The ARC and the Covenants: The State of the States, 2018
Supplementary Materials

These exhibits are the supporting documents for our 2018 *ARC and the Covenants* analysis on the US States, which assesses the risks related to unfunded pension and retiree healthcare obligations.

SM1: The 6% investment return assumption, and the risk of cash flow timing

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SM11: OPEB statistics by state (same categories as in SM10)

SM12: List of reviewed pension and OPEB plans by state

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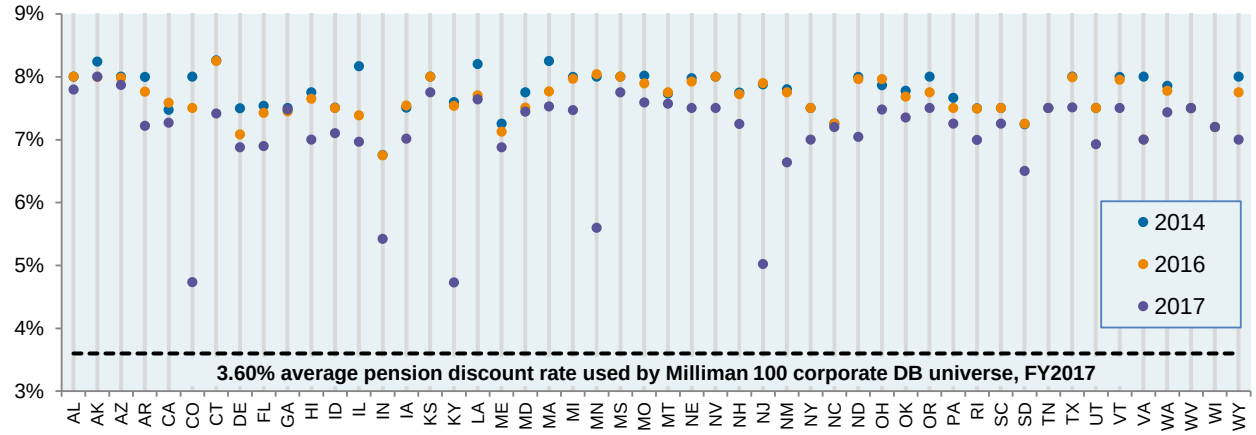
SM1: The 6% investment return assumption, and the risk of cash flow timing

The first chart shows pension plan return assumptions by state[1]. Many states have lowered their forward-looking return assumptions in recent years, but most are still above the 6% level we used in our analysis, and well above the 3.60% used by the average corporate defined benefit plan.

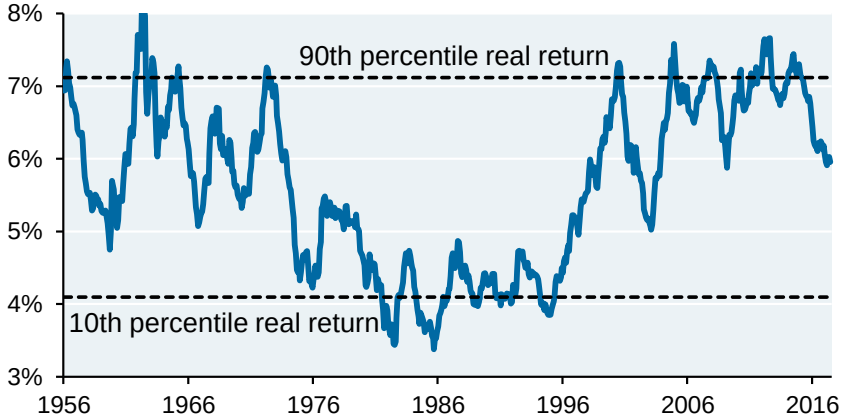
Downward migration of state pension plan discount rates



Source: J.P. Morgan Asset Management, State Annual Financial Reports, Milliman. FY 2014, 2016, 2017.

Discount rates are a widely debated topic in pension finance. **We believe 6% is conservative as a return assumption, since it implies a forward-looking 4% real return plus 2% inflation**. The next chart shows real returns on a simplified stock/bond portfolio since 1956. A 4% real return would rank close to the lowest real 30-year compound investment returns of the post-war era.

Historical real returns for hypothetical 70% stock, 30% bond portfolio, 30-year rolling real return



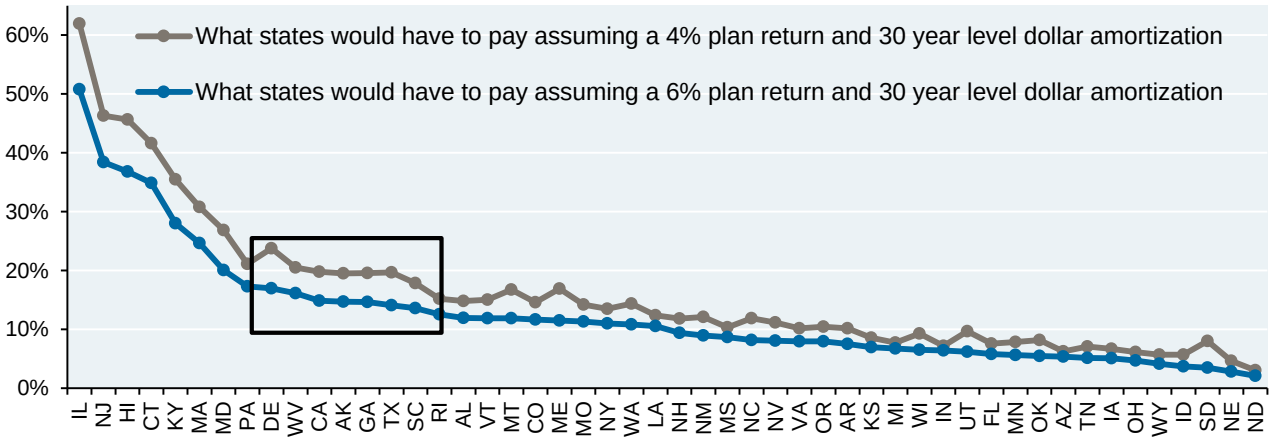
Source: JPMAM, Shiller, Ibbotson. June 2017. Past performance is not indicative of future results.

[1] The average **OPEB** discount rate used by the states is lower: 4.5%, with a standard deviation of 1.4%.

That said, there are reasons to consider alternative rate scenarios as well. An independent Blue Ribbon panel commissioned in 2014 by the US Society of Actuaries looked at the question of public pension discount rates and historical returns. Their conclusion: "return experience does not readily suggest that return assumptions currently in use have been inconsistent with prior experience"[2]. However, the panel also concluded that while historical returns can be a useful reference point, return assumptions should ideally be based on a risk-free rate plus forward-looking risk premia. As a separate risk measure, the panel also recommended disclosure of plan liabilities using the risk-free rate.

The complex issue of the *timing* of market returns. It's important to understand that not all 6% compound return scenarios are the same, since plans make ongoing distributions to retirees as time passes. The **timing** of investment returns matters a lot; scenarios with low returns earlier in the time horizon can result in substantial asset shortfalls even if the compound return over the entire period meets the expected 6% rate. This is a topic which has drawn increasing attention, and which researchers at Harvard and Pew Charitable Trusts have analyzed in detail[3]. As a very rough proxy for such a scenario, we recomputed the IPOD ratios using a 4% return assumption[4]. The results of this scenario show substantial incremental cash flow burdens on weaker states and also on states in the box, whose IPOD ratios reach 20%. Most well-funded states are not materially affected.

