Milliman 2013 Public Pension Funding Study

29 plans lowered their interest rate assumptions,
which increased their accrued liabilities and lowered their funded ratios

Most plans are setting their interest rate assumptions in a realistic manner
consistent with long-term market return expectations

Funded ratios are down slightly

Rebecca A. Sielman
FSA, MAAA, EA

Introduction

The Milliman Public Pension Funding Study uses an approach to measure the aggregate funded status of the 100 largest U.S. public pension plans that is unique among studies assessing the health of the country's public pension plans. Our study independently determines an actuarial interest rate assumption for each plan based on its unique asset allocation and Milliman's current outlook on future long-term investment returns, then uses the actuarially determined interest rates to recalibrate each plan's accrued liability. We found that the total recalibrated accrued liability for the plans in the study was just 2.6% larger than the total accrued liability reported by the plans. While the challenge of funding future pension promises remains considerable, our study results indicate that most plans have set their interest rate assumptions and measured their pension liabilities in a realistic, actuarial manner that is consistent with long-term market return expectations. There is more than one way to put a dollar figure on the value of future pension benefits; the focus of this study is the traditional budgeting approach of assessing liability based on the long-term returns expected to be earned by plan assets.

A notable finding of this year's study is that 29 of the 100 plans in the study have lowered their interest rate assumptions since the Milliman 2012 Public Pension Funding Study. The median interest rate used by the plans decreased from 8.00% in the 2012 study to 7.75% in the 2013 study. This drop is in line with a generally declining market consensus on expected long-term investment returns; our study's median actuarially determined interest rate similarly decreased from 7.65% in the 2012 study to 7.47% in the 2013 study. Note that lower interest rate assumptions cause accrued liabilities to increase and funded ratios to fall.

Plans report on the size of their assets in two ways: *market value*, which is well understood; and *actuarial value*, which reflects asset smoothing techniques designed to moderate year-to-year fluctuations in contribution amounts but which may deviate significantly from market value in periods of sizeable market gains or losses. The 100 plans in this study reported assets totaling $2.58 trillion on a market value basis and $2.73 trillion on an actuarial value basis. By comparison, reported assets in the Milliman 2012 Public Pension Funding Study stood at $2.51 trillion on a market value basis and $2.71 trillion on an actuarial value basis.

Funded ratios have fallen slightly in the Milliman 2013 Public Pension Funding Study relative to the 2012 study, reflecting changes in both

FIGURE 1: MILLIMAN 100, AGGREGATE FUNDED STATUS

	2012		2013	
$ TRILLIONS	**REPORTED FIGURES**	**RECALIBRATED FIGURES**	**REPORTED FIGURES**	**RECALIBRATED FIGURES**
Interest rate (median)	8.00%	7.65%	7.75%	7.47%
Interest rate (liability-weighted)	7.80%	7.55%	7.67%	7.44%
Accrued liability	$3.60	$3.71	$3.77	$3.86
Market value of assets	$2.51	$2.51	$2.58	$2.58
Actuarial value of assets	$2.71	$2.71	$2.73	$2.73
Funded ratio using market value of assets	69.8%	67.8%	68.5%	66.8%
Funded ratio using actuarial value of assets	75.1%	73.0%	72.4%	70.6%
Unfunded accrued liability using market value of assets	$1.09	$1.20	$1.19	$1.28
Unfunded accrued liability using actuarial value of assets	$0.89	$1.00	$1.04	$1.13

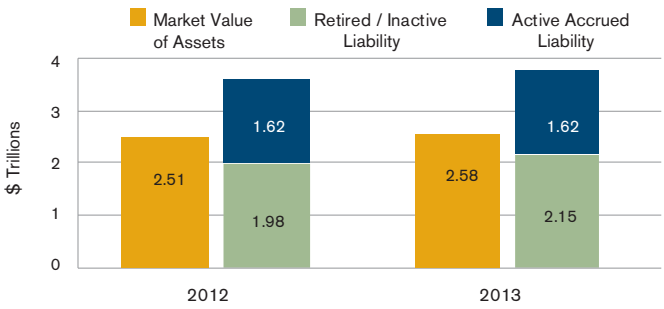
assets and liabilities. On the asset side, for more than half of the plans in this study the most recent valuation information available is as of July 1, 2012. The 12-month period from July 2011 to July 2012 generally saw disappointing investment results, with market returns hovering around 1% to 2%. On the liability side, 29 of the plans in this study lowered their interest rate assumptions and therefore increased their reported accrued liabilities.

The larger plans in the study tend to be somewhat better funded than the smaller plans in the study. The top quartile of plans by reported funded ratio accounts for 35% of the aggregate reported accrued liabilities, whereas the bottom quartile of plans accounts for just 18% of the aggregate reported accrued liabilities.

Liabilities

The plans reported aggregate accrued liabilities of $3.77 trillion. This total breaks down into $1.62 trillion for the 12.6 million plan members who are still working plus $2.15 trillion for the 11.8 million plan members who are retired and receiving benefits or who have stopped working but have not yet started collecting their pensions. The number of active members has declined by 200,000 relative to the Milliman 2012 Public Pension Funding Study, whereas the number of inactive members has grown by 900,000. In aggregate, the plans currently have assets sufficient to cover 100% of the reported accrued liability for retirees and inactive members but only 27% of the assets needed to cover the reported accrued liability for active plan members.

