

Milliman 2014 Public Pension Funding Study

Funded ratios using the market value of assets rose modestly, but remain near 70% despite several strong years of post-2009 investment returns

Average investment return assumptions reported by sponsors remained fairly level and are moderately higher than current long-term market return expectations

The sensitivity of actuarially determined contribution rates to investment volatility continues to increase

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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 collect key sponsor-reported information about each plan's assets, accrued liabilities, investment return assumptions, and asset allocations. We then determine an independent investment return assumption for each plan based on its unique asset allocation and Milliman's current capital market assumptions. That independently determined investment return assumption is used to recalibrate each plan's accrued liability. This process enables an independent assessment of plans' investment return assumptions relative to the reported returns that sponsors expect to earn on their investments. This study employs a version of the budgeting methodology used by sponsors to fund their plans over a long time horizon as a going concern. This differs from near-term settlement calculation methodologies, often referred to as "risk-free rate" methods, that have been used in some academic studies of the health of public pension plans.

Funded ratios using the market value of assets increased modestly in the Milliman 2014 Public Pension Funding Study relative to the 2013 study, largely reflecting strong asset growth. This study generally is based on valuation information from July 1, 2013, or later.

The 12-month period from July 2012 to July 2013 saw very strong investment results for most pension plans, with market rates of return well into the upper teens.

The larger plans in the study tend to be better funded than the smaller plans in the study. The best funded plans, those in the top quartile of plans as measured by the sponsor-reported funded ratio, account for 34% of the aggregate sponsor-reported accrued liabilities, whereas the worst funded plans, those in the bottom quartile, account for only 18% of the aggregate sponsor-reported accrued liabilities.

This year's study found that the gap between the recalibrated accrued liability and the sponsor-reported accrued liability widened, from 2.6% in the Milliman 2013 Public Pension Funding Study to 3.8% in 2014. This widening gap in liability mirrors a corresponding widening between the investment return assumptions reported by the plans in the study relative to our independently determined investment return assumptions. While 13 of the 100 plans in the study have lowered their reported investment return assumptions since the Milliman 2013 Public Pension Funding Study, most plans in the study have left their investment return assumptions unchanged. The median investment return assumption reported

FIGURE 1: MILLIMAN 100, AGGREGATE FUNDED STATUS (\$ TRILLIONS)

	2012		2013		2014	
	SPONSOR REPORTED	RECALIBRATED FIGURES	SPONSOR REPORTED	RECALIBRATED FIGURES	SPONSOR REPORTED	RECALIBRATED FIGURES
Investment return assumption						
Median	8.00%	7.65%	7.75%	7.47%	7.75%	7.34%
Liability-weighted	7.80%	7.55%	7.67%	7.44%	7.65%	7.32%
Accrued liability	\$3.60	\$3.71	\$3.77	\$3.86	\$3.88	\$4.03
Plan assets						
Market value	\$2.51	\$2.51	\$2.58	\$2.58	\$2.75	\$2.75
Actuarial value	\$2.71	\$2.71	\$2.73	\$2.73	\$2.80	\$2.80
Funded ratio						
Market assets	69.8%	67.8%	68.5%	66.8%	70.7%	68.2%
Actuarial assets	75.1%	73.0%	72.4%	70.6%	72.1%	69.4%
Unfunded accrued liability						
Market assets	\$1.09	\$1.20	\$1.19	\$1.28	\$1.13	\$1.28
Actuarial assets	\$0.89	\$1.00	\$1.04	\$1.13	\$1.08	\$1.23

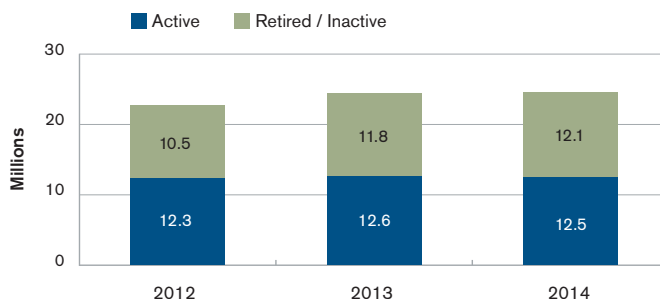
by the plans decreased from 8.00% in the 2012 study to 7.75% in the 2013 study, and it remains at 7.75% in the 2014 study. Meanwhile, Milliman sees market consensus views on long-term future investment returns continuing to decline. Reflecting this trend, our study's median independently determined investment return assumption decreased from 7.65% in the 2012 study to 7.47% in the 2013 study and to 7.34% in the 2014 study. In aggregate, this suggests that for many plans that have not recently lowered their reported assumptions, some decrease in the investment return assumption may be appropriate. 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. Note that lower investment return assumptions cause accrued liabilities to increase and therefore cause 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 that are used to dampen year-to-year contribution fluctuations. While there are a multitude of asset-smoothing techniques in use, generally speaking they offset investment gains/losses from a particular year with investment gains/losses from a nearby year. This process means that actuarial values tend to lag changes in the market and can deviate from market value substantially when there are large market movements. The 100 plans in this study reported assets totaling \$2.75 trillion on a market value basis and \$2.80 trillion on an actuarial value basis. By comparison, reported assets in the Milliman 2013 Public Pension Funding Study stood at \$2.58 trillion on a market value basis and \$2.73 trillion on an actuarial value basis. For most plans, the large market losses suffered during the financial crisis resulted in actuarial values that temporarily were far higher than market values for several years after the crisis; the generally favorable market returns since 2009 have allowed market values to gradually catch up to, and in some cases exceed, actuarial values.

