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Trends in State and Local Pension Funds

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Abstract

Unfunded public pension obligations represent the largest liability for state and local governments in the United States. As of fiscal year 2021, the total reported unfunded liabilities of these plans are $1.076 trillion. In contrast, the market value of the unfunded liability is approximately $6.501 trillion. As a result, the reported funding ratio of 82.5% falls to 43.8% under a market-based valuation. The market values reflect the fact that accrued pension promises are a form of government debt with strong statutory and contractual rights. The assumed discount rates are based on expected returns and remain elevated relative to risk-free rates, despite a decline since 2014. As a result, not only is the unfunded pension liability understated, but the yearly pension cost for newly accruing liabilities is also understated. In order to achieve high returns, pension funds have accumulated large exposure to risky assets, in particular alternative investments, which results in highly uncertain investment returns.

1. INTRODUCTION

The unfunded obligations of the pension systems sponsored by state and local governments in the United States, when measured at their market values, represent the largest liabilities of subnational US government entities. These unfunded liabilities even exceed fixed-income obligations in the municipal bond market. In this article, we review the off-balance-sheet pension promises of state and local governments, studying in detail 647 pension systems around the United States. Our sample includes all of the main pension systems of the states, the largest US cities, and the largest US counties. We report on both their own measurements of their costs and obligations and how these differ from market valuations that are consistent with the principles of financial economics. We focus on the separation of legacy versus ongoing costs and develop measures of the debt-neutral contributions that would be required to prevent unfunded obligations from growing. As of fiscal year 2021, the latest year for which complete accounts are available for all cities and states, the total reported unfunded liabilities of these plans under governmental accounting standards are $1.076 trillion. In contrast, we calculate that the market value of the unfunded liability is approximately $6.501 trillion. The market values reflect the fact that accrued pension promises are a form of government debt with strong rights and should thus be measured using default-free discount rates (Brown & Wilcox 2009; Brown & Pennacchi 2016). As a result of the revaluation, the reported average funding ratio of 82.5% overstates the extent to which pension liabilities are funded. The liability-weighted aggregate funding ratio falls to 43.8% under a market-based valuation. The 2021 unfunded liability is substantially larger than the market-based unfunded liability of $4.349 trillion in 2014, due both to declines in market discount rates and to the steady accrual of promised benefits.[1]

The discrepancy between the reported and market-based valuation of the pension liabilities originates from the gap between high actuarial assumed discount rates and the appropriate default-free market rate. The discount rates assumed under governmental accounting remain high despite a visible downward trend over the last several years. As of fiscal year 2021, the liability-weighted average discount rate is 6.76%, compared to 7.31% in fiscal year 2014. Despite this decrease, discount rates remain much higher than what a valuation requires to match the cash flow profile of future pension promises. Pension promises are often protected by statutory law and as such require discounting by a default-free rate, in some cases reduced further for inflation protection. We follow Novy-Marx & Rauh (2011) and use the US Treasury yield curve to discount pension liabilities, based on the fact that the curve is the primary benchmark for discounting default-free future payments. While the Treasury curve is certainly lowered by the liquidity of nominal Treasury bonds (Krishnamurthy & Vissing-Jorgensen 2012) that pension promises do not have, it is likely too high for pension discounting due to the partially inflation-linked payments in the public pension system.[2] Our rediscounting not only affects the pension liabilities but also affects recurring pension cost, which has to be adjusted upward to reflect the true economic cost.

The cost for newly accruing pension benefits—also known as the service cost—is the present value of expected future pension benefits that an employee earns in the fiscal year. An employer that implemented a hard freeze of a defined benefit plan would reduce the service cost to zero but

[1] Complete data are not yet available for 2022. We predict that while the increase in bond yields during 2022 will have reduced the market value of liabilities through 2022, the decline in assets will have offset this improvement to some extent, and unfunded liabilities are likely to fall in the range of $5–$6 trillion for fiscal year 2022.

[2] Novy-Marx & Rauh (2011) find that approximately 40% of state pension plans are fully or partially linked to consumer price inflation, with an additional 20% receiving ad hoc adjustments that are generally connected to inflation.

would still bear the unfunded liabilities from existing promises (Rauh, Stefanescu & Zeldes 2020). The service cost depends on the assumed discount rate because it reflects the present value of new benefit promises, although these have a longer duration than that of legacy promises. While the average reported service cost is 13.3% of payroll, the service cost under market valuation is 26.7% of payroll in 2021. This means that, on average, the public employers calculate that they must contribute approximately 13¢ out of every $1 in payroll in order to fund newly accruing pension benefits, but in fact they would have to contribute approximately 27¢ out of every $1 in payroll to fund those newly accruing pension benefits on a market basis.[3] In 2021, the economically recurring pension cost therefore exceeds the reported pension cost by approximately 13¢, which creates the perception that public employers fully fund newly accruing benefits while they actually do not. Another component of the recurring pension cost, and one that also must be met by contributions if unfunded liabilities are not to grow in expectation, is the interest cost on unfunded liabilities. Under lower discount rates, the interest cost is lower. However, the increase in the service cost dwarfs the decrease in interest cost when moving from the higher, actuarial-based discount rates to the lower, market-based discount rates.

To put the actual contributions and the required contribution under market valuations into perspective, we express the pension cost as a fraction of state and local governments' own source revenue and tax revenue. State and local government entities in our sample receive general revenue from own sources of a combined $2,023 billion while making actual contributions of $170.5 billion. Thus, contributions were 8.4% of own source revenue in 2021. Under governmental accounting, the contributions would have been approximately enough to prevent unfunded liability from rising if the assumed return targets had been realized. Yet, in fact, these contributions fell short by $117.7 billion due to the difference between assumed and market-based discount rates. The total economically required contributions thus amount to $288.2 billion ($170.5 billion + $117.7 billion), which account for approximately 14.2% of own source revenue in 2021. Alternatively, the actual reported contributions constitute approximately 12.5% of tax revenues in 2021. Considering the additional contributions to prevent the net pension liability from rising amounts to a total contribution of 21.1% of total tax revenue. It is important to emphasize that this calculation does not include any contributions to pay down the unfunded pension liability. **Table 1** provides summary statistics and the breakdown among state and local pension systems.

In fiscal year 2021, public pension funds in the United States realized a net position–weighted mean return of 23.6%. In our short time series, this realized mean return is unusual. The large realized investment returns lifted funding ratios across plans. It is noteworthy, however, that the large average return showed substantial variation across plans as corroborated by the dispersion in the realized return distribution, with a 5th percentile return of 4.9% and a 95th percentile return of 35.7% in 2021. Despite the large average investment return, approximately 9.0% of pension funds had realized asset returns below the assumed discount rate in 2021. The time series shows that the large share of risky assets exposes pension funds to substantial volatility over time. For instance, 98.7% and 88.6% of pension funds realized investment returns below the assumed discount rate in fiscal years 2015 and 2016, respectively.

