U.S. Public Pension Plan Contribution Analysis

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Introduction and Executive Summary

The Society of Actuaries (SOA) supports actuaries and advances knowledge through research and education. As part of its work, the SOA seeks to inform public policy development and public understanding through research. In that context, this report updates the June 2017 SOA study of contributions[1] among 180 large-city and state-based defined benefit pension plans[2] in the United States.

Funding public pension plans involves many factors, including approaches to cost, risk and plan management, asset allocation, investment experience, changing plan demographics, actuarial methods and assumptions for computing plan liabilities, relatively long budget planning cycles and contribution decisions that may be subject to legislative processes. If funding is regulated, it is regulated at the state level. Regardless of the complexities, the goal is to provide the plan with enough assets to pay participants' benefits when they come due.

This research analyzes and reports what has happened historically with respect to only one aspect of plan funding; employer contributions.[3] Although there are some exceptions, employee contributions are often defined in state statute or another form of regulation or contract, and employers are usually responsible for making up the difference needed to fund the benefits.[4] Accordingly, this study focuses on employer contributions and, for brevity, generally excludes the adjective "employer."

This study compares actual contributions to certain benchmarks, which may inform development of contribution policies. However, this research does not provide sufficient information from which to develop effective contribution policies.

Here is a summary of key findings during the period studied, 2003–2017:

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[1] Society of Actuaries, *U.S. Public Pension Plan Contribution Indices*, 2006–2014, June 2017, *https://www.soa.org/research-reports/2017/public-pension-indices/*.

[2] Large public-sector pension plans are also known as systems, which may or may not comprise multiple plans. This study uses the term "plan," each of which has its own actuarial valuation results.

[3] For this research, contributions from all sources other than employees are considered employer contributions.

[4] National Association of State Retirement Administrators, *NASRA Issue Brief: Employee Contributions to Public Pension Plans*, Oct. 2018, *https://www.nasra.org/files/Issue%20Briefs/NASRAContribBrief.pdf*.

- Most of the plans studied received insufficient contributions to reduce their unfunded liabilities, assuming all actuarial assumptions were met exactly.[5] In 2003, while still feeling the impact of the dot-com market crash, 55% of plans received insufficient contributions to reduce their unfunded liabilities. After reeling from the 2008 market crash, the percentage of such plans peaked at 84% in 2011 before falling to about 63% for 2016 and 2017.

- The percentage of plans whose contributions were insufficient to reduce unfunded liabilities *as a dollar amount*, assuming all actuarial assumptions were met exactly, but were sufficient to reduce unfunded liabilities *as a percent of payroll,* assuming all actuarial assumptions were met exactly, increased from 36% in fiscal year 2003 to 77% in 2017.[5] These plans may be following policies that target funding as a level percent of payroll over a long period of time.

- However, of plans whose contributions did not reduce unfunded liabilities as a dollar amount, assuming all actuarial assumptions were met exactly, more than half also fell short of the plans' Actuarially Determined Contributions (ADC) or other target contributions.[6] This suggests that the process for determining such plans' contributions may not align with the plan's funding policy.
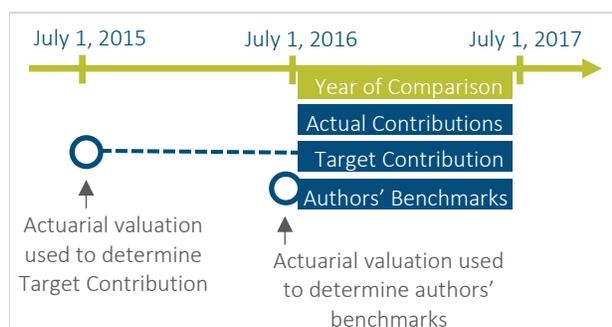
Benchmarks

The metrics used in this analysis compare contributions that plans received to certain benchmarks. In general, the authors compute benchmarks from results of the actuarial valuation that is coincident with or immediately prior to the start of the fiscal year that contributions were paid. In other words, the authors' benchmarks use the most current valuation results available at the start of the fiscal year in which contributions were received.

However, the contributions that the plan received may have been determined from earlier valuation results. To accommodate budget planning cycles, contribution rates for public plans are often determined from valuations performed one to three years in advance of the year that contributions are paid. The authors' approach reflects the impact of economic and demographic gains and losses that occur between the actuarial valuation used to determine contributions rates and the year that the contributions are paid.

On the other hand, when comparing contributions to the Actuarially Determined Contribution (target contribution), which may reflect the plan's funding policy, contributions received during a fiscal year are compared to the target contribution reported for the same fiscal year.

Figure 1 illustrates the comparison of contributions with the benchmarks studied.

Figure 1
CONTRIBUTIONS AND BENCHMARKS COMPARED

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[5] For most plans, the authors compare actual contributions to benchmarks based on more current valuation results than were used to determine actual contributions. For example, to compare to contributions paid in year X, the authors computed benchmarks using valuation results from year X-1, the most current valuation results available at the start of year X. However, many plans use valuation results from year X-2 or X-3 to determine the ADC and contribution rates. The phrase "assuming all actuarial assumptions were met exactly" refers solely to the period between the valuation date used to compute a benchmark, and the dates on which actual contributions were paid.
[6] See note 5.

This study considers three primary benchmarks as described below. Appendix C: Additional Benchmark Analysis describes and shows results for additional benchmarks.

- **Target Contribution.** Since 2014, the target contribution is the ADC computed by the plan actuary for disclosure under Government Accounting Standards Board (GASB) guidelines, if such a figure was reported. The ADC may or may not represent the contribution determined under the plan's funding policy. In some cases, the target contribution represents a value reported as "required contribution" or something similar. For years prior to 2014, the target contribution represents a similar concept, the annual required contribution (ARC) as GASB required prior to 2014. This analysis compares the target contribution for a given fiscal year to the contributions made for the same fiscal year.[7]

- **Reduce Unfunded Liability.** The threshold required to be exceeded to reduce the existing unfunded liability, assuming all actuarial assumptions are met exactly.[5] Contributions precisely equal to this benchmark will hold the unfunded liability steady at its current level. This study considers unfunded liability from two perspectives, leading to two benchmarks:

  a. Reduce unfunded liability as a dollar amount (UL$). In technical terms, this benchmark is the cost of current benefit accruals (normal cost) with interest to mid-year plus a year's interest on the unfunded liability, discounted for payment at mid-year. This benchmark reflects a common understanding of funding pension plans.

  b. Reduce unfunded liability as a percent of payroll (UL%). Except for the interest rate, the formula for computing this benchmark is the same as for reducing UL$. In this case, the interest rate is net of assumed payroll growth. This benchmark reflects another common but somewhat more complex understanding of funding pension plans relative to budgeting of salary-related employee costs.

  For both reduce unfunded liability benchmarks, contributions are assumed to be paid at mid-year. In addition, if the sum of the interest-adjusted unfunded liability and interest-adjusted normal cost is negative, the benchmark is set to zero.

The authors exclude from the body of this study any benchmark that targets full funding. The authors generally believe that a plan's contribution policy should aim to fully fund the plan but that the most appropriate contribution policy may vary from plan to plan. To avoid implying otherwise, the authors refrain from showing a full-funding benchmark in the body of the paper. However, the authors compare contributions to a few sample full-funding benchmarks in Appendix C: Additional Benchmark Analysis.

For discussions of public pension plan funding policies from varying perspectives, refer to *Actuarial Funding Policies and Practices for Public Pension Plans*, by the Conference of Consulting Actuaries' Public Plans and *Blue Ribbon Panel on Public Pension Plan Funding,* by the Blue Ribbon Panel, a panel that the SOA commissioned.[8]

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[7] GASB Statement No. 67 and No. 68 replaced GASB Statement No. 25 and No. 27 effective in 2014. Paragraph 32 of GASB no. 67 and paragraph 46 of GASB no. 68 cover ADC disclosure. Paragraph 36 of GASB No. 25 and paragraphs 9 and 10 of GASB No. 27 cover ARC requirements.

[8] Conference of Consulting Actuaries' Public Plans Community, *Actuarial Funding Policies and Practices for Public Pension Plans*, Oct. 2014, *https://www.ccactuaries.org/Portals/0/pdf/CCA_PPC_White_Paper_on_Public_Pension_Funding_Policy.pdf*, and Blue Ribbon Panel on Public Pension Plan Funding, *Report of the Blue Ribbon Panel on Public Pension Plan Funding*, Feb. 2014, *https://www.soa.org/blueribbonpanel/*.