LIABILITIES

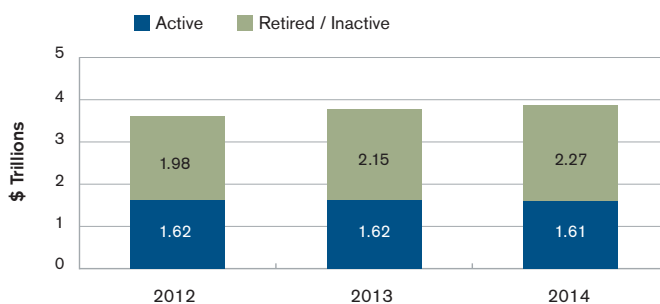
The plans reported aggregate accrued liabilities of \$3.88 trillion for the nearly 25 million members covered by the plans in the study. This total breaks down into \$1.61 trillion for the 12.5 million plan members who are still working plus \$2.27 trillion for the 12.1 million plan members who are retired and receiving benefits or who have stopped working but have not yet started collecting their pensions. Over the past three years the number of active members has been fairly stable while the number of retired and inactive members has climbed steadily, as illustrated in Figure 2.

FIGURE 2: NUMBER OF PLAN MEMBERS



The aggregate sponsor-reported accrued liabilities follow a similar pattern over time, with virtually no change in the accrued liability for active members but continued growth in the accrued liability for retired and inactive members (see Figure 3).

FIGURE 3: SPONSOR-REPORTED ACTUARIAL ACCRUED LIABILITY



On average, active members have a sponsor-reported accrued liability of \$129,000 per person and retired and inactive members have a sponsor-reported accrued liability of \$187,000 per person. In aggregate, the plans currently have assets sufficient to cover 100% of the sponsor-reported accrued liability for retirees and inactive members, but beyond that current assets would cover only 29% of the liability for active members.

METHODOLOGY

This study is based on the most recently available Comprehensive Annual Financial Reports and actuarial valuation reports, which reflect valuation dates ranging from June 30, 2011, to January 1, 2014; about two-thirds are from June 30, 2013, 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 median rate of return on plan assets. The sponsor-reported accrued 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 assumed real rate of investment return 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 accounting or near-term plan settlement purposes or to analyze the funding of individual plans.

CAPITAL MARKET ASSUMPTIONS

Milliman's opinion is that the market's consensus views on long-term future investment returns have declined over the past year, continuing a persistent trend since the turn of the century. Figure 4 (on page 4) 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, expected real returns on equity investments have fallen by about 220 basis points, while expected real returns on fixed-income investments have fallen by about 190 basis points; overall, the median expected investment return for the illustrated hypothetical asset allocation has fallen from 8.29% in 2000 to 6.28% in 2013. In response to the market consensus, many pension plan sponsors have been shifting

their investment return assumptions downward, in some cases via a single significant reduction but more commonly through a series of smaller 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. Lower investment return assumptions cause calculated accrued liabilities to increase. For many public pension plans, a 100-basis-point reduction in the investment return assumption causes a 12% to 13% increase in the accrued liability, which in turn causes a reduction in the funded ratio and an increase in the actuarially determined contribution. If market outlooks remain at current levels or continue to decline, it is likely that many plans will consider additional reductions in their investment return assumptions.

NEW ACCOUNTING STANDARDS

The Governmental Accounting Standards Board (GASB) has issued new accounting standards (Statements No. 67 and 68) that significantly change the financial reporting requirements for U.S. public pension plans, effective beginning in 2014. Among other changes, these standards require all plans to report a standardized measure of actuarial accrued 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 normal cost method) that can differ from 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 the total pension liability is to changes in the discount rate.

The new GASB standards will not have an impact on the investment return assumptions used for funding purposes, which are the focus of the Milliman Public Pension Funding Study. However, they will enable us to refine the methodology used in this study's recalibration of sponsor-reported funding liabilities. Currently, the liability recalibration factors for each plan in this study are determined based on each plan's similarity to other plans for which precise liability duration and convexity are known (see this report's technical appendix for details). The new GASB sensitivity disclosures will provide plan-specific liability duration information, which we will incorporate into this study as the information becomes available for each plan. We anticipate that the sensitivity information will be available for many plans beginning with our next (2015) study, and for all plans by the following (2016) study.

NEW ACTUARIAL STANDARD OF PRACTICE FOR SETTING ECONOMIC ASSUMPTIONS

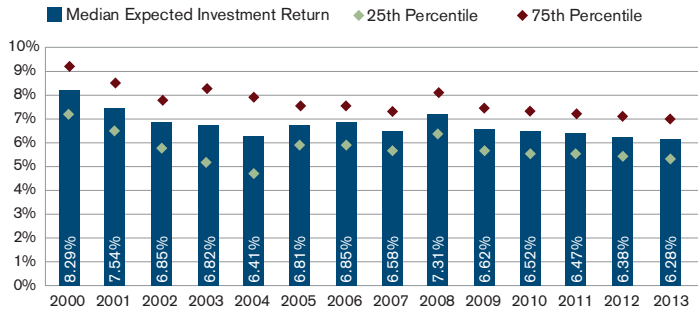
The Actuarial Standards Board of the American Academy of Actuaries establishes professional standards of practice for U.S. actuaries. These Actuarial Standards of Practice (ASOPs) identify what the actuary should consider, document, and disclose when performing an actuarial assignment. ASOP 27 governs the selection of economic assumptions that are used for measuring pension obligations, including investment returns, salary growth, inflation, and so forth. ASOP 27 has recently been revised, with the new version taking effect for actuarial valuation dates on or after September 30, 2014.

The prior version of ASOP 27 called for the actuary to construct a *best estimate range* for each assumption and then recommend a specific point within the range. The best estimate range was defined as "...the narrowest range within which the actuary reasonably anticipates that the actual results, compounded over the measurement period, are more likely than not to fall." (Prior version of ASOP 27, § 2.1.)