What if compound returns over 30 years are 6%, but returns in early years are lower?
% of state revenues required to pay the sum of interest on net direct debt, the state's share of unfunded pension and retiree healthcare liabilities, and defined contribution plan payments



Source: J.P. Morgan Asset Management, State Annual Financial Reports, Moody's. FY 2017.

[2] "*Report of the Blue Ribbon Panel on Public Pension Plan Funding*", An Independent Panel Commissioned by the Society of Actuaries, February 2014

[3] "*Risky Choices: Simulating Public Pension Funding Stress with Realistic Shocks*", Shoag (Harvard) and Farrell (Univ of S. Florida), September 2016; and "*Assessing the Risk of Fiscal Distress for Public Pensions: State Stress Test Analysis*", Mennis, Banta and Draine, Pew Charitable Trusts, May 2018.

[4] **Why 4%?** We looked at several 6% return scenarios where early year returns were lower than later year returns. To avoid asset depletion, the state would had to have planned for a 4% return instead. This is not meant to be a lower bound; there are 6% scenarios that could turn out even worse, depending on the timing of low returns.

SM2: The impact of special funding situations on state IPOD ratios

Many states make payments on behalf of cities and counties in one or more multi-employer plans (particularly Teacher plans), referred to as "**special funding**". These situations can be temporary or permanent, but since states disclose them as permanent, our state IPOD ratios include the cost of assisting local entities. In this appendix, we examine two scenarios: first, what if special funding went away (local entities pick up their share of the obligations); and second, the extreme case that states take on responsibility for 100% of the obligations in all multi-employer pension and OPEB plans (i.e., every constituent municipality requires a special funding arrangement).

What if special funding disappeared and local municipalities paid their own shares

Most of these states disclose their plan shares *without* the special funding situations as well (i.e., if local entities were making their pro-rata contributions with no help from the state). In the table, we show both IPOD ratios for states that disclosed this information. In some cases the impact is minimal, while in other cases, the impact is large. Note the substantial decline in IPOD ratios in Connecticut, Illinois, Kentucky, New Jersey and Texas when excluding special funding obligations. **We do not gain too much comfort from these lower ratios**, however, since our sense is that in most cases, the cities and counties involved are either unwilling or unable to re-assume the obligations the state is paying on their behalf. Note**:** Indiana and Pennsylvania also have special funding situations in some plans, but did not disclose what their state shares would have been without them.

State	Revised IPOD	Revised IPOD when excluding special funding situations
AK	15%	12%
CT	35%	26%
GA	14%	13%
IL	50%	25%
KS	7%	6%
KY	29%	15%
MD	20%	12%
MA	22%	21%
MT	12%	8%
NE	3%	2%
NJ	38%	25%
NM	9%	9%
NC	8%	8%
RI	13%	10%
TN	5%	5%
TX	13%	7%
VT	12%	6%
WA	11%	10%
WV	16%	10%

Source: J.P. Morgan Asset Management, State Annual Financial Reports, Moody's. FY 2017.

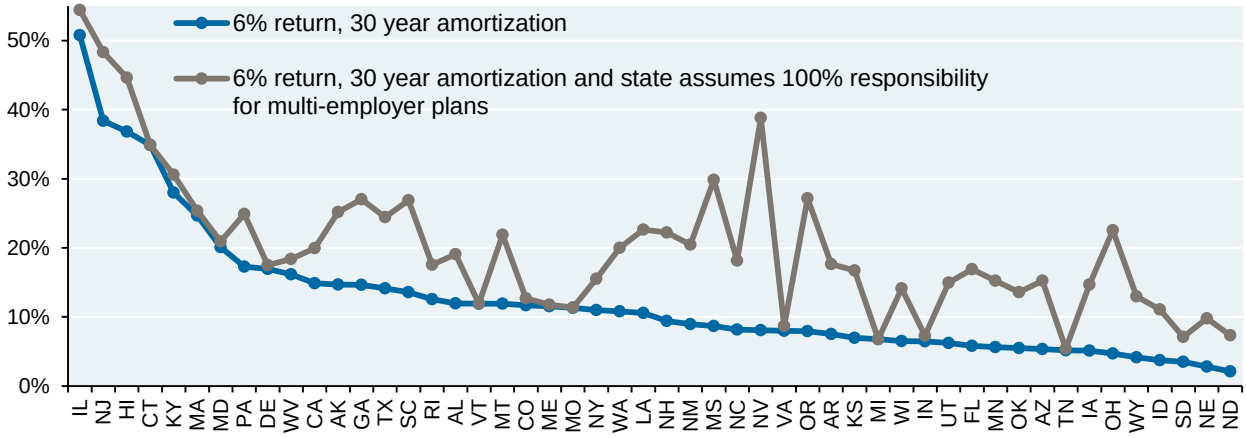
IPOD ratio is the % of state revenues required to pay the sum of interest on net direct debt, the state's share of unfunded pension and retiree healthcare liabilities, and defined contribution plan payments.

What if every local municipality required a special funding arrangement?

In this case, each state ends up responsible for 100% of the shortfalls in all multi-employer pension and OPEB plans they administer, without any contributions from local municipalities. In some of the weaker states, there's not that much of a change since this is case already for the large teacher plans. In other cases, the increase in the IPOD ratio is large, since most states have small shares of teacher plans in which local employees dominate. Here are some sample state shares for teacher or public employee plans that were increased to 100% in this scenario: Georgia (17%), Texas (67%), Nevada (16%), Oregon (21%), Louisiana (4%), Florida (18%) and Ohio (19%).

While we consider this scenario to be unlikely, state assumption of most plan liabilities has taken place in some states, and goes a long way in explaining why their ratios are so high. Illinois, for example, is responsible for 97% of the Illinois Teacher Retirement System, a $125 billion multi-employer plan that is only 40% funded. Similar dynamics exist in New Jersey, Massachusetts and Connecticut, where the state is responsible for 100% of multi-employer Teacher plans. We have not been able to fully discern what legislative process led to these outcomes, but the consequence is clearly laid out in state financial reports.

What if states had to assume 100% responsibility for all multi-employer plans?
% of state revenues required to pay the sum of interest on net direct debt, the state's share of unfunded pension and retiree healthcare liabilities, and defined contribution plan payments

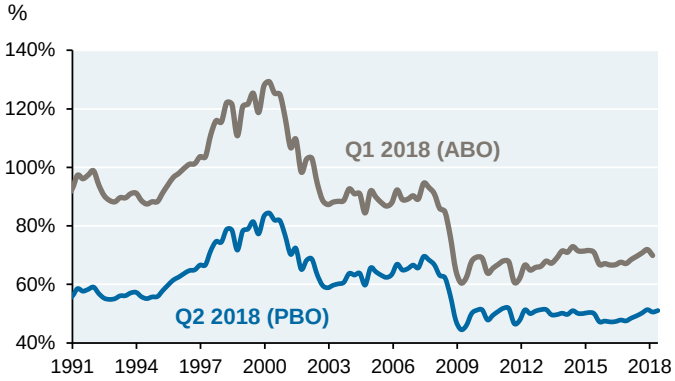


Source: J.P. Morgan Asset Management, State Annual Financial Reports, Moody's. FY 2017.