FIGURE 2: ACCRUED LIABILITY



Interest rate assumption

There are three sources of money to pay for public pension benefits: payroll deductions from active members, contributions from plan sponsors, and investment income generated by plan assets. When actuaries advise plan sponsors on contribution policy, they estimate what level of future investment income a plan's assets are likely to earn. Different types of investments carry different long-term expectations for investment earnings, so the actuary starts with return assumptions for each of the different asset classes. Collectively, these return assumptions, along with the associated variances and coefficients of correlation with other asset classes, are known as *capital market assumptions*. The actuary then takes into account each particular pension plan's allocation of investments across the different asset classes and arrives at the expected long-term average annual rate of return for the pension plan. This expected rate of return is used to discount projected future benefit payments back to the present time so that those future payments are expressed in today's dollars. Using this methodology to determine the plan's liabilities, if the plan sponsor always pays the amounts determined using actuarially sound methods and if the actual future investment results are equal to the interest rate assumption, then the plan should accumulate sufficient assets to pay benefits when due.

Capital market assumptions

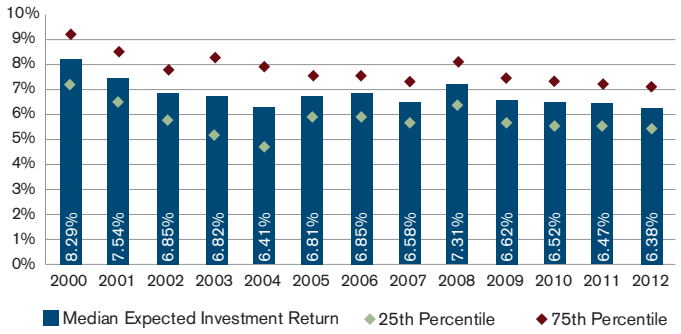
One of the most significant trends over the past decade is that the market's consensus views on long-term future investment returns have slid downward. Figure 3 illustrates this trend by showing the expected long-term return for a hypothetical asset allocation based on Milliman's capital market assumptions for each year since 2000. Over this period, expected returns on both equity and fixed-income investments have fallen by about 200 basis points. Pension plans have reflected this trend by lowering their interest rate assumptions, in some cases by making a single significant cut and in other cases by making gradual reductions. Where assumptions of 8.5% were once commonplace, over half of the plans in the study now have assumptions of 7.75% or below. With lower interest rate assumptions come higher reported accrued liabilities; for many public pension plans, a 100-basis-point reduction in the interest rate assumption causes an 11% to 15% increase in accrued liability, which in turn causes a reduction in the

Methodology

This study is based on the most recently available Comprehensive Annual Financial Reports and valuation reports, which reflect valuation dates ranging from June 30, 2010, to December 31, 2012; about two-thirds are from June 30, 2012, or later. For the purposes of this study, the reported asset allocation of each of the included plans has been analyzed to determine an independent measure of the expected long-term annual geometric average rate of return on plan assets. The reported accrued liability for each plan has then been recalibrated to reflect this actuarially determined interest rate. This study therefore adjusts for differences between each plan's assumed rate of investment return and a current market assessment of the expected return based on actual asset allocations. This study is not intended to estimate the plans' liabilities for settlement accounting purposes or to analyze the funding of individual plans.

reported funded ratio and an increase in the contributions needed to fund the plan over the long term. If market outlooks remain at current levels or continue to decline, it is likely that plans will continue to reduce their interest rate assumptions.

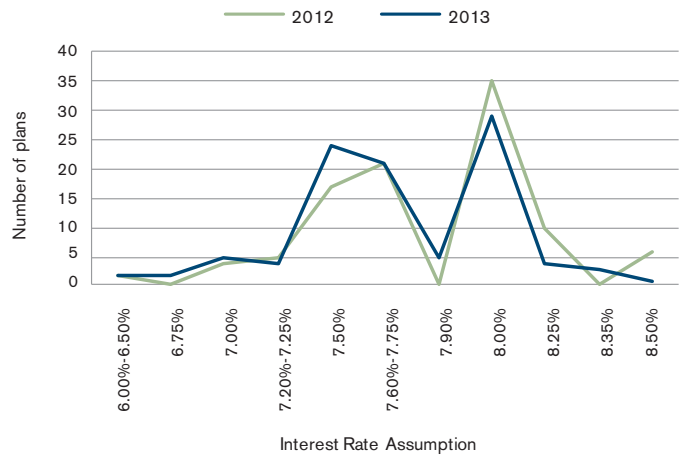
FIGURE 3: EXPECTED RETURN FOR A HYPOTHETICAL ASSET ALLOCATION BASED ON MILLIMAN'S CAPITAL MARKET ASSUMPTIONS



Asset allocation: 35% broad U.S. equities, 15% developed foreign equities, 25% core fixed income, 5% high yield bonds, 10% mortgages, 5% real estate, and 5% cash; inflation assumption is fixed at 2.5% for all years.

There is a wide diversity of investment allocations among the plans in this study, which in and of itself would naturally result in a diversity of interest rate assumptions. Expert opinion also varies regarding the expected long-term returns for different asset classes, and plans may have different attitudes about the appropriate level of conservatism to build into their interest rate assumptions. It is therefore not surprising that there is a wide spread of interest rate assumptions reported by the plans in this study, as shown in Figure 4.

