Why Discount Rates Should Reflect Liabilities: Best Practices for Setting Public Sector Pension Fund Discount Rates

by Truong Bui and Anthony Randazzo

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What are the accrued liabilities of America's public sector pension systems? This is far from a straightforward, arithmetic matter. Depending on whom you ask, the 50 states have accumulated pension debt of anywhere between $500 billion and $5 trillion.[1] To put it mildly, that is a massive range of opinion about the level of unfunded state pension liability.

The principal cause of this variation between estimates is the discount rate being used in the forecast of pension finances.[2] The discount rate is a critical factor for determining how much gets saved today to pay pensions in the future. The higher the discount rate employed, the lower will be the net present value of anticipated pension benefits, which are also known as accrued pension liabilities. The lower the present value of the accrued pension liabilities (i.e. the value of all future pension benefits measured in today's dollars), the less the government and employees will need to pay into pension coffers today to cover those promised benefits when they come due. Thus, the higher the discount rate, the lower the rate of contributions flowing into a pension fund (all else equal). Conversely, the lower the discount rate, the higher annual contributions will need to be to ensure a fully funded system.[3]

Accurately identifying the present value of pension liabilities isn't just important for understanding the current level of unfunded liabilities. It is also critical to ensuring that state and local officials make sufficiently large annual contributions to their pension funds now and in the future, thereby avoiding unfunded liabilities in the first place. Yet financial economists, actuaries and public officials disagree sharply over how the future benefit payments promised to public workers should be discounted, and therefore what the present value of pension liabilities is.

This policy brief lays out a case for how state and local officials should go about setting their discount rate. It begins with an outline of best practices for setting the discount rate. It then tackles several myths and misnomers about the discount rate that are prevalent in discussions about public sector pension reform nationwide. It concludes with recommendations.

Table of Contents

Best Practices for Setting the Discount Rate

The discount rate helps determine the present value of pension liabilities. At present, most governments provide so-called "defined-benefit" pensions to their employees. Such pensions are promises made to the employee that specific benefits, defined in law, will be provided once that employee retires. Actuaries calculate the value and timing of these promised pension benefits and then use a discount rate to determine their present value. The result, known as the actuarially accrued liability (AAL), is important for calculating the funded ratio of a pension plan, as well as for determining employer contribution rates.[4] Defined-benefit pensions can be thought of as debt securities or bonds held by public sector employees that pay out upon retirement. Any bondholder (in this case, the public employee) expects to be compensated for taking on two burdens: the forgoing of current consumption, and the risk that the bond won't pay out as assumed.

The first burden reflects the fact that people tend to prefer current consumption to future consumption. This burden is compensated by a rate of return called the *risk-free interest rate*, which represents the time value of money. So, if an employee is indifferent between $100 today and $102 in a year's time, the risk-free interest rate is 2%.

The second burden is compensated by the *risk premium*, which reflects the default risk of the underlying security: the riskier the security, the higher the risk premium. So, for example, if on average three in every hundred governments default on their pension payments, the risk premium for government pensions would be 3%.

The two compensation components together constitute the discount rate (i.e. risk-free interest rate + risk premium = discount rate).[5] In the case above, the discount rate would be 2% + 3% = 5%. In short, then, the discount rate should reflect the risk of the plan's liabilities.[6]

So how should a pension plan determine a discount rate for valuing pension obligations, a.k.a. promised benefits, a.k.a. accrued liabilities? As noted, the discount rate should be a function of the *risk-free interest rate* and the *risk premium* associated with governments

not being able to pay the promised retirement benefits. The greater the risk that pension payments will not be paid, the higher the risk premium associated with that pension plan should be.

Unfortunately, neither the risk-free rate of interest nor the risk premium is directly observable: the first is a subjective characteristic of the public employees, while the second depends on the future ability of the government to pay its debt. As a result, it is necessary to rely on proxies for both.

