STATE AND LOCAL GOVERNANCE

State and Local Pension Funds 2022

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Abstract

This paper updates the status of state and local pension funds as of the end of fiscal year 2022. Total reported unfunded liabilities increased to $1.572 trillion from $1.076 trillion in the prior year, due to weak investment returns and actuarial factors. In contrast, the market value of the unfunded liability fell to $5.120 trillion from $6.501 trillion due to substantial increases in risk-free discount rates, which are appropriate for measuring the value of a form of government debt with strong statutory and contractual rights. Both the unfunded liability and the annual pension costs for new benefit accrual remain substantially understated. Investment returns were −3.2% in fiscal year 2022, underperforming assumed discount rates by approximately 10%. Employer contributions increased substantially, with the contribution rate as of payroll rising from 26.9% in 2021 to 28.3% in 2022. The increase in employer contributions is partly driven by supplemental contributions that state and local government made at a time when they experienced budgetary surpluses inclusive of pandemic related relief.

INTRODUCTION

The unfunded obligations of the pension systems sponsored by state and local governments in the United States remain the largest liabilities of subnational US government entities. The size of unfunded liabilities even exceeds fixed-income obligations in the municipal bond market. For local governments, unfunded pension liabilities are the main contributor to the negative equity position that a large share of city governments exhibit (Giesecke, Mateen, and Jardim Sena, 2022).

In this paper, we provide an update on the state and trend of public pensions by tracking the development of 648 pension systems across the United States.[1] Our sample includes all the main pension systems of the states, the largest US cities, and the largest US counties. In sum, these plans account for approximately 90% of all public pension assets in the United States. Specifically, we contrast the liabilities and ongoing economic cost as reported by the plans

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with the market valuations that are consistent with the principles of financial economics. In our analysis we separate the economic cost of serving current employees from the required funding for legacy obligations. In addition, we provide an analysis that studies the debt-neutral contributions that would be required to prevent unfunded obligations from growing, as well as the contributions that are required under a full funding mandate over the next 25 years.

As of fiscal year 2022, the total reported unfunded liabilities of these plans under governmental accounting standards had risen to $1.572 trillion, compared to $1.076 trillion in the previous year. In contrast, the market value of the unfunded liability is approximately $5.120 trillion, a decline from $6.501 trillion the prior year. The reported average funding ratio of 75.4% (down from 83.3% in 2021) overstates the extent to which pension liabilities are funded, due to the inappropriate use of expected returns on assets as discount rates. The liability weighted aggregate funding ratio under market valuation rose to 48.5% from 43.8% the prior year. 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 and Wilcox, 2009; Brown and Pennacchi, 2016).

In comparison to fiscal year 2021, the change in market values is primarily driven by two factors. First, overall negative investment returns led to a decline in the net fiduciary asset position. Second, risk equivalent market interest rates increased when the Federal Reserve started to raise the federal funds target rate in Q2 2022. The increase in the market rate had a significant impact on the valuation of the total pension liability, and led to an overall net decline on the unfunded pension liability in comparison to fiscal year 2021.

After a year of extraordinary investment returns in fiscal year 2021, average investment returns were negative in fiscal year 2022. The asset weighted investment return was −3.2%, which meant that 88.9% of funds failed to meet their target return. The poor performance in 2022 is not an outlier. In fiscal year 2015 and 2016, 98.7% and 88.6% of pension funds realized investment returns below their assumed discount rate, respectively. The volatility in returns is a reflection of the riskiness of the asset portfolio. As of 2017, public pension funds were invested on average 43% into equities, 19% into alternative investments, and 9% into corporate bonds (Giesecke and Rauh, 2023).[2]

Discount rates continue to decline. The liability weighted average discount rate of state and local governments is 6.71% as of fiscal year 2022, compared to 7.31% in fiscal year 2014. Despite this decrease, the average discount rate remains higher than the risk appropriate discount rate. We 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.[3] Our rediscounting affects not only pension liabilities, but also recurring pension cost, which has to be adjusted upward to reflect the true economic cost.

Next we consider how the cost for newly accruing pension benefits—also known as the service cost—has evolved. The service cost is the change in the present value of expected future pension benefits due to an additional year of work by the employee. An employer who implemented a hard-freeze of a defined benefit plan could reduce the service cost to zero, but the

unfunded liabilities from existing legacy benefits would still remain (Rauh, Stefanescu, and Zeldes, 2020). The assumed discount rate affects the service cost in a similar way to its effect on liabilities, although service costs have a longer duration than accrued liabilities. The average reported service cost declined slightly to 13.1% of payroll in 2022 from 13.3% of payroll in 2021. The service cost under market valuation declined more, to 22.5% of payroll in 2022 from 27.7% in 2021, reflecting the increase in the discount rate. As explained in Giesecke and Rauh (2023), this means that on average the public employers calculate that they must contribute around 13¢ out of every $1 in payroll in order to fund newly accruing pension benefits, but in fact they would have to contribute about 22¢ out of every $1 in payroll to fund those newly accruing pension benefits on a market basis.[4]

Expressing the pension cost as a fraction of state and local governments' own source revenue and tax revenue puts the actual and required contributions into perspective. State and local government entities in our sample received general revenue from own sources of a combined $2,260 billion in 2022, while making actual pension contributions of $190.6 billion. Thus, contributions were 8.4% of own source revenue in 2022, unchanged from 2021. Under governmental accounting, total contributions exceeded the break-even contribution to prevent the unfunded liability from rising if the assumed return targets had been realized. Yet in fact these contributions fell short by $92.6 billion due to the difference between assumed and market based discount rates. The total contributions that would be economically required to prevent the unfunded pension liability from increasing thus amount to $283.2 billion ($190.6 billion + $92.6 billion), which account for about 12.5% of own source revenue in 2022. Alternatively, the actual reported contributions constitute about 11.9% of tax revenues in 2022, down from 12.5% in 2021, due to the increase in default-free discount rates. Despite this increase in interest rates, considering the additional contributions to prevent the net pension liability from rising, the total economically required contribution still amounts to 17.7% of total tax revenue. This calculation does not include any contributions that would amortize the unfunded pension liability.

As more and more states adopt full funding mandates of unfunded pension obligations, it is useful to also measure the budgetary impact by including the amortization payment. Thus, we provide an alternative measure that captures both service cost and amortization payments over 25 years.[5] Under this measure, the required annual payment totals $440.16 billion, which represents 19.48% of own source and 27.56% of tax revenues. There is substantial variation in the cross-section, ranging from 5.35% of own source revenues for the 10th percentile and 36.49% of own source revenues for the 90th percentile. At the right-tail of the distribution, the large share exerts substantial budgetary pressure.

In 2020 and 2021, federal lawmakers enacted nearly $1 trillion in financial aid for state and local governments. While to some extent legislated under uncertainty about the effects of the COVID-19 pandemic on state and local government budgets (Clemens and Veuger, 2020), ultimately states found themselves with substantial surpluses after revenues far surpassed enacted budgets in 2021 and 2022 (National Association of State Budget Officers, 2022; Fitch Ratings, 2023). Despite stipulations that funds could not be used to offset tax reductions or as contributions to pension funds, Clemens and colleagues (2023) find that state and local

governments contributed on average $72 for every $1,000 in aid received. Among the plans in our sample, the contribution rate as of payroll increased from 26.9% in 2021 to 28.3% in 2022. Among state governments, the increase was largest in Vermont, Connecticut, and Oregon, with increases of more than 10% of payroll. At the local level, the largest increases in contributions is observed for Norwich, CT, Norfolk, VA, and Dover, DE.

The trend to adjust the benefit terms of pensions and convert plans from defined benefit to a hybrid or defined contribution plans continues.[6] Some of the most material changes in 2022 and 2023 include the transition from a defined benefit plan to a defined contribution–only plan in North Dakota. Employees and employers are required to contribute 4% of payroll, with an additional 3% of matching contributions provided by the state. The terms of the new defined contribution plan are consistent with the finding of Giesecke and Rauh (2022), which surveys public employees across the United States about their pension preferences.

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.

DATA SOURCES

PENSION DISCLOSURES FROM GASB 67 STATEMENTS

We collect the disclosures under Governmental Accounting Standards Board Statement No. 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 according to the US Census and the top 100 counties by population. Additionally, we collect associated school district and transportation authority pension systems where applicable. The total sample thus included 648 state and local funds: 271 state funds and 377 local funds. The full list of funds that are part of our sample is listed in the appendix. 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 for each plan, which makes a revaluation under different interest rate scenarios possible.

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 (ASSLGF). 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

will 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. The idea behind the latter is 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 2021. We estimate 2022 revenues by using an out-of-sample extrapolation and drawing on national aggregates of the National Income and Product Accounts (NIPA) from the Bureau of Economic Analysis (BEA) and the State & Local Government Finance Historical Datasets and Tables of the US Census Bureau. For extrapolation we use the NIPAs for state and local governments (NIPA table 3.3) to compute the growth rate between 2021 and 2022. 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 9.27% between 2021 and 2022. 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 a time horizon between 1972 and 2021. These results were then used to estimate own source revenue growth rates from 2021 to 2022. 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 8.11% between 2021 and 2022. We apply an analogous methodology for tax revenues.

DISCOUNT RATES

As described in papers including Brown and Wilcox (2009), Novy-Marx and Rauh (2009, 2011), Novy-Marx (2013), and Brown and Pennacchi (2016), the correct discount rate for measuring the market value of pension obligations should be a default-free rate, rather than relying on discount rates that reflect the higher expected returns of portfolios of riskier investments. This perspective is based on the understanding that pension promises, similar to debt obligations, must be honored irrespective of pension fund investment performance. Pension liabilities, therefore, should be measured using rates that mirror the nature of pension promises as obligations that remain constant regardless of the underlying asset performance. This approach is supported by both financial theory and legal considerations. As such, we use the US Treasury yield curve to measure the value of pension liabilities using market valuation standards. We refer readers to section 3 of Giesecke and Rauh (2023) for a complete explanation.

DETAILED ANALYSIS

As of fiscal year 2022, the total reported unfunded liability under governmental accounting standards is $1.572 trillion. In contrast, we calculate that the market value of the unfunded liability is approximately $5.120 trillion. As a result of the revaluation, the reported liability weighted funding ratio of 75.4% falls to 48.5% under a market based valuation. 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 and Wilcox, 2009; Brown and Pennacchi, 2016). 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. However, there are several differences that make our methodology exhibit a tighter relationship with current market conditions. The Federal Reserve follows the methodology of the BEA.[7] The assumed discount rate broadly reflects market conditions in the corporate bond market, although with only rare adjustments over time. For example, the Federal Reserve uses a discount rate of 4.0% for the period from 2019 to 2022. Figure 1 shows the estimates based on our sample and methodology and those of the Federal Reserve. As of 2022, our sample of local and state pension plans covers about 92.2% of total assets reported by the Federal Reserve.[8] 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 more variation. The difference in the methodology results in our estimate of the total pension liability to be approximately 101.4% of the estimate of the Federal Reserve in 2022. The difference in the estimates has shrunk substantially over the last year due to the convergence in market rates and the assumed discount rate of the Federal Reserve.

The time series of the liability weighted funding ratio, displayed in figure 4, shows limited variation over time. However, we find large cross-sectional variation in the funding status across states as shown in figure 10. In terms of market values, New Jersey, Connecticut, Kentucky, and Mississippi are the states with the lowest funding ratio in 2022, with a funding status as low as 29.3%. At the other end of the spectrum, the states of Wisconsin, Tennessee, and South Dakota have funding ratios that range between 64.7% and 74.0%. This means that even the best funded states exhibit large legacy pension obligations.

In comparison to fiscal year 2021, three factors have contributed to the change in the market value of the unfunded pension liability. First, overall investment returns were negative, which led to a decline in net fiduciary asset position. Second, risk equivalent market interest rates increased when the federal funds target rate started to rise in Q2 2022. Third, state and local governments made supplemental contributions to their pension fund due to pandemic-era relief from the federal government. The contribution of each of the components is visualized in figure 2. Among all components, the increase in the market interest rates had by far the largest impact, followed by the investment returns, which were almost 10 percentage points below the assumed discount rates. In addition, state and local governments increased their contributions from 26.9% of payroll in 2021 to 28.3% of payroll in 2022, as shown in figure 6. The increase was partly driven by supplemental contributions that state and local governments made due to budgetary surpluses that resulted from pandemic related relief (Clemens et al., 2023). Tables 3 and 4 show the state and local governments with the largest increase in contributions on a contributions-as-of-payroll basis, respectively. Among state governments,

the increase was largest in Vermont, Connecticut, and Oregon, with increases of more than 10% of payroll. At the local level, the largest increases in contributions are observed for Norwich, CT, Norfolk, VA, and Dover, DE. As a result of the year-over-year changes, the market value of the unfunded liability is approximately $5.120 trillion, corresponding to a liability weighted aggregate funding ratio of 48.5% in fiscal year 2022, a substantial decrease from $6.496 trillion in fiscal year 2021. The full summary statistics for fiscal year 2021 and 2022 are shown in table 2.

There are important differences in the development of the year-over-year funding ratio. While the market based funding ratio increased for the majority of state pension systems, it was negative for Georgia and Delaware. The decrease in the funding ratio in these states, despite a positive revaluation effect of the liability, is caused by the large negative investment returns. These two states also experienced a large negative decline in the reported funding ratio, with –19.3% and –21.0% for Georgia and Delaware, respectively. The change in funding ratio for state pension funds in shown in figure 16. At the local level, the change in funding ratios was even more heterogeneous. North Miami, FL, Norwich, CT, and Norfolk, VA, experienced increases in both the reported and market based funding ratio, which was facilitated by large supplemental contributions. In contrast, Arlington Heights, IL, Memphis, TN, and Granby Town, CT, recognized large declines in both the reported and market based funding ratio, which was primarily driven by negative investment returns. An overview about the local governments with the largest 25 increases and largest 25 declines in the market based funding ratio is provided in figure 18.

After a year of extraordinary investment returns in fiscal year 2021, average investment returns were negative in fiscal year 2022. The asset weighted investment return was –3.2% which is about 10 percentage points below the assumed investment return. The negative average investment return was not driven by a few funds; in fact 88.9% of funds underperformed their target returns in fiscal year 2022. The return of 2022 is emblematic of the return volatility during our sample period. The mean return has ranged anywhere between –3.81% to 24.62%, with the dispersion around the mean often being large and the realized 5th percentile return being negative in five out of nine years, as shown in figure 9a. It is not uncommon for a large share of funds to underperform their return assumption. In fiscal years 2015 and 2016, 98.7% and 88.6% of pension funds realized investment returns below their assumed discount rate, respectively. The volatility in returns is a reflection of the riskiness of the asset portfolio. As of 2017, public pension funds were invested 43% into equities, 19% into alternative investments, and 9% into corporate bonds on average (Giesecke and Rauh, 2023). The shift toward a riskier asset allocation has been independently documented. Begenau, Siriwardane, and Liang (2022) show that public pension funds have shifted their asset allocation more and more toward alternative investments (e.g., private equity, hedge funds, and real estate) since 2006; partly a result of shifting beliefs about alternative investments' returns and risks. Andonov, Kräussl, and 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 and Zeldes (2009) establish that an allocation into risky assets is only justified if liabilities were to co-move with the market. Pennacchi and 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, the researchers 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).

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 between 2014 and 2022 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 6.71% in 2022. The downward trend is more pronounced at the state level, potentially reflecting that vested interests have less bite at the state level than at the local level.[9] The downward trajectory reflects the decisions of many pension boards to lower the discount rate to better reflect nominal asset returns. For instance, the largest public pension system in the United States, the California Public Employees' Retirement System (CalPERS), reduced the discount rate three times between 2014 and 2021, beginning at 7.75% and ending at 6.8%.

Clearly, the assumed GASB 67 discount rate of 6.71% in fiscal year 2022 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.[10] The evidence presented by Andonov, Bauer, and Cremers (2017) supports this hypothesis.