While COVID-19 had no major direct effect on pension liabilities, the macroeconomic stabilization policies that were introduced during the pandemic had at least two indirect effects. These special effects were most pronounced in fiscal year 2021 and have since waned, suggesting that these effects might be considered transitory. First, the macroeconomic stabilization policy in the wake of COVID-19 led to a decline in short- and long-term interest rates on US Treasuries. Lower

[3]An alternative interpretation of the service cost under market valuation is that it represents the economic cost of offering pension benefits under the current contractual terms if pension plans were fully funded.

Table 1 Summary statistics of state and local pension systems[a]

Number of plans total	State pensions 270	Local pensions 377	State and local pensions 647
I. Assets and liabilities			
GASB 67 standards			
Total pension liability	$5,129	$1,024	$6,153
Assets	$4,239	$837	$5,077
Net pension liability	$890	$187	$1,076
Funding ratio	82.7%	81.8%	82.5%
Market value standards			
Accumulated benefits obligation	$9,653	$1,925	$11,578
Assets	$4,239	$837	$5,077
Unfunded market value liability	$5,413	$1,088	$6,501
Funding ratio	43.9%	43.5%	43.8%
II. Discount rates			
GASB 67 standards			
Average discount rate			
Liability-weighted	6.88%	6.87%	6.87%
Liability-unweighted	6.70%	6.81%	6.76%
Market value standards			
Average discount rate			
Liability-weighted	1.63%	1.62%	1.63%
Liability-unweighted	1.61%	1.52%	1.56%
Average duration			
Liability-weighted	11.31	11.24	11.30
Liability-unweighted	11.18	10.48	10.77
III. Flows			
Benefits and refunds	$275.1	$57.3	$332.6
Employer contributions	$112.9	$34.6	$147.5
Member contributions	$47.6	$8.7	$56.4
State contributions	$22.7	$0.3	$23.0
Total contribution	$183.2	$43.6	$226.9
IV. Accrual basis			
Additional necessary contributions			
To prevent rise in net pension liability under expected return	$3.0	−$2.1	$0.8
To prevent rise in net pension liability under Treasury rate	$101.6	$16.1	$117.7

[a]Amounts are in billions of dollars, unless otherwise noted.
Abbreviation: GASB 67, Governmental Accounting Standards Board statement number 67.

Treasury yields mean that future pension promises are discounted less and lead to higher pension liabilities. As of fiscal year 2022, interest rates reverted to pre-COVID-19 or above pre-COVID-19 levels, thus reversing this temporary effect. Second, the prices of financial assets, including real estate, equity investments, corporate bonds, and treasuries, saw large increases due to a variety of factors. As a result, pension plans' net fiduciary assets increased, which raised the funding ratio across plans. Asset valuations have since reverted to levels similar to those before COVID-19.

Complementary to this study, we make our pension dashboard publicly available at **https://publicpension.stanford.edu/**. The pension dashboard provides an interactive tool to explore the cross-sectional variation across pension sponsors and the time series development for state, county, and city pension plans. The dashboard includes additional important variables that are omitted from this study due to space constraints. It also serves as a platform for timely updates to reflect newly published information.

2. DATA SOURCES

2.1. Pension Disclosures from GASB 67 Statements

We collect the disclosures under Governmental Accounting Standards Board statement number 67 (GASB 67) of all state pension systems, plus a sample of local and other municipal plans. The local plans consist of all municipal plans in the top 170 cities by population and the top 100 counties by population, according to the US Census. Additionally, we collect associated school district and transportation authority pension systems where applicable. The result are 647 state and local funds: 270 state funds and 377 local funds. The full list of funds that are part of our sample is listed in the **Supplemental Appendix**. As explained in the detailed analysis below, our sample covers approximately 90% of the public pension fund universe as measured by assets. The GASB 67 disclosures contain reconciliations of total pension liabilities from the beginning to the end of the fiscal year as well as reconciliations of total pension assets from the beginning to the end of the fiscal year. In addition, GASB disclosures provide interest rate sensitivities of the unfunded pension obligation of each plan, which makes a revaluation under different interest rate scenarios possible.

Supplemental Material >

2.2. State and Local Government Revenue Data

Data on state and local government revenues come from the individual unit files of the US Census Annual Survey of State and Local Government Finances. These files contain detailed financial information on state and local government finances. We use two measures of revenue. The first measure is "general revenue from own sources," which is defined by the Census as general revenue less intergovernmental revenue. From here on, we refer to this measure as "own source revenue." Importantly, this measure excludes insurance trust revenues (which are mostly the returns of pension funds themselves), intergovernmental revenues (which are primarily transfers from the federal government but also transfers from state governments to local governments and vice versa), and revenue from public utilities. The second measure is tax revenue alone. Expressing the pension cost as a share of tax revenue allows us to consider how state and local governments could pay for unfunded pensions through traditional taxation sources like income taxes, sales taxes, and property taxes. Compared to own source revenue, scaling by tax revenue assumes that states will not raise fees for services such as university tuition and waste management services to pay for unfunded pension liabilities—or at least not raise sufficient revenue from such fee increases considering the possibility of private economy competition in the provision of such services.

The latest individual unit files available are for fiscal year 2020. We estimate 2021 revenues by using an out-of-sample extrapolation by drawing on national aggregates of the national income and product accounts (NIPA) from the Bureau of Economic Analysis (BEA) and the State and Local Government Finance Historical Datasets and Tables of the US Census Bureau (2021). For extrapolation, we use the BEA NIPA for state and local governments to compute the growth rate between 2020 and 2021 (Bur. Econ. Anal. 2021, table 3.3). We use this growth rate to obtain an estimate for the revenues of state and local governments. The overall revenue growth for state and local governments was 9.49% between 2020 and 2021. Using the aggregate growth rates ignores likely differences in revenue growth rates at the state and local level. In order to estimate a growth

rate for own source revenue, we use historical data from the individual unit files. For each entity, a regression was run between the individual growth rate in own source revenues and the aggregate growth rate at the state and local level over the time horizon between 1972 and 2020. These results were then used to estimate own source revenue growth rates from 2020 to 2021. Each estimated growth rate was then applied to the individual government units. Again, this method does not account for likely differences in revenue growth rates at the state and local level. The median own source revenue growth rate, using this methodology, for all entities in our sample is 8.55% between 2020 and 2021. We apply an analogous methodology for tax revenues.

3. REVIEW OF REASONS FOR RISK-FREE DISCOUNTING

In this section, we briefly review the intuition behind the use of default-free discount rates to measure unfunded accumulated pension liabilities. Brown & Wilcox (2009), Novy-Marx & Rauh (2009, 2011), Novy-Marx (2013), and Brown & Pennacchi (2016) describe these points in detail. The purpose of discount rates in pension calculations is to translate a stream of future pension benefit promises into a present value figure that represents the debt that the city, county, or state owes to public employees and retirees. The discount rate also has a large impact on the costs that a government ascribes to an employee working an additional year. The fact that an employee works for an additional year raises the pension that an employee is due to receive when they retire. The additional cost of providing that pension is a compensation cost that governments must take into account. The higher the discount rate, the lower the deferred compensation cost will appear to be.