FIGURE 4: INTEREST RATE ASSUMPTIONS REPORTED BY PLANS



The median of the interest rate assumptions reported by plans in this study is 7.75% (7.67% on a liability-weighted basis), down from a median of 8.00% (7.80% liability-weighted) in the Milliman 2012 Public Pension Funding Study. Since the 2012 study, 29 of the plans have lowered their interest rate assumption, most by 25 to 50 basis points. At an aggregate level, there were no significant changes in asset allocations during this period, so the drop in interest rate assumptions reflects the general consensus trend among investment professionals toward lower expected long-term returns on most asset classes.

Recalibrating the accrued liability

We independently applied a "building-block approach" to each plan's unique asset allocation, and determined the 50th percentile 30-year geometric rate of return based on Milliman's December 31, 2012, capital market assumptions. We then applied the plan's reported inflation assumption to arrive at our independent, actuarially determined interest rate. The median of the resulting interest rates is 7.47%, which is 28 basis points lower than the median interest rate assumption reported by the plans and 18 basis points lower than the 7.65% median rate from the Milliman 2012 Public Pension Funding

Interest rates and accrued liabilities: Asking the right question

How much are our pension promises worth? This is a question being asked with increasing urgency as plan sponsors grapple with how to cope with underfunded pension plans. But there is more than one way to determine the answer to this question, and the choice of calculation method depends on why the question is being asked.

To illustrate, consider a very different question: How much is New York City's Central Park worth? If the question is being asked in the context of gauging its aesthetic value, or its value as a recreational space, or its value as a green space converting carbon dioxide to oxygen, then the answer can be determined accordingly. But imagine how different the answer would be if the question is being asked in the context of developing Central Park's acreage and filling those green spaces with high-rise apartments and office buildings.

Similarly, putting a dollar figure on pension promises depends on the background for asking the question. If the context for the question is to determine what it would cost to shut down the pension plan today or to transfer responsibility for future pension benefits to an insurance company, then the answer is arrived at by discounting future pension payments using current market interest rates. But if the context for the question is to do long-range budgeting and to work out how much should be contributed to the plan this year and next year and 20 years from now, then the answer is arrived at by discounting future pension payments using the long-term expected return on the plan's investments. Neither answer to the question is more "right" than the other; they are just different answers to a question asked in different contexts.

Study. Figure 5 details how the actuarially determined interest rates compare to the interest rate assumptions reported by the plans; Figure 6 compares the 2013 actuarially determined interest rates to the 2012 actuarially determined interest rates.

FIGURE 5:
ACTUARIALLY DETERMINED INTEREST RATE VS. REPORTED INTEREST RATE

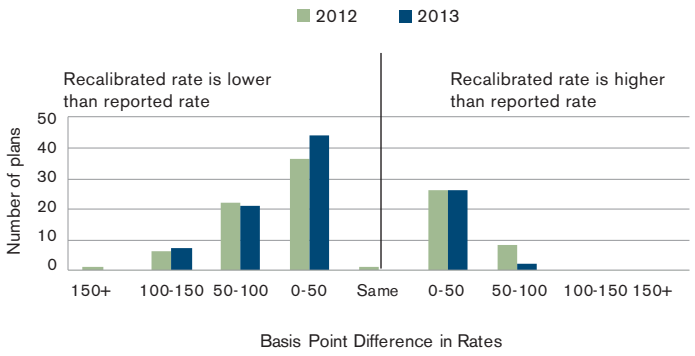
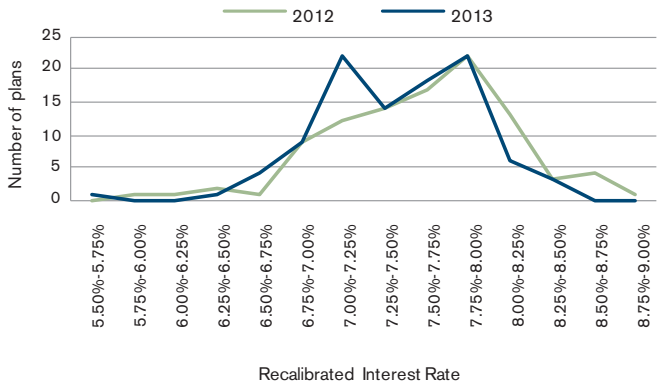


FIGURE 6: ACTUARIALLY DETERMINED INTEREST RATES IN 2013 VS. 2012

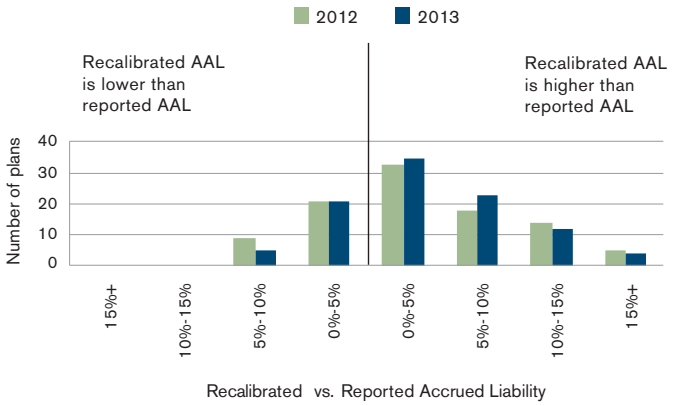


Note that for 28 of the 100 plans the actuarially determined interest rate is higher than the interest rate assumption reported by the plan; this suggests that those plans have included a margin for conservatism in their interest rate assumption.