The authors computed benchmarks from the liabilities, assets, and unfunded liabilities reported for funding purposes.[9] Neither the authors nor the SOA intend the use of these values and their underlying actuarial methods and assumptions as commentary on their appropriateness for funding these plans or any other purpose.
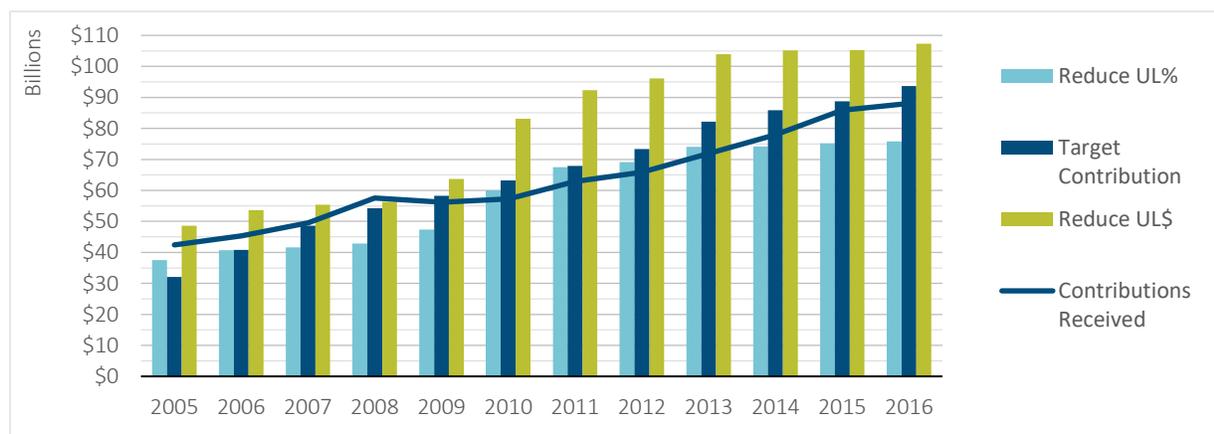
When a plan receives insufficient contributions to reduce its unfunded liability assuming all actuarial assumptions are met exactly, the plan's unfunded liability grows.[10] If, in such a case, a plan's unfunded liability decreases, it is because of one or more other financially favorable circumstances. This situation can and does occur.

The opposite situation also can and does occur. A plan's contributions may exceed the benchmark for reducing its unfunded liability, yet the unfunded liability grows because investments earned less than expected. Some examples of financially favorable circumstances include better-than-assumed investment returns, future benefit reductions, lower-than-expected salary increases, changes in the plan population that were financially more favorable than had been assumed, such as more deaths than expected by the mortality table, and changes in actuarial assumptions.

Aggregate Analysis

Figure 2 compares aggregate contributions to the two primary benchmarks over 2005–2016, using a consistent set of 133 plans that have sufficient data to compute benchmarks in each year. One plan's excess contributions over a benchmark cannot be used to meet another plan's benchmark. However, aggregate analysis does provide general context for the collection of studied plans as a whole.

Figure 2
AGGREGATE CONTRIBUTIONS AND BENCHMARKS (133 PLANS)

During 2005–2016, several observations about contributions and benchmarks in aggregate stand out:

- Contributions received for these 133 plans slightly more than doubled from $42.4 billion in 2005 to $88.1 billion in 2016.

- Prior to the 2008 market crash, actual contributions consistently exceeded the target contribution and the benchmark for reducing unfunded liabilities as a percent of payroll. However, contributions received fell short of the benchmark for reducing unfunded liabilities as a dollar amount.

- Following the 2008 market crash, benchmarks to reduce unfunded liabilities as a dollar amount jumped, but contributions received grew more slowly. In the first few years after the 2008 market crash, actual contributions consistently fell short of all three benchmarks.

- Since 2013, contributions received have exceeded the aggregate benchmark for reducing unfunded liabilities as a percent of payroll, but they have consistently fallen short of both target contributions and the benchmark for reducing unfunded liabilities as a dollar amount.

During the same years, aggregate unfunded liabilities among these 133 plans grew as a dollar amount (Figure 3). Aggregate liabilities grew 76% from $2.1 trillion in 2005 to $3.6 trillion in 2016, while unfunded liabilities grew 245% from $290 billion in 2005 to $1.0 trillion in 2016.[11]

A wide variety of factors play a role in the growth or decline of unfunded liabilities. The authors include historical aggregate unfunded liabilities in this paper for context only; analysis of all the factors is beyond the scope of this analysis.

One factor involved in in the growth or decline of unfunded liabilities is whether plans received contributions sufficient to reduce their unfunded liabilities as a dollar amount. Figure 3 shows how the aggregate liabilities and unfunded liabilities for these plans have grown as a dollar amount.
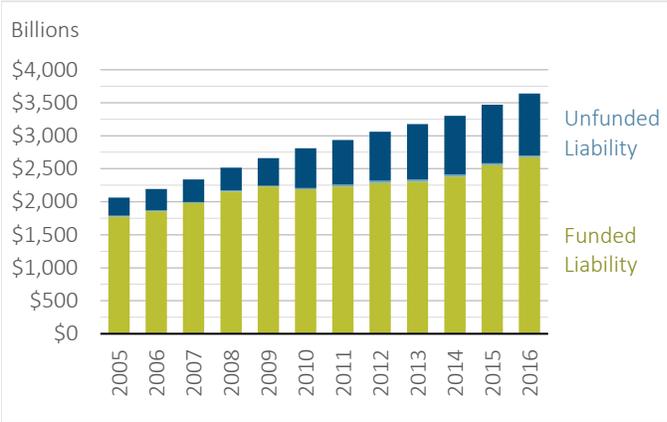
As a percent of aggregate payroll, aggregate liabilities and unfunded liabilities also grew significantly. Figure 4 shows that aggregate liabilities increased 35%, from 496% of payroll in 2005 to 669% of payroll in 2016. At the same time, unfunded liabilities increased 157%, from 69% of payroll in 2005 to 177% of payroll in 2016. One reason that unfunded liabilities as a percent of payroll grew less significantly than unfunded liabilities as a dollar amount may be that many public plans are funding as a level percent of payroll. Refer to Appendix D: Level-Dollar and Level-Percent Amortization for further discussion about the two approaches.

A wide variety of historical and current factors influence a plan's funded status. Some of the more significant factors include approaches to managing plan costs and risks; asset allocation; investment experience; actuarial methods and assumptions for computing plan liabilities; relatively long budget planning cycles; the method for determining contributions, including that contribution decisions may be subject to legislative processes; and the amount of actual contributions. This study explores only one of those factors: the amount of actual contributions.

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[11] Figure 3 shows liabilities and assets as computed for funding purposes on the valuation date coincident with or immediately preceding the start of the fiscal year shown. Interest rates used to compute liabilities vary by plan and generally shifted slightly downward during this period. In 2005, interest rates ranged from 7.25% to 8.50%, and in 2016 they ranged from 6.83% to 8.00%. If all else is equal, lower interest rates result in greater liabilities.

Figure 3
AGGREGATE FUNDED STATUS, 2005–2016
(133 PLANS)

Figure 4
AGGREGATE FUNDED STATUS AS PERCENT OF
AGGREGATE PAYROLL, 2005–2016 (133 PLANS)
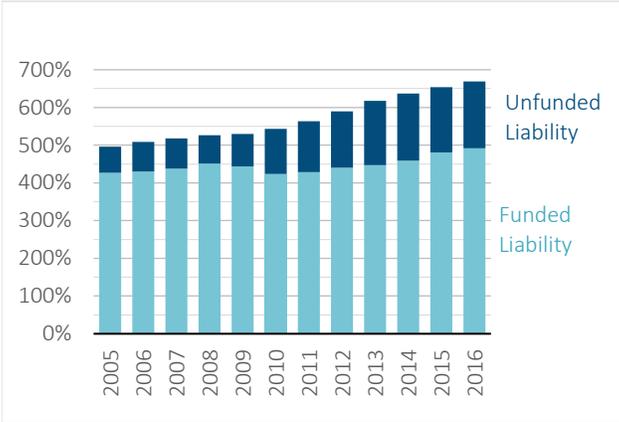
Looking at aggregate funded status, contributions and benchmarks provides a high-level overview of the plans studied *as a group*; individual plan results may differ. The remainder of this study looks at the relationship between contributions and benchmarks for individual plans.