A. Using Proxies to Determine the Discount Rate

One of the best proxies for the discount rate is the average yield on bonds issued by the government employer, if such bonds have been issued. The reason is that such bonds embody both the time value of money and a risk premium that is specific to the government issuing the bond—i.e. they reflect the expectation by bondholders of the government defaulting.[7] In some cases, where pension benefits are guaranteed by state or municipal law, and thus would be considered as senior debt claims in a bankruptcy, the risk premium should be even smaller than the yield on state or municipal bonds would suggest.[8]

For states and municipalities that have not issued bonds, another approach would be to follow Moody's Investors Service, which discounts pension liabilities using a high-grade, long-term corporate bond index.[9] While a number of quality indices exist, most long-term investment grade bond indices show yields of between 4% and 5% over the past two years.

Alternatively, governments could use one proxy for the risk-free interest rate and another proxy for the risk premium. A growing body of academic literature in financial economics suggests that in such cases using a municipal bond index or the Treasury yield curve would be a better source for implying a risk-free interest rate.[10]

Over the past three years, 10-year Treasury notes have averaged a yield of 2.3%, 30-year Treasury bonds have averaged a yield of 3.3%, and high-grade, 20-year municipal bonds have yielded 4.2%.[11] Using any of these as a risk-free interest rate in the discount rate calculation would suggest state and municipal pension managers are implying a very large risk premium when they set discount rates at 7% to 8.5%, as is common practice today.

In most cases, municipal and state legal codes and constitutional provisions guarantee the payment of pension benefits.[12] In such cases, there is practically no risk of pension default and a risk-free rate should be used. However, as previously mentioned, the lower the discount rate used, the greater the required contributions to the pension system. Politicians

thus have an incentive to pad their discount rate with a substantial implied risk premium in order to reduce their year-to-year budgetary outlays. But picking a number at will is not good policy.

B. Cohort Risk Adjustment: Following Private Sector Best Practices

While less common these days, some private sector firms still offer a defined-benefit pension plan to their employees. In the private sector, specific federal regulations determined by the Financial Accounting Standards Board (FASB) and Internal Revenue Service (IRS) guide how discount rates should be established and used.[13] Current IRS guidelines state that the specific discount rate corporations can use should be based on a high-quality corporate bond yield curve, meaning the discount rate for private sector defined-benefit plans is related to the likelihood of the corporations defaulting on their bonds.

In addition, though, each plan is required to use separate discount rates for the pension liabilities of employees who are within five years of retiring, employees who are between five and 20 years of retiring, and employees who are estimated to be 20 or more years away from retirement—reflecting the different risk preferences of these different cohorts. The IRS releases regular tables with the exact rates that can be used for the liabilities that fall into these different cohorts.[14] Public sector plans could adopt this approach as well, particularly if the baseline discount rate were linked to a municipal bond index.

C. Comparing Best Practice With Reality

Unfortunately, the discount rates being used by municipal and state pension plans are substantially higher than discount rates implied by the proxies discussed above.

Table 1 shows various risk-free interest rate proxies and the average implied risk premium being applied to state pension plans.

Table 1: Implied Risk Premium of the National Average Discount Rate 2013 Average State Pension Plan Discount Rate: 7.74%		
	"Risk-Free" Rate	Implied Risk Premium
10-Year Treasury Note (three-year average)	2.2%	5.54%
30-Year Treasury Bond (three-year average)	3.3%	4.44%

We can see that depending on how we define a risk-free rate, states on average have an implied risk premium of between 4.44% and 5.54%. This suggests there is substantial risk in the liabilities, or discount rates are being set excessively high.

A further point of comparison is the average state discount rate compared with two proxy rates that have some risk premium built in. Table 2 compares the national average discount rate with a 20-year muni bond index and the corporate bond index used by Moody's.

Table 2: National Average Discount Rate Compared to Best Practices "Risk-Free" Rate of 30-Yr. Treasury Bond: 3.3%		
	Rate	Implied Risk Premium
50 States' Pension Plans Average Discount Rate (FY2013)	7.74%	4.44%
20-Year Municipal Bond Index (three-year average)	4.2%	0.9%
Moody's Approach (high-grade, long-term corporate bond index)*	4.0%–5.0%	0.7%–1.7%

*Over the past two years, this index has averaged 4% to 5%

This further illuminates how off-base discount rates are among the 50 states today. The adopted rates of pension plans are excessively high and are contributing to a systemic undervaluing of pension liabilities. This leads to underfunding pension plans, even when states pay their full annual contributions.

