2017 Public Pension Funding Study

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Introduction

The Milliman Public Pension Funding Study annually explores the funded status of the 100 largest U.S. public pension plans. We report the plan sponsor's own assessment of how well funded a plan is. We also recalibrate the liability for each plan based on our independent assessment of the expected real return on each plan's investments.

Our study draws on the Total Pension Liability figures that are used for financial reporting under the accounting standards that apply to governmental entities, Governmental Accounting Standards Board Statements No. 67 and 68 (GASB 67/68). For many plans, this figure is similar to the measurement of liability that the plans use for determining contribution amounts. However, GASB 67/68 imposes more uniformity on the financial reporting process, so the Total Pension Liability figures are more directly comparable from plan to plan. GASB 67/68 also requires disclosure of metrics that enable us to project the Total Pension Liability forward beyond the plan sponsor's fiscal year end. With this information we can estimate how funded status will react to changes in the economic environment.
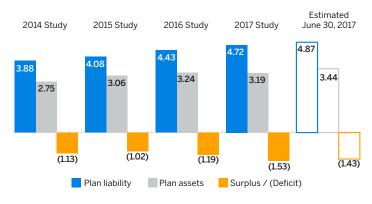
Highlights

- As of June 30, 2017, the aggregate funded ratio is estimated to be 70.7%, as assets experienced healthy growth
- One-third of the plans reduced the interest rate assumptions they use for determining contribution amounts
- The difference between the median sponsor-reported discount rate (7.50%) and our independently determined assumption (6.71%) continues to widen, indicating that further reductions in interest rate assumptions are likely

This 2017 report is based on information that was reported by the plan sponsors at their last fiscal year ends—June 30, 2016 is the measurement date for most of the plans in our 2017 study. At that time, plan assets were still feeling the effects of market downturns in 2014-2015 and 2015-2016. Total plan assets as of the last fiscal year ends stood at $3.19 trillion, down from $3.24 trillion as of the prior fiscal year ends (generally June 30, 2015). However, market performance since the last fiscal year ends has been strong, and we estimate that aggregate plan assets have jumped to $3.44 trillion as of June 30, 2017. We estimate that the plans experienced a median annualized return on assets of 11.49% in the period between their fiscal year ends and June 30, 2017.

The Total Pension Liability reported at the last fiscal year ends totaled $4.72 trillion, up from $4.43 trillion as of the prior fiscal year ends. We estimate that the Total Pension Liability has increased to $4.87 trillion as of June 30, 2017. The aggregate underfunding as of the last fiscal year ends stood at $1.53 trillion, but we estimate that the underfunding has narrowed to $1.43 trillion as of June 30, 2017.

FIGURE 1: AGGREGATE SYSTEM-REPORTED FUNDED STATUS ($ TRILLIONS)

Note: The plan liability amounts from the 2014 and 2015 studies are the accrued liability used for determining contribution amounts; the 2016 and 2017 studies report the GASB 67/68 Total Pension Liability.

Because of the dip in market values in 2015 and 2016, the aggregate funded ratio fell to 67.7% as of the most recent fiscal year ends, but we estimate that it has rebounded sharply and stands at 70.7% as of June 30, 2017 (see Figure 2). Look for our funded status updates on a quarterly basis. Note that some plan sponsors have recently announced reductions in their discount rates, which will depress funded ratios.
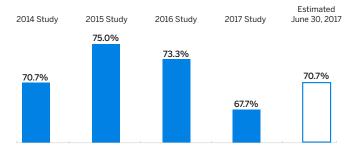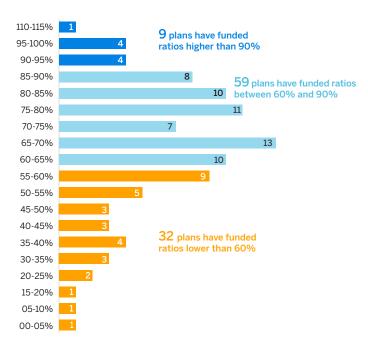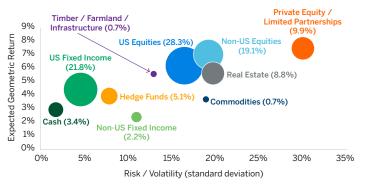
FIGURE 2: AGGREGATE FUNDED RATIO

FIGURE 3: SYSTEM-REPORTED FUNDED RATIO AT MOST RECENT MEASUREMENT DATE

Assets

The plans included in this study are invested in a mix of asset classes with different risk/return characteristics, as illustrated in Figure 4.
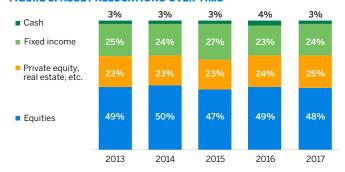
FIGURE 4: ASSET ALLOCATION, 2017

Note: The Expected Return and Risk/Volatility metrics are based on Milliman's December 31, 2016, capital market assumptions.