Using a market based interest rate also affects the value of the service cost. The service cost is 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 of payroll between 2014 and 2022. While the increase of market rates led to a noticeable decrease in service costs between 2021 and 2022, the market based service cost remains 9.1 percentage points higher than the reported service cost in 2022. Under market valuations, the public employer has to contribute, on average, about 22¢ out of $1 in payroll to fund the newly accruing pension liability. In contrast, pension funds report an average service cost of 13.1% of payroll. The discrepancy between reported service cost and the market based service cost often creates the impression that the pension sponsor covers newly accruing pension benefit and, for the most part, interest cost, while it actually does not. As a result, 2022 is the first year in which contributions were markedly above the market value of service cost, as shown in figure 7. While the contributions exceed the reported service cost by a comfortable margin, they barely covered the true service cost under market valuations between 2014 and 2021. The difference between true pension cost and contributions is even more pronounced in the cross-section. Figure 11 shows the cross-sectional distribution of

the service cost as of payroll. 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. Figure 12 presents how the service costs, measured as reported and at market values, compare relative to the actual contributions for each state.

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 $198.1 billion and the aggregate own source revenue is $2,260 billion in 2022. Thus, service costs account for about 8.8% of own source revenue on average. The aggregate, however, masks large differences among pension sponsors. Figure 13 shows the full distribution in the cross-section of state governments. At the top of the distribution, newly accruing benefits represent 20.9% of own source revenues in Nevada. On the other end of the spectrum are Indiana (4.0%) and Michigan (3.1%), 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 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 25 years.

Actual contributions are broadly consistent with the required contributions that are necessary to prevent the pension liability from rising under the assumed discount rate but fall short relative to the restated required contribution under market interest rates. Actual contributions were a remarkably stable fraction of own source revenues, fluctuating between 6.82% and 9.07% of own source revenues over the sample period 2014 to 2022. The level of employer contributions aligns closely with the required contributions that is necessary to prevent the pension liability using the assumed discount rates. The actual contribution surpasses the required contribution only in 2022, by 3.1%, as a result of the large increase in the fiduciary net position in 2021 and strong growth in own source revenues. This change is likely to revert due to negative investment returns in 2022. However, the required contribution under market valuation exceeds the actual by 47 percentage points, resulting in a major gap between the economic cost of pension benefits and the resources that pension sponsors contribute. Figure 8 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 percentage of own source revenues to facilitate interpretation as a measure of fiscal capacity. The full cross-sectional distribution of actual and required contributions of state, city, and county governments in the United States leads to similar conclusions. At the state level, actual

contributions fall short of the required contribution under market valuation. Even under the aggressive assumed discount rates, actual contributions fail to meet the required contributions for a large share of state governments, as shown in figure 14. The discrepancy of actual contributions and required contributions is also visible at the county and city government level, as shown in figure 15, which lists the 25 cities and 25 counties with the highest required contribution in our sample. Persistently making insufficient contributions to cover the economic cost of pension benefits by definition ultimately leads to an exhaustion of plan assets.

A recent trend among policymakers in the United States is to impose mandates to fund the unfunded pension liability. These mandates range from full funding requirements (e.g., Connecticut and Wisconsin) to mandates that require specific funding ratio (e.g., South Dakota, New Jersey, Illinois, Louisiana, and Michigan). These funding requirements can often consume substantial fiscal resources. Hence, we provide transparency about the anticipated payment as a share of own source revenues if a full funding mandate over the next 25 years were imposed. We provide these estimates under a market valuation and independent of the actual funding requirement for comparability. Figure 8 shows that the combined required contribution to cover service cost and amortization payment for the unfunded pension liability ranges between 19.5% and 30.1% over the sample horizon. Thus, the required contribution to fund the unfunded liability over the next 25 years would consume at least an additional 11% of own source revenues, a substantial burden on state and local governments' budget. Among state governments, the largest payment as of own source revenues is observed in South Dakota, Hawaii, and New Hampshire, as shown in figure 17. For these three states, the payment surpasses 20% of own source revenues. In contrast, Louisiana, Utah, and Indiana have the smallest burden, with 2.2%, 1.5%, and 1.1%, respectively. The variation is even larger at the local level. Several county governments, special districts, and city governments would be seriously challenged if a full funding amortization mandate were adopted, as shown in figure 19.

As a result of increasing recognition of the associated risks with pension liabilities, state and local governments enacted various pension reforms in 2021 and 2022. This is a continuation of the trend as documented by Duffy and Giesecke (2023). At the state level, some of the most far-reaching reforms have taken place in North Dakota, where the Public Employees Retirement System (PERS), a defined benefit plan, was closed, and new employees will be enrolled into a defined contribution plan. Another plan transition was enacted in Texas, where new judges will be enrolled in a cash balance plan instead of the defined benefit plan, the Judicial Retirement System (JRS). At the local level, the largest changes were observed in Milwaukee, WI, and Memphis, TN. In the former, the City of Milwaukee Employes' Retirement System (CMERS), a defined contribution plan, was closed, and new employees will be enrolled into the state plan, the Wisconsin Retirement System (WRS).[11] The WRS is a defined benefit plan with a risk sharing component, which shares part of the investment risk with the employees. Memphis, on the other hand, provides a counterpoint to the above reforms: reforms sometimes can increase, not decrease, long-term costs. The city closed the hybrid plan for public safety officials and reopened to all new public safety employees the defined benefit plan, which had previously been closed.

CONCLUSION

Unfunded public pension obligations continue to represent the largest liability for state and local governments in the United States. The rise in market rates between fiscal years 2021 and 2022 led to a material downward revaluation of the total pension liability. At the same time, asset weighted investment returns have been negative—underperforming expected discount rates by approximately 10%. The return volatility is a reflection of the large exposure to risky assets that pension funds have accumulated to increase expected investment returns. Pandemic related aid and related budgetary surpluses led to significant supplemental contributions that shored up funding ratios. Despite a continued downward trend, assumed discount rates remain above the level that the risk profile of liabilities demands. A corollary is that unfunded pension liability and the yearly pension cost for newly accruing liabilities is understated. Policymakers increasingly recognize that pension liabilities represent a financial risk to the pension sponsor. In response, several states and cities have enacted far-reaching pension reforms that enroll new employees to a retirement plan in which the investment risk is not solely carried by the employer. In addition, some states have imposed funding mandates that require a certain funding ratio of the pension liability. These funding mandates are a two-sided sword. On the one hand, they address the financial risk of the unfunded liability; on the other hand, they impose budgetary pressure, which can be substantial, especially for local governments.

ACKNOWLEDGMENTS

NOTES

1. For reports that contain a version of these calculations for prior years, see Rauh (2018) and Giesecke and Rauh (2023).

2. The year 2017 is the last for which detailed information about the asset composition is available due to changes on how the Annual Survey of Public Pensions (ASPP) is conducted. Alternative investments include private equity, venture capital, infrastructure, and hedge funds.

3. While the liquidity of nominal treasury bonds certainly reduces the overall level of the Treasury yield curve (Krishnamurthy and Vissing-Jorgensen, 2012) and pension promises are much less liquid than Treasury bonds, many pension promises are at least partially inflation-linked, suggesting a need for lower discount rates. Novy-Marx and 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.

4. 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.

5. Examples of states that enacted full funding requirements are Wisconsin and Connecticut. Other states, including South Dakota, New Jersey, Illinois, Louisiana, and Michigan, have adopted minimum funding requirements (e.g., 80% of the reported total pension liability).

6. For a comprehensive study of past reforms, see Duffy and Giesecke (2023).

7. For more details, see Lenze (2013) and Reinsdorf, Lenze, and Rassier (2014).

8. Between 2014 and 2022, the coverage of our sample varies between 87% and 92.2%.

9. Decreases in the discount rates often face stiff political opposition as they immediately affect the sponsors pension cost. One example is the resistance of the League of California Cities (2021) to reconsideration of the discount rate by CalPERS.

10. Andonov and Rauh (2022) further show that return expectations of public pension funds are positively related to differences in past performance, suggesting that investment managers should extrapolate past investment performance.

11. For more details on the transition and the anticipated cost savings, see Duffy and Giesecke (2023).

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TABLES AND FIGURES

TABLE 1 SUMMARY STATISTICS FOR STATE AND LOCAL PENSION PLANS IN FISCAL YEAR 2022 ($ IN BILLIONS)

	State pensions	Local pensions	State and local pensions
Number of plans total	271	377	648
I. Assets and liabilities			
GASB 67 standards			
Total Pension Liability (TPL)	$5,331	$1,058	$6,389
Assets	$4,026	$792	$4,818
Net Pension Liability (NPL)	$1,306	$266	$1,572
Funding ratio	75.5%	74.9%	75.4%
Market value standards			
Accumulated Benefits Obligation (ABO)	$8,306	$1,632	$9,938
Assets	$4,026	$792	$4,818
Unfunded Market Value Liability (UMVL)	$4,280	$840	$5,120
Funding ratio	48.5%	48.5%	48.5%
II. Discount rates			
GASB 67 standards			
Average discount rate			
Liability weighted	6.86%	6.88%	6.86%
Liability unweighted	6.66%	6.74%	6.71%
Market value standards			
Average discount rate			
Liability weighted	3.19%	3.29%	3.21%
Liability unweighted	3.24%	3.38%	3.32%
Average duration			
Liability weighted	11.30	11.31	11.30
Liability unweighted	10.86	10.53	10.67
III. Flows			
Benefits and refunds	$292.6	$58.2	$350.8
Employer contributions	$129.2	$35.6	$164.8
Member contributions	$50.5	$8.5	$59.0
State contributions	$25.6	$0.2	$25.8
Total contribution	$205.3	$44.3	$249.6
IV. Accrual basis			
Additional necessary contributions:			
to prevent rise in NPL under expected return	$(54.5)	$(16.4)	$(70.9)
to prevent rise in NPL under treasury rate	$79.3	$13.3	$92.6

Note: Negative values are presented in parentheses.

TABLE 2 SUMMARY STATISTICS FOR STATE AND LOCAL PENSION PLANS IN FISCAL YEARS 2021 AND 2022 ($ IN BILLIONS)

	State and local pensions, 2022	State and local pensions, 2021
Number of plans total	648	648
I. Assets and liabilities		
GASB 67 standards		
TPL	$6,389	$6,194
Assets	$4,818	$4,623
NPL	$1,572	$1,035
Funding ratio	75.4%	83.3%
Market value standards		
ABO	$9,938	$11,655
Assets	$4,818	$6,535
UMVL	$5,120	$6,496
Funding ratio	48.5%	44.3%
II. Discount rates		
GASB 67 standards		
Average discount rate		
Liability weighted	6.86%	6.88%
Liability unweighted	6.71%	6.75%
Market value standards		
Average discount rate		
Liability weighted	3.21%	1.63%
Liability unweighted	3.32%	1.55%
Average duration		
Liability weighted	11.30	11.29
Liability unweighted	10.67	10.74
III. Flows		
Benefits and refunds	$350.8	$337.8
Employer contributions	$164.8	$151.7
Member contributions	$59.0	$56.1
State contributions	$25.8	$21.5
Total contribution	$249.6	$229.3
IV. Accrual basis		
Additional necessary contributions:		
to prevent rise in NPL under expected return	$(70.9)	$0.9
to prevent rise in NPL under treasury rate	$92.6	$120.7

Note: Negative values are presented in parentheses.

TABLE 3 STATE GOVERNMENTS WITH LARGEST INCREASE IN CONTRIBUTIONS AS OF PAYROLL BETWEEN FISCAL YEARS 2021 AND 2022

State	Contributions as of payroll (%), 2021	Contributions as of payroll (%), 2022	Increase in contributions as of payroll (%), 2021–2022	Increase in contributions ($ in millions), 2021–2022
Vermont	15.55	34.85	19.30	300.25
Connecticut	35.29	49.21	13.92	1276.55
Oregon	17.67	31.14	13.47	1868.70
Wyoming	9.72	13.97	4.25	84.62
Michigan	29.89	34.04	4.15	809.76
Massachusetts	20.51	24.01	3.50	580.33
New Jersey	14.80	18.17	3.37	982.31
New Hampshire	15.45	18.81	3.37	119.75
Maine	11.21	14.40	3.19	119.96
Alaska	35.65	38.40	2.75	1.84

TABLE 4 LOCAL GOVERNMENTS WITH LARGEST INCREASE IN CONTRIBUTIONS AS OF PAYROLL BETWEEN FISCAL YEARS 2021 AND 2022

Local government	Contributions as of payroll (%), 2021	Contributions as of payroll (%), 2022	Increase in contributions as of payroll (%), 2021–2022	Increase in contributions ($ in millions), 2021–2022
Norwich City, CT	30.00	332.03	302.03	131.97
Norfolk City, VA	19.50	79.93	60.43	121.76
Dover City, DE	67.42	126.26	58.85	2.35
Merced County, CA	8.67	45.99	37.32	53.73
Hialeah City, FL	65.68	92.40	26.72	16.95
Arlington Heights Village, IL	37.65	52.79	15.14	4.09
San Diego City, CA	69.62	84.14	14.51	52.23
New Haven City, CT	56.31	70.39	14.08	17.53
Portland City, OR	92.47	105.79	13.32	24.60
Chicago Metro Water, IL	47.43	60.53	13.09	29.66

FIGURE 1 Pension asset and liabilities
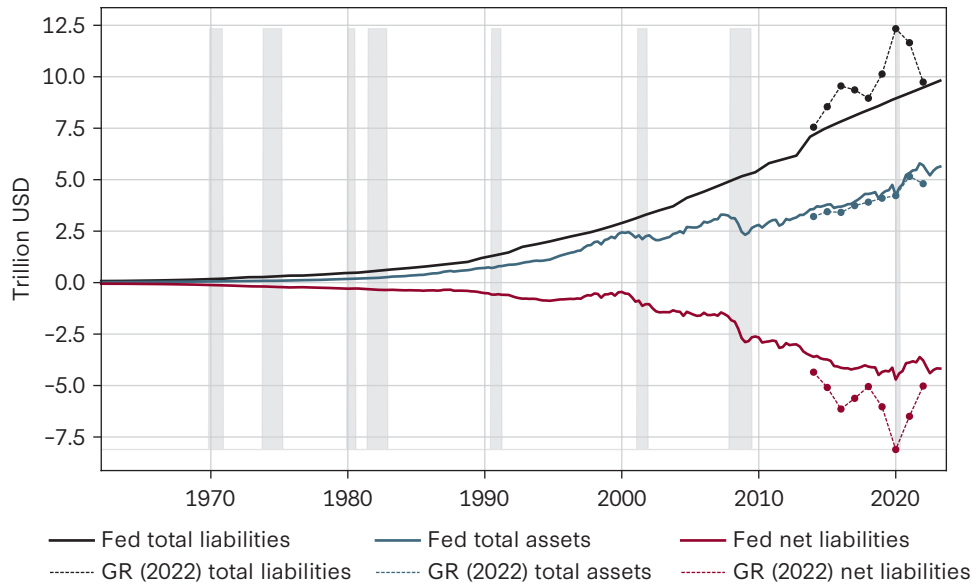
Notes: The pension entitlements of state and local government employees defined benefit retirement funds (Fed Total Liabilities), the total assets (Fed Total Assets) and the unfunded liabilities (Fed Net Liabilities) are estimates of the Board of Governors of the Federal Reserve and were retrieved from Federal Reserve Economic Data (FRED), Federal Reserve Bank St. Louis, with the series codes BOGZ1FL224190043Q, BOGZ1FL222000075Q, BOGZ1FL223073045Q, respectively. The series for GR (2022) total liabilities, GR (2022) total assets, and GR (2022) net liabilities are calculations of the authors based on the collected data of 648 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 appendix.