There is no denying the political ramifications of the additional annual contributions that would be required by using a discount rate that reflects the characteristics of the liabilities rather than the assets. Yet, actuarial assumptions like the discount rate do not themselves create reality. Continuing to use inflated discount rates simply kicks the time when pensions have to be paid for down the road to future lawmakers and taxpayers.[15]

Discount Rate Myths that Lead to Worst Practices

While finance theory argues that retirement benefits should be discounted at a rate that reflects the time value of money of the beneficiaries (the employees) and the risk of default of the employer (the government), this is not how states or local governments select their discount rate. Instead, actuaries calculate the long-run expected rate of return on the assets of a particular pension plan, and then use this as the discount rate. Thus, since public pension funding doesn't treat pension liabilities as bonds, the importance of this basic element of finance is lost. As a result, inappropriate discount rates are applied. This section considers some of the myths and errors that underlie this problematic and wide-spread practice.

A. Myth: The Discount Rate Should Match the Expected Rate of Return

About 96% of public sector pension plans discount their accrued liabilities at rates between 7% and 8.5%, according to a recent study from the Center for Retirement Research at Boston College.[16] And these discount rates typically are based on the expected rate of return for the particular pension plan. *But while this national trend is a common practice, it is not a prudent practice.*

There is no legal requirement or federal regulation that government employee pension plans use the expected rate of return as the discount rate; Government Accounting Standards Board (GASB) rules allow for this practice, but they do not demand it.[17]

Reality: The discount rate should reflect the risk of the plan's liabilities, not its assets.

The debate over how to set discount rates is, in some ways, a disagreement between actuaries and financial economists. Actuaries argue that if a plan expected to earn 8% on its investments, then it would be *consistent* to assume the liabilities should be discounted at the same rate. The implication here is that the risk of investing pension assets is relevant when considering the liability risk, i.e. whether promised retirements benefits will be paid.

But think about home mortgages for a moment: the price of a mortgage (the interest rate) isn't primarily based on how much the home's value will appreciate over time, but is relative to the borrower's credit worthiness. The value of the asset (the home) and the liability (the risk of failure to repay) are separate.

Even if we knew ahead of time that a pension plan would definitely earn an average return of 8% on its investments over a certain period of time, using the 8% discount rate would still be inappropriate.

Statistically speaking the expected rate of return is only an *average* value. An 8% long-run expected rate of return does *not* communicate that you *will* get an annualized 8% rate of return over the next 30 years. It just means that if you could repeat that 30-year investment enough times, you would see that the average of the compound annual rates of return is about 8%. In other words, the plan could get a compound annual rate of return differing from 8% in any given 30-year period.

So the actual rate of return on assets is likely to be different from the assumed expected rate. And if the expected rate of return is used as the discount rate when valuing pension liabilities—and hence for deriving the annual contribution, it is likely that the plan will not be able to meet its benefits obligations.

Since the pension's future obligations are known with a higher degree of certainty than its return on assets, basing a discount rate solely on the expected return on assets creates a discrepancy between the plan's guaranteed benefits and its uncertain ability to pay them.

The key point is that the risk of pension liabilities should be accounted for on its own terms. Therefore, *the discrepancy (between the plan's guaranteed benefits and its uncertain ability to pay them) exists even when the assumed rate of return is "correct,"* i.e. the assumed rate of return equals the expected (not actual) rate of return. Unfortunately, virtually every public sector pension plan in America sets its discount rate in conjunction with its expected rate of return.

B. Myth: Long-Term Investment Strategies Justify High Discount Rates

One argument frequently used to counter the framework presented here is that, in the long run, investment losses tend to be made up by investment gains. Therefore, so the argument goes, the longer an investment is made, the less risky it will be. This idea is called "time diversification" because it posits that time itself can lessen risk.