Recalibrated accrued liabilities

Using each plan's actuarially determined interest rate to recalibrate the accrued liabilities, these plans have an aggregate accrued liability of $3.86 trillion. For most plans in the study, as was the case in 2012, the recalibrated accrued liability is not substantially different from the reported accrued liability, as shown in Figure 7.

FIGURE 7: RECALIBRATED VS. REPORTED ACCRUED LIABILITY



Sensitivity analysis

A relatively small change in the interest rate assumption can have a significant impact on the accrued liability. The magnitude of the accrued liability impact is a function of the makeup of the plan's membership: a less "mature" plan with more active members than retirees has a higher sensitivity to interest rate changes than a more mature plan with a bigger retiree population. Using an interest rate that is 100 basis points higher or lower than the actuarially determined interest rate moves the aggregate recalibrated accrued liability by 10.6% to 13.5% (see Figure 8), but can move accrued liability by as little as 9.2% for the most mature plans or as much as 15.1% for the least mature plans.

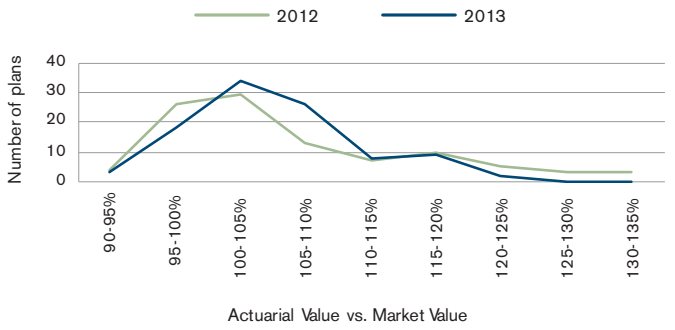
FIGURE 8: EFFECT OF CHANGING THE INTEREST RATE ASSUMPTION

RECALIBRATED ACCRUED LIABILITY ($ TRILLIONS)	- 100 BASIS POINTS	ACTUARIALLY DETERMINED INTEREST RATE	+ 100 BASIS POINTS
Most mature 25 plans	$0.75 (+11.6%)	$0.68	$0.61 (-9.2%)
Second most mature 25 plans	$1.68 (+13.1%)	$1.49	$1.33 (-10.4%)
Second least mature 25 plans	$0.91 (+14.1%)	$0.79	$0.71 (-11.1%)
Least mature 25 plans	$1.04 (+15.1%)	$0.90	$0.80 (-11.7%)
All 100 plans in aggregate	$4.38 (+13.5%)	$3.86	$3.45 (-10.6%)

Investments

The plans reported an aggregate market value of assets of $2.58 trillion and an aggregate actuarial value of assets of $2.73 trillion, compared with $2.51 trillion and $2.71 trillion, respectively, reported in the Milliman 2012 Public Pension Funding Study. Actuarial asset values are designed to reduce year-to-year contribution volatility by systematically recognizing market gains and losses over a multiyear period, typically three to five years. The advantage of asset smoothing techniques is that contribution levels are more consistent from year to year. After periods of large market losses, such as 2000 to 2002 and 2007 to 2009, actuarial asset values may be larger than market values. After periods of large market gains such as the late 1990s, the opposite is generally the case. Figure 9 shows the relationship of these two asset measures for the plans in this study. In both 2012 and 2013, the median ratio of actuarial value to market value was 104%, but the spread of values is somewhat narrower in 2013 than was the case in 2012; that is, fewer plans have a very large divergence between actuarial value and market value.

FIGURE 9: ACTUARIAL VALUE VS. MARKET VALUE



Most pension plans suffered significant asset losses in the timeframe of 2007 to 2009 and additional modest losses in 2011–2012. While there were sizeable gains experienced during 2009 to 2011, those gains were typically not as large as the losses, leading generally to plans with reported actuarial asset values larger than market values. Note that in the pension funding context, a "gain" or "loss" is based on the plan's actual investment performance relative to the interest rate assumption. While market indices have generally returned to pre-financial crisis levels, many pension plans have not fully recovered from the effects of the market meltdown. As the market gains and losses that were experienced over the past several years are gradually recognized, the relationship of actuarial value to market value will continue to shift. Most notably, much of the large losses suffered during the financial crisis have already been recognized, and many plans will have fully recognized those losses by 2013.

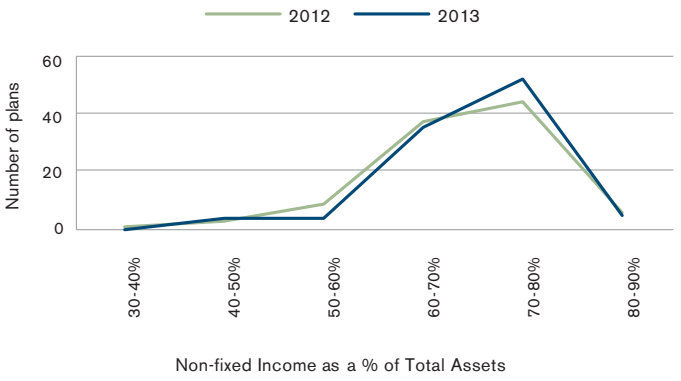
The plans included in this study are invested in a wide array of asset classes, as shown in Figure 10.