SM3: Some history on state and local pension funding ratios

When you see a chart on aggregate national pension funding ratios, the source is usually the Fed's Flow-of-Funds report. The Fed makes changes to its assumptions over time, some large and some small. In Q2 2018, they made a very big one: they switched from using **Accumulated Benefit Obligation** methodology to **Projected Benefit Obligation** methodology; the latter results in higher projected liabilities since PBO also includes estimates of future salary growth. As a result of this restatement, the entire history of funding ratios as computed with Fed Flow-of-Funds data declined relative to where it used to be. Even so, there are some inferences we can draw from the chart.

State and Local Government Pensions Funding Ratio



Source: Federal Reserve Flow of Funds. Q2 2018.

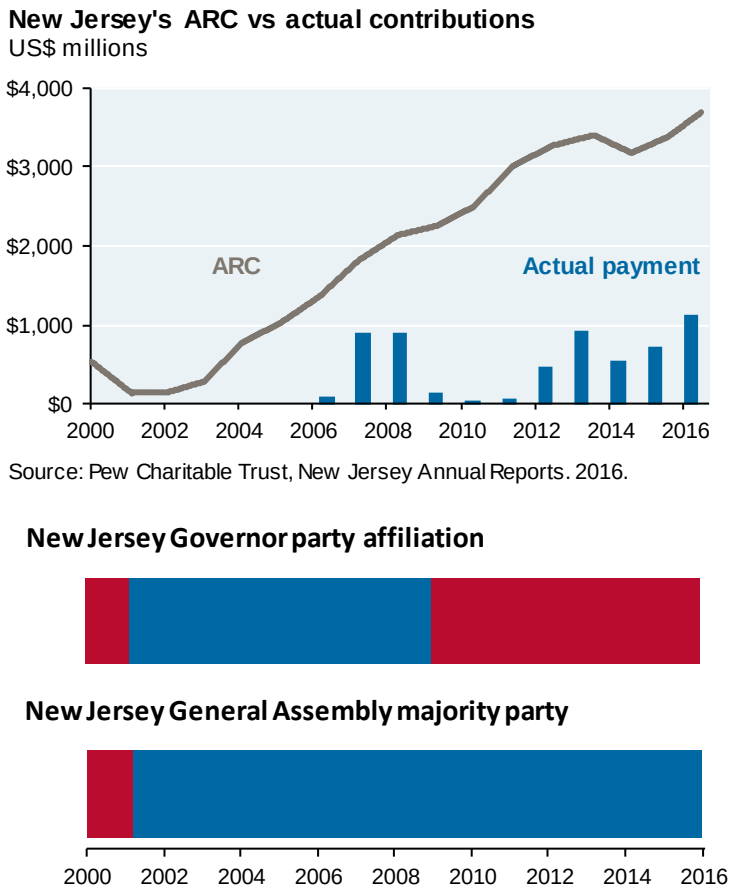
The primary factor driving both series down since 1999: two separate 40%+ stock market declines in the first decade of the 21st century, something that hadn't happened since the 1930's. What's also notable is how little public sector funding ratios have improved since 2009 on an aggregate basis. Based on my experience with public pension plans, I do not think this is a consequence of reduced portfolio risk. To me, this data suggests that other factors are in play:

- After equity and risky credit markets declined, states earned high returns but on a smaller base, and continued to pay distributions at contractually promised levels which did not decline
- Some states did not make their full ARC contributions, which are required to gradually drive funding ratios higher
- Some states increased their longevity assumptions. A recent study by PGIM Investments found that if the average life expectancy of a sample plan were to increase by four to five years, liabilities could increase by as much as 15% to 20%
- Financial repression by the Federal Reserve has lowered returns on fixed income. However, public plans tend to hold lower cash and bond allocations than corporate plans, so my sense is that the prior three factors had a greater impact. The average public plan holds fixed income and cash of around 25% vs 45% for the average corporate plan

The current Fed PBO funding ratio of 50% is much lower than the reported national state pension funding ratio of 68%. The primary reason: the Fed uses AAA corporate bond rates to discount liabilities. The current AAA corporate bond rate is 4%, compared to an average 7.1% discount rate used by states.

SM4: How did New Jersey end up in such bad shape?

New Jersey governors and state legislators basically starved the plan. For the last 15 years, actual state contributions were nowhere near the required ARC. As shown, this was a bipartisan effort. A related problem: New Jersey did not adequately disclose problems with its pension plan, which resulted in an SEC enforcement action against the state for $26 billion in fraudulent municipal bond offerings[5]. While New Jersey was the first state charged with violating federal securities laws in this manner, others were to follow, including Illinois and Kansas[6].



[5] "*SEC Charges State of New Jersey for Fraudulent Municipal Bond Offerings*", SEC Press Release 2010-152.

[6] See SEC Press Releases 2013-37 (Illinois) and 2014-164 (Kansas).

SM5: IPOD ratio methodology

IPOD ratio = $\frac{I + P + O + D}{R}$ where,

I = interest on net direct debt
P = state share of amortization of unfunded pension liability + pension service cost
O = state share of amortization of unfunded retiree healthcare obligation (OPEB) + OPEB service cost
D = state share of defined contribution payments[7]
R = state revenues

Key assumptions:

Interest rate on net direct debt	5%
Investment return on pension plan and OPEB plan assets	6%[8]
Amortization period for unfunded obligations	30 years
Amortization method for unfunded obligations	Level dollar (see SM7)

When normalizing across plans[9]:

- First, adjust gross pension or OPEB liability based on the duration of the plan[10], and the difference between the state's assumed return and our assumed return of 6%
- Second, recompute the net pension or OPEB liability (i.e., net of plan assets), which is re-amortized at 6% over 30 years using a level dollar approach
- Third, adjust service costs using the duration of the plan plus an assumed 5 year extension (since service costs apply to active workers only and not current retirees)
- The normalized annual payment for pensions and OPEB is the sum of the recomputed amortization component and the recomputed annual service cost

In many instances, our normalized estimate of pension and OPEB costs was **higher** than what states currently contribute. There are four primary reasons for this:

- Some states do not meet annual required contributions computed by their actuaries. Pension ARC compliance is considerably higher than OPEB ARC compliance (compare column 3 in SM10 vs SM11).
- Some states contribute 100% of their "required" contribution, but this payment is sometimes set by statute (e.g., by the legislature) rather than by actuaries
- We assume a 6% return instead of the generally higher returns assumed by many states on pensions; this increases the size of the gross and net pension liability
- We assume level dollar amortization instead of an approach more commonly used which assumes that ARC payments rise over time ("level percent"); the latter obscures the true cost of unfunded obligations when computing a single accrual-based ratio

[7] While we include **DC plans** in the IPOD ratio, they are infrequently used. Only half of the states use them, and they are generally very small. Aggregate DC payments are ~2% of combined pension and OPEB obligations.

[8] State and local plans generally follow an actuarial funding model and discount future benefits based on the expected return of the assets that will be used to fund the benefits.