Figure 1: Annualized Investment Rates of Return

95th percentile   Median   5th percentile
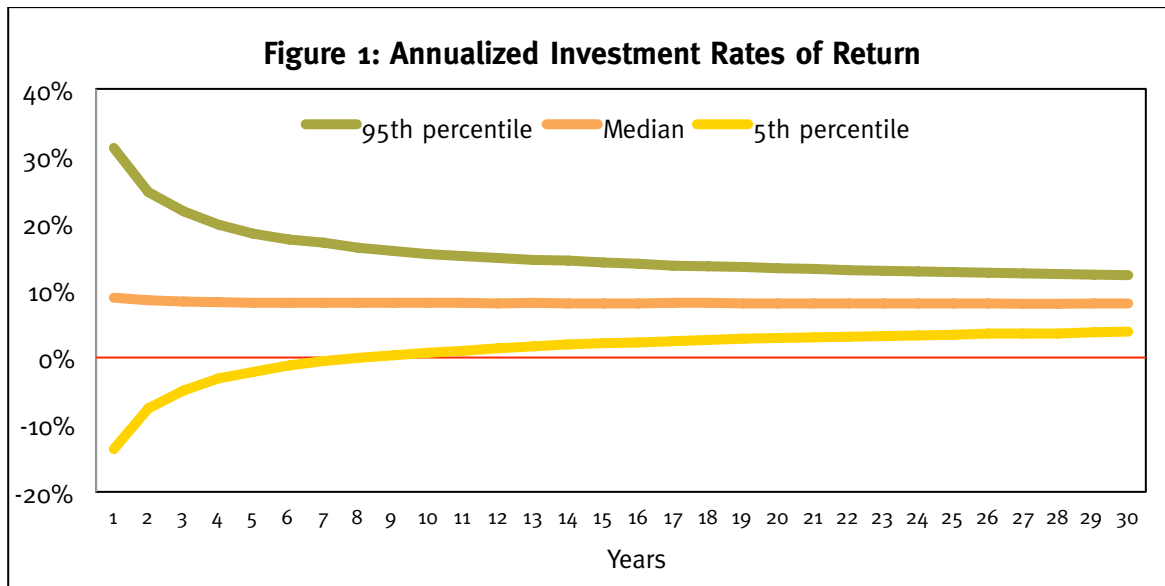
But there are structural flaws in the foundation of this reasoning; long-term investment strategies don't actually inherently reduce asset risk. Because of the compounding effect of investment returns, risk actually increases over time.[18] Time itself does not inherently diversify and lower asset risk. Thus, even ignoring our principal claim—that liabilities should be discounted differently from assets—a long-term investment strategy does not justify a high discount rate for liabilities.

## Reality: Cumulative investment risk increases over time due to the compounding effect of returns.

One popular way to measure risk is to look at how much asset prices or returns potentially deviate from the average (measured by the standard deviation or variance between returns). While it is true that the variation in the average rate of return decreases as the length of holding period increases, the variation in the cumulative return increases, as shown in Figures 1 and 2.

Figure 1 shows simulated annualized investment rates of return of a typical investment portfolio under different time horizons (from one year to 30 years). The blue line (95th percentile) represents an optimistic scenario while the green line (5th percentile) represents a pessimistic scenario. The chart shows that the two lines move close to each other and to the median as the time horizon expands. This means that the average rates of return become less volatile in the long run compared to the short run. This appears to suggest that investment risk is reduced over time, as under the theory of "time diversification."

However, if we look at the cumulative returns (dollar amounts), we see a totally different picture. Figure 2 shows the same simulated investment returns, but on a cumulative basis. Instead of moving toward each other, the lines diverge. Figure 2 shows that at year 30, the cumulative investment amount (from the initial investment of $1,000 at the beginning of year 1) can be anywhere between $3,000 and $32,500, corresponding to the 5th and 95th percentiles, respectively. In the pessimistic scenario, the cumulative investment amount is only about a third of the median ($10,200). From this perspective, risk actually increases with time.