Traditional GASB rules encourage state and local governments to consider pension promises fully funded, assuming that the expected return on pension fund assets is met. The portfolio of risky assets that pension systems invest in, however, exposes the pension system to a distribution of outcomes. The outcome depends on the performance of securities such as stocks, private equity stakes, real estate investments, and hedge fund returns—increasingly so in recent years, as public pension portfolios have shifted toward these assets. If a pension fund invests according to traditional GASB rules, it will be fully funded only if the expected return in this wide distribution of outcomes is achieved. However, pensions must be paid regardless of the performance of the assets. For example, a return assumption of 7.5% is roughly equivalent to assuming that every $1 contributed to a pension system will be worth $2 in 10 years' time, $4 in 20 years' time, and $8 in 30 years' time. Targeted returns of 7.5% can only be achieved if systems take on substantial investment risk, especially in an investment environment where the average long-term yield on safe securities was only 2.1% over the last 10 years.

That a 7.5% compound annualized return is wildly optimistic and unlikely to be achieved is clear to most observers of financial markets today. This has been pointed out by investing luminaries such as Michael Bloomberg and Warren Buffett. While some maintain that stocks in the long run are less risky and are likely to march ever upward (Siegel 2021), the experiences of other countries suggest that one cannot assume that time will bail out pension systems from the possibility of poor stock returns. For example, the Japanese stock market as represented by the Nikkei 225 rose to a high of 38,916 points at the end of 1989. As of December 2022, the total return index stands at approximately 44,160 points, representing a mere annual total return of 0.38%.[4] In addition, finance academics have written extensively about the problem of parameter uncertainty (Pástor & Stambaugh 2012) or the fact that we simply do not have a long enough history of stock returns to know what the true distribution of stock returns really is.

[4]The assumption behind the total return calculation is that dividends are reinvested into the index.

Beyond the point that 7.5% is an optimistic forecast, however, a more fundamental point exists about the nature of pension promises that implies the need to measure pension liabilities using rates on default-free government bonds. A promise to pay retirees a pension is economically equivalent to a promise to make debt payments to investors. Regardless of how pension fund assets perform, the pension promise remains unaffected, unless it is possible for the pension assets to perform so poorly that the sponsor might default on its obligations. Financial theory and logic are clear that the value of a stream of payments is determined by the risk properties of those payments themselves, having nothing to do with the assets chosen to back them.

Brown & Pennacchi (2016) deepen this point in the context of a structural credit risk model (Merton 1974). Two distinct liability concepts emerge. One is the market value of the pension promise, which could in theory reflect default risk and thus use a discount rate higher than the default-free rate, resulting in a smaller liability than would be obtained under default-free discounting. The other is the liability valuation for the purpose of measuring funding adequacy, which Brown & Pennacchi (2016) argue should always be a default-free rate. In this article, we use the Treasury yield curve to discount state and local pension liabilities. Using the logic of Brown & Pennacchi (2016), this choice can be motivated in two ways. First, our measure can be motivated as the appropriate measure for funding adequacy and for making decisions about the amount of contributions that state and local government sponsors should be making to pension funds. Second, our measure can be thought of as reflecting the market value of the pension promises under the assumption that benefits accrued through our measurement year of 2021 will not be cut even if state and local governments enter financial distress. Brown & Wilcox (2009) provide legal backing for this assumption. The legal rights of pensioners and the lack of any insolvency measure for states practically give pensions senior status in most states.

To see that a default-free rate is the correct rate for measuring the value of a pension promise, one need only put oneself in the shoes of a beneficiary of such a plan who is offered a lump sum buyout by their employer. Suppose an employee is owed a pension that will begin at $100,000 per year in 10 years' time, and the employer wants to buy the employee out of 1 year of payments. That is, the employer wants to offer the employee money today to forgo the first payment that they would receive in 10 years. The employer announces that since $48,519 can be invested at 7.5% over 10 years to pay the first $100,000 payment, it is offering a lump sum payment of $48,519 to the employee in exchange for forgoing the $100,000 payment in 10 years.

The only circumstance under which this would seem a good deal to the employee is if the employee believed they were unlikely to live for 10 years. Otherwise, the employee is going to point out that the employer has guaranteed the pension payment of $100,000 in 10 years' time, whereas investing in risky securities provides only a hope that such an amount can be obtained. Looking at the roughly 3% rate of return that can be earned on riskless assets over a 10-year horizon, an employee who was sure they would live for 10 more years would demand a payment of approximately $74,409 [$= \$100,000/(1.03)^{10}$] to forgo the first $100,000 payment. This logic does not imply that governments should invest pension money in risk-free assets. It does, however, imply that when measuring the value of the liability, governments should reflect the fact that the liability is a debt that is guaranteed. In the above example, it would be a matter of public choice how much the government should fund and how much investment risk it should take, just as the government chooses the amount and composition of its explicit debt (Bohn 2011, Lucas 2017). The question of to what extent the pension liability should be funded has been debated. Lenney et al. (2021) argue pensions are fiscally sustainable in a low-interest environment even with a delay in prefunding, while Lucas (2021), Rauh (2021), and Costrell & McGee (2022) provide reasons why fiscal sustainability would likely require significantly higher contributions.

Instead of offering a guaranteed benefit payment, in which the taxpayer covers all the downside in case expected returns are not met, the employer could instead provide a return contingent benefit payment. If benefits depend on market returns, the appropriate discount rate would increase above the risk-free rate by the amount of the risk premium. Novy-Marx & Rauh (2014a) consider one such risk-sharing arrangement in which beneficiaries would only receive positive benefit adjustments if asset returns surpassed 5%, a risk-sharing structure that would reduce unfunded accrued liabilities by more than half. More general forms of intergenerational risk-sharing are studied by Cui, De Jong & Ponds (2011), Gollier (2008), and Lucas & Smith (2020).

4. DETAILED ANALYSIS

The estimates of the pension liabilities based on our sample and methodology are broadly consistent with those of the Board of Governors of the Federal Reserve, but there are several differences that lead our methodology to exhibit a tighter relationship with current market conditions. The Board of Governors of the Federal Reserve independently estimates the pension liabilities of state and local governments following the methodology of the BEA as described by Lenze (2013) and Reinsdorf, Lenze & Rassier (2014). We first contrast the results of the Federal Reserve with the time series of our sample in the period from 2014 to 2021. **Figure 1** shows the estimates based on our sample and methodology and those of the Federal Reserve. As of 2021, our sample of local and state pension plans covers approximately 90.2% of total assets reported by the Federal Reserve.[5] While assets are a relatively stable fraction of the assets of the Federal Reserve's estimates, the revalued total pension liability in our sample shows substantially more variation.