[9] We ran scenarios that applied a maximum level of net debt as a % of state revenues, using a 65% threshold. The impacts were small, and primarily affected states that already have the highest IPOD ratios: IL, HI, CT and MA.

[10] While **duration** measures can be used to linearly re-estimate liabilities when small discount rate changes take place (i.e., plus or minus 1%), such measures are less accurate for larger changes in rates, even when convexity measures are used as well. Working with our pension team at JP Morgan Asset Management, we developed a series of prototype pension and OPEB cash flow vectors for different durations. We then used these prototype vectors when re-estimating the value of pension and OPEB liabilities using our 6% discount rate.

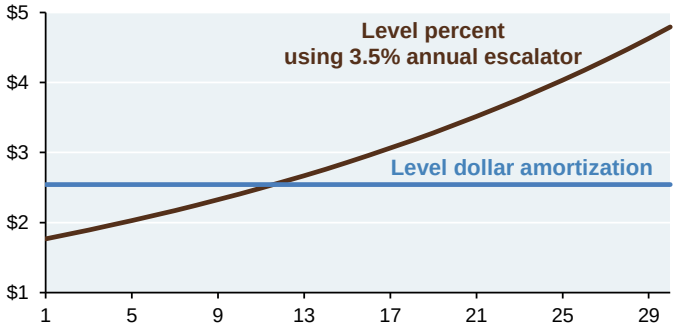
SM6: Definitions and data sources

- ***Data aggregation***. We sourced data for pensions, OPEB and defined contribution plans from FY2017 reports; we used FY2016 for Alabama since its FY2017 report was not available. All net direct debt and revenue data for FY2017 was sourced from Moody's as of July 31, 2018.
- ***Net direct debt*** includes bonds, unconditional general fund obligations, capital leases, pension obligation bonds and lease revenue bonds. This concept excludes revenue bonds of state enterprises (e.g., essential service revenue bonds) and self-supporting debt (i.e., if a city issues a general obligation bond but a water utility pays for it or has covered debt service for 3 consecutive years, the debt is excluded). We include negative operational fund balances in "net direct debt" as well.
- ***Plan liabilities***. In our model, annual pension and OPEB obligations include the state's share of (a) amortization of unfunded liabilities, and (b) service costs. We derive state service costs by deducting worker contributions from plan-level service costs, and then multiplying by the state share.
- ***State revenues*** are sourced from the Moody's series entitled "Own Source Revenue". This category includes a) real estate taxes, sales and use taxes, income taxes, and other payments into the General Fund, and b) payments into general debt service funds. According to Moody's, revenues categorized as "non-recurring" are excluded. Own Source Revenues are generally (but not always) similar to Census data on state revenue collections.
- ***State shares***. In multi-employer plans, states are often responsible for a *portion* of unfunded obligations (and not the entire amount), based typically on percentage of the plan's workers that are state-level employees; the remainder is owed by local entities whose employees make up the rest of the plan. State shares are usually disclosed, but when they weren't, we estimated them by dividing the state's reported ARC by the plan-level ARC obtained from plan-level financial reports.
- ***Special funding situations***. Many states make payments on behalf of local entities in multi-employer plans (particularly Teacher plans), referred to as "special funding". These situations can be temporary or permanent, but since states disclose them as permanent, our state IPOD ratios include the cost of assisting local entities. See SM2 for more details.
- ***Missing OPEB data***. Roughly one third of OPEB plans (by liability value) did not disclose duration; in these cases we assumed a Macaulay duration of 15 based on OPEB durations disclosed by other states. Roughly 20% of OPEB plans (by liability value) did not disclose service costs; we estimated them by subtracting our estimated amortization of unfunded liabilities from their reported ARC. **The reason for the missing data**: states are in the process of complying with new GASB rules on OPEB disclosure, and some have not adopted the new rules yet. The latter group includes Arizona, Arkansas, Florida, Illinois, Kansas, Mississippi, Montana and New York.
- ***Data uncertainties***. When data in state reports was unclear, we reached out to the state to get confirmation of our interpretations and assumptions; not all of those calls were returned. In our judgment, after reviewing over 300 single and multi-employer plans, most data uncertainties were related to smaller plans which did not materially affect our IPOD results.

SM7: Amortization methods for unfunded obligations using level dollar and level percent

When normalizing across plans, there are 3 primary components: the investment return, the amortization term and the **amortization method**. The latter refers to whether a state assumes level payments over time ("level dollar"), or assumes that amortization payments rise over time ("level percent"). Most plans in our universe use the level percent approach. However, when computing our IPOD ratios, we normalized across plans using the level dollar approach instead, since it's a better measure to use when comparing states using a single ratio to incorporate the cost of future obligations. The chart compares the ARC under both approaches for a hypothetical plan with a 70% funding ratio.

Level dollar vs. level percent amortization
ARC payment, US$ millions



Source: J.P. Morgan Asset Management. Assuming 70% funding ratio, $100mm gross pension liability and 7.5% discount rate.

The table shows how an IPOD ratio would change if a state used both a higher discount rate than our 6% assumption, and if it used the level percent approach with a 3.5% annual escalator. In the base case, the required pension amortization is $17.7 mm, and the IPOD ratio is 16%. After adjusting for a lower discount rate and the level dollar approach, the IPOD ratio rises to 26%. In this example, the use of level dollar accounts for around half the increase, while the discount rate change explains the rest.

Hypothetical Example	
Pension discount rate	7.5%
Current pension liability, $mm	1,000
Pension funding ratio	70%
Current pension assets, $mm	700
Pension duration	12%
Pension amortization term	30
Escalator	3.5%
Net pension liability ($mm)	300
Pension amortization w/escalator, $mm	17.7
Pension amortization, no escalator, $mm	25.4
OPEB Amortization, $mm	6.4
Interest, $mm	7.9
Interest + Pension + OPEB, $mm	32.0
Revenues, $mm	200
Current IPOD ratio	**16%**
Pension discount rate	6%
Pension liability , $mm	1,207
Net pension liability, $mm	507
Pension amortization, no escalator, $mm	36.8
Revised IPOD ratio	**26%**

IPOD ratio is the % of state revenues required to pay the sum of interest on net direct debt, the state's share of unfunded pension and retiree healthcare liabilities, and defined contribution plan payments.

SM8: How long might it take for a deeply underfunded pension plan to run out of money?

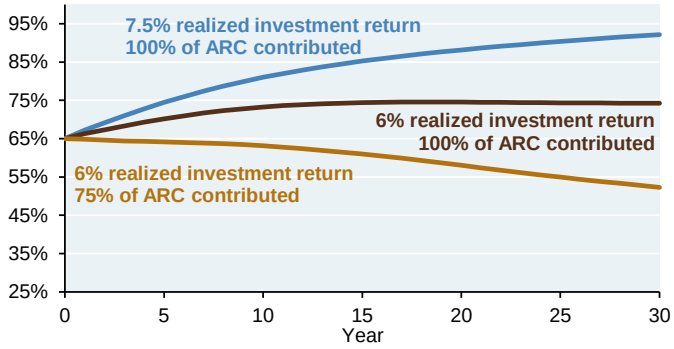
This is a complicated question with a variety of potential outcomes. Public sector plans are usually "open", meaning that new workers, new contributions and new accrued liabilities are added over time. Working with our pension team at JP Morgan Asset Management, we ran a few scenarios that looked at what could happen to a state whose pension plan was 65% funded today.