To understand which perspective on risk is more appropriate for pension funding, consider that investors ultimately care about the actual wealth accumulated over time. In the same way, taxpayers want to ensure that the assets of public sector pension funds are sufficient to pay promised pension benefits, in order to avoid higher taxes or reduced services that might be necessary to make up the difference. So, due to the compounding effect of investment returns, risk does not decrease over time, but rather it increases. While the average rates of return are less volatile in the long run, their compounding effects lead to significant differences over time.

Figure 2: Cumulative Returns on Investment
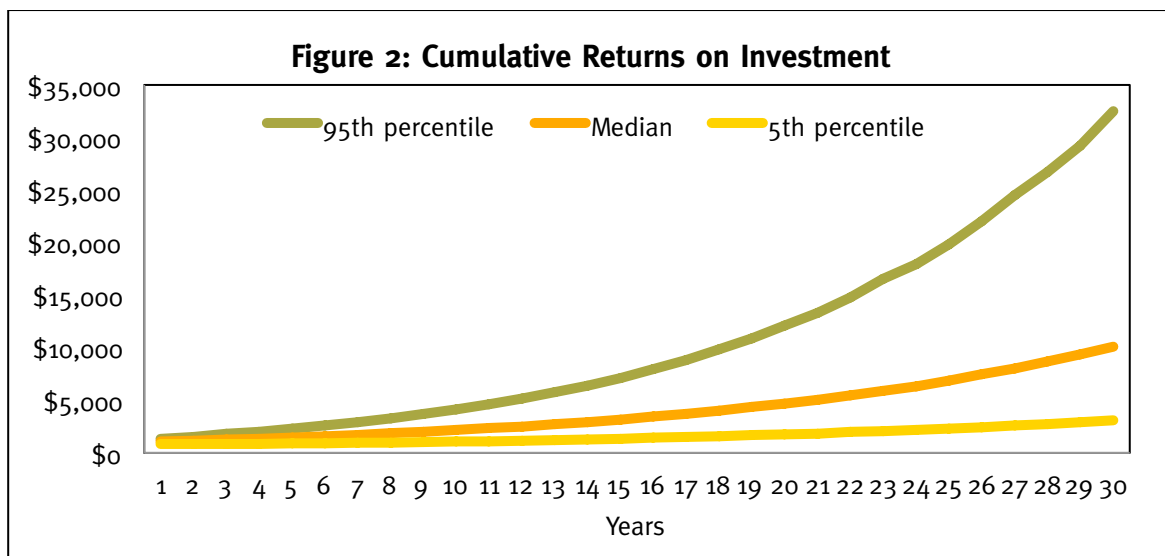
Ultimately, even if pension fund managers were able to employ long-term investment tools to reduce asset risks, this still wouldn't be justification for high discount rates on liabilities. As we've argued, the asset risk is separate from liability risk, and reducing asset risks should be considered irrelevant for setting the discount rate for liabilities.

C. Myth: Increasing Discount Rates Reduces the Cost of Pensions

Theoretically, lawmakers could explicitly prefer pension boards to use very high discount rates in order to decrease annual pension contributions—allowing public officials to spend money in other areas of interest or on non-pension-related programs. Unfortunately, officials taking this view are necessarily equating two concepts: the true "cost" of pension promises and annual pension "contributions." In reality, what earned pension benefits actually "cost" is not necessarily equal to whatever the employing government actually contributes in a given year.

As already shown, a change in the discount rate or assumed rate of return will necessarily change actuarially determined contributions. And we know that assumptions about reality do not create reality. Therefore, it is helpful to have a good definition for the "true cost" of earned pension benefits.

Reality: Changing the discount rate does not reduce the true, long-term cost of a pension.

One way to count the true cost is to construct a hedge against the investment risk in a pension fund's asset portfolio. Doing so reveals that using a high discount rate to reduce contributions today merely kicks down the road the need to pay the net cost of pension promises.