FIGURE 10: ASSET ALLOCATIONS

CLASS	2012	2013
Equities	51%	49%
Real estate	6%	8%
Private equity, etc.	13%	15%
Total non-fixed income	**70%**	**72%**
Fixed income	26%	25%
Cash	4%	3%
Total fixed income	**30%**	**28%**

While the aggregate 2013 investment allocation is 72% in non-fixed income classes and 28% in fixed income, there is considerable investment allocation variation from plan to plan. Figure 11 illustrates this variation, showing the percentage of plan assets invested in non-fixed income classes.

FIGURE 11:
PERCENTAGE ALLOCATION TO NON-FIXED INCOME ASSET CLASSES



Asset volatility ratio

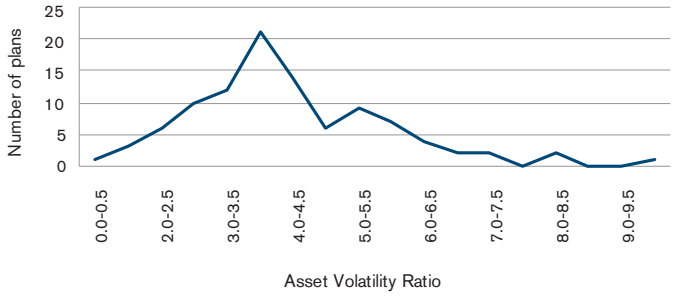
The *asset volatility ratio* is a metric that has been garnering attention lately for its ability to help plan sponsors anticipate the impact of investment volatility on contribution levels. The asset volatility ratio is simply the ratio of plan assets to the payroll for active members covered by the plan. A lower ratio means that plan assets are relatively small compared with payroll; this implies that a large single-year investment gain or loss will not move the contribution rate much. A higher ratio, on the other hand, signals that a fairly small deviation in asset performance could translate into a surprisingly large shift in the 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 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. Figure 12 illustrates how changes in the asset volatility ratio over time can alter the relationship between investment volatility and contribution volatility.

FIGURE 12: ASSET VOLATILITY RATIO ILLUSTRATION FOR A HYPOTHETICAL PENSION PLAN

	1983	1993	2003	2013
Market value of assets	$30,000	$110,000	$260,000	$390,000
Covered payroll	20,000	40,000	70,000	80,000
Asset volatility ratio = assets ÷ payroll	1.50	2.75	3.71	4.88
Increase in contribution rate resulting from a 10% asset loss (using 15-year level dollar amortization)	1.58%	2.90%	3.91%	5.14%

The median asset volatility ratio for the plans included in this study is 3.9, and most plans fall within a range of 3.1 to 5.4. However, 18 of the plans have an asset volatility ratio of 5.5 or higher, indicating that their contributions will be more volatile in reaction to market swings.

FIGURE 13:
ASSET VOLATILITY RATIOS



Acknowledgements

Principal author and project coordinator: Rebecca A. Sielman, FSA

Principal researchers: Jennifer Sorensen Senta, ASA; Richard Gordon, FSA; Ryan Lane, EA; Henry Neeb, ASA

Technical reviews: Katherine Warren, FSA; Daniel Wade, FSA; Matt Larrabee, FSA; Will Clark-Shim, FSA; Tim Bleick, FSA; Hassan Ghazi, FSA; Michael Sudduth, FSA; Alan Perry, FSA; Mark Olleman, FSA; Glenn Bowen, FSA; Jenn Castelhano, ASA