Contribution Analysis

The Aggregate Analysis section provided a year-over-year analysis of a consistent set of plans. The Contribution Analysis section studies all plans with sufficient data to compute the benchmarks for a given year, so the number of plans studied varies by year. Consequently, the analysis is not a year-over-year analysis. Figure 5 shows the number of plans studied each year in each section, out of 180 plans in the database.

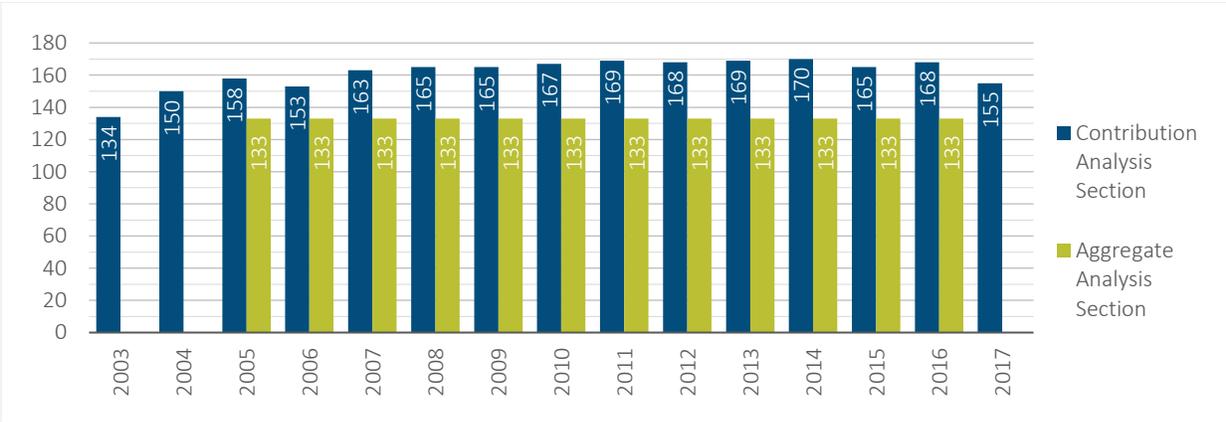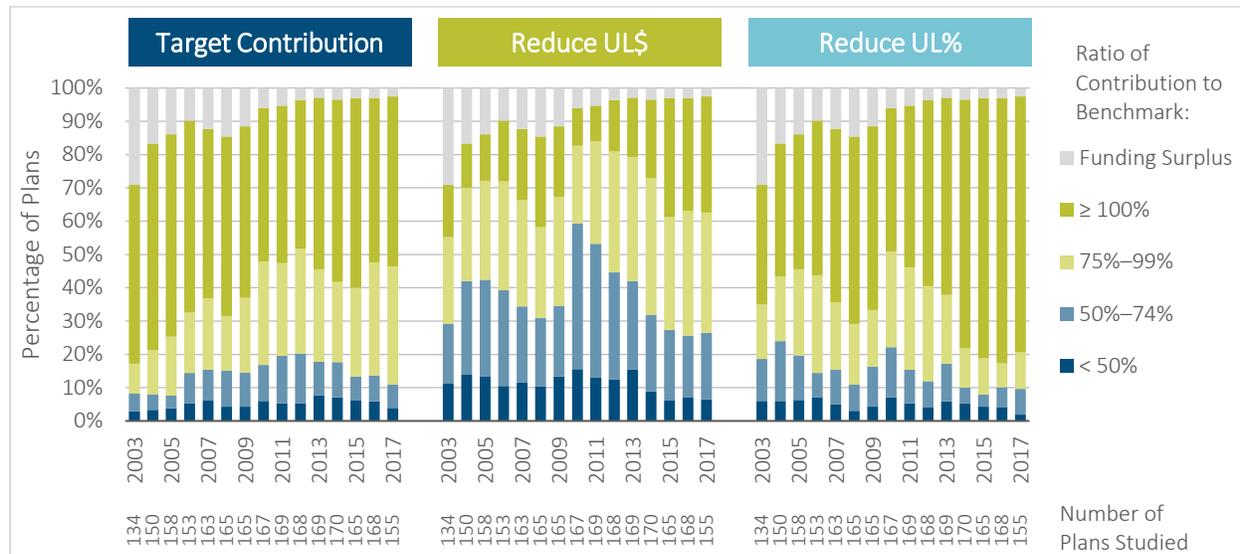**Figure 5**
NUMBER OF PLANS STUDIED

Figure 6 compares actual contributions for each plan studied to their benchmarks. The heading immediately above each section of the graph indicates the benchmark used for that section of the graph. Within each vertical bar, plans are grouped by the range in which their contribution-to-benchmark ratio falls in any given fiscal year. Ratios are not

computed for plans with a funding surplus.[12] Figure 7 focuses only on the plans that received contributions at least as great as their benchmarks.

Figure 6

RATIOS OF CONTRIBUTIONS TO BENCHMARKS, 2003–2017

Figure 7

PERCENT OF PLANS STUDIED WITH UNFUNDED LIABILITIES WHOSE CONTRIBUTIONS MET OR EXCEEDED BENCHMARKS
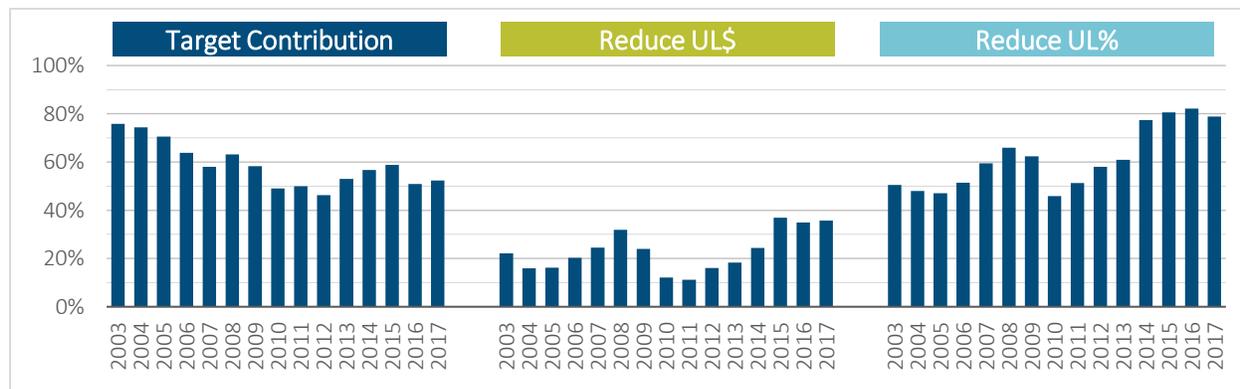
Here are some key observations about contributions relative to benchmarks during 2003–2017; percentages of plans exclude plans with funding surplus:

- The percentage of plans receiving contributions at least equal to their Target Contribution remained somewhat stable during the years studied. In fiscal year 2003, 54% of plans received at least their Target Contribution, and 51% of plans received at least their Target Contribution in fiscal year 2017. Between 2003 and 2017, the

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[12] For this study, plans are considered to have funding surplus when the actuarial value of assets exceeds accrued liabilities computed for funding purposes. All other plans are considered to have an unfunded liability. Neither the authors nor the SOA intend this approach as commentary on its appropriateness for funding these plans or any other purpose.

percentage of plans that received at least their Target Contribution ranged from 44% to 62%, but neither consistently above nor consistently below 50%.

- The percentage of plans that received insufficient contributions to reduce their UL$ increased from 55% in 2003 to 72% in 2005, at least partly a result of the dot-com crash in the early 2000's. By 2008, generally prior to the 2008 market crash, the percentage was down to 58%, only slightly above the 2003 level. While most plans at the start of 2008 received insufficient contributions to reduce their UL$, the contributions of 42% of plans did reduce their UL$.

- At the worst point following the 2008 market crash, the percentage of plans that received insufficient contributions to reduce their UL$ peaked at 84% in 2011. Since then the percentage generally declined to 63% for 2016–2017, meaning that 37% of plans received sufficient contributions to reduce their UL$.