Consider the following thought experiment, which factors in contingent liabilities to the pension cost calculation. Imagine a pension plan that promises an employee a lump sum of $100,000 in 20 years. The pension board need only make a single contribution—but it has to decide on a discount rate and expected rate of return to decide how much it should contribute now.

The net present value (NPV) of the promised benefit at an 8% discount rate is $20,910. Meanwhile, if the risk-free rate of return is 4%, the NPV of $100,000 discounted at the risk-free rate would be $44,933.

Based on the pension plan's investment strategy, the government assumes it can earn an average of 8% a year for the next 20 years. And following GASB guidelines, it discounts the liability at the same rate. Thus, the contribution for the promised benefit is $20,910.

But the pension board decides to hedge against the investment risk (the odds that the plan does not earn enough to pay out the $100,000). So, the manager buys a put option to cover the downside risk, ensuring that future taxpayers won't be asked for money if a shortfall occurs. Such a put option, using a standard Black-Scholes model, would cost $25,613. The board also wants to avoid overcharging today's taxpayers if the investment return is greater than 8% over time, and sells a call option on future returns in excess of $100,000. This would have a price of $870.[19]

The total cost of promising the benefit using the 8% discount rate is thus, $20,901 + $25,613 - $870 = $44,933—which equals the value of pension liabilities if the plan had discounted at a risk-free rate of 4% in the first place.[20] Using a high discount rate does not, therefore, reduce the true economic costs of the promised pension benefits. Risks have to be taken into account.[21]

Because pension plans are effectively promising a specific benefit at a future date, it would be fair to argue the "cost" of ensuring that benefit should include buying insurance to eliminate downside risk, and selling the upside risk, thereby locking in the ability to pay the benefit. In this way, we should count the contingent liabilities for a pension plan when calculating its cost. And if we do so, then using a higher notional discount rate does not actually reduce the "cost" of funding a pension.

Adopting a higher discount rate than warranted by the pension's actual risk cannot reduce the true, net cost of a pension plan. A plan that adopts a high discount rate and invests in risky assets to make up for the low contribution levels only shifts the pension cost from current taxpayers to future ones in the form of contingent liabilities—the money that future taxpayers will on average be required to pay due to the actual investment returns falling short of the assumed returns. Similarly, a plan that employs a low discount rate puts a larger burden on today's taxpayers, leaving smaller obligations for future generations. Either way, the total economic cost of the pension plan remains the same.[22]

Part 3

Conclusion: The Way Forward

The status quo approach to selecting discount rates for state and local governments is completely backward. Using the expected rate of return on assets to discount liabilities considers the risk of assets instead of the risk of liabilities. *Public officials should instead adjust their discount rates to reflect the time value of money to their employees and the risks of the streams of cash payments to retirees.*

Platinum Standard: The ideal approach for a state or local government discounting liabilities would be to use an average yield on its own issued bonds. This would provide a proxy that includes a risk premium associated with the employer government's capacity to pay its debts.

Gold Standard: For public employee pensions that are not protected by constitutional guarantees, an alternate approach would be to identify assets whose distributions closely match the liabilities of a pension fund and use the expected rate of return on those assets as the discount rate. The closest characteristics of such assets would likely be found in a portfolio of corporate bonds. Given the cost of constructing such a portfolio, an appropriate proxy would be a high-grade corporate bond index.

However, for the majority of pensions that are protected by a constitutional guarantee, a better proxy would be the municipal bond index, which has a much lower risk premium—and one that is far closer to the risk of a government defaulting on its pension payments.

Silver Standard: Finally, pension funds could use a combination of a risk-free rate, such as that implied by the yield on Treasury bonds, plus a fixed basis point risk premium (e.g. 100 or 200 basis, with the specific rate being determined on a case-by-case analysis). For municipalities where certain stakeholders are fiercely opposed to changing the discount rate, this might be a good first step toward better practices because it would disconnect analysis of the discount rate from the expected return.