- *Fixed assumptions*: the state's discount rate is 7.5%; the plan's service costs are 3% of total pension liabilities; payroll growth rises at 4% per year; the duration of the plan's liabilities is 13%; and the state uses an "open" amortization approach, meaning that it keeps re-amortizing its net pension liability each year over the subsequent 30 years[11]
- *Variable assumptions*: the realized investment return on plan assets; the percentage of the required ARC that the city makes each year; and whether the city uses a level dollar or level percent method when computing its ARC payments

Let's start with the chart on the left, which assumes **level dollar** amortization. If the state makes its ARC each year and achieves its target return, its funding ratio would rise over time and eventually converge towards 100% (blue line). If the state makes the full ARC but only earns 6% instead of 7.5%, its funding ratio would stay roughly constant (brown line). And if the state falls short on returns and only makes 75% of the ARC, its funding ratio would deteriorate (tan line). The dynamics are worse when a state uses **level percent** amortization (2nd chart), since the state is makes payments that represent the earlier rungs on the rising amortization ladder, and never contributes the larger amounts.

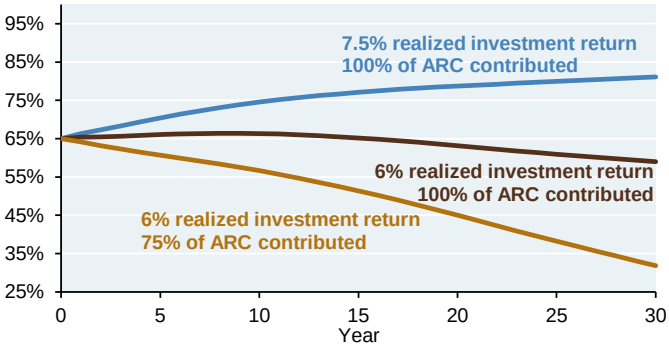
We use both approaches when estimating future 10-year pension funding ratios by state in Exhibit SM10 (see last 2 columns). Both approaches assume a 6% return. Weighted by liabilities, **80% of state plans use level percent**, so that's the more relevant column to look at.

Pension funded status: level dollar amortization
Assets/liabilities, assuming 7.5% discount rate and 30 year term



Source: J.P. Morgan Asset Management. August 2017.

Pension funded status: level percent amortization
Assets/liabilities, assuming 7.5% discount rate and 30 year term



Source: J.P. Morgan Asset Management. August 2017.

[11] In contrast, a "closed" amortization approach would require unfunded liabilities to be fully paid down by a specific fixed date, which could result in sky-rocketing ARC payments if investment shortfalls occurred.

SM9: IPOD results and remediation by state

			Who funds the gap, every year for 30 years (mutually exclusive)			
			TAXPAYERS	PUBL SEC WORKERS	STATE FUND MANAGERS	
State	Current IPOD	Revised IPOD	Increase in tax revenues *or*	Increased contributions *or*	Required pension return *and*	Required OPEB return
IL	26%	51%	25%	689%	11.5%	No solution
NJ	17%	38%	22%	521%	No solution	No solution
HI	21%	37%	16%	117091%	11.3%	18.2%
CT	22%	35%	12%	408%	10.5%	No solution
KY	12%	28%	16%	427%	No solution	No solution
MA	14%	25%	10%	237%	10.2%	No solution
MD	13%	20%	7%	216%	8.1%	No solution
PA	7%	17%	10%	532%	13.0%	No solution
DE	10%	17%	7%	614%	7.6%	No solution
WV	14%	16%	2%	116%	6.1%	17.5%
CA	8%	15%	6%	387%	8.6%	No solution
AK	5%	15%	10%	835%	11.3%	8.7%
GA	11%	15%	3%	473%	7.1%	22.7%
TX	7%	14%	7%	164%	8.9%	No solution
SC	4%	14%	10%	263%	11.8%	No solution
RI	10%	13%	2%	158%	8.2%	6.6%
AL	7%	12%	5%	216%	9.8%	No solution
VT	6%	12%	5%	276%	8.7%	No solution
MT	7%	12%	5%	159%	8.0%	No solution
CO	6%	12%	5%	305%	11.1%	No solution
ME	10%	12%	1%	52%	6.6%	7.6%
MO	7%	11%	4%	358%	9.1%	No solution
NY	7%	11%	4%	2503%	6.8%	No solution
WA	7%	11%	4%	312%	7.1%	No solution
LA	9%	11%	2%	165%	7.5%	No solution
NH	5%	9%	4%	379%	8.2%	No solution
NM	5%	9%	4%	151%	9.1%	16.3%
MS	6%	9%	3%	239%	9.8%	No solution
NC	5%	8%	4%	503%	6.7%	No solution
NV	5%	8%	3%	112%	8.3%	4.0%
VA	6%	8%	2%	153%	7.5%	No solution
OR	4%	8%	4%	19515%	No solution	-6.2%
AR	4%	8%	3%	341%	8.3%	No solution
KS	5%	7%	2%	159%	9.1%	-40.1%
MI	6%	7%	0%	312%	5.1%	12.9%
WI	5%	7%	2%	150%	7.2%	No solution
IN	6%	6%	0%	-1%	6.0%	11.9%
UT	4%	6%	2%	2515%	7.5%	-13.9%
FL	4%	6%	2%	351%	8.1%	No solution
MN	3%	6%	3%	361%	No solution	No solution
OK	5%	6%	1%	71%	6.6%	No solution
AZ	4%	5%	2%	104%	9.9%	6.9%
TN	4%	5%	1%	1519%	7.3%	No solution
IA	4%	5%	1%	147%	7.5%	No solution
OH	4%	5%	1%	110%	7.6%	9.4%
WY	2%	4%	3%	250%	8.0%	No solution
ID	3%	4%	1%	66%	6.7%	15.9%
SD	3%	3%	0%	17%	6.1%	No solution
NE	2%	3%	1%	78%	7.0%	No solution
ND	1%	2%	1%	63%	8.9%	-10.1%

Source: J.P. Morgan Asset Management, State Annual Financial Reports, Moody's. FY 2017. IPOD ratio is the % of state revenues required to pay the sum of interest on net direct debt, the state's share of unfunded pension and retiree healthcare liabilities, and defined contribution plan payments.