Reported Data

			MARKET VALUE			ACTUARIAL VALUE				
PLAN NAME	VALUATION DATE	ACCRUED LIABILITY	VALUE OF ASSETS	SURPLUS / (UNFUNDED) ACCRUED LIABILITY	FUNDED RATIO	VALUE OF ASSETS	SURPLUS / (UNFUNDED) ACCRUED LIABILITY	FUNDED RATIO	COUNT OF ACTIVE MEMBERS	COUNT OF INACTIVE / RETIRED MEMBERS
Employees' Retirement System of Alabama	09/30/11	14,367	8,057	(6,310)	56%	9,456	(4,911)	66%	85,633	52,254
Teachers' Retirement System of Alabama	09/30/11	28,776	16,597	(12,179)	58%	19,430	(9,346)	68%	135,768	97,807
State of Alaska Public Employees' Retirement System	06/30/11	10,919	6,268	(4,651)	57%	6,762	(4,157)	62%	24,393	33,773
Arizona Public Safety Personnel Retirement System	06/30/12	10,326	5,075	(5,251)	49%	6,052	(4,274)	59%	18,542	12,562
Arizona State Retirement System	06/30/12	38,044	26,048	(11,996)	68%	28,549	(9,495)	75%	203,994	328,931
Arkansas Public Employees Retirement System	06/30/12	8,163	5,678	(2,485)	70%	5,625	(2,538)	69%	45,937	42,335
Arkansas Teacher's Retirement System	06/30/11	15,521	11,895	(3,626)	77%	11,146	(4,375)	72%	76,780	44,538
California Public Employees' Retirement System	06/30/11	328,600	241,740	(86,860)	74%	271,389	(57,211)	83%	779,481	851,014
California State Teachers' Retirement System	06/30/12	214,765	134,835	(79,930)	63%	144,232	(70,533)	67%	421,499	440,693
University of California Retirement Plan	07/01/12	54,620	41,806	(12,814)	77%	42,965	(11,655)	79%	116,888	126,252
Chicago Public Schools	06/30/12	17,376	9,437	(7,939)	54%	9,364	(8,012)	54%	30,366	30,171
Municipal Employees' Annuity and Benefit Fund of Chicago	12/31/12	13,475	5,183	(8,292)	38%	5,073	(8,402)	38%	31,326	38,115
Colorado Public Employees' Retirement Association	12/31/11	60,735	37,164	(23,571)	61%	37,185	(23,550)	61%	199,741	186,673
Connecticut State Employees Retirement System	06/30/12	23,019	8,468	(14,551)	37%	9,745	(13,274)	42%	47,868	45,448
Connecticut State Teachers' Retirement System	06/30/12	24,862	13,474	(11,388)	54%	13,735	(11,127)	55%	49,808	46,179
County Employees' Annuity and Benefit Fund of Cook County	12/31/12	13,418	8,060	(5,358)	60%	7,834	(5,584)	58%	21,447	28,030
Delaware State Employees' Pension Plan	06/30/12	7,950	6,915	(1,035)	87%	7,270	(680)	91%	35,427	26,393
Florida State Retirement System	07/01/12	148,050	122,921	(25,129)	83%	127,892	(20,158)	86%	517,287	475,399
Employees' Retirement System of Georgia	06/30/12	16,778	11,537	(5,241)	69%	12,261	(4,517)	73%	63,942	47,051
Teachers' Retirement System of Georgia	06/30/11	65,979	54,084	(11,895)	82%	55,428	(10,551)	84%	216,167	178,581
Employees' Retirement System of the State of Hawaii	06/30/12	20,683	11,286	(9,397)	55%	12,242	(8,441)	59%	65,599	47,683
Public Employee Retirement System of Idaho	07/01/12	13,397	11,330	(2,067)	85%	11,306	(2,091)	84%	65,270	47,973
Illinois Municipal Retirement Fund	12/31/11	30,963	24,834	(6,129)	80%	25,711	(5,252)	83%	175,233	234,182
State Employees' Retirement System of Illinois	06/30/12	33,091	10,961	(22,130)	33%	11,477	(21,614)	35%	62,729	85,602
State Universities Retirement System of Illinois	06/30/12	33,170	13,705	(19,465)	41%	13,950	(19,220)	42%	81,156	81,341
Teachers' Retirement System of the State of Illinois	06/30/12	90,025	36,517	(53,508)	41%	37,945	(52,080)	42%	162,217	204,499
Indiana Public Employees' Retirement Fund	06/30/12	15,784	12,244	(3,540)	78%	12,088	(3,696)	77%	145,519	142,066
Indiana State Teachers' Retirement Fund	06/30/12	20,860	9,077	(11,783)	44%	8,915	(11,945)	43%	70,573	56,338
Iowa Public Employees' Retirement System	06/30/12	29,446	23,025	(6,421)	78%	23,530	(5,916)	80%	164,200	171,454
Kansas Public Employee Retirement System	12/31/11	22,607	12,477	(10,130)	55%	13,379	(9,228)	59%	155,054	126,205
Kentucky Employees Retirement Systems	06/30/12	12,114	3,459	(8,655)	29%	3,599	(8,515)	30%	46,282	51,802
Kentucky Teachers' Retirement System	06/30/12	26,974	14,797	(12,177)	55%	14,691	(12,283)	54%	75,951	52,762
County Employees Retirement System of Kentucky	06/30/12	12,150	7,051	(5,099)	58%	7,295	(4,855)	60%	92,182	64,870
Los Angeles City Employees' Retirement System	06/30/12	14,394	9,059	(5,335)	63%	9,935	(4,459)	69%	24,917	23,031
Water and Power Employees' Retirement Plan of the City of Los Angeles	07/01/12	9,693	7,389	(2,304)	76%	7,574	(2,119)	78%	8,962	10,158
Los Angeles County Employees Retirement Association	06/30/12	50,809	38,307	(12,502)	75%	39,039	(11,770)	77%	91,952	68,859
Los Angeles Fire and Police Pension Plan	06/30/12	17,031	13,269	(3,762)	78%	14,252	(2,779)	84%	13,396	12,442
Louisiana State Employees' Retirement System	06/30/12	16,158	9,516	(6,642)	59%	9,026	(7,132)	56%	52,352	98,111
Teachers' Retirement System of Louisiana	06/30/12	24,540	14,189	(10,351)	58%	13,584	(10,956)	55%	84,513	94,802
Maine Public Employees Retirement System	06/30/12	11,553	8,454	(3,099)	73%	8,881	(2,672)	77%	39,360	30,485
Maryland State Employees' Combined System	06/30/12	20,284	12,631	(7,653)	62%	12,668	(7,616)	62%	85,174	92,511
Maryland Teachers	06/30/12	34,253	22,502	(11,751)	66%	22,524	(11,729)	66%	103,694	86,732
Massachusetts State Board of Retirement System	01/01/12	27,785	18,643	(9,142)	67%	20,508	(7,277)	74%	85,935	58,671
Massachusetts Teachers' Retirement System	01/01/12	36,483	20,129	(16,354)	55%	22,141	(14,342)	61%	86,860	57,406
Michigan Public School Employee's Retirement System	09/30/11	63,427	34,675	(28,752)	55%	41,038	(22,389)	65%	236,660	207,525
Michigan State Employees Retirement System	09/30/12	15,597	8,775	(6,822)	56%	10,212	(5,385)	65%	17,860	62,043
Municipal Employees' Retirement System of Michigan	12/31/11	9,844	5,933	(3,911)	60%	7,150	(2,694)	73%	35,111	35,362
Minnesota State Retirement System	07/01/12	11,083	9,098	(1,985)	82%	9,162	(1,921)	83%	48,207	47,677
Teachers Retirement Association of Minnesota	07/01/12	23,025	16,686	(6,339)	72%	16,805	(6,220)	73%	76,649	95,217
Public Employees Retirement Association of Minnesota	06/30/12	18,599	13,578	(5,021)	73%	13,662	(4,937)	73%	139,330	119,889
Public Employees' Retirement System of Mississippi	06/30/12	34,493	19,781	(14,712)	57%	19,993	(14,500)	58%	162,311	217,970
Missouri State Employees' Plan	06/30/12	10,794	7,582	(3,212)	70%	7,897	(2,897)	73%	51,332	55,342
Public School Retirement System of Missouri	06/30/12	35,588	27,817	(7,771)	78%	29,013	(6,575)	82%	77,529	50,207