Phasing-In Changes: Whatever approach an employer government takes will likely mean a substantial near-term increase in employer contributions. As pension financial statements

more accurately reflect the accrued liabilities of a plan as higher than stated under a lower discount rate, amortization payments on unfunded liabilities (pension debt) will rise unless the amortization schedule is reset. To avoid a budget shock it would be appropriate to phase in changes to a discount rate over a three- to five-year period. Thus, a municipality with an 8% discount rate that is moving to a 5% discount rate as measured by the three-year average yield on its municipal bonds could lower the discount rate one percentage point a year for three years, instead of making the move all in one year.

Public officials should look carefully at their discount rate policies, and adopt the best practice that is politically and fiscally possible. Ultimately, the main objective should be for pension plans to shift toward having discount rates reflect the risks of liabilities—not the potential performance of assets. This is one of the most critical remedies to protect the future of public sector pension plan solvency.

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Randazzo has also testified before the House Financial Services Committee on topics related to housing policy and government-sponsored enterprises, as well as before state and local legislative bodies on privatization and pension policy matters.

Endnotes

[1] Kristen Kelly, Anthony Randazzo and Truong Bui, "The Public Employee Pension Crisis Explained," Los Angeles: Reason Foundation, 2014, available at http://bit.ly/1KD82rt.

[2] Lower estimates of unfunded liabilities assume the discount rates adopted by the states themselves. Using lower, risk-free rates of return (as proposed by Robert Novy-Marx and Joshua Rauh) for the discount rate significantly increases the present value of liabilities though, in turn driving up the amount of unfunded liabilities. See: Robert Novy-Marx and Joshua Rauh, "Public Pension Promises: How Big Are They and What Are They Worth?" *Journal of Finance*, Vol. 66, 2011, pp. 1211–49.

[3] Technically, in order to truly be fully funded, a system would need assets to match liabilities using a risk-free discount rate and risk-free assumed return. See Erick M. Elder and Gary A. Wagner, "Can Public Pensions Fulfill Their Promises?" 2015, Mercatus Working Paper, available at http://bit.ly/1Ff54Sg.

[4] For plans that share normal cost with employees, it is also important for determining employee contribution rates.

[5] In financial theory, the discount rate is also known as the "required rate of return."

[6] Pension finance scholar Robert Novy-Marx writes that the "bedrock principle" for valuing payment streams such as pensions should be the use of "discount rates that reflect the cash flows' risks." And this reflects the consensus of financial economists on how discount rates should be set. See: Robert Novy-Marx, "Economic and financial approaches to valuing pension liabilities," *Journal of Pension Economics and Finance,* 2015, Vol. 14, No. 2 (April); Franco Modigliani and Merton H. Miller "The Cost of Capital Corporation Finance and the Theory of Investment," *The American Economic Review*, Vol. 43, No. 3, 1958.

[7] Though arguably the time value of bond purchasers is different from the time value of the employees.

[8] Jeffrey R. Brown and David W. Wilcox, "Discounting State and Local Pension Liabilities." *The American Economic Review*, Vol. 99, No. 2, 2009, pp. 538–542.

[9] *Moody's Investors Service*, "Moody's Proposes Adjustments to U.S. Public Sector Pension Data," 2012, available at http://bit.ly/1qghRRA.

[10] John Lintner, "The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets," *Review of Economic Statistics*, Vol. 47, 1965, pp. 13–37; Modigliani and Miller, "The Cost of Capital, Corporation Finance, and the Theory of Investment," pp. 261–297; Novy-Marx and Rauh, "Public Pension Promises," pp. 1211–1249; W.F. Sharpe, "Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk," *Journal of Finance*, Vol. 19, 1964, pp. 425–442; Jack L. Treynor "Toward a Theory of the Market Value of Risky Assets," in Robert Korajczy, *Asset Pricing and Portfolio Performance*, (London: Risk Books, 1999); Robert Novy-Marx and Joshua Rauh, "The Liabilities and Risks of State-Sponsored Pension Plans," *Journal of Economic Perspectives*,

2009, Vol. 23, No. 4, pp. 191–210; Robert Novy-Marx and Joshua Rauh, "Policy options for state pension systems and their impact on plan liabilities," *Journal of Pension Economics and Finance*, 2011, Vol. 10, No. 2, pp. 173–194.