Over the past five years there has been very little change in the overall allocation stance of these plans (see Figure 5). While some plans have modified their asset allocation policies over the past four years, in aggregate there has not been a material move towards riskier investments.

FIGURE 5: ASSET ALLOCATIONS OVER TIME

We found little correlation between plans' asset allocations or reported discount rates and their funded ratios.

Liabilities

The plans reported aggregate Total Pension Liability of $4.72 trillion for the more than 26 million members covered by the plans in the study, for an average liability of $224,000 per member. While the number of active members has held steady for the past five years, the number of retired and inactive members has continued to climb.

FIGURE 6: NUMBER OF PLAN MEMBERS (MILLIONS)

Individually, the plans range in size of accrued liability from $9 billion to $406 billion. Collectively, the 10 largest plans cover 31% of the total members, hold 38% of the aggregate assets, and have 36% of the aggregate liability.
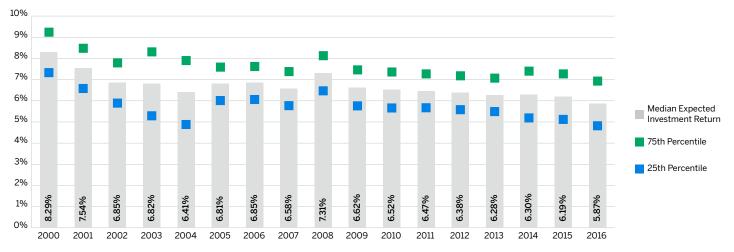
FIGURE 7: LARGEST VS. SMALLEST PLANS

Funded ratio does not vary much by the size of the plan, although it is interesting to note that the 10 smallest plans have a significantly higher aggregate funded ratio than any other decile.

Capital market assumptions

The market's consensus views on long-term future investment returns have been declining since the turn of the millennium. Figure 8 illustrates this trend by showing the expected long-term future return for a hypothetical asset allocation, based on Milliman's capital market assumptions for each year since 2000. Over this period, the median expected investment return for the illustrated hypothetical asset allocation fell from 8.29% in 2000 to 5.87% in 2016. Where interest rate assumptions of 8.00% were once commonplace, two-thirds of the plans in the study now have assumptions of 7.50% or below. Thirty-three of the plans lowered their assumptions from the 2016 study to the 2017 study; 66 have lowered their assumptions at least once since our inaugural 2012 study.

FIGURE 8: EXPECTED RETURN FOR A HYPOTHETICAL ASSET ALLOCATION BASED ON MILLIMAN'S CAPITAL MARKET ASSUMPTIONS

Note: Hypothetical asset allocation consists of 35% broad U.S. equities, 15% developed foreign equities, 25% core fixed income, 5% high-yield bonds, 10% mortgages, 5% real estate, and 5% short-term investments; inflation assumption is fixed at 2.5% for all years.
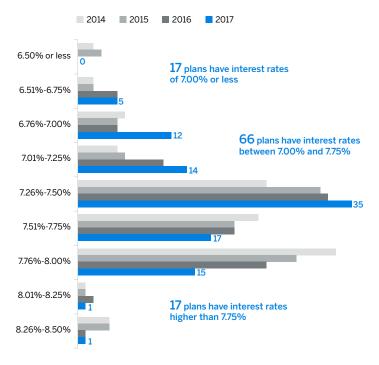
Financial reporting versus funding

The Governmental Accounting Standards Board (GASB) sets the accounting standards for public entities. Statements No. 67 and 68, which became effective in 2014 and 2015, have significantly changed the financial reporting requirements for U.S. public pension plans. Among other changes, these standards require all plans to report a standardized measure of actuarial liability, referred to as the *Total Pension Liability*. The Total Pension Liability must be calculated using a uniform actuarial cost method (the individual entry age cost method) rather than the actuarial cost method the plan uses to determine contribution amounts, and it must be calculated using a discount rate that under certain circumstances may be lower than the investment return assumption used for funding purposes. Additionally, each plan is required to disclose how sensitive its Total Pension Liability is to changes in the discount rate. For some plans a different liability measurement is used as part of the process of determining amounts that should be contributed to fund the plan.