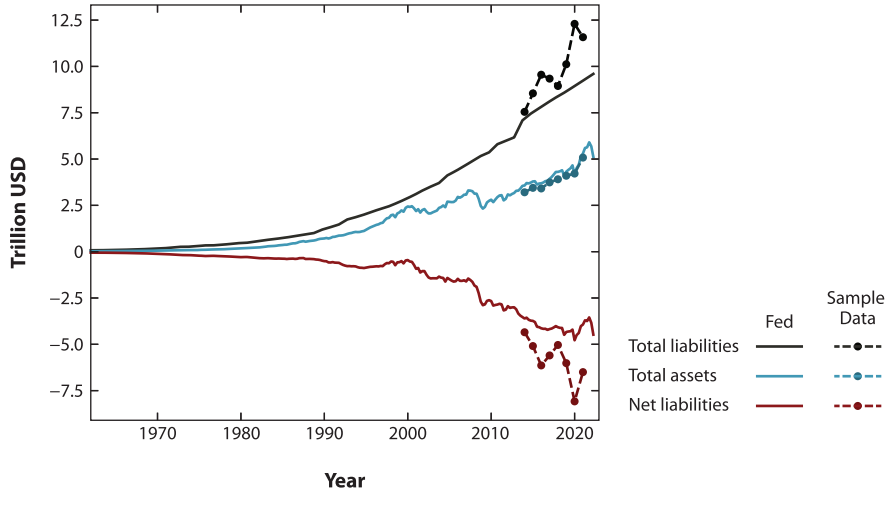

Figure 1

Pension assets and liabilities. The pension entitlements of state and local government employees defined as benefit retirement funds (Fed total liabilities), total assets (Fed total assets), and unfunded liabilities (Fed net liabilities) are estimates of the Board of Governors of the Federal Reserve and retrieved from FRED, Federal Reserve Bank of St. Louis, with the series codes BOGZ1FL224190043Q, BOGZ1FL222000075Q, and BOGZ1FL223073045Q, respectively. The sample total liabilities, the sample total assets, and the sample net liabilities are calculations of the authors based on the collected data of 647 city, county, and state pension funds. The total liabilities and net liabilities are restated to reflect the market valuation. The list of included pension funds is available in the **Supplemental Appendix**.

Supplemental Material >

[5] Between 2014 and 2021, the coverage of our sample varies between 87% and 94%.

The Federal Reserve, analogous to the methodology of the BEA, uses a discount rate that broadly reflects market conditions in the corporate bond market. It mirrors the methodology used for the valuation of corporate pensions, although with only rare adjustments to the discount rate. For example, the Federal Reserve uses a discount rate of 4.0% for the period 2019–2021.[6] This ignores the fact that public pensions often have statutory protections that make the pension promises harder to shed in periods of financial distress. In order to be consistent with principles of financial economics, this security has to be reflected in the discount rate—thus, warranting an even lower discount rate.

Instead, our analysis uses the duration-matched US Treasury yield for each pension plan. As a reference point, the liability-weighted average sensitivity of duration among the 647 pension funds is 11.30 years in fiscal year 2021. That is, for a decrease of the discount rate of 1%, the total pension liability increases by 11.30% on average.[7] Using the interest rate sensitivities in the GASB disclosures, we revalue the pension liabilities and the pension cost under the US zero coupon Treasury yield that matches the duration of the plan. As a result, the total pension liability in our sample is approximately $4.349 trillion in 2014, approximately 102.5% of the Federal Reserve's estimate, and approximately $6.501 trillion (123.5%) in 2021. As a corollary, the value of the unfunded liability shows larger variation as assets remain unaffected by the valuation methodology.

Approximately 83% of this liability rests with state governments, which makes pension benefits the largest liability of state governments. As a result of the revaluation, the reported average funding ratio of 82.5% overstates the extent to which pension liabilities are funded. The funding ratio falls to 43.9% under a market-based valuation.[8] While there is large dispersion of funding ratios across pension plans, there is little systematic difference in funding ratios between state and local governments, for which the funding ratios hover at approximately 44%. The time series of the liability-weighted funding ratio, displayed in **Figure 2**, shows limited variation over time. However, we find large cross-sectional variation in the funding status across states, as shown in **Supplemental Figure 1**. In terms of market values, Hawaii, New Jersey, Connecticut, Kentucky, and Illinois are the states with the lowest funding ratios in 2021, with a funding status as low as 26.9%. At the other end of the spectrum, the states of Wisconsin, Delaware, Washington, South Dakota, and New York have funding ratios that range between 55.0% and 62.0%. This means that even the most well-funded states exhibit large legacy pension obligations.

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The large revaluation of the pension liability originates from the discrepancy between assumed discount rates and what the principles of financial economics require. **Figure 3** shows the total liability-weighted average discount rate for local, state, and state and local pension funds between 2014 and 2021 as reported under GASB 67. The development of discount rates shows a clear downward trajectory. While the liability-weighted average discount rate was 7.31% in fiscal year 2014, it is 6.76% in 2021. The downward trend is more pronounced at the state level, potentially reflecting that vested interest has less bite at the state level than at the local level.[9] The downward

[6]The monthly average Moody's Seasoned Aaa Corporate Bond Yield was 2.87%, the ICE BofA BB US High Yield Index Effective Yield was 4.11%, and the 10-year constant Treasury yield was 1.49% over the 2019–2021 period.

[7]This back-of-the-envelope calculation ignores the effect of convexity and is presented merely for exposition. In the revaluation of the pension liabilities and pension cost, we account for the convexity effect.

[8]The average funding ratio is liability-weighted.

[9]Decreases in the discount rates face often stiff political opposition, as they immediately affect the sponsor's pension cost. One recent example is the resistance of the League of California Cities to reconsideration of the discount rate by CalPERS, as announced by the League of California Cities (2021).

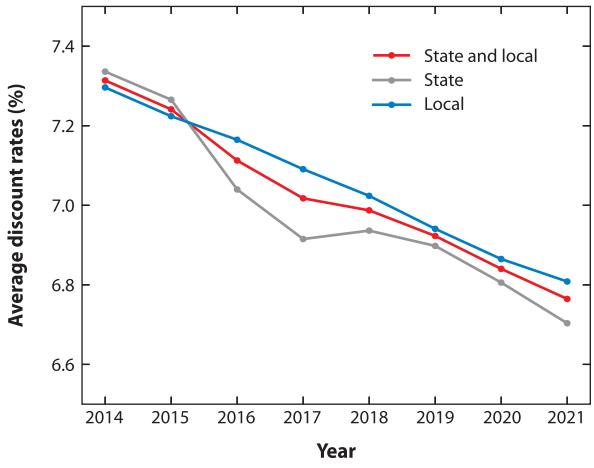

Figure 2

Discount rates. The figure displays the liability-weighted discount rate for all 647 local and state plans between 2014 and 2021. The time series is constructed by weighting the plan-specific discount rate by the total pension liability.

trajectory reflects the decisions of many pension boards to lower the discount rate to better reflect nominal asset returns. For instance, CalPERS, California's retirement system for public employees and the largest public pension system in the United States, reduced the discount rate three times between 2014 and 2021, beginning at 7.75% and ending at 6.8%.