FIGURE 2 Net change unfunded pension liability, 2021–2022
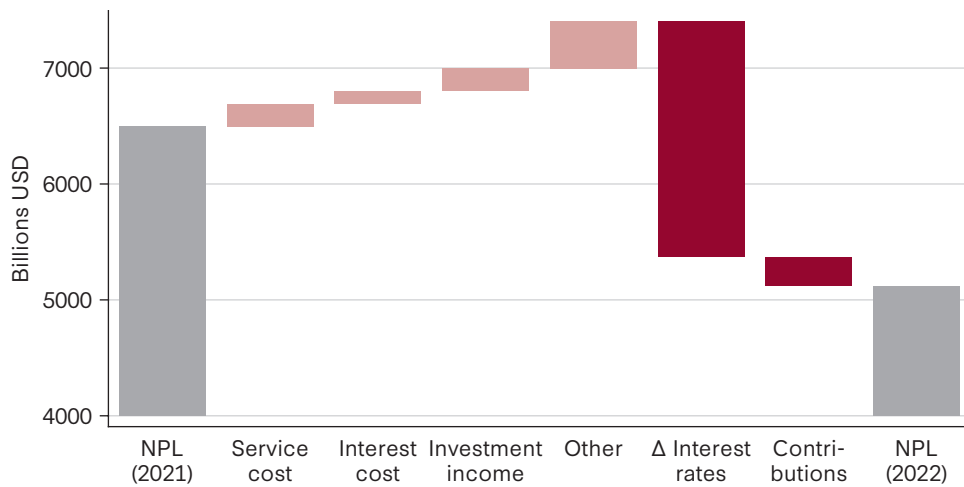
Notes: The figure shows the components that contributed to the year-over-year changes in the unfunded pension liability (NPL) for all local and state plans between fiscal years 2021 and 2022. "Other" includes differences between actual and expected experience, changes in demographic assumptions, changes in benefit terms, and administrative expenses.

FIGURE 3 Discount rates
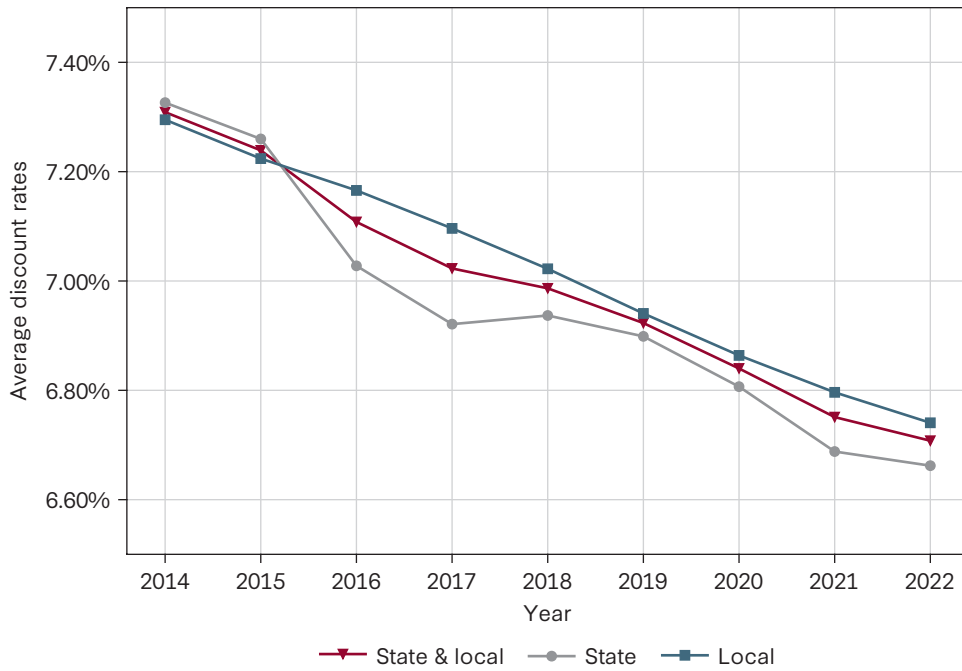
Notes: The figure displays the liability weighted discount rate for all 648 local and state plans between 2014 to 2022. The time series is constructed by weighting the plan-specific discount rate by the total pension liability.

FIGURE 4 Funding ratio
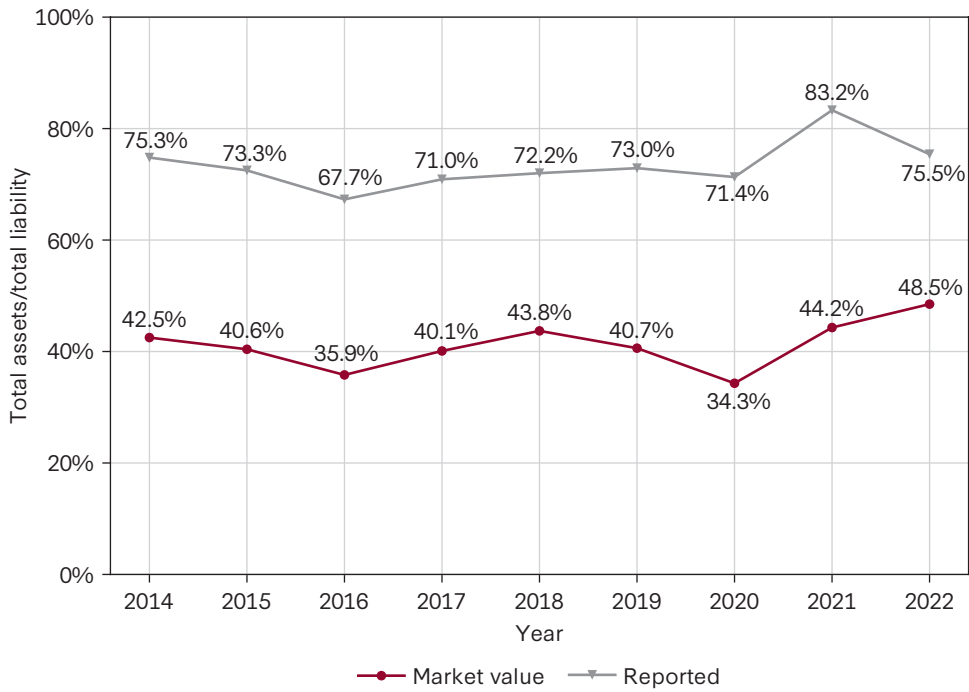
Notes: The figure displays the funding ratio for all local and state plans from 2014 to 2022. The time series is constructed by weighting the funding ratio of each plan by the total pension liability.

FIGURE 5   Service cost as percentage of payroll
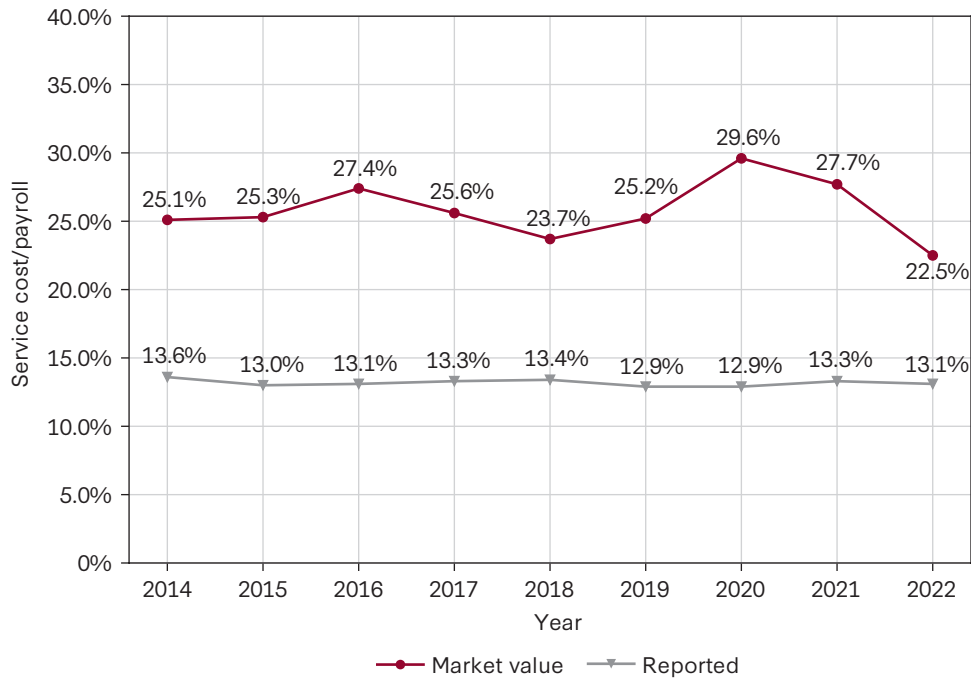
Notes: The figure shows service cost as a share of covered employee payroll for all local and state plans from 2014 to 2022. The time series is constructed by weighting the service cost to covered employee payroll ratio by the covered payroll. The pink line uses the market value of service cost divided by covered employee payroll. The grey line uses the reported value service cost divided by covered employee payroll.

FIGURE 6   Contributions as percentage of payroll, 2014–2022
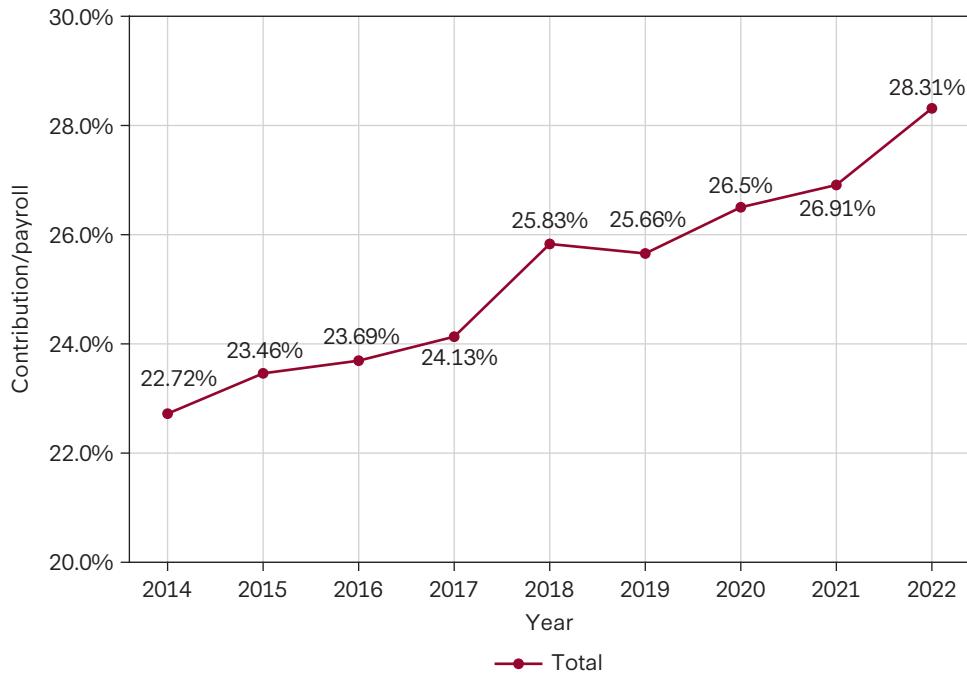
Notes: The figure shows the actual contributions as a share of covered employee payroll for all local and state plans from 2014 to 2022. The time series is constructed by weighting the contribution as of covered employee payroll ratio by the covered payroll.

FIGURE 7 Contribution minus service cost as percentage of payroll
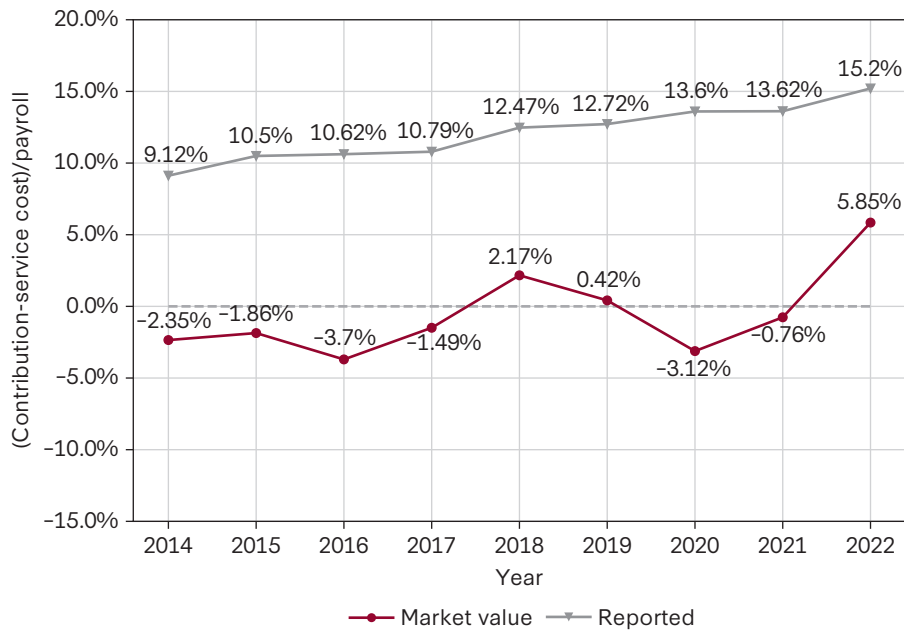
Notes: The figure shows the actual contributions minus service cost as a share of covered employee payroll for all local and state plans from 2014 to 2022. The time series is constructed by weighting the service cost to covered employee payroll ratio by the covered payroll. The grey line uses the actual 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.

FIGURE 8 Actual and required employer contributions
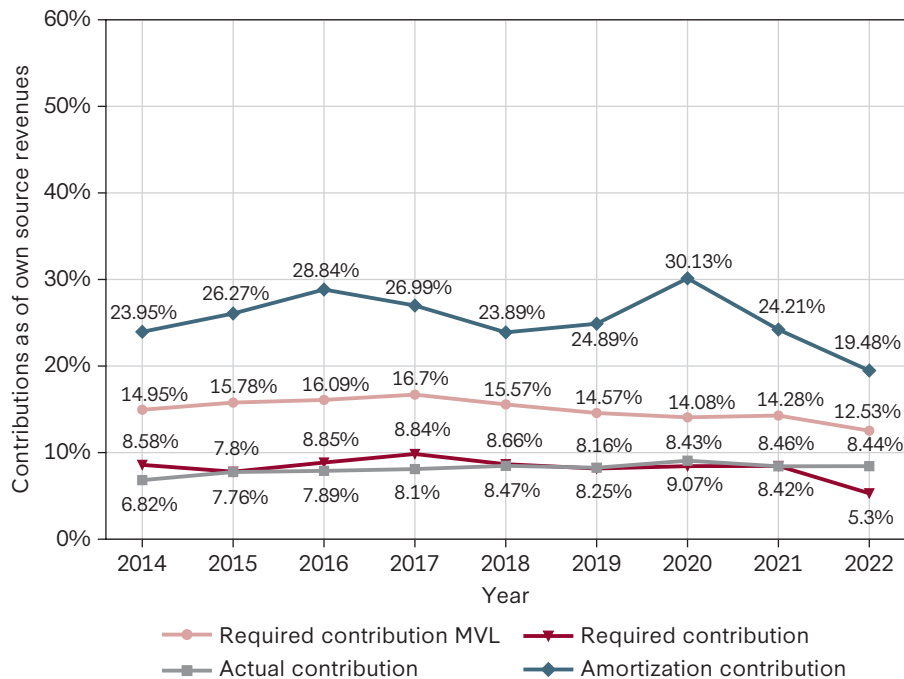
Notes: The figure displays the actual contribution as a share of own source revenues, the required contribution to keep the unfunded liability constant, and the required contribution under market valuation to keep the unfunded liability constant for local, state, and local and state plans from 2014 to 2022. The time series is constructed by weighting the contribution to own source revenue ratio by the own source revenue of the entity.