Interest rates and discount rates

The terms "interest rate" and "discount rate" are often used interchangeably; both represent the rate used to translate future expected benefit payments into current day liabilities. For this study, we use the term "interest rate" to indicate the assumption the plan sponsor has chosen to determine contribution amounts, and we use the term "discount rate" to indicate the rate that is used to measure liabilities for financial reporting purposes. Interest rates have continued to move lower each year, with a median of 7.50% and a spread from 6.50% to 8.50% (see Figure 9). For most of the plans in this study, the funding interest rate and the financial reporting discount rate are the same. However, GASB 67/68 requires that the discount rate be adjusted downward in situations where current contribution policy is projected to result in a plan running out of plan assets (using the GASB-mandated projection methodology). Such a downward adjustment occurs for 11 of the plans in the study.
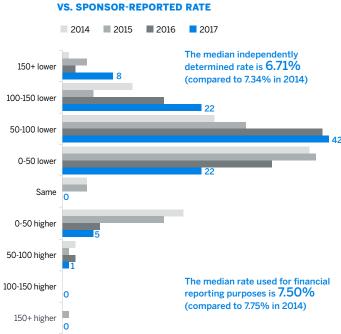
FIGURE 9: SPONSOR-REPORTED FUNDING INTEREST RATE

Recalibrating the Total Pension Liability

Using each plan's specific asset allocation, we determined the 50th percentile 30-year geometric average annual real rate of return based on Milliman's December 31, 2016 capital market assumptions. We then applied each plan's reported inflation assumption to arrive at our independently determined investment return assumption for that plan. The median of the resulting independently determined investment return assumptions is 6.71%, which is 79 basis points lower than the 7.50% median discount rate used by the plans. All but six of the plans have a lower independently determined rate than the discount rate the plan uses for financial reporting.

FIGURE 10: INDEPENDENTLY DETERMINED RATE VS. SPONSOR-REPORTED RATE

Plan sponsors periodically reassess their interest rate assumptions to ensure that they reflect updated market expectations about future investment returns. Such reassessments typically take place on a three- to five-year cycle. Because market expectations have been falling continuously since 2000, there has been a persistent lag between the plan sponsor's interest rates and Milliman's independently determined interest rates. While one-third of the plans in the study did lower their interest rate assumptions since the previous study, the gap between the sponsor-reported rates and our independently determined rates has widened. This indicates that it is likely that coming years will see yet more reductions in interest rates.
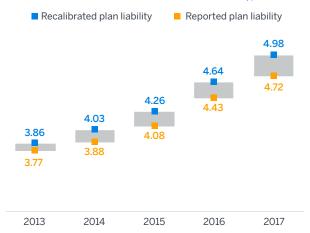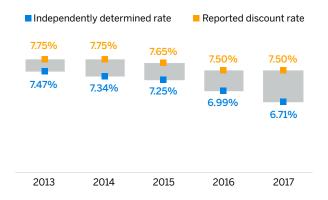
Recalibrated Total Pension Liabilities

We used each plan's independently determined investment return assumption to recalibrate the plan's Total Pension Liability. In aggregate, these plans have a recalibrated Total Pension Liability of $4.98 trillion, compared with a sponsor-reported Total Pension Liability of $4.72 trillion. This year's study found that the gap between the recalibrated accrued liability and the sponsor-reported accrued liability continues to widen.

FIGURE 11: AGGREGATE RECALIBRATION RESULTS ($ TRILLIONS)

As shown in Figure 12, this widening gap in liability mirrors a corresponding widening between the median discount rate reported by the plans in the study and our median independently determined investment return assumption.

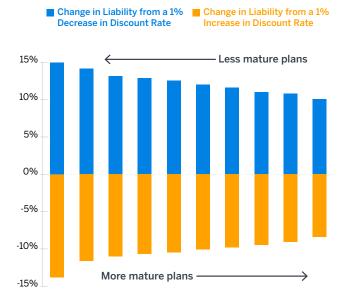**FIGURE 12: REPORTED VS. INDEPENDENTLY DETERMINED RATES**

The widening gap suggests that plans should continue to monitor emerging market return expectations and adjust their assumptions as needed, to ensure that liabilities are calculated using assumptions that are based on best-estimate expectations from investment professionals.