The revised version of ASOP 27 no longer includes the concept of a best estimate range. Instead, it calls for the actuary to select a single *reasonable* assumption. An assumption is considered reasonable in this context if it has no significant bias, i.e., it is neither significantly optimistic nor pessimistic. The revised edition goes on to describe a *range of reasonable assumptions*. It states, "The actuary should also recognize that different actuaries will apply different professional judgment and may choose different reasonable assumptions. As a result, a range of reasonable assumptions may develop both for an individual actuary and across actuarial practice." (Revised version of ASOP 27, § 3.6.2.)

The past decade has seen a gradual reduction in the capital market assumptions used by both actuarial firms and investment consultants (see Figure 4). There has been an accompanying trend toward lower sponsor-selected investment return assumptions. It is possible that the revised version of ASOP 27 may accelerate this trend toward lower reported investment return assumptions, as actuaries incorporate the revised guidance into their recommendations to plan sponsors. We will continue to monitor this situation.

FIGURE 4: 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.

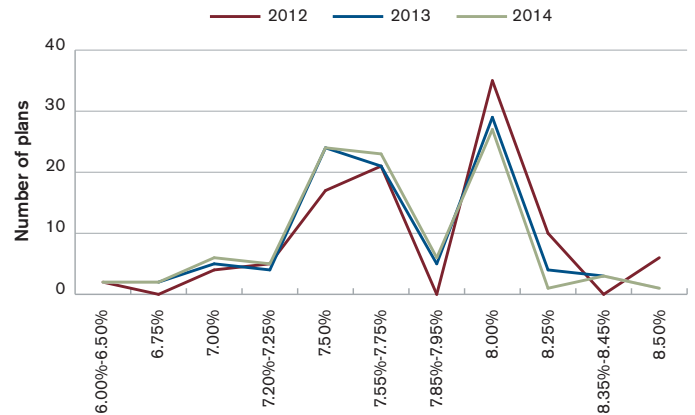
SELECTION OF THE INVESTMENT RETURN ASSUMPTION

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 look to investment professionals for estimates of what level of future investment income a given plan's assets are expected to earn on average over the long term. Different types of investments carry different long-term expectations for investment earnings, so return assumptions vary 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 takes into account each plan's allocation of investments across the different asset classes and applies the capital market assumptions to arrive at the long-term expected average annual rate of return for that plan's investments. The entity that sets funding policies for the plan then selects the investment return assumption, taking into account the advice received from its actuaries and investment professionals. This investment return assumption is used to discount projected future benefit payments back to the present time so that those future payments are expressed as a net present value in today's dollars. Using this methodology to determine the plan's liabilities for funding purposes, the plan should accumulate sufficient assets to pay all benefits in full, so long as a) the plan sponsor always pays the actuarially determined contribution, b) the contribution is determined using actuarially sound methods, and c) actual future investment results are equal to the selected investment return assumption.

REPORTED INVESTMENT RETURN ASSUMPTIONS

The plans in this study reported a wide spread of investment return assumptions, with a modest shift to somewhat lower rates (see Figure 5 below). The median reported investment return assumption is 7.75%, which is unchanged from the Milliman 2013 Public Pension Funding Study. On a liability-weighted basis, which reflects the relative sizes of the plans in the study, the reported investment return assumption is 7.65%, down very slightly from 7.67% in 2013. Since the 2013 study, 13 of the plans have lowered their investment return assumptions, most by 25 to 50 basis points, while four of the plans have increased their investment return assumptions.

FIGURE 5: SPONSOR-REPORTED INVESTMENT RETURN ASSUMPTIONS

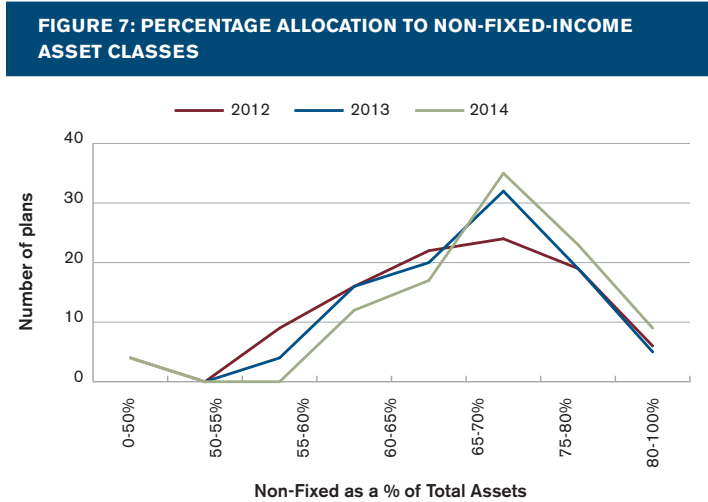


The plans included in this study are invested in a wide array of asset classes, as illustrated in Figure 6. There has been a slight shift away from fixed income and into equities, real estate, and alternative investment classes such as private equity.

FIGURE 6: ASSET ALLOCATIONS

CLASS	2012	2013	2014
Fixed income	26%	25%	24%
Cash	4%	3%	3%
Total fixed income	30%	28%	27%
Equities	51%	49%	50%
Real estate	6%	8%	8%
Private equity, etc.	13%	15%	15%
Total non-fixed income	70%	72%	73%

While the aggregate 2014 investment allocation is 73% in non-fixed-income classes and 27% in fixed income, there is considerable investment allocation variation from plan to plan. Figure 7 illustrates this variation, showing the percentage of plan assets invested in non-fixed-income asset classes.