- Some plans that received insufficient contributions to reduce their UL$ did receive sufficient contributions to reduce their UL%. In 2003, 16% of plans received sufficient contributions to reduce their UL$ but 36% of plans received sufficient contributions to reduce their UL%. In 2017, 35% of plans received sufficient contributions to reduce their UL$ but 77% of plans received sufficient contributions to reduce their UL%.

- In general, few plans received very small contributions relative to the amount needed to reduce their UL$. For most of the years studied, 85% or more plans received contributions that were at least half of the amount needed to reduce their UL$.

- In general, the proportion of plans with unfunded liabilities has been increasing since the dot-com crash in 2000–2001.[13] In 2003, 29% of plans had a funding surplus, meaning 71% had unfunded liabilities. By 2009, 88% of plans had unfunded liabilities, and in 2017, 97% of plans had an unfunded liability.

Figure 8
PERCENTILE DISTRIBUTION OF CONTRIBUTION-TO-BENCHMARK RATIOS, 2003–2017

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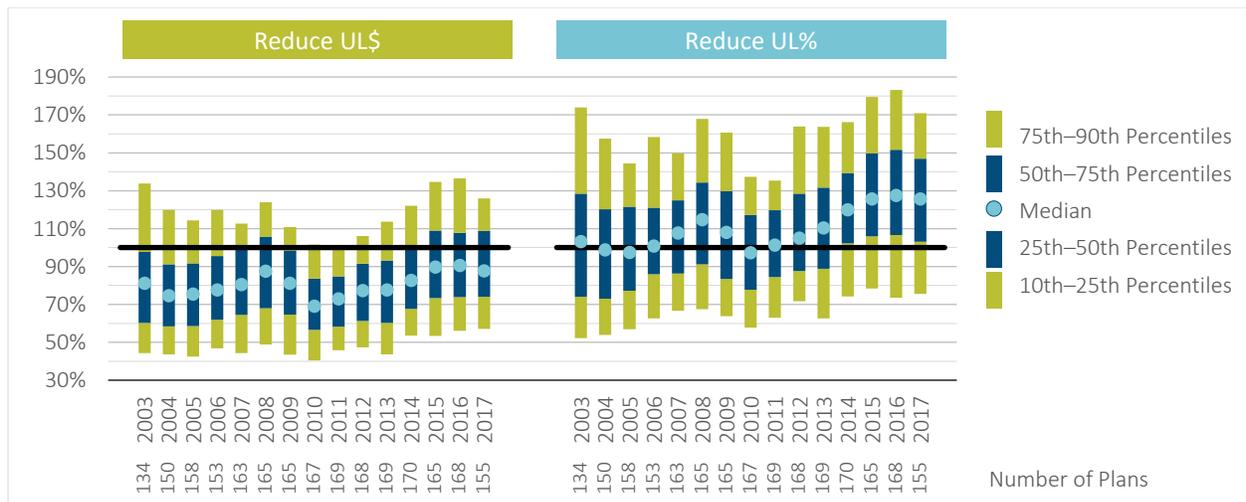
[13] The Economist, *The Dotcom Wreckage*, March 21, 2001, https://www.economist.com/unknown/2001/03/21/the-dotcom-wreckage.

Figure 8 offers percentile distributions of the ratios of contributions to benchmark for reducing UL$ and UL%. The median ratio of contributions received to the benchmark for reducing UL$ increased consistently from a low of 69% in 2010 to 91% in 2016 and 88% in 2017.

When considering the ratio of contributions received to benchmarks for reducing UL%, the median increased from a low of 97% in 2010 to 127% in 2016 and 126% in 2017.

Frequency of Insufficient Contributions

Another question to consider is how frequently any given plan receives insufficient contributions to reduce its unfunded liability. The authors analyzed the 107 plans that had at least 14 years of data sufficient for analysis and an unfunded liability in at least one of those years (the 14 years may not be consecutive). Figure 9 shows the frequency that each of these plans received insufficient contributions to reduce its UL$. Each vertical bar in the graph represents one plan, and years with a funding surplus are represented as having a sufficient contribution. Table 1 numerically summarizes Figure 9.
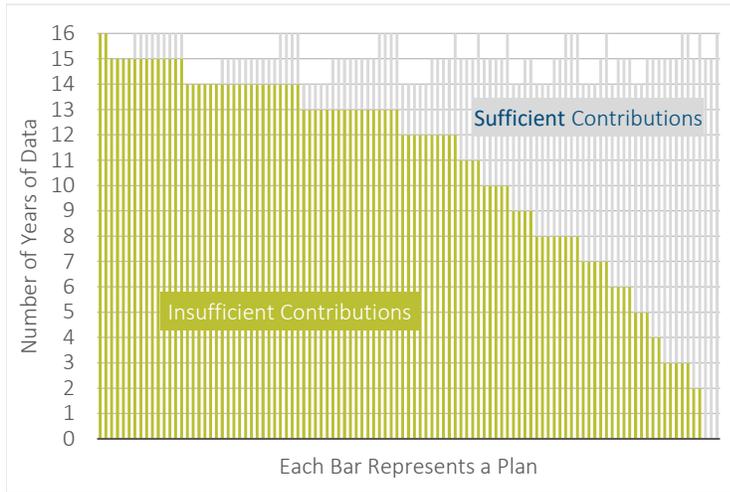
Figure 10 shows the frequency that each plan received insufficient contributions to reduce its UL% and Table 2 summarizes Figure 10. While the set of plans studied are the same in Figure 9 and Figure 10, they are sorted differently.

During 2002–2017, many of the plans regularly received insufficient contributions to reduce their unfunded liabilities. Of the 107 plans studied, 86 plans (80%) received insufficient contributions to reduce their UL$ at least half of the time, while 40 plans (37%) received insufficient contributions to reduce their UL% at least half of the time.
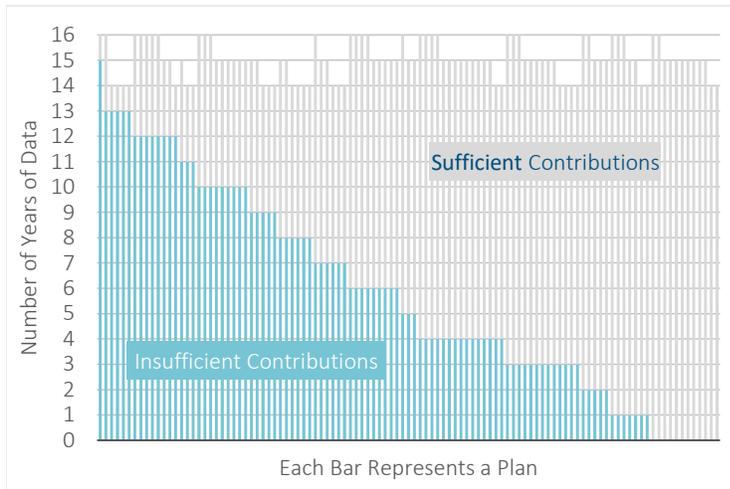
Twelve plans (11%) always received insufficient contributions to reduce their UL$, but no plans' contributions were always insufficient to reduce their UL%.

On the other end of the spectrum, 7 plans (7%) always received sufficient contributions to reduce their UL$, 12 plans (11%) always received sufficient contributions to reduce their UL%.

Figure 9

FREQUENCY OF CONTRIBUTIONS INSUFFICIENT TO REDUCE UL$,
2002–2017 (107 PLANS)

Table 1

NUMERICAL SUMMARY OF FIGURE 9

Percent of Years That Contributions Did Not Reduce UL$	Plan Count	Percent of Plans
0%	3	3%
1%–24.9%	7	7%
25%–49.9%	11	10%
50%–74.9%	24	22%
75%–99.9%	50	47%
100%	12	11%
Total	107	100%

Figure 10

FREQUENCY OF CONTRIBUTIONS INSUFFICIENT TO REDUCE UL%,
2002–2017 (107 PLANS)

Table 2

NUMERICAL SUMMARY OF FIGURE 10

Percent of Years That Contributions Did Not Reduce UL%	Plan Count	Percent of Plans
0%	12	11%
1%–24.9%	25	23%
25%–49.9%	30	28%
50%–74.9%	24	22%
75%–99.9%	16	15%
100%	0	0%
Total	107	100%

Note: The plans in Figure 9 and Figure 10 are the same but sorted differently.
Plans with funding surplus are excluded from both figures.

