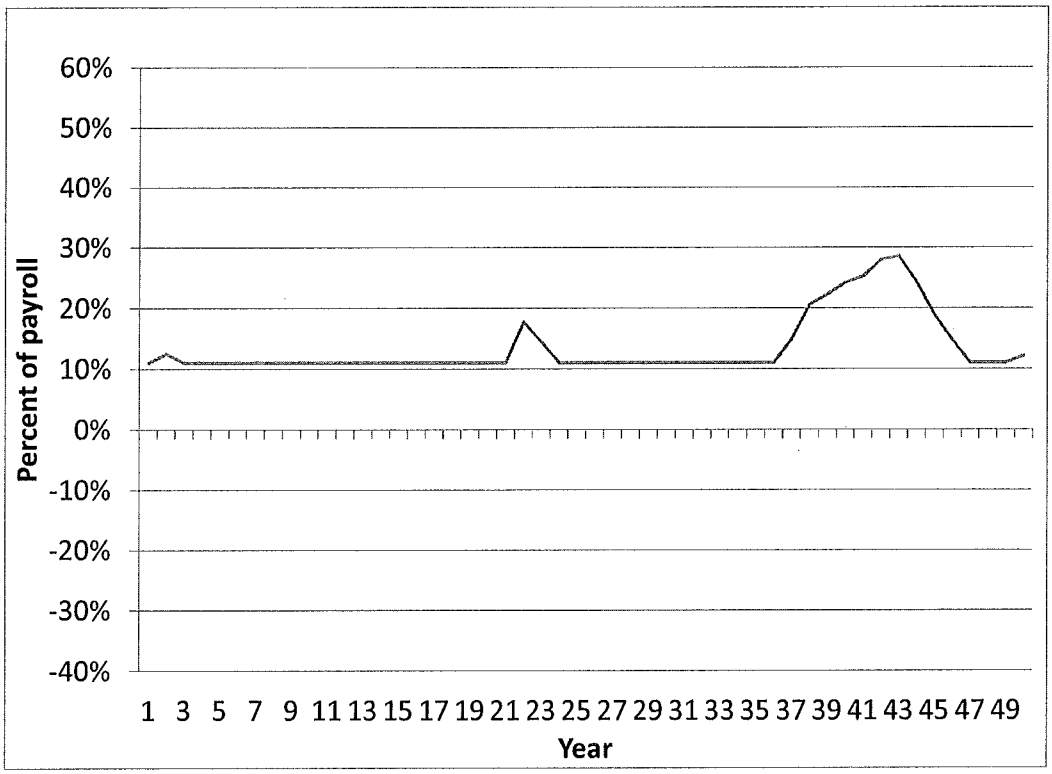
Policy 7 recreates Policy 4, but substitutes an 11 percent total minimum contribution rate. Each year the plan will contribute no less than the average expected cost of 11 percent of payroll, with employees always contributing 5 percent of pay and employers no less than 6 percent. To what degree does doing so insulate the plan against the need for higher employer contributions in certain years?

In many simulations, the plan will never need to contribute more than 11 percent of wages and, indeed, will see plan assets explode relative to payroll. While a less pressing problem than underfunding, ever-increasing assets raise questions regarding how such surpluses should equitably be drawn down and whether poorly-designed drawdowns could plan the plan in financial jeopardy in future years, as benefit enhancements enacted in the late 1990s have done to certain programs.

On the other hand, there will remain many cases in which higher contributions will be necessary. Indeed, raising the minimum contribution from 6 to 11 percent of wages does little to reduce the risk of extremely high contributions in certain years. Policy 4 has an average maximum annual contribution over 100 years of 37 percent of wages; Policy 8 reduces that worst-case scenario only 34 percent. Even when the plan never reduces its baseline contribution rate of 11 percent of payroll, it can expect to face at least 10 years over a 100-year period with required contributions in excess of 17 percent of wages.

Year-to-year variations in contributions are reduced by Policy 7's 11 percent minimum contribution rate, with an ACD of 1.1 percent versus 1.6 percent in Policy 4. Similarly, the SDC is reduced from 5.7 percent in Policy 4 to 3.58 percent in Policy 7. Yet part of that reduction derives from the lower bound of contributions being limited at 11 percent even if the plan becomes overfunded. In any event, lower contribution volatility comes at the cost of a higher average contribution rate of 14.6 percent of wages, versus 12.6 percent under Policy 4 and only 11 percent under a deterministic baseline.