RECALIBRATING THE ACCRUED 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 capital market assumptions of December 31, 2013. 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 7.34%, which is 41 basis points lower than the 7.75% median assumption reported by the plans in 2014 and 13 basis points lower than the 7.47% median rate from the Milliman 2013 Public Pension Funding Study. Figure 8 details how the independently determined investment return assumptions compare to the investment return assumptions reported by the plans; Figure 9 illustrates changes in the independently determined rates over the past several years.

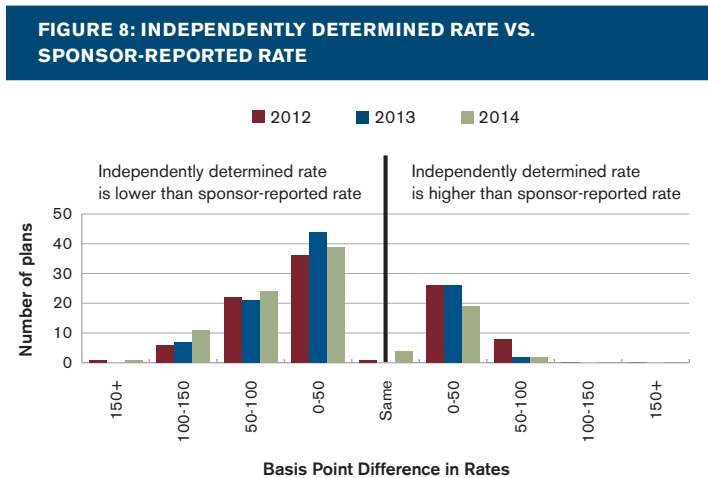
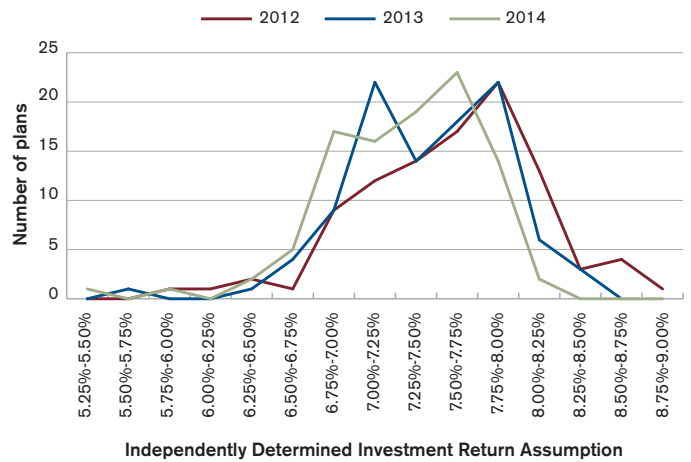


FIGURE 9: INDEPENDENTLY DETERMINED RATES OVER TIME



Note that, for 21 of the 100 plans, the independently determined investment return rate is higher than the plan’s reported investment return assumption; this suggests that those plans have included a margin for conservatism in their reported investment return assumptions.

NEW MORTALITY TABLE

The Society of Actuaries (SOA) periodically publishes mortality tables for use in valuing pension liabilities. The mortality table currently in widespread use is known as the RP-2000 Mortality Table, and it is typically paired with Scale AA for projecting future mortality improvement. The data underlying RP-2000 was drawn from the mortality experience of both public and private pension plans during 1990 to 1994. In February 2014, the SOA published exposure drafts of updated tables, the RP-2014 mortality table and the MP-2014 mortality improvement scale. The SOA final report adopting these models was issued on October 27, 2014.

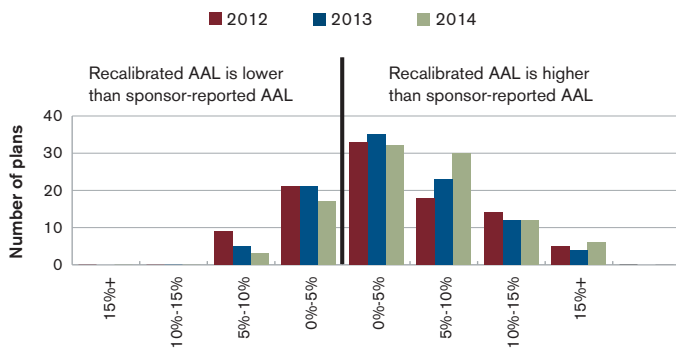
The reader should note that SOA elected to eliminate *all* of the data they had collected from public plan sponsors because it did not meet their standards as to credible data or statistical confidence intervals. However, the SOA recommends the use of the updated mortality improvement scale for *all* pension plans and the use of the updated mortality table for *private* pension plans (emphasis added). A number of actuaries have expressed reservations regarding using the 2014 tables for public plans given that no public plan data was used in creating them.

We expect that plans and their actuaries will review their mortality assumptions in light of the SOA final report. To the extent that using the new mortality tables and/or the new mortality improvement scale projects longer lifespans, accrued liabilities will increase and funded ratios will decrease. We will monitor this situation and report on the results in future studies.

RECALIBRATED ACCRUED LIABILITIES

We used each plan's independently determined investment return assumption to recalibrate the plan's actuarial accrued liabilities (AAL). In aggregate, these plans have a recalibrated accrued liability of \$4.03 trillion, compared to a sponsor-reported accrued liability of \$3.88 trillion, an aggregate difference of 3.9%. For most plans in the study the recalibrated accrued liability is within 10% of the sponsor-reported accrued liability, although there are an increasing number of plans where the gap has been widening from within the zero to 5% range up to the 5% to 10% range (see Figure 10).