FIGURE 9 Investment returns
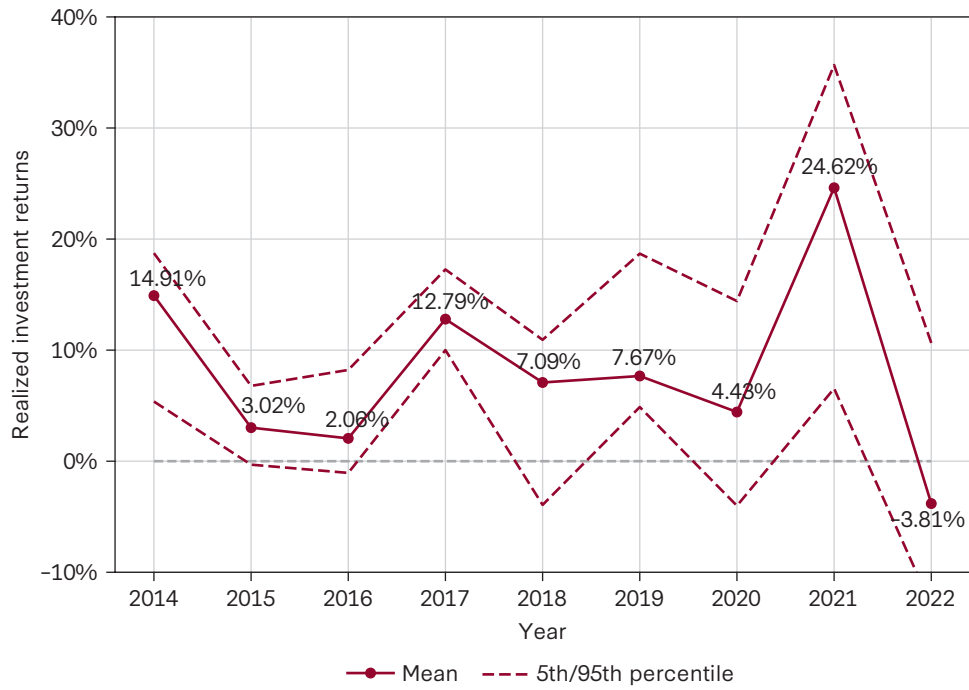
(a) Realized returns
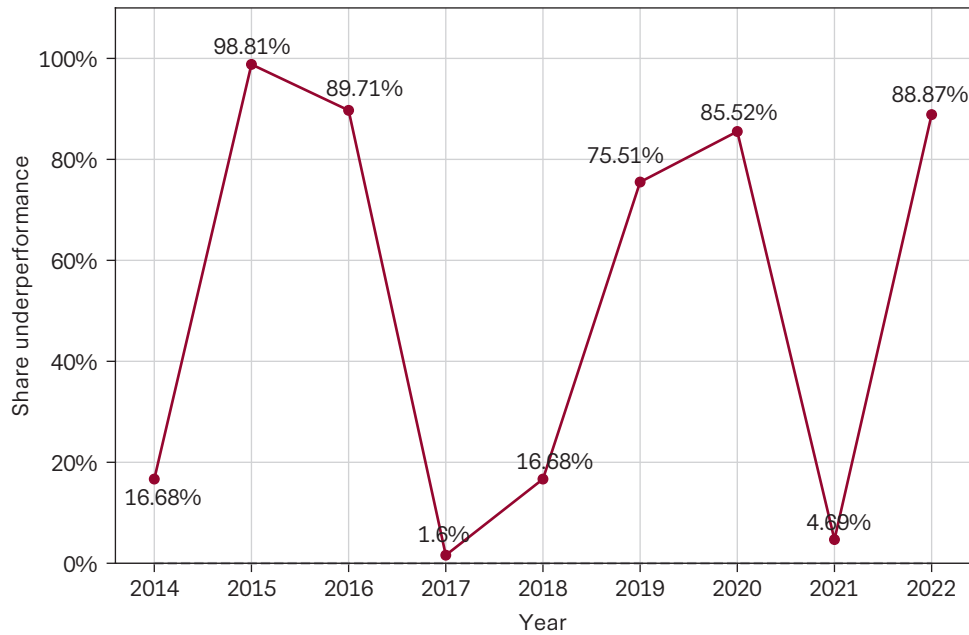
(b) Share underperformance

Notes: Panel (a) displays the mean and the 5th and 95th percentiles of the yearly realized investment returns for local, state, and local and state plans between 2014 to 2022. The time series is constructed by weighting the investment returns of each plan by the fiduciary net position (assets). Panel (b) plots the share of pension funds whose realized returns are below the assumed discount rates. The share represents the fiduciary net position (assets) weighted proportion of underperforming funds.

FIGURE 10 State funding ratio

(a) Lowest 25 states

State	Market value	Reported
New Jersey	29.3%	45.0%
Kentucky	32.2%	47.7%
Connecticut	32.6%	50.9%
Mississippi	35.5%	60.1%
Illinois	36.2%	55.9%
South Carolina	36.8%	58.3%
Hawaii	38.8%	62.8%
Vermont	38.8%	61.9%
Alabama	40.1%	61.4%
Pennsylvania	40.9%	61.4%
Massachusetts	41.3%	63.0%
New Mexico	41.7%	67.1%
North Dakota	42.7%	60.4%
New Hampshire	42.8%	65.1%
Colorado	44.0%	65.8%
Kansas	44.0%	69.8%
Montana	44.4%	72.8%
Nevada	44.8%	75.2%
Texas	45.1%	75.3%
Georgia	45.1%	72.4%
Alaska	45.9%	71.8%
Arizona	46.5%	73.4%
Michigan	46.6%	62.1%
Rhode Island	47.4%	67.4%
California	47.5%	76.8%

(b) Highest 25 states

State	Market value	Reported
Arkansas	47.7%	78.0%
Missouri	48.5%	79.2%
Maryland	49.0%	75.7%
Ohio	50.0%	75.7%
Louisiana	50.1%	73.8%
Oklahoma	50.3%	77.8%
Indiana	50.4%	72.9%
Minnesota	51.4%	77.7%
Wyoming	52.7%	75.5%
Delaware	53.7%	87.2%
Virginia	54.2%	85.0%
Florida	54.2%	82.9%
Oregon	54.7%	84.5%
West Virginia	56.0%	87.5%
Idaho	56.7%	84.1%
North Carolina	56.7%	84.2%
Nebraska	56.8%	94.1%
Maine	58.1%	87.3%
Utah	62.6%	94.0%
Washington	63.7%	103.9%
Iowa	64.5%	90.5%
New York	64.5%	101.4%
South Dakota	64.7%	100.1%
Tennessee	67.4%	104.8%
Wisconsin	74.0%	106.0%

Notes: Panel (a) plots the funding ratio for the 25 states with the lowest funding ratio under market values in 2022. Panel (b) plots the funding ratio for the 25 states with the highest funding ratio under market values. The pink bar represents the funding ratio which is calculated as the ratio of the reported pension assets and the restated total pension liability under market values. The grey bar represents the reported funding ratio, which uses the ratio of reported total pension assets divided by reported total pension liability.

FIGURE 11 State service cost as percentage of payroll

(a) Highest 25 states   (b) Lowest 25 states
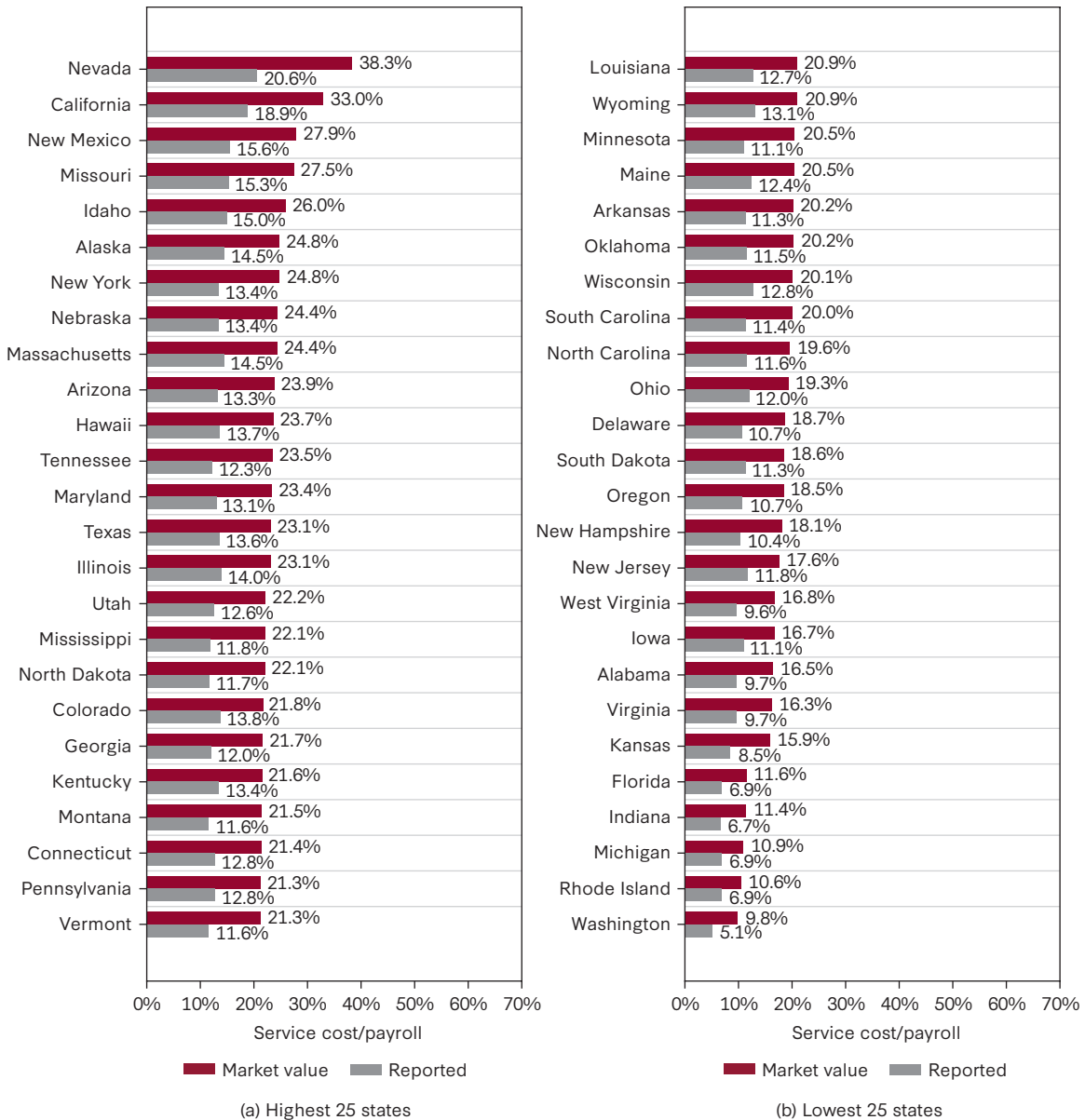
Notes: Panel (a) plots the states with the 25 highest service cost as percentage of payroll under market valuation in 2022. Panel (b) plots the states with the 25 lowest service cost as percentage of payroll under market valuation. The reported service cost as a percentage of payroll normalizes the service cost by the payroll paid in the current period. It provides a measure of newly accrued pension liability per unit of payroll. The market value of the service cost as a percentage of payroll uses the market valuation of the service cost by restating the service cost using a zero-coupon Treasury yield curve instead of the reported discount rate.

FIGURE 12 State contribution minus service cost as percentage of payroll

(a) Lowest 25 states
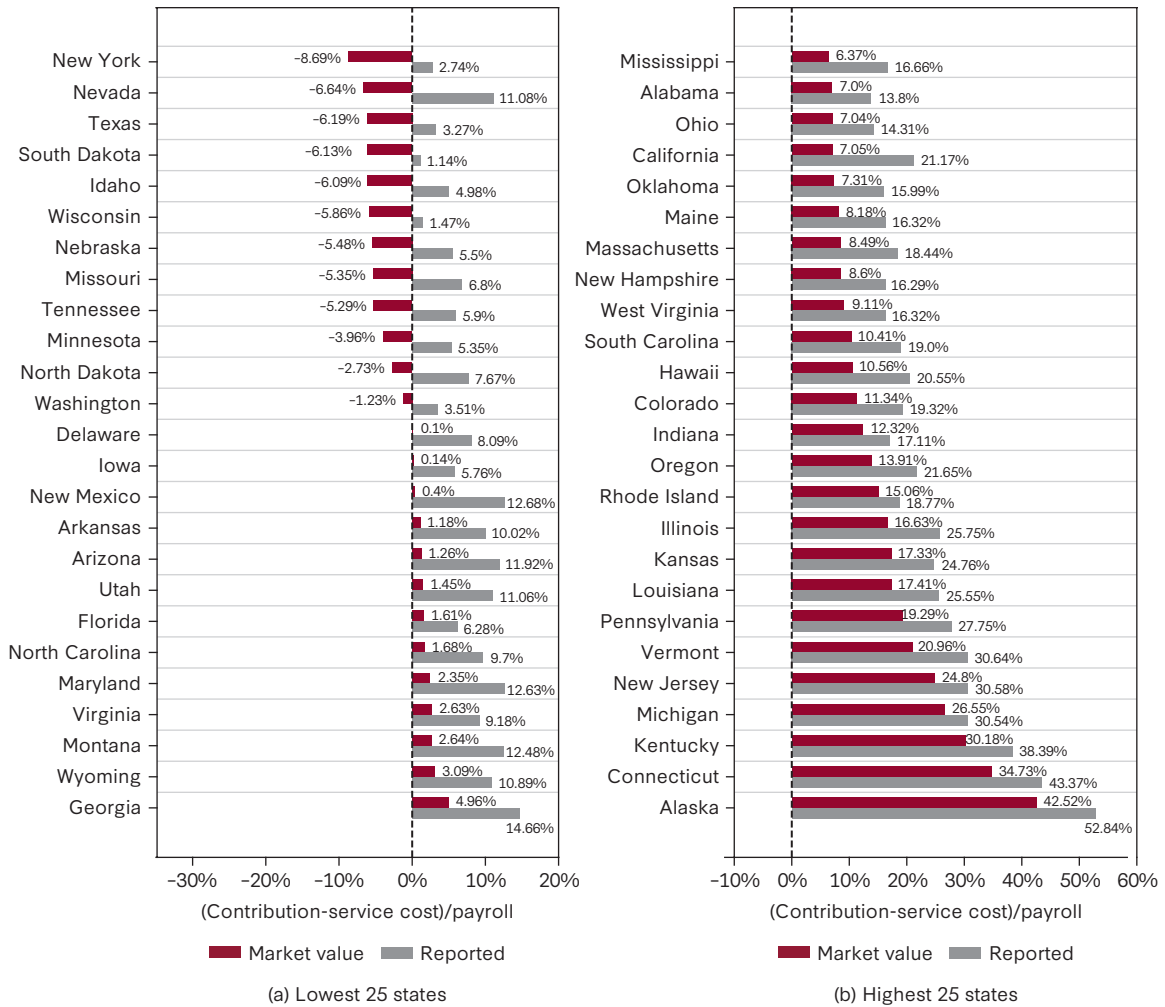
(b) Highest 25 states

Notes: Panel (a) plots the states with the lowest values of the contribution minus service cost as percentage of payroll under market valuation in 2022. Panel (b) plots the states with the highest 25 values of the same measure. Under the market valuation we restate the value of the service cost using a zero-coupon Treasury yield curve instead of the reported discount rate.

FIGURE 13 State service cost as percentage of own source revenue

(a) Highest 25 states

State	Market value	Reported
Nevada	19.6%	10.5%
Missouri	15.1%	8.4%
Texas	12.4%	7.3%
South Dakota	12.4%	7.5%
Illinois	12.3%	7.4%
Ohio	11.9%	7.4%
Washington	11.0%	5.7%
Louisiana	10.9%	6.6%
Idaho	10.8%	6.2%
Wyoming	10.6%	6.7%
New Mexico	10.6%	5.9%
Montana	10.1%	5.5%
Mississippi	9.8%	5.2%
North Carolina	9.6%	5.7%
Wisconsin	9.5%	6.1%
New York	9.4%	5.1%
Arizona	9.4%	5.2%
California	9.4%	5.4%
Georgia	9.1%	5.0%
New Hampshire	9.1%	5.2%
Minnesota	8.9%	4.9%
South Carolina	8.8%	5.0%
Hawaii	8.7%	5.0%
Maryland	8.6%	4.8%
Nebraska	8.6%	4.7%

(b) Lowest 25 states

State	Market value	Reported
Colorado	8.6%	5.5%
Kentucky	8.5%	5.3%
Iowa	8.1%	5.4%
Maine	7.8%	4.7%
New Jersey	7.7%	5.2%
Alabama	7.6%	4.5%
Oklahoma	7.6%	4.3%
Oregon	7.4%	4.3%
Massachusetts	7.2%	4.2%
Arkansas	7.1%	4.0%
North Dakota	7.0%	3.7%
Alaska	6.8%	3.9%
Connecticut	6.7%	4.0%
Kansas	6.4%	3.4%
Virginia	6.3%	3.7%
Florida	6.2%	3.7%
Utah	5.9%	3.4%
Vermont	5.8%	3.2%
Pennsylvania	5.7%	3.4%
Delaware	5.7%	3.3%
Tennessee	5.6%	2.9%
West Virginia	5.5%	3.2%
Rhode Island	4.4%	2.9%
Indiana	3.5%	2.1%
Michigan	2.7%	1.7%

Notes: Panel (a) displays the states with the highest service cost as a percentage of own source revenue under market valuation in 2022. Panel (b) shows the states with the lowest service cost as a percentage of own source revenue under market valuation. The market value of service cost as a percentage of own source revenue restates the service cost as a percentage of own source revenues by using a zero-coupon Treasury yield curve instead of the assumed discount rate.