The governmental accounting standards that were introduced in 2014 restrict the assumed discount rates for those plans that are projected to exhaust their assets. Under GASB 67, plan sponsors that project an exhaustion of their pension assets at some future date must use a high-quality municipal bond rate for the pension cash flows that are not covered by the assets on hand

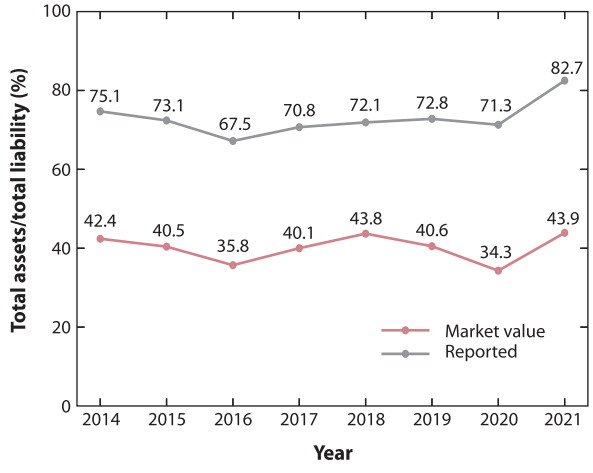

Figure 3

Funding ratio. The figure displays the funding ratio for all local and state plans from 2014 to 2021. The time series is constructed by weighting the funding ratio of each plan by the total pension liability. Market values are shown in red, and reported values are in gray.

for the purpose of the sponsor's liability measurement.[10] While this restriction is economically sensible, more and more plans assert successfully that future contributions will be sufficient and thus avoid this restriction. The fraction of pension funds that fall under this special reporting requirement has varied over time, reaching the highest share of 10.5% in 2017. Beginning with 2018, some pension funds reverted to the high discount, asserting that future contributions will be sufficient, so that their pension funds never run out of money. This reversal occurred despite stable or falling funding ratios under market valuations, which broke the steady downward trend in discount rates at the state level, as visible in the time series of average discount rates in **Figure 3**.

Clearly, the assumed GASB 67 discount rate of 6.76% in fiscal year 2021 obscures the true extent of public sector liabilities. A higher discount rate means that future pension liabilities are lower than under more realistic return assumptions. Thus, pension funds with large unfunded liabilities have an incentive to take on riskier investments to increase expected returns and thus increase their discount rate.[11] The evidence from Andonov, Bauer & Cremers (2017) supports this hypothesis.

This risk-taking is also reflected in the investment position: To increase risk, funds increase their exposure to the stock market and other risky asset classes such as private equity, hedge funds, and real estate. Begenau, Siriwardane & Liang (2022) document that public pension funds have shifted their asset allocation more and more toward alternative investments since 2006—partly a result of shifting beliefs about alternative investments' returns and risks. Andonov, Kräussl & Rauh (2021) show further that public pension funds have increased their exposure to infrastructure investments and that they earned subpar investment returns vis-à-vis private investors. This extension of the investment universe stands in contrast to what economic theory demands. Lucas & Zeldes (2009) establish that an allocation into risky assets is only justified if liabilities were to comove with the market. Pennacchi & Rastad (2011) find empirical support that the match between assets and liabilities is generally weak for public pensions in the United States. In search of other explanations for the observed asset allocation, they find that funds shift their asset allocation toward riskier assets after a decline in relative performance. Thus, the choice of an asset allocation that increases expected returns above the risk-free rate is a gamble to reduce the cost of retirement benefits and improve the solvency of the plan at the sacrifice of intergenerational equity, investment risk, and the associated variation in contributions (Biggs 2014).

We find evidence for a shift in the asset composition toward riskier assets even in the aggregate time series across all public pension funds of the United States. Over the time horizon from 1993 to 2017, public pension funds have increased their relative exposure toward equities and alternative investments mostly at the expense of government debt securities, as **Figure 4** demonstrates. The targeted returns may or may not be achieved, but public sector accounting and budgeting proceed under the assumption that they will be achieved with certainty.

The change of the discount rate also affects the value of the service cost, the present value of future pension benefits that an employee earns in the fiscal year. As such, it is sensitive to the used discount rate. **Figure 5** shows the reported and revalued service cost as percentage of payroll between 2014 and 2021. In fiscal year 2021, the average service cost under market valuation is 26.7% of payroll. This means that, on average, the public employer has to contribute approximately 27¢ out of $1 in payroll to fund the newly accruing pension liability. In contrast, pension funds report

[10] Biggs (2011) opposes this practice on the grounds that it continues to obscure the true value of the contingent pension liability, as this approach remains inconsistent with the principles of financial economics.

[11] Andonov & Rauh (2022) further show that return expectations of public pension funds are positively related to differences in past performance, thus suggesting that investment managers extrapolate past investment performance.

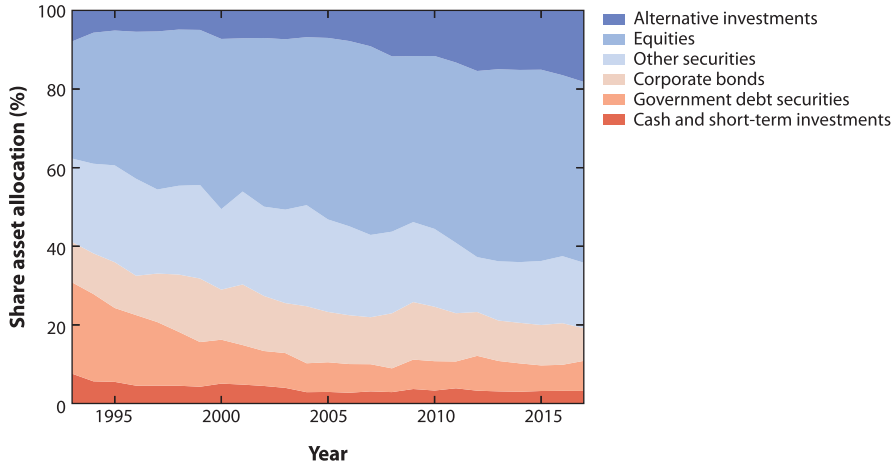

Figure 4

Asset composition. The figure plots the asset class composition of public pension funds across the United States between 1993 and 2017. Government debt securities subsume federal Treasury securities, federal agency securities, state and local government securities, and corporate bonds of federally sponsored agencies. Alternative investments subsume investments into private markets and real property. Data are from the Annual Survey of Public Pensions (ASPP) conducted by the US Census Bureau (2017). The ASPP ceased to report the asset composition after 2017, which limits our exposition. The Census Bureau conducts a full survey of all pension plans in years that end in "2" and "7." In the intervening years, the Census Bureau conducts the survey for a representative sample.