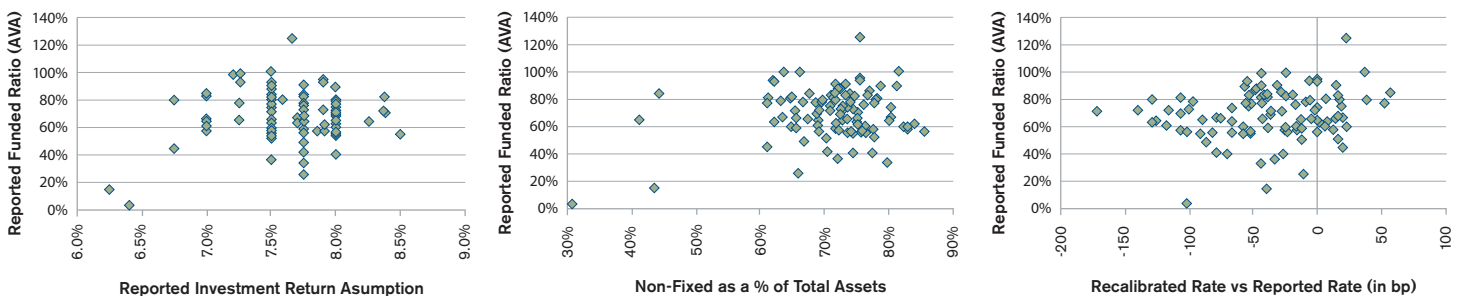
FIGURE 10: RECALIBRATED AAL VS. SPONSOR-REPORTED AAL



PLANS WITH LOWER FUNDED RATIOS

We explored whether sponsor-reported investment return assumptions or investment allocations varied based on a plan's funded ratio. It has been suggested that plans with lower funded ratios may be more likely to use higher investment return assumptions and/or allocate a higher portion of their assets to riskier investment classes. This study found, on the contrary, a very low correlation between sponsor-reported funded ratios (actuarial value of assets ÷ reported accrued liability) and sponsor-reported investment return assumptions, as well as a low correlation between reported funded ratios and the percentage of non-fixed-income assets. This study also found that there was very little correlation between reported funded ratios and the gap between sponsor-reported investment return assumptions and our independently determined investment return assumptions.

FIGURE 11: CORRELATION BETWEEN SPONSOR-REPORTED FUNDED RATIO AND OTHER FACTORS



These findings indicate that there is little correlation between funded status and the use of more aggressive investment return assumptions and/or riskier investments (see Figure 11 below).

SENSITIVITY ANALYSIS

A relatively small change in the investment return 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; other factors, such as automatic cost of living features, also come into play in determining a plan's sensitivity. Using an interest rate that is 100 basis points higher or lower than the independently determined investment return assumption moves the aggregate recalibrated accrued liability by 10.7% to 13.4% (see Figure 12), but can move accrued liability by as little as 9.1% for the most mature plans or by as much as 15.8% for the least mature plans.

FIGURE 12: EFFECTS OF CHANGING THE INVESTMENT RETURN ASSUMPTION

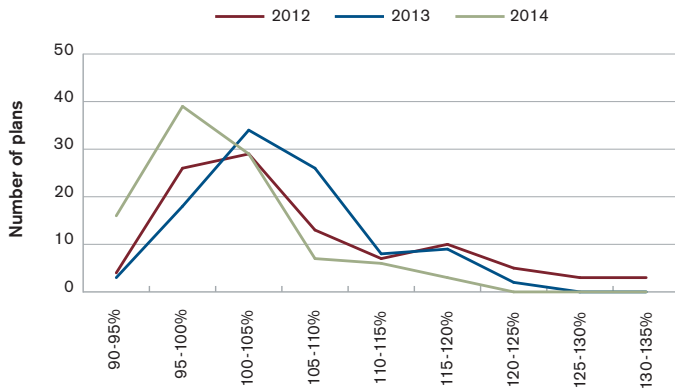
	RECALIBRATED ACCRUED LIABILITY (\$ TRILLIONS)		
	-100 BASIS POINTS	INDEPENDENTLY DETERMINED INVESTMENT RATE	+100 BASIS POINTS
Most mature 25 plans	\$0.86 (+11.7%)	\$0.77	\$0.70 (-9.1%)
2nd most mature 25 plans	\$1.80 (+13.2%)	\$1.59	\$1.42 (-10.7%)
2nd least mature 25 plans	\$0.74 (+13.8%)	\$0.65	\$0.58 (-10.8%)
Least mature 25 plans	\$1.17 (+15.8%)	\$1.01	\$0.90 (-10.9%)
All 100 plans in aggregate	\$4.57 (+13.4%)	\$4.03	\$3.60 (-10.7%)

ASSET SMOOTHING

The plans reported an aggregate market value of assets of \$2.75 trillion and an aggregate actuarial value of assets of \$2.80 trillion, compared with \$2.58 trillion and \$2.73 trillion, respectively, reported in the Milliman 2013 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 13 shows the relationship of these two asset measures for the plans in this study.

FIGURE 13: ACTUARIAL VALUE VS. MARKET VALUE



The ratio of actuarial value to market value is a measure of the extent to which plans have experienced overall market gains or losses in the past few years. A ratio over 100% indicates more recent losses than gains (i.e., the actuarial value exceeds the market value by the amount of deferred market losses), while a ratio under 100% indicates more recent gains than losses. In both 2012 and 2013, the median ratio of actuarial value to market value was 104%. However, in 2014 the median ratio has dropped to 99%. Near-term, we expect this downward trend to likely continue because the period 2012 to 2014 has seen strong market gains and those gains will continue to systematically flow into actuarial values over the next several years.

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 actuarially determined 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 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.