FIGURE 14 Contribution scenario—states

(a) Highest 25 states (b) Lowest 25 states
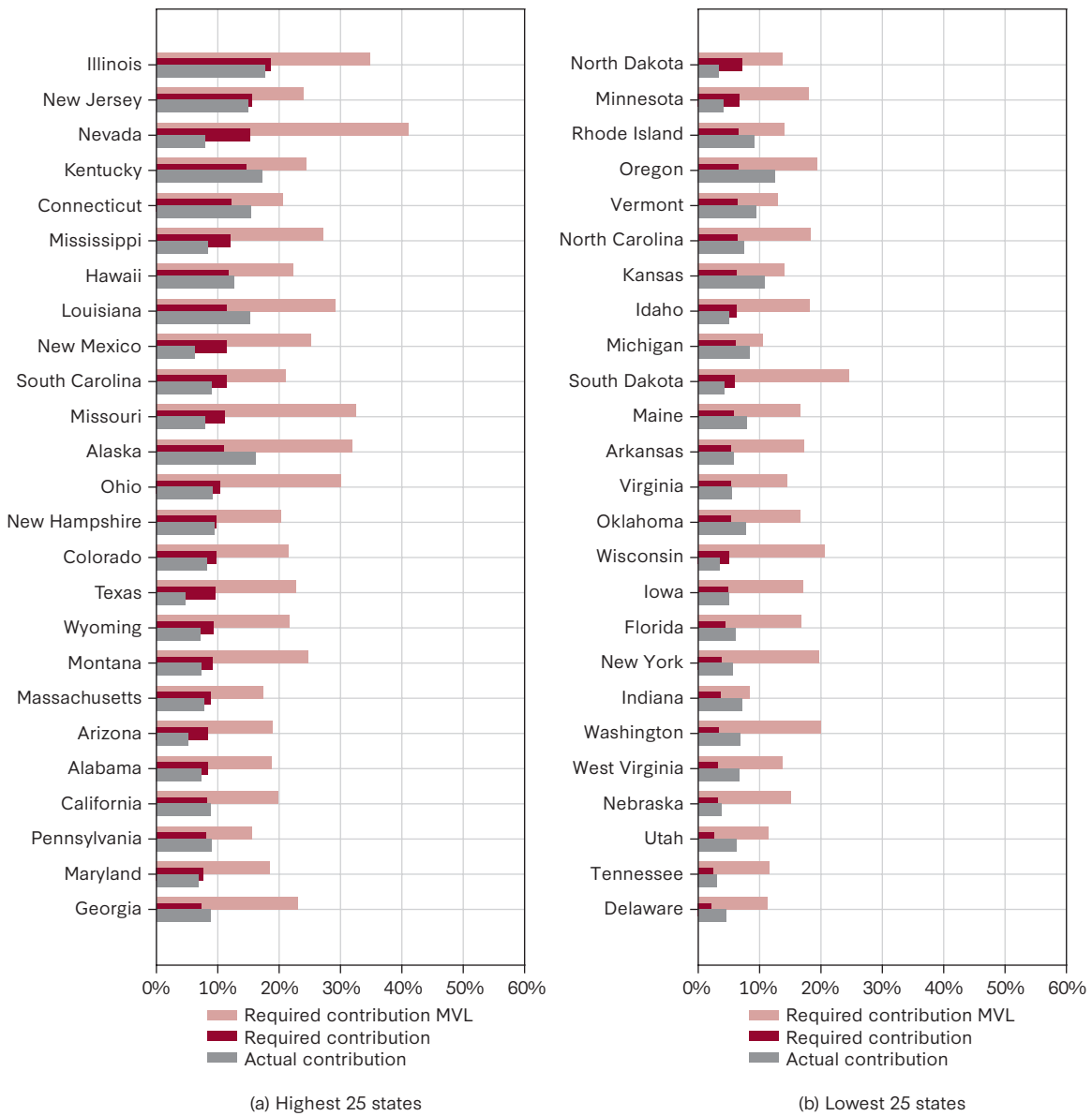
Notes: Panel (a) displays the 25 states with the highest required contribution to prevent the unfunded liability from rising as of own source revenue in fiscal year 2022. Panel (b) shows the 25 states with the lowest required contribution to prevent the unfunded liability from rising. The required contribution under market valuation restates the interest and service cost, as well as investment returns under a duration matched zero-coupon Treasury yield curve instead of the stated discount rate.

FIGURE 15 Contribution scenario—cities and counties

(a) Highest 25 cities

(a) Highest 25 counties
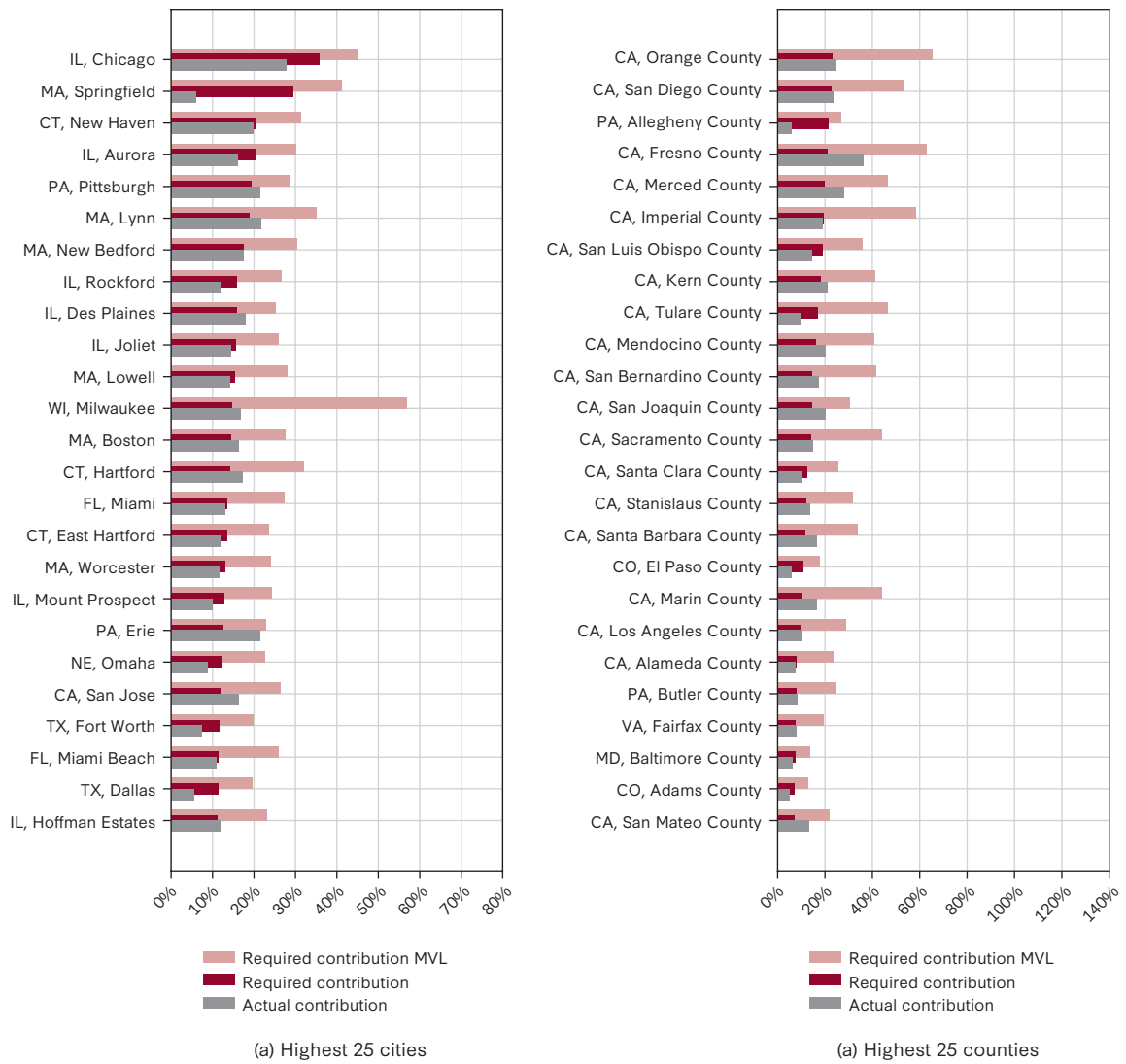
Notes: Panel (a) displays the 25 cities with the highest required contribution to prevent the unfunded liability from rising as of own source revenue in fiscal year 2022. Panel (b) shows the 25 counties with the highest required contribution to prevent the unfunded liability from rising. The required contribution under market valuation restates the interest and service cost, as well as investment returns under a duration matched zero-coupon Treasury yield curve instead of the stated discount rate.

FIGURE 16 Change in state funding ratio, 2021–2022

(a) Highest 25 states

State	Market value	Reported
Wisconsin	17.8%	0.0%
Iowa	11.4%	−9.9%
Montana	10.2%	−6.3%
Oregon	9.0%	−3.1%
Utah	8.4%	−11.3%
Rhode Island	8.3%	−4.7%
Tennessee	7.8%	−9.6%
Virginia	7.0%	−3.4%
Maine	6.5%	−5.6%
Michigan	6.4%	−11.4%
Wyoming	6.3%	−9.5%
Hawaii	6.3%	−1.5%
Washington	5.9%	−14.7%
Maryland	5.7%	−5.1%
Arizona	5.5%	−4.3%
South Dakota	5.3%	−5.4%
California	5.1%	−6.4%
Massachusetts	5.1%	−5.4%
Texas	4.8%	−2.6%
Indiana	4.3%	−7.4%
Minnesota	4.2%	−11.8%
Louisiana	4.1%	−9.9%
Kansas	4.1%	−6.6%
New Mexico	3.8%	−6.4%
South Carolina	3.8%	−3.7%

Δ Total assets/total liability

(b) Lowest 25 states

State	Market value	Reported
North Carolina	3.7%	−10.9%
Connecticut	3.6%	−3.3%
Vermont	3.6%	−6.5%
Alaska	3.1%	−9.3%
New Hampshire	3.1%	−7.1%
Idaho	3.0%	−17.5%
West Virginia	3.0%	−10.5%
Colorado	2.9%	−13.4%
Illinois	2.7%	−7.3%
Ohio	2.6%	−12.6%
New York	2.5%	−2.5%
Arkansas	2.4%	−12.2%
North Dakota	2.4%	−17.7%
Kentucky	2.4%	−5.4%
Florida	2.3%	−13.5%
Nebraska	2.3%	−16.7%
Nevada	2.1%	−11.3%
Missouri	2.0%	−10.7%
New Jersey	2.0%	−5.1%
Pennsylvania	1.5%	−6.2%
Alabama	1.2%	−14.0%
Mississippi	0.9%	−10.5%
Oklahoma	0.5%	−13.8%
Georgia	−0.8%	−19.3%
Delaware	−3.8%	−21.0%

Δ Total assets/total liability

Notes: Panel (a) displays the states with the largest change in the funding ratio based on market values between 2021 and 2022. Panel (b) displays the states with the smallest change in the funding ratio based on market values between 2021 and 2022. The funding ratio based on market values is computed using a zero-coupon Treasury yield curve instead of the assumed discount rate.

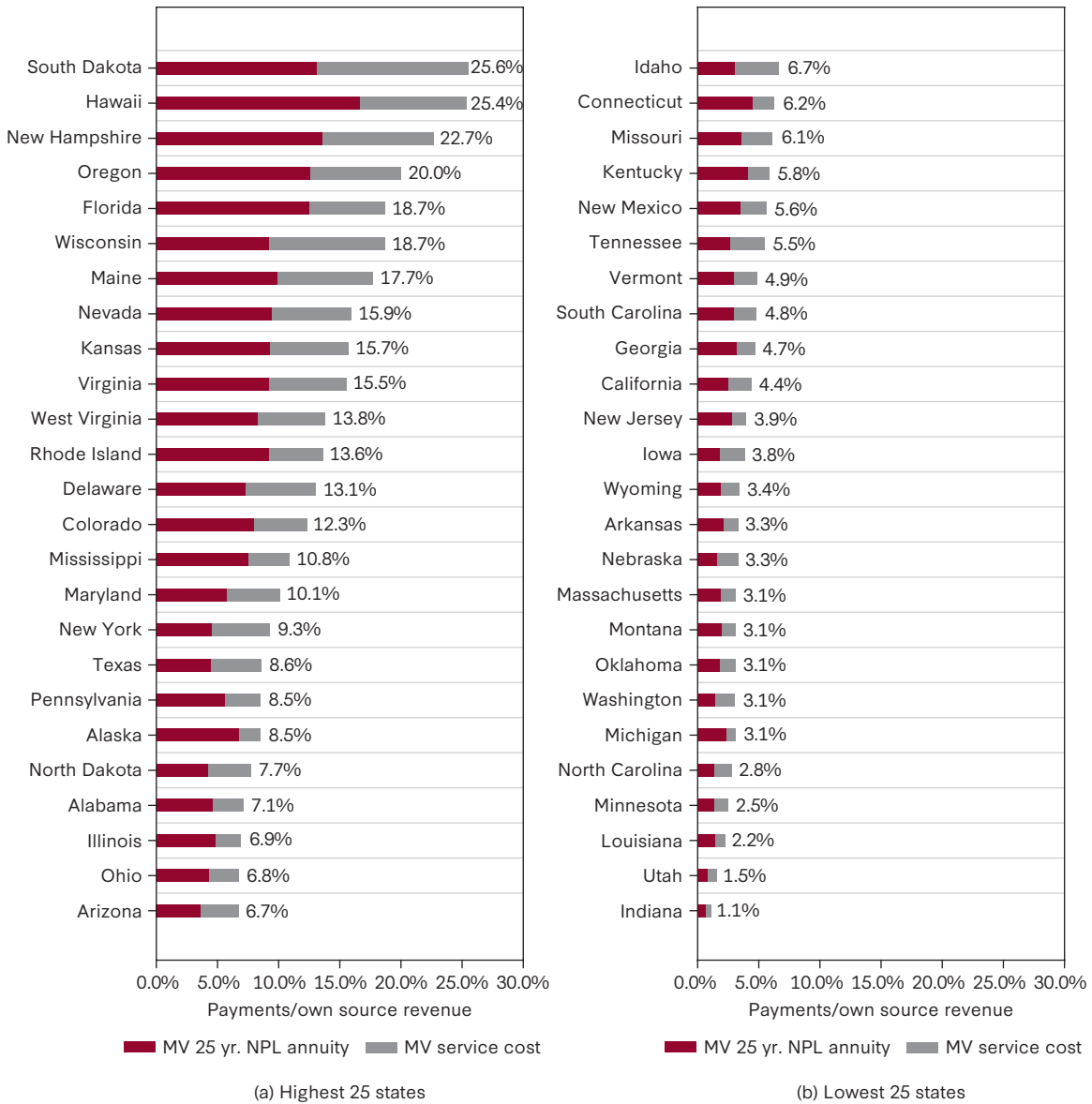**FIGURE 17** Annuitization of state NPL, service cost as percentage of payroll

(a) Highest 25 states

State	Value
South Dakota	25.6%
Hawaii	25.4%
New Hampshire	22.7%
Oregon	20.0%
Florida	18.7%
Wisconsin	18.7%
Maine	17.7%
Nevada	15.9%
Kansas	15.7%
Virginia	15.5%
West Virginia	13.8%
Rhode Island	13.6%
Delaware	13.1%
Colorado	12.3%
Mississippi	10.8%
Maryland	10.1%
New York	9.3%
Texas	8.6%
Pennsylvania	8.5%
Alaska	8.5%
North Dakota	7.7%
Alabama	7.1%
Illinois	6.9%
Ohio	6.8%
Arizona	6.7%