Sensitivity analysis

A relatively small change in the discount rate can have a significant impact on the Total Pension Liability. How big that impact is depends on the makeup of the plan's membership: a less "mature" plan with more active members than retirees typically has a higher sensitivity to interest rate changes than a more mature plan with a bigger retiree population. Other factors, such as automatic cost of living features, also come into play in determining a plan's sensitivity. Using a discount rate that is 100 basis points higher or lower than the independently determined investment return assumption moves the aggregate recalibrated Total Pension Liability by anywhere from 8% to 15% (see Figure 13).

FIGURE 13: EFFECTS OF CHANGING THE DISCOUNT RATE

Asset volatility ratio

The *asset volatility ratio* is a metric that helps plan sponsors anticipate the impact of investment volatility on actuarially determined contribution rates. The asset volatility ratio is the ratio of plan assets to the payroll for active members covered by the plan. A lower ratio means that plan assets are relatively small compared with payroll; this implies that a single-year deviation in asset performance may not move the contribution rate much. A higher ratio, on the other hand, signals that a similar single-year deviation in asset performance could translate into a significant shift in the actuarially determined contribution rate. It is unsurprising that, as pension plans have accumulated assets and their member populations have matured over the past several decades, asset volatility ratios have risen. These higher ratios mean that actuarially determined contribution rates are now more sensitive than they once were to investment volatility, despite the use of asset-smoothing methods to help mitigate the impact of market movements.

The median asset volatility ratio for the plans included in this study is 4.5, down slightly from 4.7 in the Milliman 2016 Public Pension Funding Study (see Figure 14). Thirty-three of the plans have an asset volatility ratio of 5.5 or higher, indicating that their actuarially determined contributions will be more volatile in reaction to future market swings. Four years ago, just 18 of the plans exceeded the 5.5 mark, suggesting that for a significant number of plans the actuarially determined contribution levels are becoming more and more sensitive to market swings.

FIGURE 14: ASSET VOLATILITY RATIO

The 2017 median asset volatility ratio is **4.5%** (compared to 4.7% in 2016)

Acknowledgements

Methodology

This study is based on the most recently available Comprehensive Annual Financial Reports, which reflect measurement dates ranging from June 30, 2015 to December 31, 2016; 89 are from June 30, 2016 or later. For the purposes of this study, the reported asset allocation of each of the plans has been analyzed to determine an independent measure of the expected long-term median real rate of return on plan assets. The sponsor-reported Total Pension Liability for each plan has then been recalibrated to reflect this independently determined investment return assumption. This study therefore adjusts for differences between each plan's reported discount rate and an independently calibrated current market assessment of the expected real return based on actual asset allocations. This study is not intended to price the plans' liabilities for purposes of determining contribution amounts or near-term plan settlement purposes nor to analyze the funding of individual plans.