Example of Policy 7



4. Employer costs and budgetary effects

Public pension financing has entered the public policy debate due to its prominence in state and local government budgets. Actuarial Required Contributions calculated under GASB accounting rules have more than doubled over the past decade, putting increased pressure on budgets during a period when resources have been scarce.

Pension financing can contribute to uncertainty in public budgeting because the government – rather than the employee – generally bears all the investment risk.[20] The employee contribution is generally a fixed portion of the normal cost of accruing benefits, while the employer contributes part of

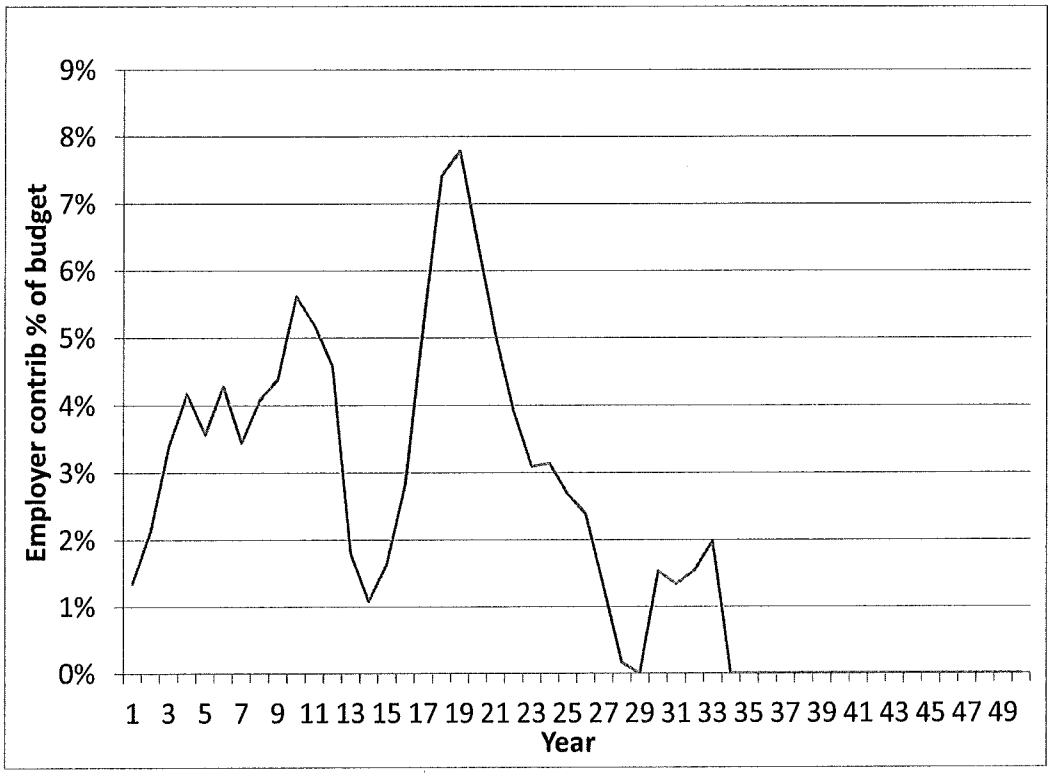
[20] There are some plans, such as Nevada PERS, in which employees share in paying amortization costs; in others, such as Wisconsin, post-retirement benefit increases are contingent upon plan financing. In these cases, risk is shared between employers and employees. In most cases, however, risk is formally borne by the plan sponsor and transmitted to employees only indirectly, such as through lower wage increases.

the normal cost and *all* of the costs of amortizing unfunded liabilities. It is the latter amortization payments that vary from year to year. This framework increases the risk to state and local budgets, because the employer contribution is generally small and steady in a deterministic baseline but highly variable in practice.

We model budgetary effects beginning with Policy 4, in which employees contribute 6 percent of wages with the remaining 5 percentage points of the 11 percent normal cost and all amortization costs funded by employers. Investment returns are smoothed over 5 years and over- or under-funding amortized over 30 years. In addition, as of 2010, employee salaries made up 27 percent of state and local government budgets, based on U.S. Census Bureau data. Thus, the baseline government contribution of 5 percent of wages is equal to 1.35 percent of the total budget.