Sources of Insufficient Contributions

A significant number of public plans regularly have been receiving insufficient contributions to reduce their unfunded liabilities. Figure 11 shows the number of plans in each year whose contributions did not reduce their UL$. Counts are split by the number of plans whose contributions exceeded or fell short of their target contribution. Figure 12 shows percentage of plans whose contributions exceeded or fell short of their target contribution. Because the set of plans studied in each year varies, the analysis may indicate general trends but is not a year-over-year analysis.

PLANS WITH CONTRIBUTIONS INSUFFICIENT TO REDUCE UL$, 2003–2017
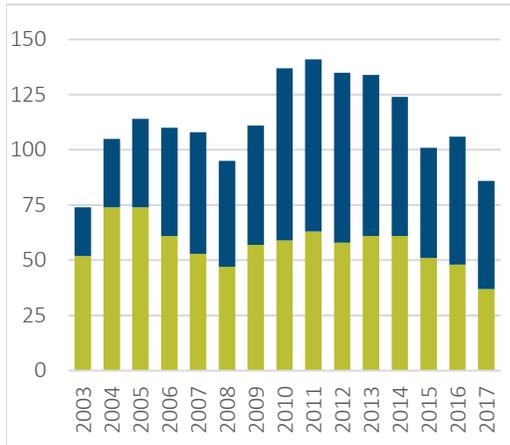
Figure 11
NUMBER OF PLANS

Figure 12
PERCENTAGE OF PLANS
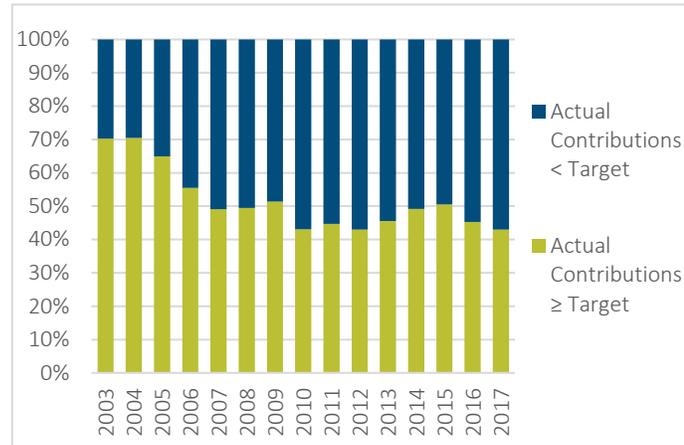
Roughly two-thirds of the plans that received insufficient contributions to reduce their UL$ during 2003–2005 received at least as much as their target contributions, while one-third received less than that. Since 2006, the split was generally closer to even, with slightly more plans receiving less than their target contributions.

Plans that received insufficient contributions to reduce their UL$ in the short term may have a funding policy that will fully fund the plan over the long term. However, a significant portion of these plans received less than their target contributions, which may indicate that their plan sponsors were not following the plans' funding policies.

The amortization approach, if any, used in computing the target contribution can influence whether contributions reduce the unfunded liability as a dollar amount. When the amortization approach does not reduce the UL$, the amortization approach is said to entail negative amortization. See Appendix B: Amortization Approaches for a summary of amortization approaches the studied plans used.

Level-dollar amortization does not entail negative amortization,[14] but level-percent amortization may entail negative amortization. Whether level-percent amortization entails negative amortization depends on the assumptions and length of amortization. Appendix D: Level-Dollar and Level-Percent Amortization provides further information on this topic.

Conclusions

Although contributions to large-city and state-based pension plans have been generally growing, their unfunded liabilities have also been growing. During 2003–2017, most of the plans studied received insufficient contributions to reduce their UL$. As plans recovered from market crashes in the early 2000s and 2008, the proportion of plans receiving insufficient contributions to reduce their unfunded liabilities as a dollar amount declined from a peak of 84% in 2011 to 63% for 2016–2017.

Many plans that received insufficient contributions to reduce their UL$ did receive sufficient contributions to reduce their UL%. Some of these plans may be following a funding policy that uses amortization as a percent of payroll over

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[14] This assumes that the interest rate used in amortization is positive.

a long period. For these plans, unfunded liabilities may continue to grow before they decline and eventually become fully funded.

However, about half of the plans whose contributions did not reduce their UL$ also received less than their target contributions, suggesting that some plan sponsors may not be following the plans' funding policies. Plans whose plan sponsors regularly contribute less than the plan's funding policy may be unlikely ever to attain full funding.

Contribution amounts are only one of many factors that influence pension plans' funded status, including approaches to plan, cost and risk management; asset allocation; investment experience; changing plan demographics; actuarial methods and assumptions for computing plan liabilities; relatively long budget planning cycles; and contribution decisions that may be subject to legislative processes.

Data and Methods

This study uses plan-level data from Public Plans Data (PPD) on November 15, 2018. The authors supplemented the database with information reported in the actuarial valuation reports that are also available from PPD. The Center for Retirement Research at Boston College produces the PPD in partnership with the Center for State & Local Government Excellence and the National Association of State Retirement Administrators, and purports to account for 95 percent of state and local pension assets and members in the US.[15] Data were used as reported except for adjustments for obvious errors and the adjustments noted below.

For some plans, data were sufficient to complete calculations except the payroll growth assumption was missing.[16] In cases where the payroll growth assumption was available in neighboring years, the authors interpolated the available years' data. In cases where the payroll growth assumption was generally not available for a given plan, the authors imputed an assumption by adding 50 basis points to the reported assumption for inflation. If an assumption for inflation was not reported, the authors used the median assumption computed across all plans with a reported inflation assumption for the year in question.

Assets and liabilities used in this study are those used for funding purposes. In addition to reflecting a variety of actuarial cost methods, unfunded liabilities also reflect a variety of asset valuation methods, interest or discount rates, salary increase rates, inflation rates, mortality tables and other actuarial assumptions. Because funded status and benchmarks for this study are developed from liabilities and assets that reflect a variety of actuarial methods and assumptions, neither funded status nor the benchmarks reflect a mathematically consistent basis. They are consistent only from the perspective that they reflect the assumptions and methods used for funding purposes. In addition, they do not represent a market value of liabilities and assets, unless a plan happens to fund on a market value basis.

The present value of future employee normal costs is assumed to equal the present value of future employee contributions for all plans. Therefore, employer contributions are compared to benchmarks based on the employer normal cost and the full unfunded liability.

Neither the authors nor the SOA intends the use of reported values as commentary on their appropriateness for funding, financial reporting or any other purpose, for these plans or for any other plans.

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[15] Center for Retirement Research at Boston College and the Center for State & Local Government Excellence, Public Plans Data, http://publicplansdata.org/public-plans-database/.
[16] For plans that contribute a fixed percentage of payroll and plans that use only level-dollar amount amortization, a payroll growth assumption may not be necessary and therefore excluded from the actuarial valuation report.

Modifications to the assumptions and methods used in this study may result in different numerical outcomes. Different assumptions and methods may be more appropriate for analysis of a specific plan or smaller set of plans.

Appendix A: Sample Calculation

Except for the Target Contribution, the metrics in this study compare contributions received for a fiscal year to benchmarks based on actuarial valuation results as of the most recent valuation date at least 10 days prior to the start of the fiscal year. This approach recognizes that the retirement system's actual experience during the time lag between the year that contribution rates are determined and the year that actual contributions are paid often differs from the actuarial assumptions used to compute the contribution rates. In contrast, the ADC determined for a fiscal year is compared to the contributions received during that fiscal year.

For this sample retirement system, contributions received during the fiscal year ending June 30, 2016, are compared to the Target Contribution (ADC) determined for the fiscal year ending June 30, 2016, and other benchmarks computed from valuation results as of July 1, 2015. Table 3 shows a sample calculation of the metrics,

Table 3
SAMPLE METRIC CALCULATIONS ($ IN MILLIONS)

	July 1, 2014 – June 30, 2015	July 1, 2015 – June 30, 2016
Contribution received		$920
Actuarial valuation results		
Valuation date	July 1, 2014	July 1, 2015
Interest rate	7.5%	7.5%
Accrued liability	$25,000	$26,000
Actuarial value of assets	17,000	16,000
Unfunded accrued liability (UAL)	8,000	10,000
Employer normal cost (NC)	510	530
ADC (Target Contribution)	$900	
For fiscal year ending	June 30, 2016	
Benchmark for reducing UAL		
NC		$530
Half year interest on NC		20
Full year interest on UAL, discounted back to mid-year		723
Benchmark		$1,273
For fiscal year ending		June 30, 2016
Contribution ratios		
Contribution received		$920
Target contribution		$900
Target contribution ratio		102%
Contribution received		$920
Benchmark for reducing UL$		$1,273
Reduce UL$ ratio		72%

Appendix B: Amortization Approaches

Although there are other approaches, the amortization approaches that the studied plans use typically involve three primary components:

- Amortization length: the number of years over which the unfunded liability (UAL) is repaid.