OCTOBER 2017

Appendix

Sponsor-reported data

Plan Name	Measurement Date	GASB 68 Discount Rate	Total Pension Liability ($ millions)	Fiduciary Net Position ($ millions)	Net Pension Liability ($ millions)	Funded Ratio	Count of Active Members	Count of Inactive / Retired Members
Alabama Employees' Retirement System	09/30/2016	8.00%	16,960	11,177	5,783	65.9%	84,563	75,572
Alabama Teachers' Retirement System	09/30/2016	7.75%	33,762	22,936	10,826	67.9%	135,986	105,248
Alaska Public Employees' Retirement System	06/30/2016	8.00%	13,817	8,228	5,590	59.5%	16,237	39,211
Arizona Public Safety Personnel Retirement System	06/30/2016							
Arizona State Retirement System	06/30/2016	8.00%	49,001	32,860	16,141	67.1%	208,741	365,103
Arkansas Public Employees Retirement System	06/30/2016	7.50%	9,762	7,371	2,391	75.5%	45,676	47,838
Arkansas Teacher's Retirement System	06/30/2016	8.00%	18,970	14,559	4,411	76.7%	72,232	56,032
California Public Employees' Retirement System	06/30/2016							
California State Teachers' Retirement System	06/30/2016	7.60%	269,994	189,113	80,881	70.0%	438,537	475,917
Chicago Municipal Employees' Annuity and Benefit Fund	12/31/2015	3.70%	23,359	4,741	18,617	20.3%	30,683	41,232
Chicago Public Schools	06/30/2016	7.75%	21,125	10,113	11,011	47.9%	29,543	34,013
Colorado Public Employees' Retirement Association	12/31/2015	7.50%	70,583	42,658	27,924	60.4%	203,969	135,921
Connecticut State Employees Retirement System	06/30/2016	6.90%	33,617	10,654	22,963	31.7%	50,019	49,603
Connecticut State Teachers' Retirement System	06/30/2015	8.50%	27,092	16,120	10,972	59.5%	50,877	37,545
Cook County Employees' Annuity and Benefit Fund	12/31/2016	7.50%	23,240	9,116	14,125	39.2%	20,969	31,914
Delaware State Employees' Pension Plan	06/30/2016	7.20%	9,484	7,978	1,507	84.1%	36,198	30,200
Florida State Retirement System	06/30/2016	7.65%	167,031	141,781	25,250	84.9%	514,629	532,853
Georgia Employees' Retirement System	06/30/2016	7.50%	17,104	12,374	4,730	72.3%	59,766	106,444
Georgia Teachers' Retirement System	06/30/2016	7.50%	86,184	65,552	20,631	76.1%	218,215	214,956
Hawaii State Employees' Retirement System	06/30/2016	7.00%	27,439	14,070	13,369	51.3%	67,377	67,801
Idaho Public Employee Retirement System	06/30/2016	7.10%	15,911	13,884	2,027	87.3%	68,517	56,432
Illinois Municipal Retirement Fund	12/31/2016							
Illinois State Employees' Retirement System	06/30/2016	6.64%	49,184	15,039	34,145	30.6%	61,317	96,364
Illinois State Teachers' Retirement System	06/30/2016	6.83%	124,187	45,251	78,936	36.4%	159,735	247,120
Illinois State Universities Retirement System	06/30/2016	7.25%	42,971	17,006	25,965	39.6%	66,245	142,641
Indiana Public Employees' Retirement Fund	06/30/2016	6.75%	18,409	13,871	4,538	75.3%	131,178	163,102
Indiana State Teachers' Retirement Fund	06/30/2016	6.75%	23,232	10,399	12,833	44.8%	69,592	65,006
Iowa Public Employees' Retirement System	06/30/2016	7.50%	34,620	28,326	6,293	81.8%	168,372	181,338
Kansas Public Employee Retirement System	06/30/2016	8.00%	26,411	17,192	9,218	65.1%	152,175	147,492
Kentucky County Employees Retirement System	06/30/2016	7.50%	14,791	8,152	6,640	55.1%	92,485	86,720
Kentucky Employees Retirement Systems	06/30/2016	6.80%	14,299	2,508	11,791	17.5%	41,738	58,850
Kentucky Teachers' Retirement System	06/30/2016	4.20%	47,737	16,813	30,924	35.2%	71,848	60,803
Los Angeles City Employees' Retirement System	06/30/2016	7.50%	17,425	11,809	5,616	67.8%	24,446	25,252
Los Angeles City Water and Power Employees' Retirement Plan	06/30/2016	7.25%	12,289	10,097	2,192	82.2%	9,348	10,877
Los Angeles County Employees Retirement Association	06/30/2016	7.63%	58,528	47,847	10,682	81.7%	95,444	70,131
Los Angeles Fire and Police Pension Plan	06/30/2016	7.50%	19,565	17,104	2,461	87.4%	13,050	12,947
Louisiana State Employees' Retirement System	06/30/2016	7.75%	18,576	10,724	7,853	57.7%	39,284	106,512
Louisiana Teachers' Retirement System	06/30/2016	7.75%	29,272	17,535	11,737	59.9%	84,068	104,861

Appendix

Sponsor-reported data (continued)