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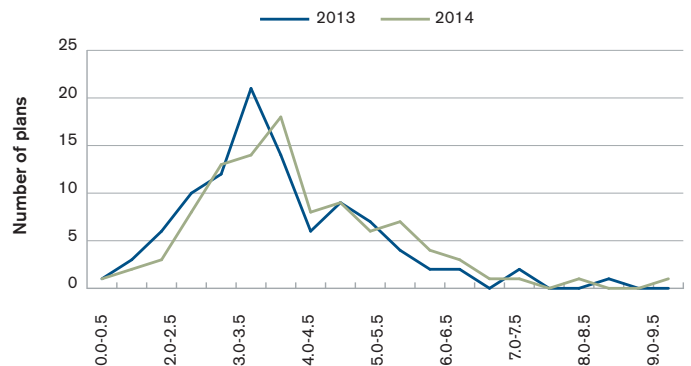
It is unsurprising that, as pension plans have accumulated assets and their member populations have matured over the past several decades, asset volatility ratios have risen. These higher ratios mean that actuarially determined contribution rates are now more sensitive than they once were to investment volatility, despite the use of asset-smoothing methods to help mitigate the impact of market movements. Figure 14 illustrates how changes in the asset volatility ratio over time can alter the relationship between investment volatility and contribution volatility.

FIGURE 14: 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 4.3, up from 3.9 in the Milliman 2013 Public Pension Funding Study. Nearly a quarter 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. This upward trend in asset volatility ratios is likely to continue and means that actuarially determined contribution levels will likely become increasingly sensitive to actual returns experienced by plans in the investment markets.

FIGURE 15: ASSET VOLATILITY RATIO



SPONSOR-REPORTED DATA

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		
Alabama Employees' Retirement System	09/30/13	14,537	10,013	4,524	68.9%	9,546	(4,991)	65.7%	84,035	71,462
Alabama Teachers' Retirement System	09/30/12	28,251	18,786	9,465	66.5%	18,786	(9,465)	66.5%	133,791	101,374
Alaska Public Employees' Retirement System	06/30/12	11,429	6,118	5,311	53.5%	6,530	(4,899)	57.1%	22,730	34,834
Arizona Public Safety Personnel Retirement System	06/30/13	10,824	5,557	5,267	51.3%	6,185	(4,639)	57.1%	18,436	13,083
Arizona State Retirement System	06/30/13	39,499	28,677	10,822	72.6%	29,734	(9,765)	75.3%	202,693	338,240
Arkansas Teacher's Retirement System	06/30/13	16,718	12,830	3,888	76.7%	12,247	(4,471)	73.3%	74,925	49,353
California Public Employees' Retirement System	06/30/12	340,429	236,800	103,629	69.6%	282,991	(57,438)	83.1%	786,586	859,576
California State Teachers' Retirement System	06/30/13	221,861	147,907	73,954	66.7%	148,614	(73,247)	67.0%	416,643	451,850
Chicago Public Schools	06/30/13	19,045	9,674	9,371	50.8%	9,423	(9,622)	49.5%	30,969	31,942
Colorado Public Employees' Retirement Association	12/31/12	61,791	39,793	21,998	64.4%	39,079	(22,712)	63.2%	196,435	119,180
Connecticut State Employees Retirement System	06/30/13	23,768	9,182	14,586	38.6%	9,785	(13,983)	41.2%	47,868	45,448
Connecticut State Teachers' Retirement System	06/30/12	24,862	13,474	11,388	54.2%	13,735	(11,127)	55.2%	49,808	46,179
Cook County Employees' Annuity and Benefit Fund	12/31/13	13,637	8,927	4,710	65.5%	8,381	(5,256)	61.5%	21,287	29,424
Delaware State Employees' Pension Plan	06/30/13	8,257	7,396	861	89.6%	7,520	(737)	91.1%	35,571	27,384
Florida State Retirement System	07/01/13	154,126	133,028	21,098	86.3%	131,681	(22,445)	85.4%	513,823	492,703
Georgia Employees' Retirement System	06/30/13	16,982	12,130	4,852	71.4%	12,130	(4,852)	71.4%	61,550	49,608
Georgia Teachers' Retirement System	06/30/12	68,349	53,487	14,862	78.3%	56,262	(12,087)	82.3%	213,675	186,138
Hawaii State Employees' Retirement System	06/30/13	21,244	12,358	8,886	58.2%	12,749	(8,495)	60.0%	66,226	49,124
Idaho Public Employee Retirement System	07/01/13	14,173	12,080	2,093	85.2%	12,054	(2,119)	85.0%	65,535	50,031
Illinois Municipal Retirement Fund	12/31/12	32,603	27,995	4,608	85.9%	27,492	(5,111)	84.3%	174,381	240,698
Illinois State Employees' Retirement System	06/30/13	34,721	12,400	22,321	35.7%	11,877	(22,844)	34.2%	61,545	89,281