PLAN NAME	VALUATION DATE	ACCRUED LIABILITY	MARKET VALUE			ACTUARIAL VALUE			COUNT OF ACTIVE MEMBERS	COUNT OF INACTIVE / RETIRED MEMBERS
			VALUE OF ASSETS	SURPLUS / (UNFUNDED) ACCRUED LIABILITY	FUNDED RATIO	VALUE OF ASSETS	SURPLUS / (UNFUNDED) ACCRUED LIABILITY	FUNDED RATIO		
Nebraska Public Employees Retirement Systems School Retirement System	06/30/12	9,609	7,246	(2,363)	75%	7,359	(2,250)	77%	39,477	40,068
Public Employees' Retirement System of the State of Nevada	06/30/10	35,078	20,906	(14,172)	60%	24,725	(10,353)	70%	102,594	55,726
New Hampshire Retirement System	06/30/12	10,362	5,774	(4,588)	56%	5,818	(4,544)	56%	48,625	29,826
Public Employees' Retirement System of New Jersey	07/01/12	45,393	25,176	(20,217)	55%	28,887	(16,506)	64%	280,158	153,625
Teachers' Pension and Annuity Fund of New Jersey	06/30/12	51,405	26,038	(25,367)	51%	31,079	(20,326)	60%	150,200	89,700
The Police and Firemen's Retirement System of New Jersey	07/01/12	31,732	21,126	(10,606)	67%	23,687	(8,045)	75%	40,819	39,767
Educational Retirement Board of New Mexico	06/30/12	15,837	9,489	(6,348)	60%	9,606	(6,231)	61%	60,855	71,368
Public Employees Retirement Association of New Mexico	06/30/12	17,788	11,600	(6,188)	65%	11,612	(6,176)	65%	48,483	36,623
New York City Employees' Retirement System	06/30/10	62,935	35,384	(27,551)	56%	40,433	(22,502)	64%	184,982	141,428
New York City Police Pension Fund	06/30/10	38,134	19,985	(18,149)	52%	22,909	(15,225)	60%	34,597	44,634
Teachers' Retirement System of the City of New York	06/30/10	55,138	26,398	(28,740)	48%	32,478	(22,660)	59%	111,647	80,526
New York State and Local Employees Retirement System	04/01/11	140,087	130,506	(9,581)	93%	126,395	(13,692)	90%	513,092	478,769
New York State Teachers' Retirement System	06/30/11	89,825	89,890	65	100%	86,892	(2,933)	97%	280,435	146,843
New York State and Local Police & Fire	03/31/12	24,169	22,357	(1,812)	93%	22,205	(1,964)	92%	31,024	34,799
North Carolina Local Governmental Employees' Retirement System	12/31/11	19,374	17,908	(1,466)	92%	19,326	(48)	100%	121,638	96,050
North Carolina Teachers and State Employees Retirement System	12/31/11	61,847	53,402	(8,445)	86%	58,125	(3,722)	94%	310,627	282,472
Ohio Police and Fire Pension Fund	01/01/12	16,347	9,688	(6,659)	59%	10,309	(6,038)	63%	27,463	30,029
Ohio Public Employees Retirement System	12/31/10	79,629	63,816	(15,813)	80%	60,599	(19,030)	76%	356,734	617,999
Schools Employees' Retirement System of Ohio	06/30/12	16,372	10,219	(6,153)	62%	10,284	(6,088)	63%	121,811	81,648
State Teachers Retirement System of Ohio	07/01/12	106,302	60,694	(45,608)	57%	59,490	(46,812)	56%	173,044	160,581
Oklahoma Public Employees Retirement System	07/01/12	8,335	6,821	(1,514)	82%	6,682	(1,653)	80%	42,569	35,760
Teachers' Retirement System of Oklahoma	06/30/12	18,588	10,195	(8,393)	55%	10,190	(8,398)	55%	87,778	61,403
Orange County Employees Retirement System	12/31/11	13,523	8,466	(5,057)	63%	9,064	(4,459)	67%	21,421	17,695
Oregon Public Employees Retirement System	12/31/11	61,198	51,389	(9,809)	84%	50,168	(11,030)	82%	170,972	158,915
Pennsylvania State Employees' Retirement System	12/31/11	42,282	24,371	(17,911)	58%	27,618	(14,664)	65%	107,021	121,531
Public School Employees' Retirement System of Pennsylvania	06/30/12	87,761	48,534	(39,227)	55%	58,228	(29,533)	66%	273,504	324,301
Puerto Rico Government Employees Retirement System	06/30/12	27,646	1,237	(26,409)	4%	1,237	(26,409)	4%	134,566	117,861
Puerto Rico Teachers Retirement System	06/30/11	11,449	2,386	(9,063)	21%	2,386	(9,063)	21%	43,402	36,129
Rhode Island Employees Retirement System	06/30/12	10,670	5,757	(4,913)	54%	6,167	(4,503)	58%	24,378	27,305
Sacramento County Employees' Retirement System	06/30/12	7,838	6,074	(1,764)	77%	6,530	(1,308)	83%	12,155	12,090
San Bernardino County Employees' Retirement Association	06/30/12	8,570	6,173	(2,397)	72%	6,789	(1,781)	79%	19,306	13,518
San Diego County Employees Retirement Association	06/30/12	10,943	8,437	(2,506)	77%	8,607	(2,336)	79%	16,457	20,205
City and County of San Francisco Employees' Retirement System	07/01/12	19,394	15,294	(4,100)	79%	16,028	(3,366)	83%	28,282	30,748
South Carolina Retirement System	07/01/11	40,016	22,395	(17,621)	56%	25,605	(14,411)	64%	192,865	268,382
South Dakota Retirement System	07/01/12	8,453	7,843	(610)	93%	7,828	(625)	93%	38,207	37,161
Tennessee Consolidated Retirement System	07/01/11	40,069	33,662	(6,407)	84%	36,681	(3,388)	92%	215,076	116,585
Texas County & District Retirement System	12/31/12	22,953	19,530	(3,423)	85%	20,250	(2,703)	88%	121,963	115,524
Texas Municipal Retirement System	12/31/12	22,683	20,491	(2,192)	90%	19,784	(2,899)	87%	101,827	87,958
Employees' Retirement System of Texas	08/31/12	29,377	21,826	(7,551)	74%	24,273	(5,104)	83%	132,669	177,989
Teacher Retirement System of Texas	08/31/12	144,427	111,450	(32,977)	77%	118,326	(26,101)	82%	815,155	404,166
Utah Retirement Systems	01/01/12	20,743	15,756	(4,987)	76%	16,615	(4,128)	80%	87,220	81,354
Virginia Employees Retirement System	06/30/11	75,185	50,267	(24,918)	67%	52,559	(22,626)	70%	326,357	186,423
Washington Public Employees' Retirement System	06/30/11	31,382	28,274	(3,108)	90%	29,880	(1,502)	95%	152,417	207,853
Washington State Law Enforcement Officer's and Fire Fighters' Plan 1 and 2	06/30/11	9,710	11,550	1,840	119%	12,186	2,476	125%	17,055	12,264
Washington State Teachers' Retirement System	06/30/11	15,557	13,741	(1,816)	88%	14,626	(931)	94%	66,203	50,913
West Virginia Teachers' Retirement System	06/30/11	9,445	5,075	(4,370)	54%	5,075	(4,370)	54%	35,855	34,291
Wisconsin Retirement System	12/31/11	76,565	71,455	(5,110)	93%	76,466	(99)	100%	256,232	353,525