- Amortization method: level-dollar and level-percent, as discussed in the Benchmarks section.

- Open or closed: the frequency with which amortization is re-started or re-computed.

  o Open: Amortization is re-started periodically, typically annually or biennially. Payments are computed independently from previous payments and are spread over the same number of years that the previous amortization payment was computed. Open amortization may also be known as rolling amortization.

  o Closed: Once an amortization payment is computed, it will be paid through the entire length of amortization. Closed amortization typically occurs in one of two forms:
    - Layered: The initial UAL is amortized over a closed period. With every actuarial valuation, the incremental change in UAL is amortized over a new closed period, and the resulting payment is added to the existing amortization payments.
    - Fixed: The length of amortization ends at a specific date. With every actuarial valuation, the UAL is reamortized over the remaining length of time until that date. Payments are computed independently from previous payments.

The following figures summarize the amortization approaches used for actuarial valuation dates during 2016. At the time of writing, these are generally the most recent actuarial valuation reports available from Public Plans Data. Many plans use amortization approaches that vary depending on the reason that the UAL changed. For such plans, this study uses an average length weighted on outstanding balance of UAL and the method, including whether open or closed, of the biggest portion of the UAL.

Figure 13 through Figure 16 show the frequency of various elements of amortization approaches. Frequencies are counted or weighted three ways: by plan count, by amount of accrued liability (AL), and by amount of unfunded accrued liability (UAL). Amortization periods are considered open or closed according to the approaches outlined above.

Figure 13 shows that about 75% of the plans studied used closed amortization, and those plans represent nearly 80% of the total UAL among the plans studied. The remaining 25% of plans used open amortization and represent about 20% of total UAL.

One can see in Figure 14 that about 15% of plans representing about 25% of the total UAL were amortizing over 30 or more years. And about 7% of plans representing only 2% of total UAL were amortizing over fewer than 15 years. In other words, plans with the longest amortization periods tended to have lower funded ratios (larger UAL relative to their total liabilities), and plans with the shortest amortization periods tended to have higher funded ratios (smaller UAL relative to their total liabilities).
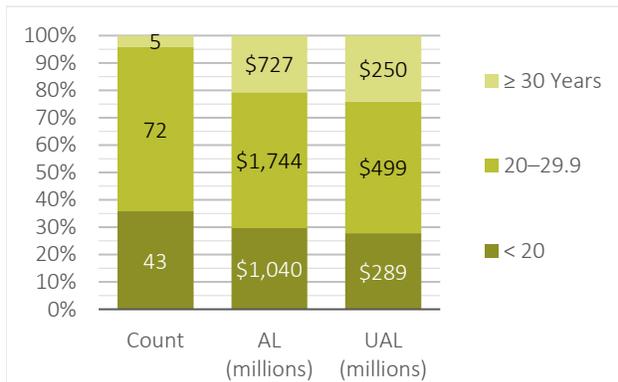
Figure 13
AMORTIZATION METHODS (156 PLANS)
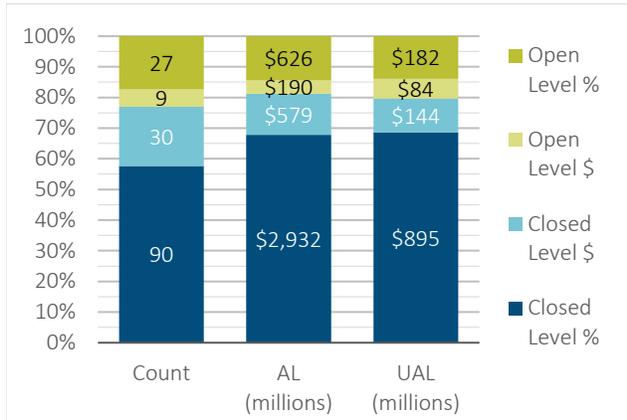
Figure 14
AMORTIZATION LENGTH (156 PLANS)

Figure 15
CLOSED AMORTIZATION (120 PLANS)
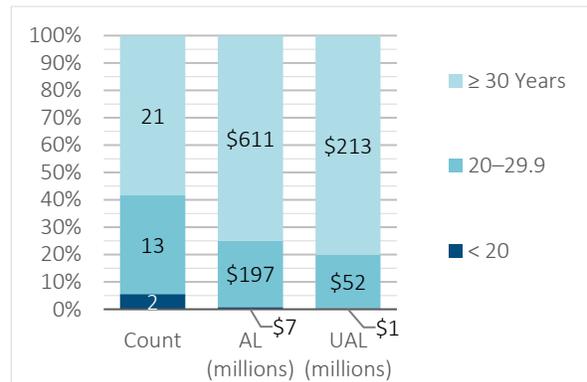

Figure 16
OPEN AMORTIZATION (36 PLANS)

Figure 13 through Figure 16 reflect amortization policies in effect on actuarial valuation dates during 2016.

Among plans using open amortization, Figure 15 shows that 65% of plans are amortizing UAL over 20 or more years. Those 65% of plans carry more than 70% of the UAL among plans that use open amortization.

Among plans using closed amortization, Figure 16 exhibits that 95% of plans are amortizing UAL over 20 or more years. Those 95% of plans hold more than 99% of the UAL among plans that use closed amortization.

Level-percent amortization over longer than 20 years generally entails negative amortization for many current combinations of assumptions.[17] Figure 17 shows that 15% of the 117 plans using level-percent amortization have a remaining amortization length of 30 or more years, and those plans represent 34% of the UAL among plans using level-percent amortization. In total, 76% of the 117 plans using level-percent amortization have a remaining amortization length of 20 or more years, representing 80% of the UAL among plans using level-percent amortization.

Open amortization methods that entail negative amortization are especially risky and may lead to situations in which UAL have little chance of ever being repaid. Figure 18 shows that 26 out of the 27 plans (96%) using open, level-

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[17] Conference of Consulting Actuaries' Public Plans Community, *Actuarial Funding Policies and Practices for Public Pension Plans*, Oct. 2014, p. 21, *https://www.ccactuaries.org/Portals/0/pdf/CCA_PPC_White_Paper_on_Public_Pension_Funding_Policy.pdf*.

percent amortization have remaining amortization lengths of 20 or more years, representing 99% of the UAL among plans using open, level-percent amortization.

Figure 17
LEVEL-PERCENT AMORTIZATION AND REMAINING AMORTIZATION LENGTH (117 PLANS)
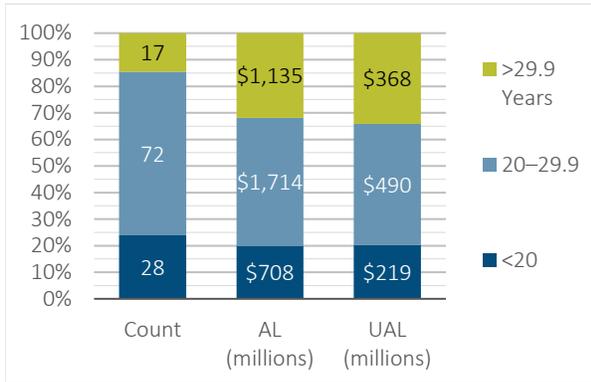
Figure 18
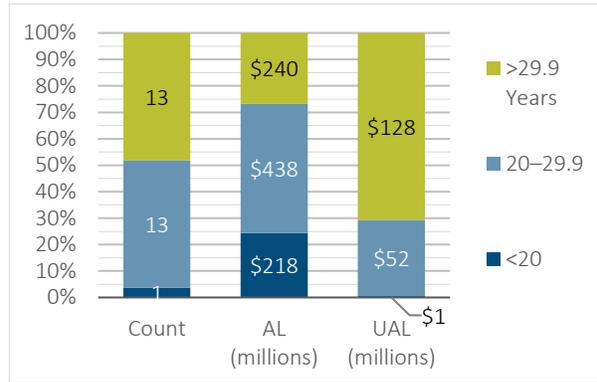OPEN, LEVEL-PERCENT AMORTIZATION AND REMAINING AMORTIZATION LENGTH (27 PLANS)

Figure 17 and Figure 18 reflect amortization policies in effect on actuarial valuation dates during 2016.