(b) Lowest 25 states

State	Value
Idaho	6.7%
Connecticut	6.2%
Missouri	6.1%
Kentucky	5.8%
New Mexico	5.6%
Tennessee	5.5%
Vermont	4.9%
South Carolina	4.8%
Georgia	4.7%
California	4.4%
New Jersey	3.9%
Iowa	3.8%
Wyoming	3.4%
Arkansas	3.3%
Nebraska	3.3%
Massachusetts	3.1%
Montana	3.1%
Oklahoma	3.1%
Washington	3.1%
Michigan	3.1%
North Carolina	2.8%
Minnesota	2.5%
Louisiana	2.2%
Utah	1.5%
Indiana	1.1%

X-axis: Payments/own source revenue
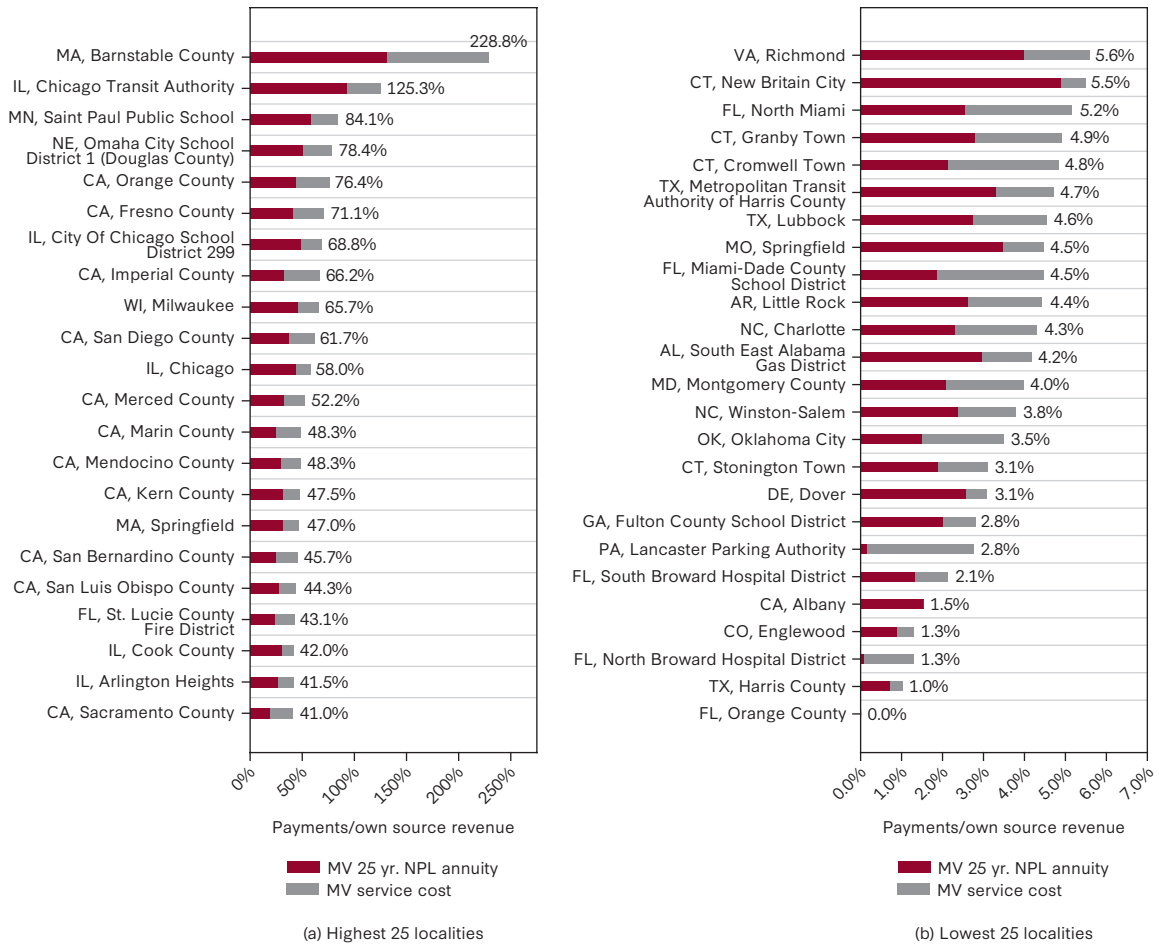
Legend: MV 25 yr. NPL annuity, MV service cost

Notes: Panel (a) displays the states with the largest combined required payment for service cost and amortization of the unfunded pension obligation under market values in fiscal year 2022. Panel (b) displays the states with the lowest combined required payment for service cost and amortization of the unfunded pension obligation under market values in fiscal year 2022. Market values are computed under the duration matched Treasury yield instead of the assumed discount rate.

FIGURE 18 Change in local funding ratio, 2021–2022
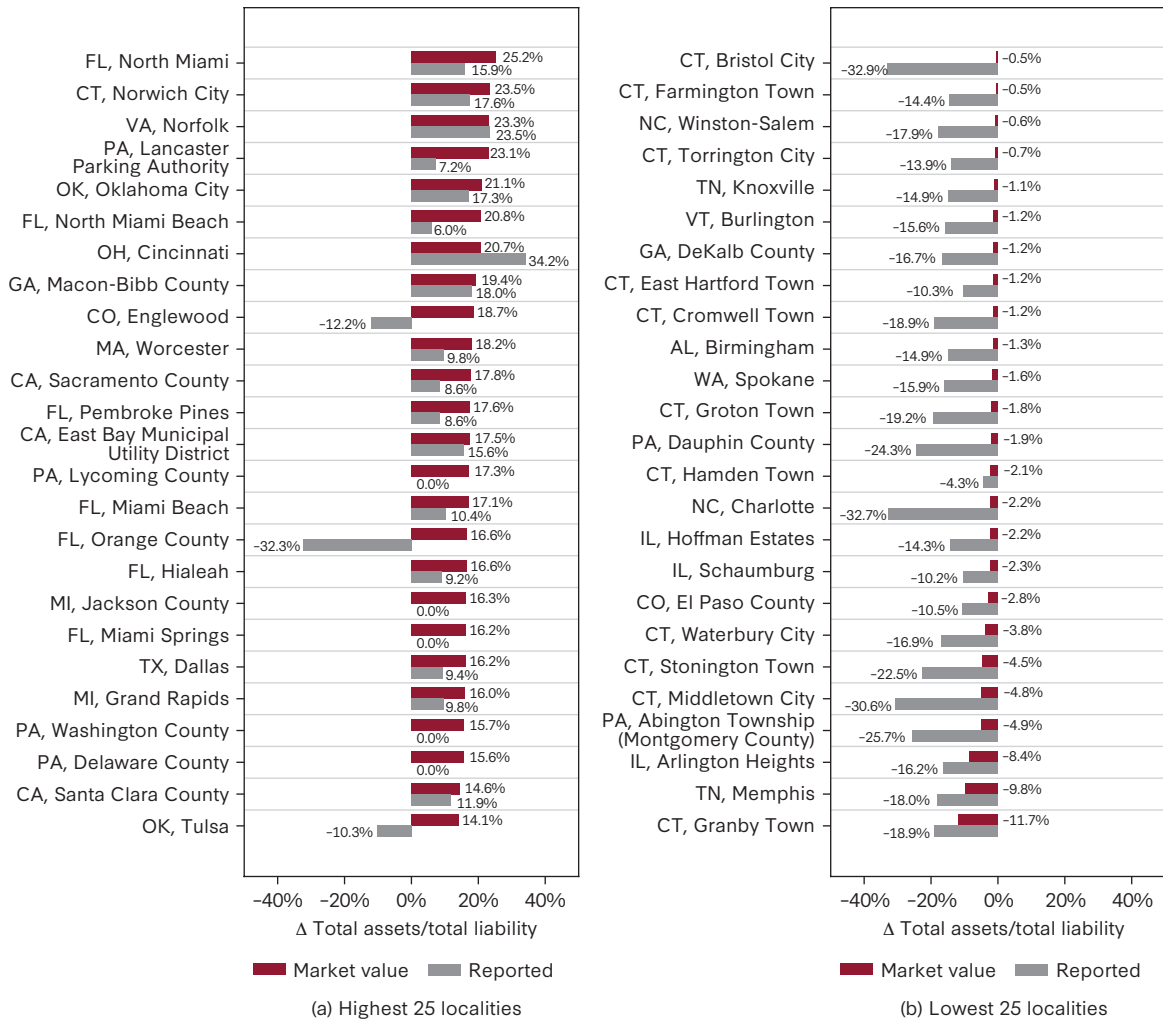
(a) Highest 25 localities

(b) Lowest 25 localities

Notes: Panel (a) displays the local governments with the largest change in the funding ratio based on market values between 2021 and 2022. Panel (b) displays the local governments with the smallest change in the funding ratio based on market values between 2021 and 2022. The funding ratio based on market values is computed using a zero-coupon Treasury yield curve instead of the assumed discount rate.

FIGURE 19 Annuitization of local NPL, service cost as percentage of payroll

(a) Highest 25 localities	
MA, Barnstable County	228.8%
IL, Chicago Transit Authority	125.3%
MN, Saint Paul Public School	84.1%
NE, Omaha City School District 1 (Douglas County)	78.4%
CA, Orange County	76.4%
CA, Fresno County	71.1%
IL, City Of Chicago School District 299	68.8%
CA, Imperial County	66.2%
WI, Milwaukee	65.7%
CA, San Diego County	61.7%
IL, Chicago	58.0%
CA, Merced County	52.2%
CA, Marin County	48.3%
CA, Mendocino County	48.3%
CA, Kern County	47.5%
MA, Springfield	47.0%
CA, San Bernardino County	45.7%
CA, San Luis Obispo County	44.3%
FL, St. Lucie County Fire District	43.1%
IL, Cook County	42.0%
IL, Arlington Heights	41.5%
CA, Sacramento County	41.0%

(b) Lowest 25 localities	
VA, Richmond	5.6%
CT, New Britain City	5.5%
FL, North Miami	5.2%
CT, Granby Town	4.9%
CT, Cromwell Town	4.8%
TX, Metropolitan Transit Authority of Harris County	4.7%
TX, Lubbock	4.6%
MO, Springfield	4.5%
FL, Miami-Dade County School District	4.5%
AR, Little Rock	4.4%
NC, Charlotte	4.3%
AL, South East Alabama Gas District	4.2%
MD, Montgomery County	4.0%
NC, Winston-Salem	3.8%
OK, Oklahoma City	3.5%
CT, Stonington Town	3.1%
DE, Dover	3.1%
GA, Fulton County School District	2.8%
PA, Lancaster Parking Authority	2.8%
FL, South Broward Hospital District	2.1%
CA, Albany	1.5%
CO, Englewood	1.3%
FL, North Broward Hospital District	1.3%
TX, Harris County	1.0%
FL, Orange County	0.0%

Payments/own source revenue

■ MV 25 yr. NPL annuity
■ MV service cost

Notes: Panel (a) displays the local governments with the largest combined required payment for service cost and amortization of the unfunded pension obligation under market values in fiscal year 2022. Panel (b) displays the local governments with the lowest combined required payment for service cost and amortization of the unfunded pension obligation under market values in fiscal year 2022. Market values are computed under the duration matched Treasury yield instead of the assumed discount rate.

APPENDIX

DETAILS ON REVALUATION AND ADDITIONAL CONTRIBUTIONS

$TPL_t = TPL_{t-1} + Service\ Cost_t + Interest\ Cost_t - Benefits\ Paid_t + All\ other\ Adjustments$

$Assets_t\ (FNP)_t = Assets\ (FNP)_{t-1} + Employer\ Contribution_t + Member\ Contribution_t$
$+ Other\ Contribution_t + Net\ Investment\ Income_t$
$- Benefits\ Paid_t - Administrative\ Expenses_t$
$+ Transfers\ Among\ Employers\ and\ All\ Other\ Adjustments$

$NPL_t = TPL_t - Assets_t$

$Required\ Additional\ Contribution\ Under\ Assumed\ Return_t =$
$(Service\ Cost_t + Interest\ Cost_t) - (Employer\ Contribution_t$
$+ Member\ Contribution_t + Other\ Contribution_t)$
$- Assumed\ Return\ \% \times FNP_{t-1}$

$Required\ Additional\ Contribution\ Under\ MVL_t =$
$(Service\ Cost_t^\star + Interest\ Cost_t^\star)$
$- (Employer\ Contribution_t + Member\ Contribution_t$
$+ Other\ Contribution_t) - R' \times FNP_{t-1}$

where R' is the duration matched treasury yield and $Service\ Cost_t^\star$ and $Interest\ Cost_t^\star$ is the service cost and interest cost under market valuation, respectively.

$Annuitization\ Cost_{t,\ 25\ years}^\star = Service\ Cost_t^\star + Annuitization\ Payment_{t,\ 25\ years}^\star$

$Annuitization\ Payment_{t,\ 25\ years}^\star = \dfrac{NPL_t^\star \times R'}{1 - (1+R')^{-25}}$

$Duration = \dfrac{TPL_{R+1\%} - TPL_{R-1\%}}{2 \times TPL_R}$

$Convexity = \dfrac{TPL_{R+1\%} + TPL_{R-1\%} - 2 \times TPL_R}{TPL_R \times (0.01)^2}$

$TPL_{R'} = -Duration \times \Delta R + 0.5 \times Convexity \times (\Delta R)^2$

where $\Delta R = (R' - R)$

TABLE A.1 PENSION PLAN LIST

Pension plan	Pension plan
AK, State of Alaska Judicial Retirement System	CA, Alameda County Employees' Retirement Association
AK, State of Alaska National Guard and Naval Militia Retirement System	CA, Albany Police and Fire Relief Fund
AK, State of Alaska Public Employees' Retirement System	CA, California State Teachers' Retirement System
AK, State of Alaska Teachers' Retirement System	CA, CalPERS: Public Employees' Retirement Fund B (schools)
AL, Birmingham Firemen's and Policemen's Supplemental Pension System	CA, CalPERS: Public Employees' Retirement Fund C (small agencies)
AL, Birmingham Retirement and Relief Plan	CA, City of Concord Retirement System Plan
AL, Employees' Retirement System of Alabama	CA, City of Fresno Employees' Retirement System
AL, Judicial Retirement Fund	CA, City of Fresno Fire and Police Retirement System
AL, Southeast Alabama Gas District Pension Plan	CA, City of Oakland Police and Fire Retirement System
AL, Teachers' Retirement System of Alabama	CA, City of Pasadena Fire and Police Retirement System
AR, Arkansas Judicial Retirement System	CA, City of San Jose Federated City Employees' Retirement System
AR, Arkansas Local Police and Fire Retirement System	CA, City of San Jose Police and Fire Department Retirement Plan
AR, Arkansas Public Employees' Retirement System	CA, Contra Costa County Employees' Retirement Association
AR, Arkansas State Highway Employees' Retirement System	CA, East Bay Municipal Utility District Employees' Retirement Plan
AR, Arkansas State Police Retirement System	CA, Fresno County Employees' Retirement Association
AR, Arkansas Teacher Retirement System	CA, Imperial County Employees' Retirement System
AR, Fayetteville Firemen's Pension and Relief Fund	CA, Judges' Retirement Fund
AR, Fayetteville Policemen's Retirement System	CA, Judges' Retirement Fund II
AR, Little Rock 2014 Defined Benefit	CA, Kern County Employees' Retirement Association
AR, Little Rock City Firemen's Relief and Pension Fund	CA, Legislators' Retirement Fund
AR, Little Rock City Police Pension and Relief Fund	CA, Long Beach Public Trans Co. Employees' Retirement System
AR, Little Rock Non-Uniformed Employees' Defined Benefit Plan	CA, Los Angeles City Employees' Retirement System
AZ, Arizona State Retirement System	CA, Los Angeles City Fire and Police Pension System
AZ, City of Phoenix Employees' Retirement System	
AZ, Corrections Officer Retirement Plan	
AZ, Elected Officials' Retirement Plan	
AZ, Tuscon Supplemental Retirement System	

(Continued)