[11]   See the Federal Reserve Bank of St. Louis Economic Research Database, "Bond Buyer Go 20-Bond," "10-Year Treasury," "30-Year Treasury," available at http://bit.ly/11neTAV.

[12]   The extent of those guarantees has been tested in many municipalities over the past few years, with judges issuing varied and conflicting rulings, some finding that pension benefits cannot be reduced due to constitutional guarantees, and others finding that pension benefits can be reduced in bankruptcy.

[13]   Regulations governing public sector pensions today are mandated by: Pension Protection Act of 2006, Moving Ahead for Progress in the 21st Century Act (2012), and the Highway and Transportation Funding Act of 2014

[14]   Internal Revenue Service, "Funding Yield Curve Segment Rates," available at http://1.usa.gov/1aD55F7.

[15]   When states and municipalities use debt to finance infrastructure projects, kicking some of the cost of funding the project to future taxpayers, the financing approach is justified by noting that future taxpayers will be benefiting from the infrastructure project as well as current taxpayers. By contrast, the costs of financing pension benefits should be carried by the taxpayers who are the ones receiving the services from the public sector employees. Kicking the costs of today's benefits into the future means future taxpayers are footing the bill for services rendered by employees in the past.

[16]   Alicia H. Munnell, Jean-Pierre Aubry and Mark Cafarelli, "The Funding of State and Local Pensions: 2013–2017," *Center for Retirement Research at Boston College*, 2014, available at http://bit.ly/1EFBXqJ.

[17]   In 2012, GASB adopted new guidance for how the discount rate should be set, known as Statement No. 67. Prior to this, GASB's rules for pension finance reporting allowed for the discount rate to be set using the assumed rate of return for the plan's assets. With the adoption of Statement No. 67—effective starting with plans with fiscal years starting after June 15, 2013—the states and municipalities are to use what is called a "single equivalent discount rate." The process of determining the single equivalent discount rate starts by using the assumed rate of return to discount liabilities. However, for the years where liabilities exceed assets GASB requires the additional liabilities be discounted using a 20-year, tax-free, high-grade municipal bond or index. The two discount rates will yield a single NPV for pension benefits, and that single NPV will be used to calculate the combined, single equivalent discount rate (which when applied to the liabilities as a whole should yield the same value as the dual-method). Total Pension Liability, a concept replacing Accrued Actuarial Liability, will be determined using the single equivalent discount rate and age entry normal actuarial cost method. For more details see GASB's definition available at http://bit.ly/1Au6Q4y.

[18]   Paul A. Samuelson, "Risk and Uncertainty: A Fallacy of Large Numbers," *Scientia*, Vol. 98, 1963, pp. 108–113; Zvi Bodie, "On The Risk of Stocks in the Long Run," *Financial Analysts Journal*, 1995, available at http://bit.ly/1LSj5tZ.

[19]   Option values are calculated based on a 4% risk-free rate of return and a 14% annual volatility.

[20]   This thought experiment necessarily makes certain assumptions: the portfolio's asset allocation is constant over time, volatility (i.e. risk) is constant over time, options are available in the market, no transaction costs, and no arbitrage opportunity. However, these assumptions do not undermine the veracity of the thought experiment: option pricing is about risk pricing, and

when we take risks into account—the economic costs of the two approaches are the same. The two numbers wind up being the same because they aim at the same result: guaranteed pension benefits.

[21] The put and call options offset the risk that returns will deviate in either direction, and their price can be theoretically considered part of the cost of pension financing. However, no government actually does this to manage the risks—all risks are simply placed on the taxpayers' shoulders.

[22] While the economic costs are the same, that does not mean the two approaches are inherently equal. Public choice considerations require politicians to weigh whether it is appropriate to have future taxpayers bearing the costs of remuneration paid to public employees who are working on behalf of present-day taxpayers. We would argue normatively that they should not, and taxpayers today should carry the costs of all services rendered to them, but we acknowledge this is a point separate from the simple observation we make about economic costs.

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