Plan Name	Measurement Date	GASB 68 Discount Rate	Total Pension Liability ($ millions)	Fiduciary Net Position ($ millions)	Net Pension Liability ($ millions)	Funded Ratio	Count of Active Members	Count of Inactive / Retired Members
Maine Public Employees Retirement System	06/30/2016	6.88%	13,070	9,960	3,110	76.2%	39,942	41,964
Maryland State Employees' Combined System	06/30/2016	7.55%	24,347	15,331	9,015	63.0%	82,627	102,098
Maryland Teachers	06/30/2016	7.55%	40,533	27,542	12,991	67.9%	105,547	98,880
Massachusetts State Board of Retirement System	06/30/2016							
Massachusetts Teachers' Retirement System	06/30/2016	7.50%	47,300	24,942	22,358	52.7%	91,059	
Michigan Municipal Employees' Retirement System	12/31/2016							
Michigan Public School Employees' Retirement System	09/30/2016	8.00%	68,970	43,461	25,509	63.0%	207,645	228,875
Michigan State Employees' Retirement System	09/30/2016	8.00%	16,272	10,980	5,292	67.5%	12,381	63,263
Minnesota Public Employees Retirement Association	06/30/2016	7.50%	26,114	17,995	8,120	68.9%	148,745	146,804
Minnesota State Retirement System	06/30/2016	4.17%	23,622	11,223	12,399	47.5%	49,472	54,971
Minnesota Teachers Retirement Association	06/30/2016	4.66%	43,277	19,424	23,852	44.9%	80,530	109,033
Mississippi Public Employees' Retirement System	06/30/2016	7.75%	41,998	24,135	17,862	57.5%	154,104	242,118
Missouri Public School Retirement System	06/30/2015	7.75%	41,745	34,304	7,441	82.2%	78,129	74,396
Missouri State Employees' Plan	06/30/2016	7.65%	12,751	8,109	4,642	63.6%	49,464	64,340
Nebraska Public Employees' Retirement Systems School Retirement System	06/30/2016							
Nevada State Public Employees' Retirement System	06/30/2016	8.00%	48,459	35,002	13,457	72.2%	105,167	76,819
New Hampshire Retirement System	06/30/2016	7.25%	12,752	7,434	5,318	58.3%	48,069	34,561
New Jersey Police and Firemen's Retirement System	06/30/2016	5.55%	49,402	23,985	25,417	48.5%	42,036	45,474
New Jersey Public Employees' Retirement System	06/30/2016	3.98%	85,770	26,762	59,008	31.2%	261,171	172,125
New Jersey Teachers' Pension and Annuity Fund	06/30/2016	3.22%	101,747	22,718	79,029	22.3%	155,882	101,473
New Mexico Educational Retirement Board	06/30/2016	7.75%	18,729	11,533	7,196	61.6%	60,057	90,025
New Mexico Public Employees Retirement Association	06/30/2016	7.48%	19,986	13,827	6,159	69.2%	49,294	47,503
New York City Employees' Retirement System	06/30/2016	7.00%	79,839	55,542	24,297	69.6%	184,762	151,769
New York City Police Pension Fund	06/30/2016	7.00%	51,141	35,502	15,638	69.4%	34,402	58,784
New York City Teachers' Retirement System	06/30/2016	7.00%	70,001	43,630	26,371	62.3%	111,726	92,768
New York State and Local Retirement System	03/31/2016	7.00%	172,304	156,253	16,050	90.7%	494,411	524,995
New York State and Local Police & Fire	03/31/2016	7.00%	30,348	27,387	2,961	90.2%	31,720	37,216
New York State Teachers' Retirement System	06/30/2016	7.50%	108,577	107,506	1,071	99.0%	257,792	169,706
North Carolina Local Governmental Employees' Retirement System	06/30/2016	7.25%	24,882	22,760	2,122	91.5%	124,974	122,399
North Carolina Teachers and State Employees Retirement System	06/30/2016	7.25%	72,460	63,269	9,191	87.3%	305,291	344,736
Ohio Police and Fire Pension Fund	12/31/2016	8.25%	20,016	13,682	6,334	68.4%	27,624	28,638
Ohio Public Employees Retirement System	12/31/2015	8.00%	91,823	74,550	17,273	81.2%	334,382	722,898
Ohio Schools Employees' Retirement System	06/30/2016	7.50%	19,771	12,452	7,319	63.0%	124,540	83,099
Ohio State Teachers Retirement System	06/30/2016	7.75%	100,756	67,283	33,473	66.8%	169,212	175,565
Oklahoma Public Employees Retirement System	06/30/2016	7.25%	9,428	8,436	992	89.5%	41,806	39,695
Oklahoma Teachers' Retirement System	06/30/2016	7.50%	22,193	13,814	8,379	62.2%	90,167	71,746

Appendix

Sponsor-reported data (continued)