Appendix C: Additional Benchmark Analysis

In addition to the two primary benchmarks considered in the main report, this appendix presents four additional benchmarks without commentary:

- **30-Year Funding Pace.** This is the amount needed to eliminate any unfunded liability in 30 years. This study includes benchmarks with two different amortization approaches:
  - Level-dollar: Amortization payments are projected to be the same dollar amount each year.
  - Level-percent: Amortization payments are projected to be the same percentage of payroll each year.
  - For additional information about the two approaches, see Appendix D: Level-Dollar and Level-Percent Amortization.

- **15-Year Funding Pace**. This study also includes two benchmarks for funding over 15 years; they are the same as the 30-year funding-pace benchmarks, but with a shorter 15-year funding period.

Neither the authors nor the SOA intend the use of these benchmarks or the underlying actuarial valuations and assumptions as commentary on their appropriateness for funding these plans or any other purpose.

Figure 19
AGGREGATE CONTRIBUTIONS AND BENCHMARKS (133 PLANS)
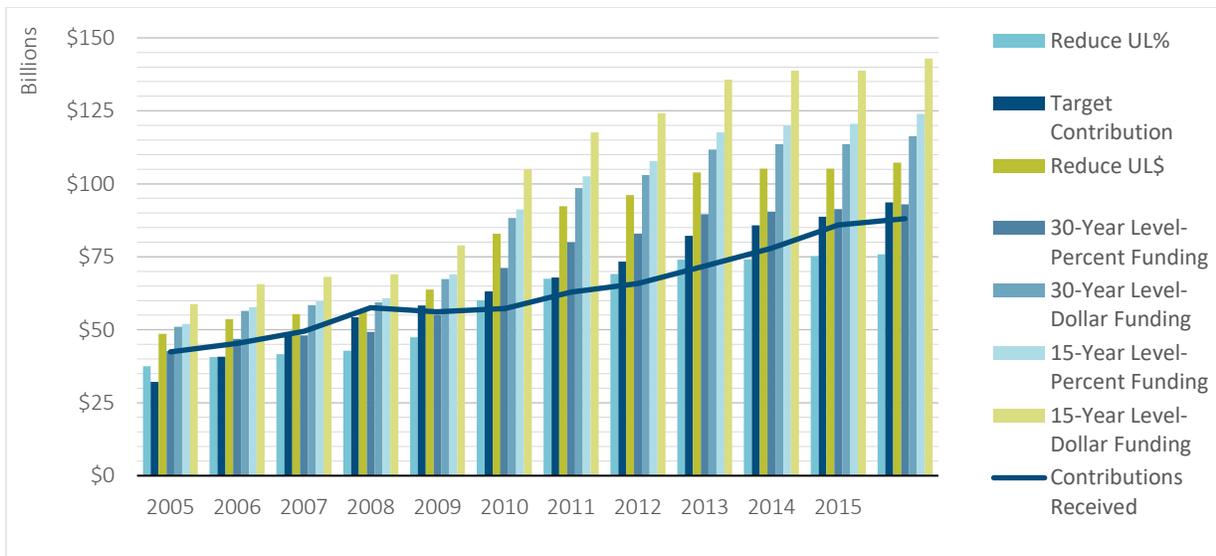
Figure 20
RATIOS OF CONTRIBUTIONS TO BENCHMARKS, 2003–2017

The number of plans analyzed is the same as for the three benchmarks above.
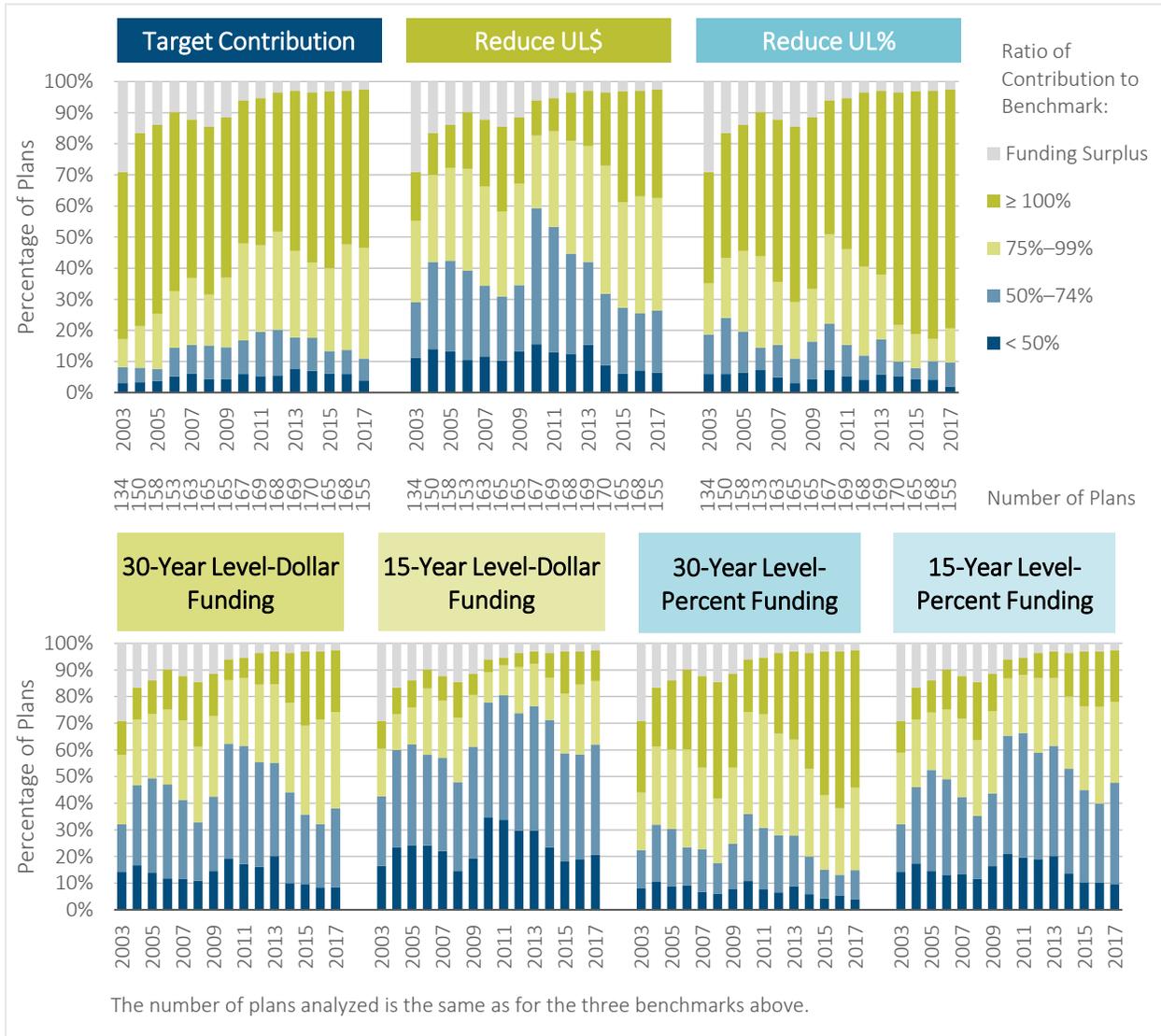
# Appendix D: Level-Dollar and Level-Percent Amortization

Level-dollar and level-percent amortization differ in the way that amortization payments are computed. Level-dollar amortization payments are computed to be the same dollar amount for each payment. Level-percent amortization payments are computed to be the same percentage of payroll for each payment, with the general expectation that the amount of each payment will vary as payroll varies.

Both level-dollar and level-percent amortization payments require an interest rate and the number of years (or periods) over which payments are spread. In addition, level-percent amortization requires an assumption about how payroll will change annually (or each period).

Because payroll typically increases across time, the level-percent payment amount will typically be lower at the start of amortization than at the end.