But Figure 2, which is based on the parameters of Policy 4, illustrates that this amount can vary significantly once we take market risk into account. In many years, favorable investment returns could mean that no government contribution was necessary – a so-called "contribution holiday." But lower returns mean that pension costs could rapidly increase to become a sizable portion of the budget. In Figure 2, for instance, required contributions rise from 1 percent to almost 8 percent of the budget in less than a decade, despite the use of contribution stabilization policies.

Fig. 2. Illustration of potential budgetary costs



Moreover, investment returns and tax revenues generally are correlated, as both are linked to the state of the economy. This means that higher pension contributions will tend to be required during protracted economic downturns, when tax revenues available to make such contributions are reduced. As Washington State's actuary has written with regard to its own plans' experiences: "Weak economic environments were correlated with weak investment returns. Lower investment returns created the need for increased contributions at a time when employers and members could least afford them."[21] Additional dollars are needed when the marginal value of a dollar is highest, while surpluses occur when a marginal dollar is less valuable.

In general, pension contributions will be a larger percentage of budgets for local than for state governments, as personnel costs form a larger part of local government budgets. In 2011, employee

[21] Office of the State Actuary, "Washington State 2009 Actuarial Valuation Report," October 2010; and Office of the State Actuary, "2010 Risk Assessment: Moving Beyond Expectations," August 31, 2010.

salaries made up only 13 percent of total state expenditures, but 36 percent of expenditures at the local level.[22] So, roughly speaking, the effects illustrated in Figure 2 could be cut in half for state budgets but increased by one-third for local government.

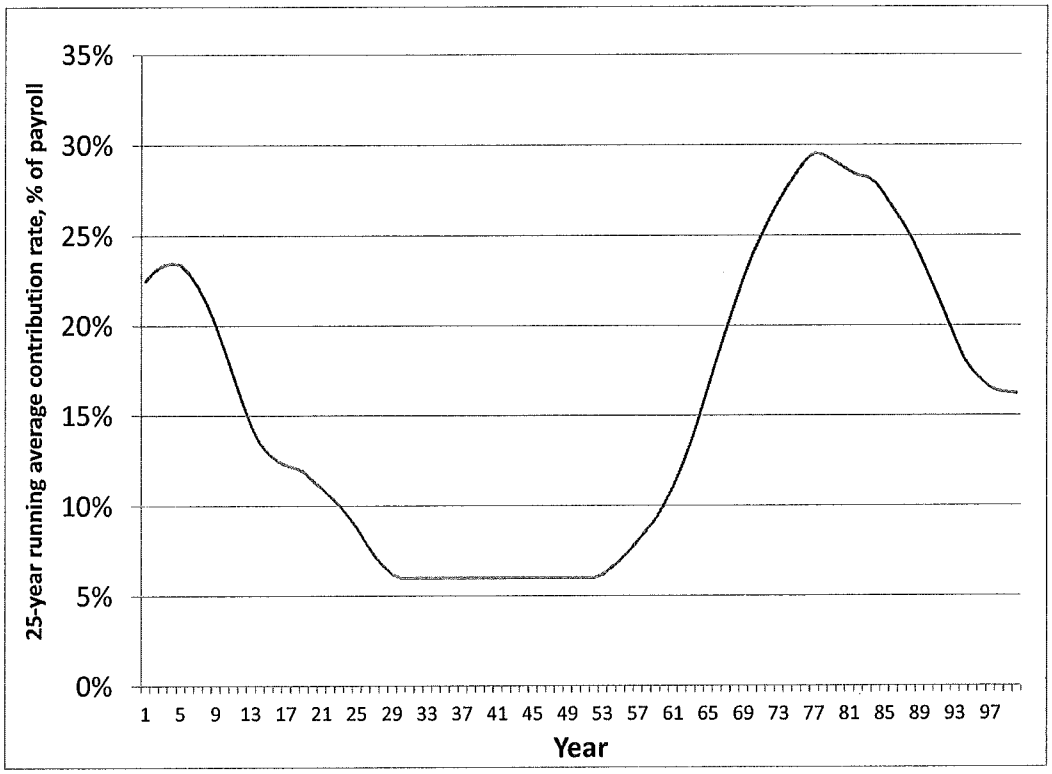
5. Year-to-year contribution smoothing and generational equity