SM10: Pension statistics by state

Pensions										
State	Reported funding ratio	Revised funding ratio	Actual vs reported ARC	Actual vs revised ARC	Pension share of Pen+OPEB	Liability-weighted discount rate	Liability-weighted duration	Year 10 Projected Funding Ratio Level Dollar	Year 10 Projected Funding Ratio Level Percent
IL	38%	34%	95%	53%	78%	7.0%	13.6%	63%	52%
NJ	36%	40%	49%	35%	58%	5.0%	13.4%	36%	27%
HI	55%	48%	100%	41%	56%	7.0%	13.6%	73%	65%
CT	41%	35%	99%	62%	71%	7.4%	12.0%	64%	53%
KY	34%	40%	72%	36%	77%	4.7%	13.8%	51%	40%
MA	60%	50%	100%	45%	78%	7.5%	11.4%	72%	64%
MD	69%	56%	99%	61%	79%	7.4%	12.8%	77%	71%
PA	55%	48%	102%	28%	75%	7.3%	10.8%	70%	61%
DE	82%	74%	99%	58%	39%	6.9%	11.8%	86%	82%
WV	79%	67%	100%	93%	71%	7.5%	10.8%	81%	76%
CA	68%	57%	100%	53%	68%	7.3%	13.7%	78%	72%
AK	67%	52%	100%	24%	77%	8.0%	11.4%	74%	67%
GA	79%	65%	100%	72%	43%	7.5%	12.7%	82%	78%
TX	76%	62%	99%	41%	78%	7.5%	12.4%	80%	75%
SC	54%	46%	100%	16%	83%	7.3%	13.5%	72%	64%
RI	53%	47%	100%	74%	88%	7.0%	11.8%	70%	61%
AL	67%	55%	100%	49%	84%	7.8%	10.5%	73%	66%
VT	62%	51%	109%	58%	62%	7.5%	11.6%	77%	69%
MT	73%	60%	100%	59%	88%	7.6%	12.0%	79%	73%
CO	43%	51%	100%	43%	92%	4.7%	13.8%	74%	64%
ME	81%	73%	100%	81%	77%	6.9%	12.3%	86%	82%
MO	64%	53%	102%	57%	86%	7.6%	11.5%	75%	67%
NY	95%	84%	100%	69%	38%	7.0%	11.7%	92%	90%
WA	90%	73%	100%	51%	71%	7.4%	13.7%	87%	85%
LA	66%	55%	101%	81%	73%	7.6%	9.8%	73%	65%
NH	63%	54%	100%	66%	41%	7.2%	11.8%	75%	67%
NM	63%	57%	92%	41%	89%	6.6%	13.3%	75%	68%
MS	62%	49%	100%	46%	90%	7.8%	12.0%	73%	65%
NC	89%	78%	100%	75%	26%	7.2%	11.1%	88%	85%
NV	74%	61%	100%	47%	92%	7.5%	13.1%	80%	75%
VA	75%	66%	100%	66%	78%	7.0%	11.8%	82%	76%
OR	83%	69%	100%	26%	98%	7.5%	11.9%	83%	79%
AR	77%	66%	103%	53%	72%	7.2%	12.5%	83%	78%
KS	68%	55%	75%	46%	99%	7.8%	11.8%	65%	58%
MI	69%	60%	99%	110%	42%	7.5%	9.5%	74%	67%
WI	99%	87%	100%	46%	83%	7.2%	10.7%	93%	92%
IN	61%	65%	100%	100%	97%	5.4%	10.7%	79%	71%
UT	90%	80%	100%	55%	98%	6.9%	13.2%	90%	88%
FL	79%	70%	100%	46%	69%	6.9%	13.1%	85%	81%
MN	61%	64%	93%	25%	96%	5.6%	14.7%	79%	73%
OK	79%	67%	101%	80%	100%	7.4%	11.4%	83%	78%
AZ	67%	57%	100%	55%	97%	7.9%	8.9%	71%	63%
TN	88%	73%	104%	64%	81%	7.5%	11.6%	87%	84%
IA	82%	72%	101%	59%	79%	7.0%	12.2%	86%	82%
OH	80%	67%	100%	56%	90%	7.5%	11.3%	82%	77%
WY	77%	68%	102%	49%	51%	7.0%	12.2%	84%	79%
ID	91%	79%	100%	71%	93%	7.1%	12.3%	89%	87%
SD	100%	93%	100%	85%	100%	6.5%	14.4%	98%	98%
NE	86%	70%	113%	64%	100%	7.5%	13.0%	89%	86%
ND	64%	56%	98%	43%	108%	7.0%	12.9%	76%	69%

Source: J.P. Morgan Asset Management, State Annual Financial Reports, Moody's. FY 2017.

SM11: OPEB statistics by state

OPEB (retiree healthcare)							
State	Reported funding ratio	Revised funding ratio	Actual vs reported ARC	Actual vs revised ARC	OPEB share of Pen+OPEB	Liability-weighted discount rate	Liability-weighted duration
IL	0%	0%	17%	11%	22%	4.1%	20%
NJ	0%	0%	30%	36%	42%	4.5%	na
HI	9%	7%	89%	61%	44%	7.0%	na
CT	3%	4%	57%	42%	29%	3.7%	16%
KY	33%	29%	138%	43%	23%	6.9%	13%
MA	5%	7%	29%	36%	22%	3.6%	20%
MD	3%	4%	63%	63%	21%	3.6%	16%
PA	1%	2%	55%	47%	25%	3.6%	18%
DE	4%	6%	43%	45%	61%	3.6%	19%
WV	25%	22%	69%	53%	29%	7.2%	12%
CA	1%	1%	53%	36%	32%	3.9%	18%
AK	91%	70%	100%	35%	23%	8.0%	12%
GA	10%	12%	102%	72%	57%	4.4%	18%
TX	1%	2%	62%	71%	22%	3.6%	18%
SC	8%	11%	62%	52%	17%	3.6%	16%
RI	26%	31%	100%	108%	12%	4.6%	na
AL	5%	8%	46%	47%	16%	3.6%	19%
VT	0%	0%	53%	37%	38%	3.6%	17%
MT	0%	0%	31%	32%	12%	4.3%	na
CO	15%	15%	48%	46%	8%	6.4%	10%
ME	15%	19%	86%	100%	23%	4.2%	15%
MO	5%	5%	55%	60%	14%	5.1%	15%
NY	0%	0%	43%	36%	62%	3.2%	na
WA	0%	0%	18%	20%	29%	3.8%	13%
LA	0%	0%	65%	72%	27%	4.5%	na
NH	0%	0%	32%	29%	59%	4.5%	19%
NM	11%	16%	50%	65%	11%	3.8%	19%
MS	0%	0%	71%	64%	10%	3.6%	na
NC	5%	7%	100%	36%	74%	3.6%	18%
NV	0%	0%	100%	124%	8%	4.0%	na
VA	35%	32%	55%	76%	22%	6.8%	13%
OR	87%	79%	26%	194%	2%	7.0%	10%
AR	0%	0%	31%	36%	28%	4.5%	na
KS	0%	0%	102%	197%	1%	3.6%	na
MI	18%	16%	96%	79%	58%	7.0%	11%
WI	45%	52%	27%	35%	17%	4.6%	na
IN	24%	36%	95%	109%	3%	3.6%	19%
UT	70%	78%	115%	345%	2%	3.8%	5%
FL	0%	0%	25%	25%	31%	4.0%	na
MN	0%	0%	46%	74%	4%	3.0%	14%
OK	0%	0%	58%	61%	0%	4.5%	na
AZ	104%	85%	100%	70%	3%	8.0%	9%
TN	0%	0%	62%	79%	19%	4.0%	na
IA	0%	0%	34%	34%	21%	4.9%	na
OH	52%	70%	60%	77%	10%	3.9%	16%
WY	0%	0%	29%	26%	49%	5.0%	na
ID	20%	24%	59%	84%	7%	4.3%	na
SD	na	na	na	na	0%	na	na
NE	na	na	na	na	0%	na	na
ND	58%	50%	106%	-181%	-8%	7.4%	10%

Source: J.P. Morgan Asset Management, State Annual Financial Reports, Moody's. FY 2017.