Study Technical Appendix

Methodology: Expected rate of return on assets

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 (CAFRs). We did not make adjustments for potential differences between actual asset allocations and target policy asset allocations.

Our method for calculation of the expected rate of return was the "building-block method" as outlined in Actuarial Standard of Practice No. 27, using geometric averaging methodology. We used Milliman's December 31, 2012, capital market assumptions to calculate the 50th percentile 30-year geometric 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 inflation assumption was not available, we used Milliman's December 31, 2012, capital market 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 adjustment benchmarks based on detailed calculations for certain pension plans meeting broad categorization definitions. For these benchmark plans, we developed precise liability durations separately for active, terminated vested, and retired member populations. These calculated liability durations were modified durations, further adjusted for plan- and population-specific convexity. We applied a variety of cost of living adjustments (COLAs) to the various benchmark plans, resulting in a library of adjustment factors taking into account plan type, plan provisions, demographic group, and COLA.

We then selected liability adjustment factors for each plan in the study based on plan type, COLA provisions, and average demographic characteristics where available. For example, a teachers' plan was typically matched with a set of teachers' plan adjustment factors, with similar COLA provisions. If average ages, service levels, or expected working lifetimes were available, we also used these criteria to aid in choosing the adjustment factors. For each liability recalibration calculation, we then recalculated the selected benchmark durations to reflect the actual starting plan interest rate assumption. We performed separate liability adjustments for active, terminated vested, and retired liabilities, thereby adjusting for varying plan maturity levels.

The liability durations used for adjustment provide an estimate of the sensitivity of the present value of benefits (PVB) to changes in the interest rate assumption. We assumed that for active populations, the actuarial accrued liabilities (AAL) varied 85% as much as the PVB when liabilities were reported under the projected unit credit cost method, and 70% as much as the PVB when liabilities were reported under the entry age normal cost method. These assumptions for the relative change in AAL compared with PVB were based on the average results of a survey of actual changes in AAL versus PVB for selected Milliman clients. Although most plans in the study reported liability results under one of these two cost methods for Government Accounting Standards Board (GASB) reporting purposes, a handful of plans disclosed liabilities only under the frozen initial liability cost method. For those plans, we used the entry age normal assumption for the relative change of AAL to PVB.

Where any discrepancy occurred between liabilities disclosed for GASB reporting and liabilities disclosed elsewhere, the GASB reporting numbers were relied upon.