Smoothing and amortization policies do reduce year-to-year fluctuations in contribution rates, which is of benefit to plan sponsors who must allocate funds each year. In the process, however, these policies introduce longer term hill-and-valley patterns to contribution rates, which imply that certain generations of taxpayers will pay far more for public employees' pension compensation than others. This pattern violates the commonly-held goal of interperiod 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 illustrates this concept with such terms as "living within our means" and "fairness."[23]

Figure 3 illustrates 25-year running average contribution rates under Policy 4. In this instance, early cohorts have an average contribution rate over 25 years that exceeds 22 percent of payroll, twice the deterministic cost of the plan. Similarly, over 20 cohorts pay the minimum employee contribution of 6 percent of wages each year for 25 years or more; in these instances, the taxpayer cost is zero. But later in the period there are roughly 25 cohorts who pay an average 25-year contribution rate of between 20 and 29 percent of wages.

[22] Barnett and Vidal (2013).
[23] GASB (2009). "The User's Perspective: Interperiod Equity and What It Means to You" (June):

Illustration of 25-year running average contribution rates, Policy 4



Over 1,000 simulations, the standard deviation of running average 25-year contribution rates in Policy 4 is 4.7 percentage points, showing (to this writer, at least) a high degree of generational inequity. If we repeal the 6 percent minimum contribution rate – say, as way to approximate the chance of contribution holidays or benefit enhancements when the plan becomes overfunded – the standard deviation of 25-year average contribution rates rises to 10.7 percent, almost as large as the 11 percent baseline contribution.

These results suggest a policy trade-off: to the degree that stabilization policies reduce year-to-year contribution risk, these policies may generate larger generation-to-generation differences in contributions, thereby undermining the policy goal of intergenerational equity in pension financing.

6. The effects of short- and long-term investment returns

Plan sponsors generally focus on what is referred to as a "long term investment return," a phrase that is open to interpretation. One possible view is that the long term return refers to some steady state after that takes place after any near-term discrepancies – say, excessively high or low valuations – are resolved. An alternate interpretation, and one which is more mathematically applicable, is that the long-term return is a constant rate that generates the same present values as the actual sequences of returns that plan sponsors anticipate to receive. For instance, if sponsors expect to receive returns below 8 percent in the near term, a long term return of 8 percent would be appropriate only if following returns are anticipated to be in excess of 8 percent.

In any event, the implication of the focus on "long term" returns is that the year-to-year ups and downs of the market will tend to event out over time. But the results of the modeling show this is often not the case. In reality returns over the first several decades – which are subject to substantial risk – have a strong influence on funding health much further down the road.

For instance, under Policy 4, nearly three-quarters of the variation in funding ratios as of Year 50 derives from differences in investment returns over the first 15 years. Plans receiving 15-year returns in the top quartile of the distribution – in this case, 9.6 percent or more – have assets 35 years later that are on average 160 percent of those held by plans that received 15-year returns in the bottom quartile (4.3 percent or lower). Even after 100 years, funding differences generated during the first 15 years are not fully resolved.[24]

One practical implication of this result is that if near-term investment returns are below those projected by public plans, as many independent financial consultants believe they will be, pension stakeholders could expect that plan funding may remain below target levels for decades thereafter.

[24] Plans receiving higher 15-year returns have average assets around 5 percent above those in the bottom quartile of the return distribution as of Year 100.

7. Discussion and Conclusions

The goal of the model of pension financing outlined here is to provide both a qualitative and quantitative understanding of the degree to which investment risk translates – through the medium of stabilization policies and parameters – into changes in annual contribution rates. A number of lessons come from the simulations undertaken here.

First, while it may initially appear that long time horizons allow public employee pensions to provide generous, guaranteed benefits for participants funded by low, stable contributions from employers, in reality, a public plan can provide only three of the four: contributions can be low or they can be stable but they cannot be both, at least so long as plan sponsors must pay mind to the solvency of the fund. The short- and long-term risks inherent to the investments held by public plans cannot be fully stabilized by investment return smoothing and long amortization periods. Under the most typical approach, a plan sponsor could expect a 1.6 percentage point positive or negative change in its contribution rate each year; put another way, relative to the 11 percent contribution baseline, annual dollar costs would vary up or down by around 15 percent each year. It is not clear whether most plan sponsors understand these risks or believe that they are able to bear them.