SM12: List of reviewed pension and OPEB plans by state

Alabama Employees Retirement System
Alabama Teacher's Retirement System
Alabama Judicial Retirement Fund
Alabama State Employees' Health Insurance Pla

Alaska Public Employees' Retirement System
Alaska Teacher Retirement System
Alaska Judicial Retirement System
Alaska NGNMRS
Alaska Public Employees' Retirement System -
Alaska Teachers' Retirement System - OPEB
Alaska Judicial Retirement System - OPEB

Arizona State Retirement System
Arizona Public Safety Personnel Retirement Sy
Arizona Correctional Officers Retirement Plan
Arizona Elected Officials Retirement Plan
Arizona State Retirement System HBS OPEB
Arizona State Retirement System LTD OPEB
Arizona Department of Administration OPEB

Arkansas Public Employees' Retirement System
Arkansas Teacher Retirement System
Arkansas Judicial Retirement System
Arkansas State Police Retirement System
Arkansas State Highw ay Employees Retirement S
Arkansas State Police Medical and Rx Plan
Arkansas State Employee Health Plan

California CALPERS PERF A
California State Teachers' Retirement Plan
California Judges' Retirement Fund
California Judges' Retirement Fund II
California Legislators' Retirement Fund
California OPEB

Colorado State Division Trust Fund
Colorado Judicial Division Trust Fund
Colorado PERA Health Care Trust Fund OPEB
Colorado University Post-Retirement HC & Life
Colorado DCP Refund
Colorado PERA Subsidy
Colorado Rx Subsidy
Colorado LTD Income Replacement

Connecticut State Employee Retirement System
Connecticut Teachers' Retirement System
Connecticut Judicial Retirement System
Connecticut State Employee OPEB Plan
Connecticut Retired Teacher Healthcare Plan

Delaw are State Employees' Pension Plan
Delaw are Special Fund
Delaw are New State Police Pension Plan
Delaw are Judiciary Pension Plans
Delaw are Closed State Police Plan
Delaw are OPEB Fund Trust
Delaw are Transit Corporation (DTC) OPEB Trust

Florida Retirement System
Florida Retiree Health Insurance Subsidy Prog
Florida National Guard Supplemental Retiremen
Florida State Employees' Health Insurance Pro

Georgia Employees' Retirement System
Georgia Teachers Retirement System
Georgia Peace Officers' Annuity and Benefit F
Georgia Firefighters' Pension Fund
Georgia Public School Employees Retirement Sy
Georgia Judicial Retirement System
Georgia State OPEB Fund
Georgia School OPEB Fund
Georgia SEAD-OPEB Plan
Georgia Regents OPEB Plan

Haw aii ERS
Haw aii EUTF

Idaho Public Employee Retirement System
Idaho Judges' Retirement Fund
Idaho Retiree Healthcare OPEB Plan
Idaho Retiree Life Insurance OPEB Plan
Idaho University OPEB Plan
Idaho Long-Term Disability - Healthcare
Idaho Long-Term Disability - Life Insurance
Idaho Long-Term Disability - Income

Illinois General Assembly Retirement System
Illinois Judges' Retirement System
Illinois State Employees' Retirement System
Illinois Teachers' Retirement System
Illinois State Universities Retirement System
Illinois State OPEB
Illinois Teacher Health Insurance Security Fu
Illinois Community College Health Insurance S

Indiana State Police Retirement Fund
Indiana State Police Supplemental Trust Fund
Indiana State Excise Police, Gaming Agent, Ga
Indiana Prosecuting Attorney's Retirement Fun
Indiana Legislators' Retirement System
Indiana Judges Retirement System
Indiana Public Employees' Retirement Fund
Indiana State Teachers' Retirement Fund 1996
Indiana State Teachers' Retirement Fund Pre-1
Indiana State Personnel Plan
Indiana Legislature Plan
Indiana State Police Plan
Indiana Conservation and Excise Police Plan

Iow a Public Employees' Retirement System
Iow a Peace Officers' Retirement, Accident and
Iow a Judicial Retirement System
Iow a State OPEB
University of Iow a OPEB
Iow a State University OPEB
University of Northern Iow a OPEB

Kansas Public Employees Retirement System
Kansas Police and Firemen's Retirement System
Kansas Retirement System for Judges
Kansas Health Care Finance

Kentucky Employees' Retirement System, Non-Ha
Kentucky Employees' Retirement System, Hazard
Kentucky State Police Retirement System
Kentucky Judicial Retirement Plan
Kentucky Legislators' Retirement Plan
Kentucky Teachers' Retirement System
Kentucky Judicial Retirement Plan OPEB
Kentucky Legislators' Retirement Plan OPEB
Kentucky State Police Retirement System OPEB
Kentucky Employees' Retirement System, Non-Ha
Kentucky Employees' Retirement System, Hazard
Kentucky Teachers' Retirement System OPEB

Louisiana State Employees' Retirement System
Louisiana State Police Retirement System
Louisiana Teachers' Retirement System
Louisiana School Employees' Retirement System
Louisiana District Attorneys' Retirement Syst
Louisiana Clerks' of Court Retirement and Rel
Louisiana Registrar of Voters Employees' Reti
Louisiana Office of Group Benefits OPEB Plan
Louisiana State University System OPEB Plan

Maine SETP - State Employees
Maine SETP - Teachers
Maine Judicial Defined Benefit Plan
Maine Legislative Defined Benefit Plan
Maine State Employees OPEB
Maine Teacher OPEB
Maine First Responders OPEB
Maine State Group Life OPEB
Maine Teachers Group Life OPEB

Maryland State Retirement and Pension System
Maryland Transit Administration Pension Plan
Maryland State Employee and Retiree Health an
Maryland Transit Administration Retiree Healt

Massachusetts State Employees Retirement Syst
Massachusetts Teachers Retirement System
Massachusetts Boston Retirement System - Teac
Massachusetts State Retirees' Benefits Trust

Michican State Employees Retirement System
Michigan State Police Retirement System
Michigan Legislative Retirement System
Michigan Military Retirement System (MRP)
Michigan Judges Retirement System
Michican State Employees Retirement System OP
Michigan State Police Retirement System OPEB
Michigan Legislative Retirement System OPEB
Michigan Judges Retirement System - OPEB
Michigan Life Insurance

Minnesota State Employees Retirement Fund
Minnesota Correctional Employees Retirement F
Minnesota General Employees Retirement Fund
Minnesota Judges Retirement Fund
Minnesota Legislators Retirement Fund
Minnesota State Patrol Retirement Fund
Minnesota Teachers Retirement Fund
Minnesota St. Paul Teachers' Retirement Fund
Minnesota Volunteer Firefighter Retirement Fu
Minnesota Main OPEB plan
Minnesota Metropolitan Council OPEB
Minnesota UofM OPEB

Mississippi Public Employees' Retirement Syst
Mississippi Highw ay Safety Patrol Retirement
Mississippi Supplemental Legislative Retireme
Mississippi State and School Employees' Life

Missouri State Employees' Plan
Missouri Judicial Plan
Missouri Dept of Transportation & Highw ay Pat