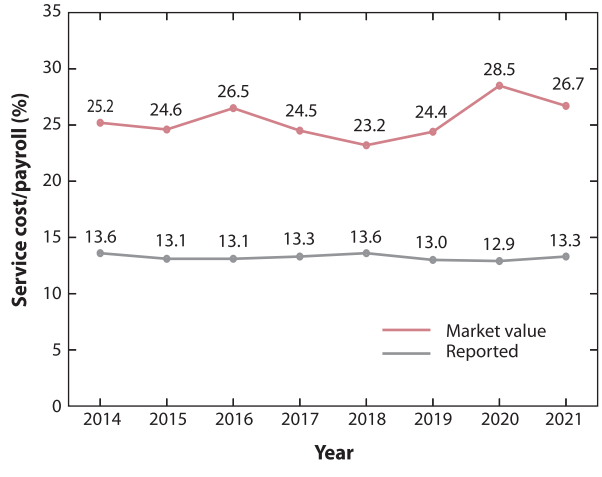

Figure 5

Service cost as percentage of payroll. The figure shows service cost as a share of covered employee payroll for all local and state plans from 2014 to 2021. The time series is constructed by weighting the service cost to covered employee payroll ratio by the covered payroll. The pink line uses the market value of service cost divided by covered employee payroll. The gray line uses the reported value service cost divided by covered employee payroll.

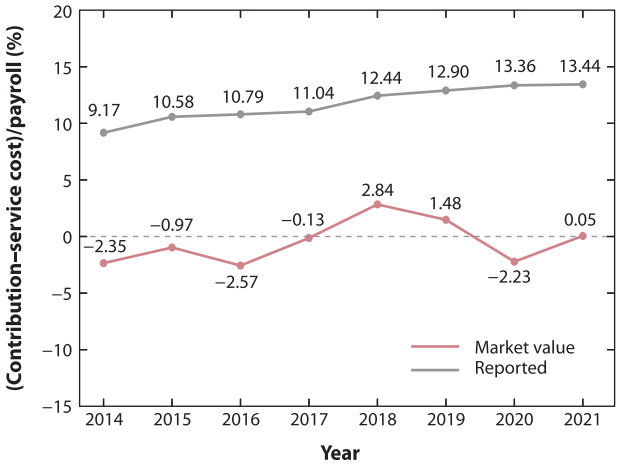

Figure 6

Contribution minus service cost as percentage of payroll. The figure shows the actual contributions minus service cost as a share of covered employee payroll for all local and state plans from 2014 to 2021. The time series is constructed by weighting the service cost to covered employee payroll ratio by the covered payroll. The gray line uses the actual contributions minus the reported service cost divided by covered employee payroll. The pink line uses the actual contributions minus the market value of service cost divided by covered employee payroll.

an average service cost of 13.3% of payroll. The discrepancy between reported service cost and the market-based service cost creates the impression that the pension sponsor covers newly accruing pension benefits and, for the most part, interest cost, while it barely covers the economically relevant service cost as shown in **Figure 6**. **Figure 6** displays the actual contributions minus the service cost rescaled by the total covered payroll. While the contribution exceeds the service cost by a comfortable margin, the contributions hardly cover the true service cost under market valuations between 2014 and 2021. Thus, the evidence suggests that pension funds across the United States barely fund the economic cost of current benefits, not considering the large unfunded pension liability. The full cross-sectional distribution of the service cost as percentage of payroll for states is shown in **Supplemental Figure 2**. The service cost is predominantly determined by the generosity of the benefit terms and the extent to which newer employees have been placed in less generous pension tiers.

Supplemental Material >

The service cost represents the expense of the sponsor to offer a pension plan if the pension plan were fully funded. As such, measuring the service cost as a share of own source revenues provides an estimate of the cost of the current contractual terms. Across all plans of our sample, the aggregate service cost under market valuation is $226.4 billion and the aggregate own source revenue is $2,023 billion in 2021. Thus, service costs account for approximately 11.2% of own source revenue on average. The aggregate, however, masks large differences among pension sponsors. **Supplemental Figure 4** shows the full distribution in the cross section of state governments. At the top of the distribution, newly accruing benefits represent 21.6% of own source revenues in Nevada. On the other end of the spectrum are Indiana (4.3%) and Michigan (4.0%), states that are unusual in that many public employees are currently in defined contribution as opposed to defined benefit pension plans.

An alternative way to express the actual cost of a pension is through the lens of the required contributions that are necessary to maintain the current value of the unfunded pension liability.

This measure captures both newly accruing pension benefits and the interest cost for the unfunded liability. As such, this measure can be interpreted as the recurring cost of pension benefits, which includes the cost from new benefits and the cost from the legacy liability. It is important to emphasize that this measure does not capture any amortization payment to repay the unfunded liability and thus may be perceived as a lower bound of the required contribution. Alternatively, we could ask what contributions are necessary to fully fund state and local pension systems across the United States over the next 30 years. Novy-Marx & Rauh (2014b) made this calculation and found that contributions would have to increase approximately 2.5 times over the current level as of 2010. In the following, we focus on the more modest goal to prevent the unfunded liability from rising and find that, as of 2021, contribution increases of a similar magnitude are required just to achieve this more modest goal.

Actual contributions have fallen short of the restated required contribution under market valuation by a wide margin. Between 2014 and 2021, required contributions under market valuations ranged between 24.11% and 31.68% of own source revenues, while actual contributions were in the range of 6.77% and 8.94% of own source revenues, resulting in a major gap between the economic cost of pension benefits and the resources that pension sponsors contributed. **Figure 7** visualizes the relationship between the actual contribution, the required contribution under market valuations, and the required contribution under the assumed discount rates. We express all measures as a percent of own source revenues to facilitate interpretation as a measure of fiscal capacity.