Pension plan	Pension plan
CA, Los Angeles City Water and Power Employees' Retirement Plan	CA, San Francisco Employees' Retirement System
CA, Los Angeles County Employees' Retirement Association	CA, San Joaquin County Employees' Retirement Association
CA, Marin County Employees' Retirement Association	CA, San Luis Obispo County Pension Trust
CA, Mendocino County Employees' Retirement Association	CA, San Mateo County Employees' Retirement Association
CA, Merced County Employees' Retirement Association	CA, Santa Barbara County Employees' Retirement System
CA, Orange County Employees' Retirement System	CA, Santa Clara Amalgamated Transit Union Pension Plan
CA, Public Employees' Retirement Fund Plans (California Highway Patrol)	CA, Santa Clara County Central Fire Safety Plan
CA, Public Employees' Retirement Fund Plans (State Industrial)	CA, Santa Clara County Housing Authority Miscellaneous Plan
CA, Public Employees' Retirement Fund Plans (State Miscellaneous)	CA, Santa Clara County Miscellaneous Plan
CA, Public Employees' Retirement Fund Plans (State Peace Officers and Firefighters)	CA, Santa Clara County Safety Plan
CA, Public Employees' Retirement Fund Plans (State Safety)	CA, Sonoma County Employees' Retirement Association
CA, Richmond Garfield Pension Plan	CA, Stanislaus County Employees' Retirement Association
CA, Richmond General Pension Plan	CA, Tulare County Employees' Retirement Association
CA, Richmond Police and Firemen's Pension Plan	CA, University of California Retirement Plan
CA, Sacramento City Employees' Retirement System	CA, Ventura County Employees' Retirement Association
CA, Sacramento County Employees' Retirement System	CO, Adams County Retirement Plan
CA, San Bernardino County Employees' Retirement Association	CO, Board of Water Commissioners' Retirement Plan Trust Fund
CA, San Diego City Employees' Retirement System—City of San Diego	CO, City of Aurora General Employees' Retirement Plan
CA, San Diego City Employees' Retirement System—Regional Airport Authority	CO, City of Boulder Fire Pension Fund
CA, San Diego City Employees' Retirement System—Unified Port District	CO, City of Boulder Police Pension Fund
CA, San Diego County Employees' Retirement Association	CO, City of Longmont Employee Pension Plan
	CO, City of Longmont Fire Pension Plan
	CO, City of Longmont Police Pension Plan
	CO, Colorado Public Employees' Retirement Association—Denver Public Schools Division
	CO, Colorado Public Employees' Retirement Association—Judicial Division

(*Continued*)

TABLE A.1 PENSION PLAN LIST (*continued*)

Pension plan	Pension plan
CO, Colorado Public Employees' Retirement Association—Local Government Division	CT, Judicial Retirement System
	CT, Milford Retirement System
CO, Colorado Public Employees' Retirement Association—School Division	CT, Municipal Employees' Retirement System
	CT, New Britain Fire Pension Fund
CO, Colorado Public Employees' Retirement Association—State Division	CT, New Britain Police Pension Fund
CO, Denver Employees' Retirement Plan	CT, New Haven City Employees' Retirement Plan
CO, El Paso County Retirement Plan	CT, New Haven Police and Firemen Retirement Plan
CO, Englewood City Employees' Pension System—Non-Emergency Pension Plan	CT, Norwalk Employees' Pension Plan
CO, Fire and Police Pension Association of Colorado—Colorado Springs New Hire Plan (Fire)	CT, Norwalk Fire Benefit Fund
	CT, Norwalk Food Service Employees' Fund
	CT, Norwalk Police Benefit Fund
CO, Fire and Police Pension Association of Colorado—Colorado Springs New Hire Plan (Police)	CT, Stamford Classified Employees' Retirement Fund
CO, Fire and Police Pension Association of Colorado—Statewide Defined Benefit Plan	CT, Stamford Custodians' and Mechanics' Retirement Fund
	CT, Stamford Firefighters' Pension Trust
CO, Fire and Police Pension Association of Colorado—Statewide Hybrid Plan	CT, Stamford Policemen's Pension Trust
CT, Cheshire Fire Department Retirement Plan	CT, State Employees' Retirement System
CT, Cheshire Police Department Retirement Plan	CT, Teachers' Retirement System
CT, Cheshire Town Retirement Plan	CT, Town of Darien Police Pension Fund
CT, City of Bristol Retirement System	CT, Town of Darien Town Pension Plan
CT, City of Hartford Municipal Employees' Retirement Fund	CT, Town of Fairfield Employees' Retirement Plan
	CT, Town of Fairfield Police and Firemen's Retirement Plan
CT, City of Hartford RAF/PBF/FRF Plan	
CT, City of Middletown Employees' Pension Plan	CT, Town of Farmington Town Pension Plan
CT, City of Norwich Retirement System—City Employees	CT, Town of Groton Retirement Fund—Town and Board of Education
CT, City of Norwich Retirement System—Volunteer Fire	CT, Town of Hamden Retirement Pension Trust
	CT, Town of Stonington Employees' Pension Plan
CT, City of Torrington Employee Retirement Plan—Municipal Employees	CT, Town of West Hartford Retirement System
CT, City of Torrington Employee Retirement Plan—Police and Fire	CT, Waterbury Retirement System
	CT, Westport Fire Pension Fund
CT, Cromwell Town Retirement Plan	CT, Westport Police Pension Fund
CT, East Hartford Town Retirement System	CT, Westport Town Pension Fund—Municipal Interim
CT, Granby Town Pension Plan	
CT, Greenwich Town Employee Retirement Plan	CT, Westport Town Pension Fund—Non-Union

(*Continued*)

Pension plan	Pension plan
CT, Westport Town Pension Fund—Public Works	FL, City of Hialeah Employees' Retirement System
DC, District of Columbia Police Officers' and Firefighters' Retirement Fund	FL, City of Jacksonville Corrections Officers' Pension Plan
DC, District of Columbia Teachers' Retirement Fund	FL, City of Jacksonville General Employees' Retirement Plan
DE, City of Dover General Employee Pension Plan	FL, City of Jacksonville Police and Fire Pension Fund
DE, City of Dover Police Pension Plan	FL, City of Miami Elected Officers Retirement Trust
DE, City of Wilmington Firefighters Pension Fund	FL, City of Miami Firefighters and Police Retirement Fund
DE, City of Wilmington Plan I Non-Uniformed	FL, City of Miami General and Sanitation Employees' Excess Benefit Plan
DE, City of Wilmington Plan II Non-Uniformed	FL, City of Miami General and Sanitation Employees' Retirement Fund
DE, City of Wilmington Plan III Non-Uniformed	FL, City of Miami General and Sanitation Employees' Staff Trust Plan
DE, City of Wilmington Police Pension Fund	FL, City of Miami Springs General Employees' Retirement System
DE, Delaware Public Employees' Retirement System—Closed State Police Plan	FL, City of Miami Springs Police and Firefighters' Retirement System
DE, Delaware Public Employees' Retirement System—County and Municipal Other Employees' Plan	FL, City of St Petersburg Employees' Retirement System
DE, Delaware Public Employees' Retirement System—County and Municipal Police and Firefighters' Plans	FL, City of St Petersburg Firefighters' Retirement System
DE, Delaware Public Employees' Retirement System—Delaware Volunteer Firemen's Fund	FL, City of St Petersburg Police Officers' Retirement System
DE, Delaware Public Employees' Retirement System—Diamond State Port Corporation Plan	FL, City of Tallahassee Firefighters' Pension Plan
DE, Delaware Public Employees' Retirement System—Judiciary Pension Plans	FL, City of Tallahassee General Employees' Pension Plan
DE, Delaware Public Employees' Retirement System—New State Police Plan	FL, City of Tallahassee Police Officers' Pension Plan
DE, Delaware Public Employees' Retirement System—Special Fund	FL, City of Tampa General Employees' Pension Plan
DE, Delaware Public Employees' Retirement System—State Employees' Plan	FL, City of Tampa Pension Fund for Firemen and Policemen
FL, City of Cape Coral Municipal Firefighters' Pension Plan	FL, Florida Retirement System Pension Plan
FL, City of Cape Coral Municipal General Employees' Pension Plan	FL, Fort Lauderdale General Employees' Retirement System
FL, City of Cape Coral Municipal Police Officers' Pension Plan	
FL, City of Hialeah Elected Officials' Retirement System	

(Continued)

TABLE A.1 PENSION PLAN LIST (*continued*)

Pension plan	Pension plan
FL, Fort Lauderdale Police and Firefighters' Retirement System	GA, Augusta City 1945 Pension Plan
FL, Hollywood City Fire Pension System	GA, Augusta City General Retirement Plan
FL, Hollywood City General Employees' Pension Plan	GA, DeKalb County Pension Plan
FL, Hollywood City Police Officers' Retirement System	GA, Employees' Retirement System of Georgia
FL, Miami Beach Employees' Retirement System	GA, Fulton County Employees' Retirement System
FL, Miami Beach Retirement System for Firefighters and Police Officers	GA, Fulton County School Employees' Pension Fund
FL, Miami-Dade County Public Health Trust Defined Benefit Retirement Plan	GA, Georgia Firefighters' Pension Fund
FL, Miami Department of Off-Street Parking Retirement Plan	GA, Georgia Judicial Retirement System
FL, North Broward Hospital District Defined Benefit Pension Plan	GA, Georgia Military Pension Fund
FL, North Miami Clair T. Singerman Employees' Retirement System	GA, Legislative Retirement System
	GA, Macon-Bibb County Employee Pension Plan
FL, North Miami Police Pension Plan	GA, Macon-Bibb County Fire and Police Pension Plan
FL, Orange County Library District General Retirement System	GA, Macon County General Employees' Pension Plan (closed to new entrants from 2014)
FL, Orlando Firefighter Pension Fund	GA, Peace Officers' Annuity and Benefit Fund of Georgia
FL, Orlando General Employees' Pension Fund	
FL, Orlando Police Pension Fund	GA, Public School Employees' Retirement System
FL, Pembroke Pines City Pension Fund for Firefighters and Police Officers	GA, Teachers' Retirement System of Georgia
FL, Pembroke Pines General Employees' Pension Plan	HI, Employees' Retirement System of the State of Hawaii
FL, Retirement Plan for General Employees of the City of North Miami Beach	IA, Iowa Judicial Retirement System
	IA, Iowa Public Employees' Retirement System
FL, Retirement System for General Employees of the St. Lucie County Fire District	IA, Municipal Fire and Police Retirement System of Iowa
FL, South Broward Hospital District General Employee Pension Plan	IA, Peace Officers' Retirement, Accident and Disability System
FL, St. Lucie County Fire District Firefighters' Pension Trust Fund	ID, Firefighters' Retirement Fund
	ID, Judges' Retirement Fund
GA, Atlanta Firemen's Pension Fund	ID, Public Employee Retirement System of Idaho
GA, Atlanta General Employees' Pension Fund	IL, City of Aurora Firefighters' Pension Fund
GA, Atlanta Policemen's Pension Fund	IL, City of Aurora Police Pension Fund
	IL, City of Evanston Fire Pension Fund
	IL, City of Evanston Police Pension Fund

(*Continued*)

Pension plan	Pension plan
IL, City of Joliet Firefighters' Pension Plan	IL, Village of Arlington Firefighters' Pension Plan
IL, City of Joliet Police Pension Plan	IL, Village of Arlington Police Pension Plan
IL, City of Naperville Firefighters' Pension Fund	IL, Village of Mount Prospect Firefighters' Pension Fund
IL, City of Naperville Police Pension Fund	IL, Village of Mount Prospect Police Pension Fund
IL, City of Rockford Firefighters' Pension Fund	IL, Village of Orland Park Police Pension Fund
IL, City of Rockford Police Pension Fund	IL, Village of Schaumburg Firefighters' Pension Fund
IL, City of Springfield Firefighters' Pension Plan	IL, Village of Schaumburg Police Pension Fund
IL, City of Springfield Police Pension Plan	IN, 1977 Police Officers' and Firefighters' Pension and Disability Fund
IL, Cook County Employees' and Officers' Annuity and Benefit Fund	IN, City of Indianapolis Firefighters' Pre-1977 Plan
IL, Des Plaines Firefighters' Pension Fund	IN, City of Indianapolis Police Pre-1977 Plan
IL, Des Plaines Police Pension Fund	IN, Judges' Retirement System
IL, General Assembly Retirement System	IN, Legislators' Defined Benefit Plan
IL, Hoffman Estates Firefighters' Pension Plan	IN, Prosecuting Attorneys' Retirement Fund
IL, Hoffman Estates Police Pension Fund	IN, Public Employees' Retirement Fund
IL, Illinois Municipal Retirement Fund	IN, State Excise Police, Gaming Agent, Gaming Control Officer and Conservation Enforcement Officers' Retirement Plan
IL, Illinois Teachers' Retirement System	IN, State Police Retirement Fund
IL, Judges' Retirement System of Illinois	IN, Teachers' Retirement Fund 1996 Account
IL, Metropolitan Water Reclamation District Retirement Fund	IN, Teachers' Retirement Fund Pre-1996 Account
IL, Public School Teachers' Pension and Retirement Fund of Chicago	KS, Kansas Public Employees' Retirement System
IL, Retirement Plan for Chicago Transit Authority Employees	KS, Wichita Employees' Retirement System
IL, State Employees' Retirement System of Illinois	KS, Wichita Police and Fire Retirement System
IL, State Universities Retirement System	KY, Judicial Retirement Plan
IL, The Firemen's Annuity and Benefit Fund of Chicago	KY, Kentucky County Employees' Retirement System—Hazardous
IL, The Laborers' and Retirement Board Employees' Annuity and Benefit Fund of Chicago	KY, Kentucky County Employees' Retirement System—Nonhazardous
IL, The Municipal Employees' Annuity and Benefit Fund of Chicago	KY, Kentucky Employees' Retirement System—Hazardous
IL, The Policemen's Annuity and Benefit Fund of Chicago	KY, Kentucky Employees' Retirement System—Nonhazardous
IL, Tinley Park Police Pension System	KY, Kentucky State Police Retirement System
IL, Town of Normal Firefighters' Pension Plan	
IL, Town of Normal Police Pension Plan	

(*Continued*)

Pension plan	Pension plan
KY, Kentucky Teachers' Retirement System	LA, Teachers' Retirement System of Louisiana
KY, Legislators' Retirement Plan	MA, Barnstable County Retirement Association
LA, City of New Orleans Employees' Retirement System	MA, Boston Retirement System
LA, CPERS—Police Guarantee Trust	MA, Bristol County Retirement Association
LA, Employees' Retirement System of the City of Baton Rouge and Parish of East Baton Rouge (CPERS)	MA, Brookline Town Contributory Retirement System
LA, Firefighters' Pension and Relief Fund of the City of New Orleans—New System	MA, City of Cambridge Retirement System
	MA, City of Lynn Contributory Retirement System
LA, Firefighters' Pension and Relief Fund of the City of New Orleans—Old System	MA, City of New Bedford Contributory Retirement System
LA, Firefighters' Retirement System of Louisiana	MA, City of Newton Retirement System
LA, Louisiana Assessors' Retirement Fund	MA, City of Worcester Retirement Plan
LA, Louisiana Clerks of Court Retirement and Relief Fund	MA, Essex Regional Retirement System
	MA, Framingham Town Retirement System
LA, Louisiana District Attorneys' Retirement System	MA, Franklin Regional Retirement System
LA, Louisiana School Employees' Retirement System	MA, Lowell Contributory Retirement System
	MA, Massachusetts Teachers' Retirement System
LA, Louisiana Sheriffs' Pension and Relief Fund	MA, Middlesex County Retirement System
LA, Louisiana State Employees' Retirement System	MA, Norfolk County Retirement System
	MA, Plymouth (Town of) Contributory Retirement
LA, Louisiana State Police Retirement System	MA, Plymouth County Retirement Association
LA, Municipal Employees' Retirement System of Louisiana—Plan A	MA, Springfield Contributory Retirement System
	MA, State Employees' Retirement System
LA, Municipal Employees' Retirement System of Louisiana—Plan B	MA, Worcester Regional Retirement System
LA, Municipal Police Employees' Retirement System	MD, Anne Arundel County Detention Officers' and Deputy Sheriffs' Plan
LA, Parochial Employees' Retirement System of Louisiana—Plan A	MD, Anne Arundel County Employees' Retirement Plan
LA, Parochial Employees' Retirement System of Louisiana—Plan B	MD, Anne Arundel County Fire Service Retirement Plan
LA, Registrar of Voters Employees' Retirement System for the State of Louisiana	MD, Anne Arundel County Police Service Retirement Plan
	MD, City of Baltimore Elected Officials' Retirement System
LA, Shreveport Employees' Retirement System	MD, City of Baltimore Employees' Retirement System
LA, Shreveport Firemen's Pension Relief Fund	
LA, Shreveport Police Pension Relief Fund	MD, City of Baltimore Fire and Police Employees' Retirement System