University of Missouri Retirement System
Missouri Consolidated Health Care Plan
MoDOT & MSHP Medical and Life Insurance Plan
Conservation Employees' Insurance Plan
University of Missouri OPEB

Montana Public Employees' Retirement System D
Montana Judges' Retirement System
Montana Highway Patrol Officers' Retirement S
Montana Sheriffs' Retirement System
Montana Game Wardens' and Peace Officers' Ret
Montana Municipal Police Officers' Retirement
Montana Firefighters' Unified Retirement Syst
Montana Volunteer Firefighters' Compensation
Montana Teachers' Retirement System
State of Montana OPEB
Montana University System OPEB

Nebraska State Employees' Retirement Cash Bal
Nebraska School Employees' Retirement System
Nebraska Judges Retirement System
Nebraska State Patrol Retirement System
Nebraska Omaha School Employees' Retirement
Nebraska School Employees' Retirement System

Nevada Public Employees' Retirement System
Nevada Legislators' Retirement System
Nevada Judicial Retirement System
Nevada Public Employees' Benefits Program

New Hampshire Retirement System
New Hampshire Judicial Retirement Plan
New Hampshire OPEB

New Jersey Consolidated Police and Firemen's
New Jersey Judicial Retirement System
New Jersey Police and Firemen's Retirement Sy
New Jersey Prison Officers' Pension Fund
New Jersey Public Employees' Retirement Syste
New Jersey State Police Retirement System
New Jersey Teachers' Pension and Annuity Fund
New Jersey State Health Benefit Program Fund

New Mexico Public Employees Retirement System
New Mexico Judicial Retirement System
New Mexico Magistrate Retirement System
New Mexico Volunteer Firefighter Retirement S
New Mexico Educational Employees Retirement S
New Mexico Retiree Health Care Authority

New York Employee Retirement System
New York Police and Fire Retirement System
New York State Health Insurance Program
City University of New York

North Carolina Teachers' and State Employees'
North Carolina Firefighters' and Rescue Squad
North Carolina Consolidated Judicial Retireme
North Carolina Legislative Retirement System
North Carolina National Guard Pension Fund
North Carolina Retiree Health Benefit Fund
North Carolina Disability Income Plan

North Dakota Public Employees' Retirement Sys
North Dakota Highway Patrolmen's Retirement S
North Dakota Retirement Plan for the Employee

North Dakota Teachers' Fund for Retirement
North Dakota Retiree Health Insurance Credit
North Dakota Implicit Subsidy Unfunded OPEB
North Dakota Retirement Plan for the Employee

Ohio Public Employees Retirement System
Ohio State Teachers Retirement System
Ohio State Highway Patrol Retirement System
Ohio Public Employees Retirement System - OPE
Ohio State Teachers Retirement System -OPEB
Ohio State Highway Patrol Retirement System -

Oklahoma Firefighters Pension and Retirement
Oklahoma Law Enforcement Retirement System
Oklahoma Public Employees Retirement System
Oklahoma Uniform Retirement System for Justic
Oklahoma Police Pension and Retirement System
Oklahoma Teachers Retirement System
Oklahoma Wildlife Conservation Retirement Pla
Oklahoma Wildlife Conservation OPEB Plan

Oregon Public Employee Retirement System
Oregon Retirement Health Insurance Account
Oregon Retiree Health Insurance Premium Accou
Oregon Public Employees Benefit Board

Pennsylvania State Employee Retirement System
Pennsylvania Public School Employee Retiremen
Pennsylvania Retired Employees Health Program
Pennsylvania Retired Pennsylvania State Polic

Rhode Island Employees' Retirement System - S
Rhode Island Employees' Retirement System - T
Rhode Island State Police Retirement Benefits
Rhode Island Judicial Retirement Benefits Tru
Rhode Island Judicial Retiremenet Fund Trust
Rhode Island State Police Retirement Fund Tru
Rhode Island Judiciary Non-Contributory Retir
Rhode Island State Employee OPEB
Rhode Island Teachers OPEB
Rhode Island Judicial OPEB
Rhode Island State Police OPEB
Rhode Island Legislators OPEB
Rhode Island Board of Education OPEB

South Carolina Retirement System
South Carolina Police Officers Retirement Sys
South Carolina Retirement System for General
South Carolina Retirement System for Judges
South Carolina National Guard Supplemental Re
South Carolina Retiree Health Insurance Trust
South Carolina Long Term Disability Insurance

South Dakota Retirement System

Tennessee CRS - Closed State and Higher Ed Em
Tennessee CRS - State and Higher Education E
Tennessee Employee Group Plan Total
Tennessee Teacher Group Plan
Tennessee Medicare Supplement Plan
Tennessee Local Government Group Plan Compone

Texas Employees Retirement System of Texas Pl
Texas Law Enforcement and Custodial Officer S
Texas Judicial Retirement System One
Texas Judicial Retirement System Two

Texas Teacher Retirement System
Texas Emergency Services Retirement Plan
University of Texas System Employee Group Ins
Texas A&M University System Group Insurance P
Texas State Retiree Health Plan
Texas TRS-CARE

Utah Public Employees Noncontributory Ret Sys
Utah Public Employees Contributory Ret System
Utah Firefighters Ret System
Utah Public Safety Retirement System
Utah Judges Retirement System
Utah Governors and Legislators Retirement Pla
Utah Tier 2 Public Employees System
Utah Tier 2 Public Safety and Firefighters Sy
Utah State Employee OPEB Plan
Utah Elected Official OPEB Plan

Vermont State Retirement System
Vermont State Teachers' Retirement System
Vermont State Postemployment Benefit
Vermont Retired Teachers' Health and Medical

Virginia Retirement System
Virginia State Police Officers' Retirement Sy
Virginia Law Officers' Retirement System
Virginia Judicial Retirement System
Virginia Group Life Insurance Fund
Virginia Retiree Health Insurance Credit Fund
Virginia Disability Insurance Trust Fund
Virginia Line of Duty Death and Disability
Virginia Pre-Medicare Retiree Healthcare

Washington Public Employees' Retirement Syste
Washington Public Employees' Retirement Syste
Washington Teachers' Retirement System 1
Washington Teachers' Retirement System 2&3
Washington Law Enforcement Officers' and Fire
Washington Law Enforcement Officers' and Fire
Washington Public Safety Employees' Retiremen
Washington State Patrol Retirement System 1&2
Washington Judges' Retirement Fund
Washington Judicial Retirement System
Washington Volunteer Fire Fighters' and Reser
Washington Higher Education Supplemental Defi
Washington Public Employees' Benefits Board

West Virginia Public Employees Retiremenet Sy
West Virginia Teachers' Retirement System
West Virginia State Police Death, Disability,
West Virginia State Police Retirement System
West Virginia Judges' Retirement System
West Virginia Retiree Health Benefit Trust

Wisconsin Retirement System
Wisconsin State Retiree Health Insurance Fund
Wisconsin Duty Disability Fund
Wisconsin State Retiree Life Insurance Fund

Wyoming Public Employees Pension Plan
Wyoming State Patrol, Game & Fish Warden & Cr
Wyoming Judicial Pension Plan
Wyoming Law Enforcement Pension Plan
Wyoming Air Guard Firefighters Plan
Wyoming State OPEB

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