Noteworthy is that even under the assumed discount rates, actual contributions fall short of the required contribution. Concretely, required contributions under assumed discount rates range between 10.56% and 12.73% of own source revenues over this time period, exceeding the actual contribution by a margin of approximately 2–3%. The full cross-sectional distribution of actual and required contributions of state, city, and county governments in the United States leads to

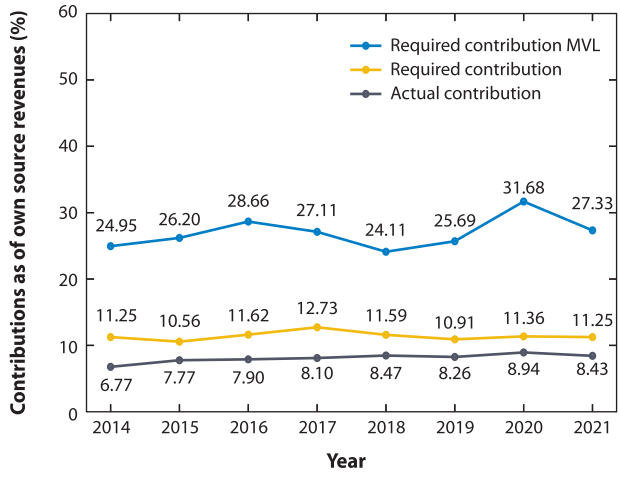

Figure 7

Actual and required contribution. The figure displays the actual contribution as a share of own source revenues, the required contribution to keep the unfunded liability constant, and the required contribution under the market value of liabilities (MVL) to keep the unfunded liability constant for local, state, and local and state plans from 2014 to 2021. The time series is constructed by weighting the contribution to own source revenue ratio by the own source revenue of the entity.

similar conclusions. At the state level, actual contributions fall short of the required contribution under market valuation for every single state. Even under the aggressive assumed discount rates, actual contributions fail to meet the required contributions for the overwhelming share of state governments. The discrepancy of actual contributions and required contributions is also visible at the county and city government levels, as shown in **Supplemental Figure 6**, which lists the 25 cities and 25 counties with the highest required contribution in our sample. Persistently insufficient contributions to cover the economic cost of pension benefits by definition ultimately lead to an exhaustion of plan assets. While it is too early to say what happens when pension funds run short of assets, our 8-year sample period offers some clues about who has to make additional contributions.

Supplemental Material >

We find that employers step in with additional contributions to support pension funds with low funding ratios; employees have largely been shielded from additional contributions. Pension funds that reported a low funding ratio in 2014 saw, on average, large increases in the employer contributions in the subsequent 7 years. In addition, pension funds have increased the required employee contributions, but the relationship is much smaller and is completely dwarfed by the increase in employer contributions, as shown in **Figure 8**. The evidence suggests that employers either lack the flexibility to change the contractual terms that determine the employee contributions, at least over a time frame of 7 years, or have chosen to insulate their employees from the fiscal burden that the pension funds exert. The extent to which employers and employees have to offset future shortfalls will depend on future investment returns. The large portfolio share of risky assets that is necessitated to justify the high expected returns and related discount rates exposes the investment position to the volatility in financial markets.

Pension funds have shown volatile investment returns, and the dispersion of realized returns has been large. In the period from 2014 to 2021, the mean return has ranged anywhere between 2.02% to 23.63%, with the dispersion around the mean often being large and the realized 5th percentile return being negative in 4 out of 8 years as shown in **Figure 9*a***. Even in relationship to

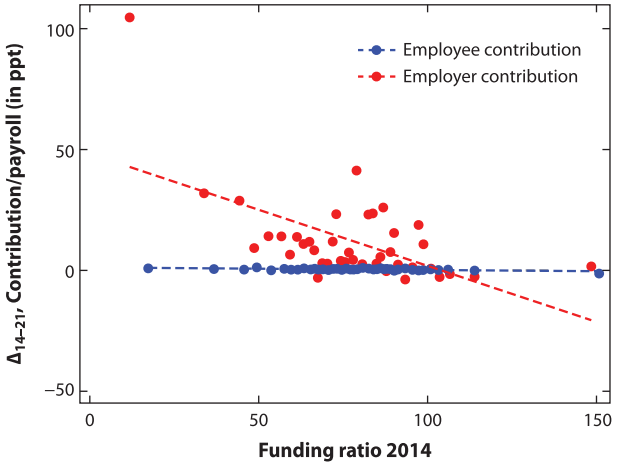

Figure 8

Employer and employee contribution change. The figure relates the change of reported employer contribution over payroll (*red dots*) and reported employee contribution over payroll (*blue dots*) to the funding rate in the first year of our sample in 2014. The figure is a binned scatterplot with a total of 40 bins. Each dot represents the average of the observations that fall within the same bin.

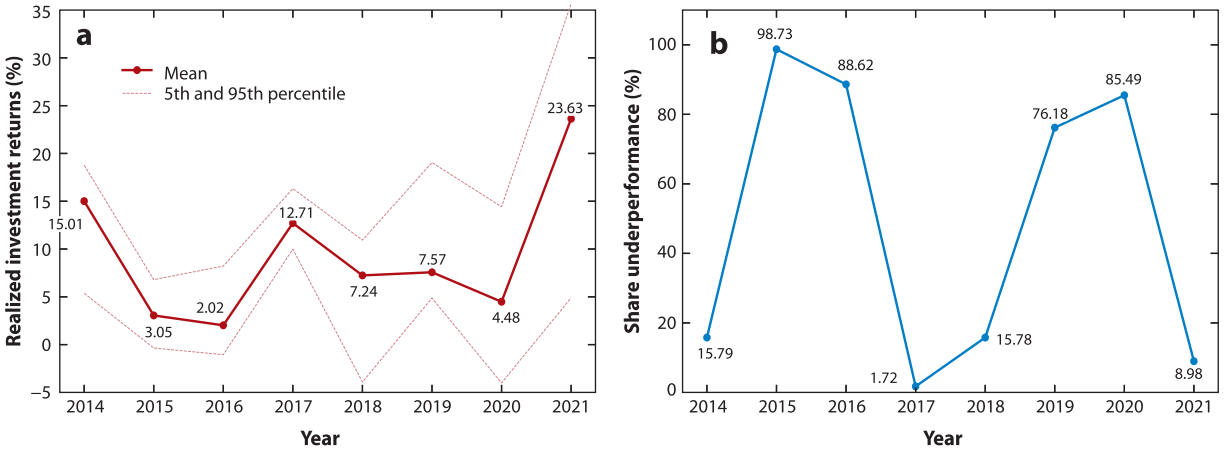

Figure 9

Investment returns. Panel *a* displays the mean and the 5th and 95th percentile of the yearly realized investment returns for local, state, and local and state plans between 2014 and 2021. The time series is constructed by weighting the investment returns of each plan by the fiduciary net position (asset). Panel *b* plots the share of pension funds whose realized returns are below the assumed discount rates. The share represents the fiduciary net position–weighted (asset) proportion of underperforming funds.

pension funds' own benchmark, the plan's expected return, the realized investment performance allows at best for a mixed assessment. In 4 out of 8 years, more than 75% of pension funds were not able to meet their return expectations. For instance, 98.7% and 88.6% of pension funds realized investment returns below the assumed discount rate in fiscal years 2015 and 2016, respectively, as shown in **Figure 9*b***. Fiscal year 2021, with an average investment return of 23.6%, was unusual and mostly due to some of the aforementioned special effects in the wake of the COVID-19 pandemic. The investment returns for fiscal year 2022 are still incompletely reported, although, for funds for which returns are already available, returns have generally been weak. For instance, CalPERS, the largest pension fund in the United States, has announced a preliminary net investment return of −6.1% for fiscal year 2022 (CalPERS 2022). To put this number into perspective: With an assumed discount rate of 6.8%, it takes a realized investment return of approximately 11% for 4 consecutive years to offset a decline of −6.1% in the asset position.