Second, a plan sponsor should expect that in certain years required plan contributions will vastly exceed levels projected on an expected-returns basis. For a typical plan, total required contributions will rise to at least triple the expected rate in at least one year over a 100-year period. Employer contributions may rise by a factor of five or more. And these are not simple one-time events: over a 100-year time horizon, a plan sponsor could expect that its employer contribution rate would exceed triple the baseline rate for at least 10 years.

Third, volatility of plan contributions works in both directions. If a plan receives favorable investment returns, it may generate scheduled benefits at well less than projected costs. While overfunding may be most likely to occur in good economic times, in a significant number of cases a plan

may remain overfunded – and thus require reduced contributions or no contributions at all – even over very long time periods.

Fourth, if plans are willing and able to make any and all contributions as required, insolvency of the fund is extremely unlikely, even over very long periods of time in which many poor investment returns may accumulate.

But fifth, if a plan cannot or will not make all required contributions, insolvency of the fund becomes a real possibility. For instance, capping annual contributions at twice the expected rate generates an approximately 9 percent probability of fund insolvency over 100 years for a plan that was fully funded at the outset. For a plan that starts out underfunded, as most U.S. public plans do today, insolvency risk is presumably higher.

Sixth, because the plan sponsor bears most or all of the investment risk, employer costs will vary far more than employee contributions. The budgetary impact of cost fluctuations will depend upon the size of employee payroll relative to overall expenditures. Labor costs are generally a larger share of budget at the local than the state level, meaning that pension funding poses a greater risk to local government budgets.

Broadly speaking, public plan sponsors appear to face essentially the same trade-off between risk and return – between low contributions or stable contributions – as do other market participants. The policy problem is that many plan stakeholders appear unaware of this choice. GASB accounting rules, which dictate how pensions value and report their liabilities and funding progress, make no reference to investment risk with the exception of rewarding plan sponsors for taking it. A plan that takes greater investment risk can assume a higher expected return and then apply that higher return in discounting its future liabilities. Similarly, public plans have shifted heavily into equities and alternative investments – public plans are the largest investors in hedge funds and private equity in the U.S. – but it is unclear how

well plan sponsors understand the risks they are taking. There is little evidence in public plan publications and disclosures with regard to how investment risk translates into contribution risk.

These results, while focused almost entirely on plan contributions, also lend themselves to the debate over how to value public pension liabilities and overall plan financing. Current GASB rules allow plans to discount their liabilities using the expected return on assets, which today is slightly under 8 percent. This practice produces average funding ratios of around 75 percent and unfunded liabilities of around $1 trillion. Most economists, by contrast, argue that a guaranteed benefit should be valued using a lower interest derived from riskless investments. Using this approach, often termed "fair market valuation," public plans are only around half funded and unfunded liabilities top $4 trillion.

These results turn that debate on its head. Instead of analyzing the risk of plan benefits, which many plan stakeholders find counterintuitive, we may analyze the risk of pension contribution rates. A plan with steady contribution rates will be preferable for plan sponsors –ultimately meaning taxpayers – than one whose contribution rates vary widely, particularly if higher required contributions correspond with poor outcomes in the economy. Taxpayers would be willing to pay a higher steady rate to a lower but variable rate. This steady rate – a certainty equivalent, in financial economics terms – would be the best descriptor of the economic cost of the plan to the taxpayer. Given the unusual distribution of contribution rates within and across years we do not attempt to derive such a value here, but in general it would be something close to the contribution rate calculated using a riskless rate of return.[25]

It may be that plan stakeholders would prefer low-but-variable over high-but-steady contributions: pension financing is very sensitive to the assumed investment return, such that reducing investment risk/return produces significant increases in expected funding costs. The policy key, however,

[25] Gollier (2007) shows that by accessing the ability to spread benefits and costs across generations, a perfectly-designed public plan could effectively increase the risk-adjusted return on investments by 100 basis points, meaning that the certainty equivalent contribution rate could be calculated using an interest rate around one percentage point above the riskless return. Using more realistic pension designs, the gains in risk-adjusted returns are around 50 basis points, meaning that the certainty equivalent contribution rate would remain quite high relative to those based upon expected returns on investments.

is that plan stakeholders – from pension trustees, to public employees, to elected officials, to taxpayers – have a clearer idea regarding the choices they face.

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