(*Continued*)

TABLE A.1 PENSION PLAN LIST (*continued*)

Pension plan	Pension plan
MD, Employees' Retirement System of Baltimore County	ME, Maine Public Employees' Retirement System—Participating Local District Consolidated Plan
MD, Maryland State Retirement and Pension System—Employees	ME, Maine Public Employees' Retirement System—State Employee and Teacher Plan
MD, Maryland State Retirement and Pension System—Judges	MI, City of Detroit General Retirement System
MD, Maryland State Retirement and Pension System—Law Enforcement Officers	MI, City of Detroit Police and Fire Retirement System
MD, Maryland State Retirement and Pension System—State Police	MI, City of Grand Rapids General Retirement System
MD, Maryland State Retirement and Pension System—Teachers	MI, City of Grand Rapids Police and Fire Retirement System
MD, Maryland Transit Administration Pension Plan	MI, Jackson County Employees' Retirement System
MD, Montgomery County Employees' Retirement System	MI, Judges' Retirement System
MD, Prince Georges County American Federation of State, County and Municipal Employees' Pension Plan	MI, Oakland County Employees' Retirement System
	MI, Public School Employees' Retirement System
MD, Prince George's County Correctional Officers' Comprehensive Pension Plan	MI, State Employees' Retirement System
MD, Prince George's County Correctional Officers' Supplementary Pension Plan	MI, State Police Retirement System
	MI, Township of Macomb County Employees' Retirement System
MD, Prince George's County Crossing Guards Pension Plan	MI, Wayne County Employees' Retirement System
MD, Prince George's County Deputy Sheriff's Comprehensive Pension Plan	MN, Minnesota State Retirement System—Correctional Employees' Retirement Fund
MD, Prince George's County Deputy Sheriff's Supplemental Pension Plan	MN, Minnesota State Retirement System—Judges' Retirement Fund
MD, Prince George's County Fire Civilian Pension Plan	MN, Minnesota State Retirement System—Legislators' Retirement Fund
MD, Prince George's County Fire Service Pension Plan	MN, Minnesota State Retirement System—State Employees' Retirement Fund
MD, Prince George's County General Schedule Pension Plan	MN, Minnesota State Retirement System—State Patrol Retirement Fund
MD, Prince George's County Police Civilian Pension Plan	MN, Public Employees' Retirement Association—General Employees' Retirement Fund
MD, Prince George's County Police Pension Plan	MN, Public Employees' Retirement Association—Police and Fire Fund
ME, Maine Public Employees' Retirement System—Judicial Plan	MN, St. Paul Teachers' Retirement Fund Association
ME, Maine Public Employees' Retirement System—Legislative Plan	MN, Teachers' Retirement Association

(Continued)

Pension plan	Pension plan
MO, City of Springfield Police Officers' and Firefighters' Retirement System	MT, Public Employees' Retirement System—Judges' Retirement System
MO, City of St. Louis Employees' Retirement System	MT, Public Employees' Retirement System—Municipal Police Officers' Retirement System
MO, Firemen's Retirement System of St. Louis	MT, Public Employees' Retirement System—Sheriffs' Retirement System
MO, Kansas City Police Department Civilian Employees' Retirement System	MT, Public Employees' Retirement System—Volunteer Firefighters' Compensation Act
MO, Kansas City Police Retirement System	NC, City of Charlotte Firefighters' Retirement System
MO, Kansas City Public School Retirement System	NC, Consolidated Judicial Retirement System
MO, Missouri Department of Transportation and Patrol Employees' Retirement System	NC, Firefighters' and Rescue Squad Workers' Pension Fund
MO, Missouri Local Government Employees' Retirement System	NC, Legislative Retirement System
MO, Missouri State Employees' Retirement System—Judicial Plan	NC, Local Governmental Employees' Retirement System
MO, Missouri State Employees' Retirement System—State Employees' Plan	NC, North Carolina National Guard Pension Fund
MO, Public Education Employee Retirement System of Missouri	NC, Registers of Deeds Supplemental Pension Fund
MO, Public School Retirement System of Missouri	NC, Teachers' and State Employees' Retirement System
MO, Public School Retirement System of the City of St. Louis	NC, Winston-Salem Police Officers' Retirement System
MO, St. Louis County Missouri Employees' Retirement Plan	NC, Winston-Salem Police Officers' Separation Allowance
MS, Mississippi Highway Safety Patrol Retirement System	ND, Highway Patrolmen's Retirement System
MS, Public Employees' Retirement System of Mississippi	ND, North Dakota Teachers' Fund for Retirement
MS, Supplemental Legislative Retirement Plan	ND, Public Employees' Retirement System
MT, Montana Teachers' Retirement System	ND, Retirement Plan for Employees of Job Service North Dakota
MT, Public Employees' Retirement System—Defined Benefit Retirement Plan	NE, City of Lincoln Police and Fire Pension Plan
MT, Public Employees' Retirement System—Firefighters' Unified Retirement System	NE, City of Omaha Employees' Retirement System (the Civilian Plan)
MT, Public Employees' Retirement System—Game Wardens' and Peace Officers' Retirement System	NE, City of Omaha Police and Firefighters' Retirement System (the Uniformed Plan)
MT, Public Employees' Retirement System—Highway Patrol Officers' Retirement System	NE, County Employee Retirement System
	NE, Judges' Retirement System
	NE, Omaha School Employees' Retirement System
	NE, School Retirement System

(*Continued*)

TABLE A.1 PENSION PLAN LIST (*continued*)

Pension plan	Pension plan
NE, State Employee Retirement System	OH, State Teachers' Retirement System of Ohio
NE, State Patrol Retirement System	OK, City of Tulsa Municipal Employees' Retirement Plan Defined Benefits Pension Plan
NH, New Hampshire Retirement System	
NJ, Consolidated Police and Fire Pension Fund	OK, Oklahoma City Employees' Retirement System
NJ, Judicial Retirement System	
NJ, Police and Firemen's Retirement System	OK, Oklahoma Firefighters' Pension and Retirement System
NJ, Prison Officers' Pension Fund	OK, Oklahoma Law Enforcement Retirement System
NJ, Public Employees' Retirement System	
NJ, State Police Retirement System	OK, Oklahoma Police Pension and Retirement System
NJ, Teachers' Pension and Annuity Fund	
NM, New Mexico Judicial Retirement Fund	OK, Oklahoma Public Employees' Retirement Plan
NM, New Mexico Magistrate Retirement Fund	
NM, New Mexico State Educational Retirement Board	OK, Oklahoma Teachers' Retirement System
	OK, Uniform Retirement System for Justices and Judges
NM, New Mexico Volunteer Firefighter Fund	
NM, Public Employees' Retirement Association of New Mexico	OR, City of Portland Fire and Police Disability, Retirement, and Death Benefit Plan
NV, Judicial Retirement System	OR, Oregon Public Employees' Retirement System
NV, Legislators' Retirement System	
NV, Public Employees' Retirement System	PA, Abington Township Non-Uniformed Pension Fund
NY, Employees' Retirement System	
NY, New York City Board of Education Retirement System	PA, Abington Township Police Pension Fund
	PA, Allegheny County Non-Uniformed Retirement Plan
NY, New York City Employees' Retirement System	
	PA, Bensalem Non-Uniformed Pension Plan
NY, New York City Fire Department Pension Fund	PA, Bensalem Township Police Pension Plan
NY, New York City Police Pension Fund	PA, Bethlehem Parking Authority Pension Plan
NY, New York State Teachers' Retirement System	PA, Butler Area Public Library Non-Uniform Pension Plan
NY, Police and Fire Retirement System	
NY, Teachers' Retirement System of the City of New York	PA, City of Allentown Firemen Pension Plan
	PA, City of Allentown Officers' and Employees' Plan
OH, City of Cincinnati Retirement System	
OH, Highway Patrol Retirement System	PA, City of Allentown Police Pension Plan
OH, Ohio Police and Fire Pension Fund	PA, City of Bethlehem Firemen Pension Plan
OH, Ohio Public Employees' Retirement System	PA, City of Bethlehem Police Pension Plan
OH, School Employees' Retirement System of Ohio	PA, City of Erie Firefighters' Pension Trust Fund
	PA, City of Erie Officers' and Employees' Pension Trust Fund

(*Continued*)

Pension plan	Pension plan
PA, City of Erie Police Pension Trust Fund	PA, Washington County Employees' Retirement Plan
PA, City of Lancaster Fire Pension Fund	RI, Employees' Retirement System Plan—State Employees
PA, City of Lancaster Police Pension Fund	
PA, City of Pittsburgh Policemens Relief and Pension Fund	RI, Employees' Retirement System Plan—Teachers
PA, City of Reading Officers' and Employees' Pension Fund	RI, Judicial Retirement Benefits Trust Plan
PA, City of Reading Paid Firemen's Pension Fund	RI, Municipal Employees' Retirement System Plan—General Employees
PA, City of Reading Police Pension Fund	RI, Municipal Employees' Retirement System Plan—Police and Fire
PA, City of Scranton Firemen's Pension Plan	RI, Rhode Island Judicial Retirement Fund Trust Plan
PA, City of Scranton Non-Uniformed Pension Plan	
PA, City of Scranton Police Pension Plan	RI, State Police Retirement Benefits Trust
PA, Cumberland County Retirement Fund	RI, Teachers' Survivors Benefits Plan
PA, Dauphin County Employees' Retirement Plan	SC, General Assembly Retirement System
PA, Delaware County Employees' Retirement System	SC, Judges' and Solicitors' Retirement System
	SC, Police Officers' Retirement System
PA, Lancaster City Parking Authority Pension Plan	SC, South Carolina National Guard Supplemental Retirement Plan
PA, Lower Merion Township Employees' Pension Fund	SC, South Carolina Retirement System
PA, Lower Merion Township Municipal Police Pension Fund	SD, Sioux Falls City Employee's Retirement System
PA, Lycoming County Employees' Retirement System	SD, Sioux Falls City Firefighters' Pension Fund
	SD, South Dakota Retirement System
PA, Pennsylvania Public School Employees' Retirement System	TN, City of Chattanooga Fire and Police Pension Trust Fund
PA, Pennsylvania State Employees' Retirement System	TN, City of Chattanooga General Pension Trust Fund
PA, Philadelphia Gas Works Non-Uniformed Pension System	TN, Knoxville City Employees' Pension Fund
PA, Philadelphia Municipal Retirement System	TN, Memphis Employees' Retirement System—City
PA, Redevelopment Authority of the City of Bethlehem Non-Uniformed Pension	TN, Memphis Employees' Retirement System—Library
PA, Upper Darby Township Firefighters' Pension Plan	TN, Nashville-Davidson City Education Retirement Plan
PA, Upper Darby Township Municipal Employees' Pension Plan	TN, Nashville-Davidson City Retirement Plan
PA, Upper Darby Township Police Pension Plan	TN, Nashville-Davidson County Education Retirement Plan

(*Continued*)

Pension plan	Pension plan
TN, Nashville-Davidson County Retirement Plan (Closed)	TX, Employee Retirement System of Texas—Law Enforcement and Custodial Officer Supplemental Fund
TN, Nashville-Davidson Metropolitan Board of Education Teachers' Retirement Trust Fund	TX, Employees' Retirement Fund of the City of Dallas
TN, Nashville-Davidson Metropolitan Employees' Benefit Trust Fund	TX, Harris County Hospital District Pension Plan
TN, Shelby County Retirement System	TX, Harris County Non-Union Pension Plan
TN, Tennessee Consolidated Retirement System—Closed State and Higher Education Employee Pension Plan—component units	TX, Harris County Transport Workers Union Pension Plan
TN, Tennessee Consolidated Retirement System—Closed State and Higher Education Employee Pension Plan—primary government	TX, Houston Firefighters' Relief and Retirement Fund
TN, Tennessee Consolidated Retirement System—State and Higher Education Employee Pension Plan—component units	TX, Houston Municipal Employees' Pension System
TN, Tennessee Consolidated Retirement System—State and Higher Education Employee Pension Plan—primary government	TX, Houston Police Officers' Pension System
TN, Tennessee Consolidated Retirement System—Teacher Legacy Pension Plan	TX, Lubbock Fire Pension Fund
TN, Tennessee Consolidated Retirement System—Teacher Retirement Plan	TX, San Antonio Firemen's and Policemen's Pension Fund
TX, Austin Firefighters' Retirement Fund	TX, San Antonio Water System Retirement Plan
TX, Austin Police Officers' Retirement Fund	TX, Teachers' Retirement System of Texas
TX, City of Austin Employees' Retirement System	UT, Firefighters' Retirement System
TX, City of Fort Worth Employees' Retirement Fund—City Plan	UT, Judges' Retirement System
TX, City of Fort Worth Employees' Retirement Fund—Staff Plan	UT, Public Employees' Contributory Retirement System
TX, Dallas Police and Fire Pension System	UT, Public Employees' Noncontributory Retirement System
TX, Dallas Police and Fire Pension System—Supplemental Pension Plan	UT, Public Safety Retirement System
TX, El Paso City Employees' Pension Fund	UT, Tier 2 Public Employees' Contributory Retirement System
TX, El Paso Firemen's Pension Fund	UT, Tier 2 Public Safety and Firefighter Contributory Retirement System
TX, El Paso Policemen's Pension Fund	UT, Utah Governors' and Legislators' Retirement Plan
TX, Employee Retirement System of Texas—Employees' Retirement Fund	VA, Fairfax County Education Employees' Supplemental Retirement System
TX, Employee Retirement System of Texas—Judicial Retirement System Plan II	VA, Fairfax County Employees' Retirement System
	VA, Fairfax County Police Officers' Retirement System
	VA, Fairfax County Uniformed Retirement System
	VA, Judicial Retirement System

(*Continued*)

Pension plan	Pension plan
VA, Newport News Employees' Retirement Fund	WA, Teachers' Retirement System Plan 1
VA, Norfolk Employees' Retirement System	WA, Teachers' Retirement System Plan 2/3
VA, Richmond Retirement System	WA, Volunteer Firefighters' and Reserve Officers' Relief and Pension Fund
VA, State Police Officers' Retirement System	WA, Washington State Patrol Retirement System Plan 1/2
VA, Virginia Law Officers' Retirement System	
VA, Virginia Retirement System—Political Subdivisions	WI, Employees' Retirement System of the City of Milwaukee
VA, Virginia Retirement System—State Employees	WI, Milwaukee County Employees' Retirement System
VA, Virginia Retirement System—Teachers	WI, Milwaukee County Transit Employee Pension Plan
VT, City of Burlington Employees' Retirement System	WI, Wisconsin Retirement System
VT, Vermont Municipal Employees' Retirement System	WV, Deputy Sheriff Retirement System
VT, Vermont State Employees' Retirement System	WV, Emergency Medical Services Retirement System
VT, Vermont State Teachers' Retirement System	WV, Judges' Retirement System
WA, Judges' Retirement Fund	WV, Municipal Police Officers' and Firefighters' Retirement System
WA, Judicial Retirement System	WV, Public Employees' Retirement System
WA, Law Enforcement Officers' and Firefighters' Retirement System Plan 1	WV, State Police Death, Disability amd Retirement System
WA, Law Enforcement Officers' and Firefighters' Retirement System Plan 2	WV, State Police Retirement System
WA, Public Employees' Retirement System Plan 1	WV, Teachers' Retirement System
WA, Public Employees' Retirement System Plan 2/3	WY, Air Guard Firefighter Pension Plan
	WY, Judicial Pension Plan
WA, Public Safety Employees' Retirement System Plan 2	WY, Law Enforcement Pension Plan
WA, School Employees' Retirement System Plan 2/3	WY, Paid Firemen's Pension Plan A
	WY, Paid Firemen's Pension Plan B
WA, Seattle City Employees' Retirement System	WY, Public Employee Pension Plan
WA, Spokane City Employees' Retirement System	WY, State Patrol, Game and Fish, Warden and Criminal Investigator Pension Plan
WA, Tacoma Employees' Retirement System	WY, Volunteer Firemen and Emergency Medical Technician Pension Plan

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