Illinois State Teachers' Retirement System	06/30/13	93,887	39,859	54,028	42.5%	38,155	(55,732)	40.6%	160,692	229,108
Illinois State Universities Retirement System	06/30/13	34,373	15,037	19,336	43.7%	14,263	(20,110)	41.5%	81,302	139,425
Indiana Public Employees' Retirement Fund	06/30/13	16,146	12,721	3,425	78.8%	12,947	(3,199)	80.2%	137,937	150,511
Indiana State Teachers' Retirement Fund	06/30/13	21,212	9,649	11,563	45.5%	9,689	(11,523)	45.7%	70,414	59,427
Iowa Public Employees' Retirement System	06/30/13	30,498	24,757	5,741	81.2%	24,711	(5,787)	81.0%	165,095	177,557
Kansas Public Employee Retirement System	12/31/12	23,531	13,817	9,714	58.7%	13,278	(10,253)	56.4%	156,053	130,111
Kentucky County Employees Retirement System	06/30/13	12,503	7,611	4,892	60.9%	7,439	(5,064)	59.5%	90,938	67,482
Kentucky Employees Retirement Systems	06/30/13	12,171	3,261	8,910	26.8%	3,142	(9,029)	25.8%	46,353	52,181
Kentucky Teachers' Retirement System	06/30/13	28,817	16,109	12,708	55.9%	14,963	(13,854)	51.9%	74,831	54,600
Los Angeles City Employees' Retirement System	06/30/13	14,882	10,154	4,728	68.2%	10,224	(4,658)	68.7%	24,441	23,161
Los Angeles City Water and Power Employees' Retirement Plan	07/01/13	10,095	8,311	1,784	82.3%	7,958	(2,137)	78.8%	8,913	10,197
Los Angeles County Employees Retirement Association	06/30/13	53,247	41,774	11,473	78.5%	39,932	(13,315)	75.0%	91,545	70,405
Los Angeles Fire and Police Pension Plan	06/30/13	17,632	14,730	2,902	83.5%	14,658	(2,974)	83.1%	13,224	12,565
Louisiana State Employees' Retirement System	06/30/13	16,182	10,328	5,854	63.8%	9,741	(6,441)	60.2%	44,111	104,064
Louisiana Teachers' Retirement System	06/30/13	26,018	15,490	10,528	59.5%	14,669	(11,349)	56.4%	82,910	97,828
Maine Public Employees Retirement System	06/30/13	11,831	9,091	2,740	76.8%	9,178	(2,653)	77.6%	41,809	31,624
Maryland State Employees' Combined System	06/30/13	21,047	13,670	7,377	64.9%	13,327	(7,720)	63.3%	84,677	94,844
Maryland Teachers	06/30/13	35,530	24,470	11,060	68.9%	23,846	(11,684)	67.1%	104,028	89,945
Massachusetts State Board of Retirement System	01/01/14	30,680	22,721	7,959	74.1%	21,581	(9,099)	70.3%	88,156	60,543
Massachusetts Teachers' Retirement System	01/01/13	39,135	21,934	17,201	56.0%	21,787	(17,348)	55.7%	87,765	59,019
Michigan Municipal Employees' Retirement System	12/31/12	10,248	6,400	3,848	62.5%	7,316	(2,932)	71.4%	34,187	37,001
Michigan Public School Employee's Retirement System	09/30/12	62,716	40,016	22,700	63.8%	38,450	(24,266)	61.3%	223,769	212,828
Michigan State Employees Retirement System	09/30/13	15,654	9,617	6,037	61.4%	9,447	(6,207)	60.3%	16,475	61,751
Minnesota Public Employees Retirement Association	06/30/13	19,380	15,085	4,295	77.8%	14,113	(5,267)	72.8%	139,763	125,029
Minnesota State Retirement System	07/01/13	11,429	10,033	1,396	87.8%	9,376	(2,053)	82.0%	49,121	49,348
Minnesota Teachers Retirement Association	07/01/13	23,419	18,015	5,404	76.9%	16,775	(6,644)	71.6%	76,765	98,663
Mississippi Public Employees' Retirement System	06/30/13	35,543	21,687	13,856	61.0%	20,491	(15,052)	57.7%	161,744	220,909
Missouri Public School Retirement System	06/30/13	36,758	30,375	6,383	82.6%	29,443	(7,315)	80.1%	78,076	52,191
Missouri State Employees' Plan	06/30/13	11,135	7,994	3,141	71.8%	8,096	(3,039)	72.7%	50,833	58,975
Nebraska Public Employees Retirement Systems School Retirement System	06/30/13	9,985	8,093	1,892	81.1%	7,703	(2,282)	77.1%	40,314	40,906
Nevada State Public Employees' Retirement System	06/30/13	41,984	28,835	13,149	68.7%	29,109	(12,875)	69.3%	99,038	66,169