Plan Name	Measurement Date	GASB 68 Discount Rate	Total Pension Liability ($ millions)	Fiduciary Net Position ($ millions)	Net Pension Liability ($ millions)	Funded Ratio	Count of Active Members	Count of Inactive / Retired Members
Orange County Employees Retirement System	12/31/2016	7.25%	18,000	12,809	5,191	71.2%	21,746	21,739
Oregon Public Employees Retirement System	06/30/2016	7.50%	77,094	62,082	15,012	80.5%	168,177	179,147
Pennsylvania Public School Employees' Retirement System	06/30/2016	7.25%	99,389	49,832	49,557	50.1%	259,868	241,684
Pennsylvania State Employees' Retirement System	12/31/2015	7.50%	44,239	26,055	18,184	58.9%	105,025	131,607
Puerto Rico Government Employees Retirement System	06/30/2015	3.80%	32,669	(579)	33,248	-1.8%	119,790	
Puerto Rico Teacher's Retirement System	06/30/2015	3.82%	16,308	1,313	14,995	8.1%	37,700	42,188
Rhode Island Employees Retirement System	06/30/2016	7.50%	10,905	5,799	5,106	53.2%	24,466	28,076
Sacramento County Employees' Retirement System	06/30/2016	7.50%	9,436	7,681	1,755	81.4%	12,393	14,261
San Bernardino County Employees' Retirement Association	06/30/2016	7.50%	10,665	8,197	2,468	76.9%	20,538	16,766
San Diego County Employees Retirement Association	06/30/2016	7.25%	14,559	10,261	4,298	70.5%	17,768	23,147
San Francisco City and County Employees' Retirement System	06/30/2016	7.50%	25,967	20,155	5,813	77.6%	32,406	35,931
South Carolina Retirement System	06/30/2016	7.50%	45,356	23,996	21,360	52.9%	190,923	299,329
South Dakota Retirement System	06/30/2016	7.50%	10,851	10,513	338	96.9%	39,940	44,108
Tennessee Consolidated Retirement System	06/30/2016	7.50%	22,113	21,210	903	95.9%	69,125	78,238
Texas County & District Retirement System	12/31/2016							
Texas Employees' Retirement System	08/31/2016	5.73%	44,223	24,466	19,757	55.3%	146,390	120,355
Texas Municipal Retirement System	12/31/2016							
Texas Teacher Retirement System	08/31/2016	8.00%	171,797	134,009	37,789	78.0%	847,631	488,992
University of California Retirement Plan	06/30/2016	7.25%	69,231	54,165	15,066	78.2%	128,513	151,672
Utah Retirement Systems	12/31/2016	7.20%	33,195	28,544	4,651	86.0%	98,435	117,501
Virginia Retirement System	06/30/2016	7.00%	87,958	63,954	24,004	72.7%	330,159	232,486
Washington Public Employees' Retirement System	06/30/2016	7.50%	48,014	37,609	10,405	78.3%	156,252	156,797
Washington State Law Enforcement Officer's and Fire Fighters' Plan 1 and 2	06/30/2016	7.50%	13,970	15,581	(1,612)	111.5%	17,383	12,779
Washington State Teachers' Retirement System	06/30/2016	7.50%	21,173	16,386	4,788	77.4%	71,991	59,464
West Virginia Teachers' Retirement System	06/30/2016	7.50%	10,653	6,543	4,110	61.4%	35,811	37,307
Wisconsin Retirement System	12/31/2015	7.20%	90,130	88,505	1,625	98.2%	256,077	779,796

Study technical appendix

Methodology: Expected investment return

For the purposes of this study, we recalibrated liabilities for included plans to reflect discounting at the expected rate of return on current plan assets. To develop the expected rate of return used in these calculations, we relied on the most recently available asset statements for each plan, particularly on Statements of Plan Net Assets as disclosed in published Comprehensive Annual Financial Reports. We did not make adjustments for potential differences between actual asset allocations and target policy asset allocations.

We calculated the expected rate of return using a "building-block method" based on geometric averaging methodology. We used Milliman's December 31, 2016 capital market assumptions to calculate the 50th percentile 30-year real rate of return, and then added the plan's inflation assumption to arrive at the total expected investment return on plan assets. Where the plan's inflation assumption was not available, we used an inflation assumption of 2.50%. We did not make any adjustment to the expected rate of return for plan expenses, nor did we include any assumption for investment alpha (i.e., we did not assume any excess return over market averages resulting from active versus passive management).

Methodology: Liability recalibration

We performed the recalibration of liabilities for pension plans included in the study using the sensitivity information disclosed in published Comprehensive Annual Financial Reports. Where this information was not available, we made adjustments based on available information.

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