5. CONCLUSION

Unfunded public pension obligations represent the largest liability for state and local governments in the United States. Despite increased disclosure requirements and new restrictions under the updated governmental accounting standards, the valuation of pension obligations tends to be too aggressive and is inconsistent with the principles of financial economics. As a result, the reported pension obligation understates the economic liability of pension promises that state and local governments have made. The continued use of high discount rates is the main culprit. Despite a downward trend over the last several years, the assumed discount rates remain above the level that the risk profile of liabilities demands. A corollary is that not only is the unfunded pension liability understated but so is the yearly pension cost for newly accruing liabilities, thus creating the perception that pension sponsors contribute enough while they do not. In order to achieve high returns, pension funds have accumulated a large exposure to risky assets, which results in volatility and a large dispersion in possible future investment returns.

DISCLOSURE STATEMENT

The authors are not aware of any affiliations, memberships, funding, or financial holdings that might be perceived as affecting the objectivity of this review.

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LITERATURE CITED

Andonov A, Bauer RM, Cremers K. 2017. Pension fund asset allocation and liability discount rates. *Rev. Financ. Stud.* 30(8):2555–95

Andonov A, Kräussl R, Rauh J. 2021. Institutional investors and infrastructure investing. *Rev. Financ. Stud.* 34(8):3880–934

Andonov A, Rauh JD. 2022. The return expectations of public pension funds. *Rev. Financ. Stud.* 35(8):3777–822

Begenau J, Siriwardane E, Liang P. 2022. *Unpacking the rise in alternatives*. SSRN Work. Pap. 4105813

Biggs AG. 2011. Proposed GASB rules show why only market valuation fully captures public pension liabilities. *Financ. Anal. J.* 67(2):18–22

Biggs AG. 2014. The public pension quadrilemma: the intersection of investment risk and contribution risk. *J. Retire.* 2(1):115–27

Bohn H. 2011. Should public retirement plans be fully funded? *J. Pension Econ. Finance* 10(2):195–219

Brown JR, Pennacchi GG. 2016. Discounting state and local pension liabilities: funding versus value. *J. Pension Econ. Finance* 15(3):254–84

Brown JR, Wilcox DW. 2009. Discounting state and local pension liabilities. *Am. Econ. Rev.* 99(2):538–42

Bur. Econ. Anal. 2021. *National income and product accounts.* Rep., Bur. Econ. Anal., Suitland, MD. **https://www.bea.gov/products/national-income-and-product-accounts**

CalPERS. 2022. CalPERS announces preliminary net investment return of −6.1% for the 2021–22 fiscal year. *CalPERS News*, July 20. **https://www.calpers.ca.gov/page/newsroom/calpers-news/2022/calpers-preliminary-investment-return-2021-22**

Costrell RM, McGee JB. 2022. *Economics of sustainable public pension funding.* Work. Pap., Univ. Ark., Fayetteville, AR

Cui J, De Jong F, Ponds E. 2011. Intergenerational risk sharing within funded pension schemes. *J. Pension Econ. Finance* 10(1):1–29

Gollier C. 2008. Intergenerational risk-sharing and risk-taking of a pension fund. *J. Public Econ.* 92(5–6):1463–85

Krishnamurthy A, Vissing-Jorgensen A. 2012. The aggregate demand for treasury debt. *J. Political Econ.* 120(2):233–67

League of California Cities. 2021. CalPERS to consider further adjustments to the discount rate; cities can offer testimony during CalPERS board meeting. *League of California Cities*, Sept. 8. **https://www.calcities.org/news/post/2021/09/08/calpers-considers-further-adjustments-to-the-discount-rate-cities-urged-to-offer-testimony-during-upcoming-board-meeting**

Lenney J, Lutz B, Schuele F, Sheiner L. 2021. The sustainability of state and local pensions. *Brookings Pap. Econ. Act.* 2021:1–48

Lenze DG. 2013. *State and local government defined benefit pension plans: estimates of liabilities and employer normal costs by state, 2000–2011.* Work. Pap., Bur. Econ. Anal., US Dep. Commer., Washington, DC

Lucas D. 2017. *Towards fair value accounting for public pensions: the case for delinking disclosure and funding requirements.* Work. Pap., Mass. Inst. Technol., Cambridge, Mass.

Lucas D. 2021. Comments and discussion. *Brookings Pap. Econ. Act.* 2021:49–57

Lucas DJ, Smith D. 2020. How much can collective defined contribution plans improve risk-sharing? *J. Invest. Manag.* 18(4):55–74

Lucas DJ, Zeldes SP. 2009. How should public pension plans invest? *Am. Econ. Rev.* 99(2):527–32

Merton RC. 1974. On the pricing of corporate debt: the risk structure of interest rates. *J. Finance* 29(2):449–70
Novy-Marx R. 2013. Logical implications of the GASB's methodology for valuing pension liabilities. *Financ. Anal. J.* 69(1):26–32
Novy-Marx R, Rauh JD. 2009. The liabilities and risks of state-sponsored pension plans. *J. Econ. Perspect.* 23(4):191–210
Novy-Marx R, Rauh JD. 2011. Public pension promises: How big are they and what are they worth? *J. Finance* 66(4):1211–49
Novy-Marx R, Rauh JD. 2014a. Linking benefits to investment performance in US public pension systems. *J. Public Econ.* 116:47–61
Novy-Marx R, Rauh JD. 2014b. The revenue demands of public employee pension promises. *Am. Econ. J. Econ. Policy* 6(1):193–229
Pástor L, Stambaugh RF. 2012. Are stocks really less volatile in the long run? *J. Finance* 67(2):431–78
Pennacchi G, Rastad M. 2011. Portfolio allocation for public pension funds. *J. Pension Econ. Finance* 10(2):221–45
Rauh JD. 2021. Comments and discussion. *Brookings Pap. Econ. Act.* 2021:57–61
Rauh JD, Stefanescu I, Zeldes SP. 2020. Cost saving and the freezing of corporate pension plans. *J. Public Econ.* 188:104211
Reinsdorf M, Lenze D, Rassier D. 2014. *Bringing actuarial measures of defined benefit pensions into the U.S. national accounts.* Work. Pap., Int. Assoc. Res. Income Wealth, 33rd Gen. Conf., Rotterdam, Neth.
Siegel JJ. 2021. *Stocks for the Long Run: The Definitive Guide to Financial Market Returns and Long-Term Investment Strategies.* New York: McGraw-Hill. 6th ed.
US Census Bureau. 2017. *Annual survey of public pensions.* Survey, US Census Bureau, Washington, DC. **https://www.census.gov/programs-surveys/aspp.html**
US Census Bureau. 2021. *State and local government finance historical datasets and tables.* Datasets, US Census Bureau, Washington, DC. **https://www.census.gov/programs-surveys/gov-finances/data/datasets.html**