SPONSOR-REPORTED DATA

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		
New Hampshire Retirement System	06/30/13	10,709	6,428	4,281	60.0%	6,071	(4,638)	56.7%	48,688	30,990
New Jersey Police and Firemen's Retirement System	07/01/13	33,000	22,632	10,368	68.6%	24,298	(8,702)	73.6%	40,372	41,252
New Jersey Public Employees' Retirement System	07/01/13	47,000	26,760	20,240	56.9%	29,167	(17,833)	62.1%	272,846	157,410
New Jersey Teachers' Pension and Annuity Fund	06/30/13	52,367	26,860	25,507	51.3%	30,470	(21,897)	58.2%	151,887	92,080
New Mexico Educational Retirement Board	06/30/13	16,362	10,192	6,170	62.3%	9,829	(6,533)	60.1%	61,177	74,407
New Mexico Public Employees Retirement Association	06/30/13	17,057	12,708	4,349	74.5%	12,438	(4,619)	72.9%	50,012	39,601
New York City Employees' Retirement System	06/30/11	65,269	42,409	22,860	65.0%	42,409	(22,860)	65.0%	182,021	144,382
New York City Police Pension Fund	06/30/11	40,525	24,749	15,776	61.1%	24,749	(15,776)	61.1%	33,705	45,755
New York City Teachers' Retirement System	06/30/11	57,703	33,602	24,101	58.2%	33,602	(24,101)	58.2%	109,636	82,996
New York State and Local Employees Retirement System	04/01/12	144,170	130,506	13,664	90.5%	125,751	(18,419)	87.2%	505,575	488,000
New York State and Local Police & Fire	03/31/13	25,096	22,888	2,208	91.2%	22,058	(3,038)	87.9%	30,780	35,401
New York State Teachers' Retirement System	06/30/12	92,251	88,056	4,195	95.5%	82,871	(9,380)	89.8%	270,470	156,615
North Carolina Local Governmental Employees' Retirement System	12/31/12	20,339	19,724	615	97.0%	20,295	(44)	99.8%	122,270	102,210
North Carolina Teachers and State Employees Retirement System	12/31/12	63,630	57,780	5,850	90.8%	59,912	(3,718)	94.2%	312,512	297,397
Ohio Police and Fire Pension Fund	01/01/13	16,008	10,603	5,405	66.2%	10,278	(5,730)	64.2%	27,289	30,278
Ohio Public Employees Retirement System	12/31/11	84,529	61,664	22,865	73.0%	65,435	(19,094)	77.4%	349,188	641,177
Ohio Schools Employees' Retirement System	06/30/13	16,826	11,161	5,665	66.3%	10,988	(5,838)	65.3%	121,642	78,017
Ohio State Teachers Retirement System	07/01/13	94,367	64,706	29,661	68.6%	62,591	(31,776)	66.3%	169,945	166,302
Oklahoma Public Employees Retirement System	07/01/13	8,556	7,442	1,114	87.0%	6,979	(1,577)	81.6%	43,273	36,730
Oklahoma Teachers' Retirement System	06/30/13	18,973	11,810	7,163	62.2%	10,861	(8,112)	57.2%	89,333	63,701
Orange County Employees Retirement System	12/31/13	15,785	10,679	5,106	67.7%	10,417	(5,368)	66.0%	21,368	19,118
Oregon Public Employees Retirement System	12/31/12	60,405	56,118	4,287	92.9%	54,784	(5,621)	90.7%	167,103	163,908
Pennsylvania Public School Employees' Retirement System	06/30/13	89,952	49,016	40,936	54.5%	57,353	(32,599)	63.8%	267,428	228,115
Pennsylvania State Employees' Retirement System	12/31/12	43,056	25,386	17,670	59.0%	25,303	(17,753)	58.8%	106,048	123,786
Puerto Rico Government Employees Retirement System	06/30/13	23,712	731	22,981	3.1%	731	(22,981)	3.1%	125,671	124,497
Puerto Rico Teachers Retirement System	06/30/13	12,252	1,907	10,345	15.6%	1,907	(10,345)	15.6%	41,553	39,065
Rhode Island Employees Retirement System	06/30/13	10,654	5,949	4,705	55.8%	6,109	(4,545)	57.3%	24,473	27,638
Sacramento County Employees' Retirement System	06/30/13	8,211	6,788	1,423	82.7%	6,798	(1,413)	82.8%	12,026	12,883
San Bernardino County Employees' Retirement Association	06/30/13	9,051	7,105	1,946	78.5%	7,205	(1,846)	79.6%	19,401	14,094
San Diego County Employees Retirement Association	06/30/13	11,631	9,064	2,567	77.9%	9,186	(2,445)	79.0%	16,891	20,820
San Francisco City and County Employees' Retirement System	07/01/13	20,225	17,012	3,213	84.1%	16,303	(3,922)	80.6%	28,789	32,007
South Carolina Retirement System	07/01/12	39,458	21,537	17,921	54.6%	25,541	(13,917)	64.7%	192,533	269,215
South Dakota Retirement System	07/01/13	8,804	9,086	(282)	103.2%	8,804	0	100.0%	38,594	38,509
Tennessee Consolidated Retirement System	07/01/13	41,913	37,567	4,346	89.6%	39,249	(2,664)	93.6%	209,964	163,995
Texas County & District Retirement System	12/31/13	24,515	22,374	2,141	91.3%	21,913	(2,602)	89.4%	124,525	123,280
Texas Employees' Retirement System	08/31/13	31,886	22,869	9,017	71.7%	24,668	(7,218)	77.4%	133,669	108,381
Texas Municipal Retirement System	12/31/13	25,320	22,469	2,851	88.7%	21,293	(4,027)	84.1%	102,870	92,547
Texas Teacher Retirement System	08/31/13	150,666	117,388	33,278	77.9%	121,730	(28,936)	80.8%	831,302	425,752
University of California Retirement Plan	07/01/13	57,381	45,341	12,040	79.0%	43,572	(13,809)	75.9%	118,321	135,304
Utah Retirement Systems	01/01/13	21,675	17,433	4,242	80.4%	16,778	(4,897)	77.4%	80,837	85,614
Virginia Employees Retirement System	06/30/12	77,859	50,267	27,592	64.6%	51,212	(26,647)	65.8%	328,385	195,058
Washington Public Employees' Retirement System	06/30/12	32,714	28,052	4,662	85.7%	31,173	(1,541)	95.3%	150,590	212,633
Washington State Law Enforcement Officer's and Fire Fighters' Plan 1 and 2	06/30/12	10,193	11,544	(1,351)	113.3%	12,783	2,590	125.4%	16,906	12,477
Washington State Teachers' Retirement System	06/30/12	15,857	13,276	2,581	83.7%	14,902	(955)	94.0%	65,357	52,463
West Virginia Teachers' Retirement System	06/30/12	9,713	5,144	4,569	53.0%	5,144	(4,569)	53.0%	35,807	35,457
Wisconsin Retirement System	12/31/12	78,683	78,492	191	99.8%	78,613	(70)	99.9%	255,253	363,451
Wyoming Retirement System	01/01/14	8,045	6,525	1,520	81.1%	6,245	(1,800)	77.6%	36,354	47,504

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

Our method to calculate 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, 2013, 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 inflation assumption was not available, we used Milliman’s December 31, 2013, 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 duration 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 investment return 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 investment return 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.

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