Figure 21 and Figure 22 illustrate the general shape of level-dollar amortization versus level-percent amortization payments amounts over a 30-year amortization period for an initial UAL of $1 million. Figure 21 illustrates payments as a dollar amount, and Figure 22 illustrates the same payments as a percent of payroll. Different assumptions for interest and payroll increases would produce different payments, changing the height of the lines as well as the slope of the slanted lines.

Figure 21
AMORTIZATION PAYMENT AMOUNT

Based on 7.0% interest and 3.0% payroll increases.
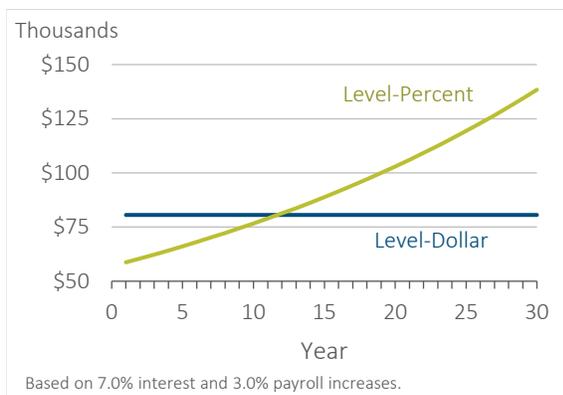
Figure 22
AMORTIZATION PAYMENT AS PERCENT OF PAYROLL

Based on 7.0% interest and 3.0% payroll increases.
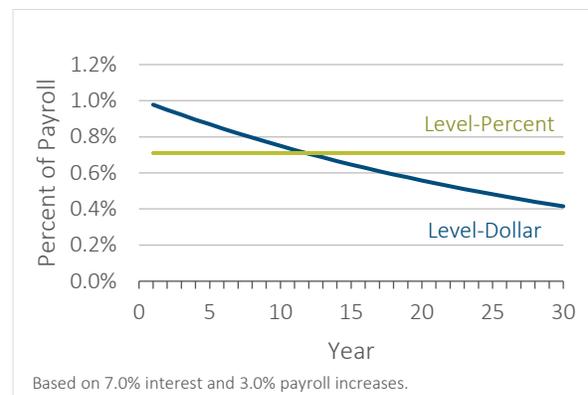
Amortization over 30 years is fairly common among target contributions. Effective through 2013, GASB 25 and 27 prescribed a maximum amortization period of 30 years.[18] Effective with 2014, GASB 67 and 68 do not explicitly prescribe a maximum amortization period, but GASB 68 disclaims any relationship to funding.[19] Refer to Appendix B: Amortization Approaches for a summary of amortization approaches in use among the plans studied.

In October 2014, the Conference of Consulting Actuaries' (CCA) Public Plans Community published a white paper to "provide guidance to policymakers and other interested parties on the development of actuarially based funding policies for public pension plans." The paper describes a general preference for a layered approach using a range of 15 to 20 years for annual fluctuations in the UAL caused by differences between actual plan experience and actuarial assumptions (also known as actuarial gains and losses). Stated rationales for 15 to 20 years include avoiding (a) partial or full contribution holidays that are associated with shorter periods; (b) difficulties with

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[18] Governmental Accounting Standards Board Statement No. 25, paragraph 36, and No. 27, paragraph 10, November 1994.
[19] Governmental Accounting Standards Board Statements No. 67, paragraph 51, and No. 68, paragraph 139, June 2012, reference Actuarial Standards of Practice.

demographic matching and intergenerational inequity that are associated with longer periods; and (c) negative amortization, "which starts at around 16 to 18 years for many current combinations of assumptions."[20] Refer to the Sources of Insufficient Contributions section of this study for additional information about negative amortization.

In February 2014, the Blue Ribbon Panel, a panel that the SOA commissioned, recommended that public pension plans disclose for comparison purposes a standardized contribution based on 15-year level-percent amortization as well as other elements that are not relevant to this study.[21]

Figure 23 illustrates how an UAL of $1 million changes over the course of a 30-year amortization period, assuming an interest rate of 7.0% and 3% annual payroll increases. With 30-year level-dollar amortization, the UAL decreases with each annual payment. But with 30-year level-percent amortization, the UAL increases before it decreases; it takes 15 years for the UAL to return to its starting point of $1 million.
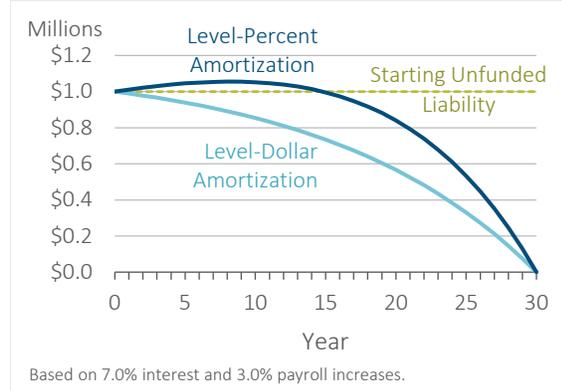
The illustration in Figure 24 uses the same assumptions as Figure 23, but the length of amortization is 15 years rather than 30 years. Assuming 7.0% interest and 3% annual payroll increases, level-percent amortization over 15 years does not entail negative amortization.
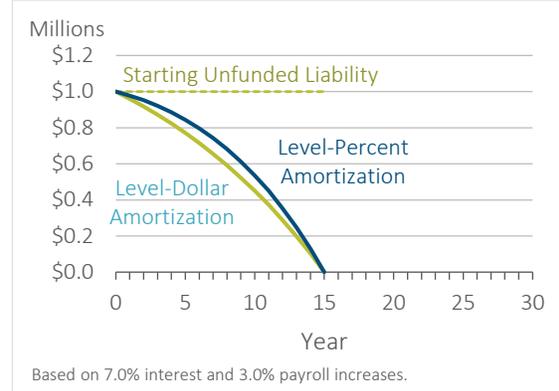
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[20] Conference of Consulting Actuaries' Public Plans Community, *Actuarial Funding Policies and Practices for Public Pension Plans*, Oct. 2014, p. 22, *https://www.ccactuaries.org/Portals/0/pdf/CCA_PPC_White_Paper_on_Public_Pension_Funding_Policy.pdf*.
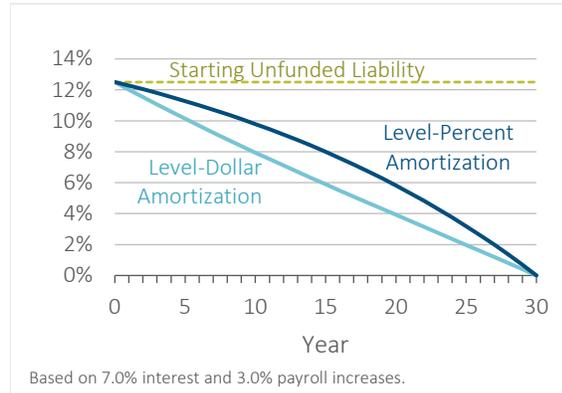[21] Blue Ribbon Panel on Public Pension Plan Funding, *Report of the Blue Ribbon Panel on Public Pension Plan Funding,* Feb. 2014, p. 24, *https://www.soa.org/blueribbonpanel/*.

Figure 23
UAL AS DOLLAR AMOUNT: 30-YEAR AMORTIZATION

Millions
Level-Percent Amortization
Starting Unfunded Liability
Level-Dollar Amortization
$1.2
$1.0
$0.8
$0.6
$0.4
$0.2
$0.0
Year
Based on 7.0% interest and 3.0% payroll increases.

Figure 24
UAL AS DOLLAR AMOUNT: 15-YEAR AMORTIZATION

Millions
Starting Unfunded Liability
Level-Percent Amortization
Level-Dollar Amortization
$1.2
$1.0
$0.8
$0.6
$0.4
$0.2
$0.0
Year
Based on 7.0% interest and 3.0% payroll increases.

Figure 25
UAL AS PERCENT OF PAYROLL:
30-YEAR AMORTIZATION

Starting Unfunded Liability
Level-Percent Amortization
Level-Dollar Amortization
14%
12%
10%
8%
6%
4%
2%
0%
Year
Based on 7.0% interest and 3.0% payroll increases.

Figure 26
UAL AS PERCENT OF PAYROLL:
15-YEAR AMORTIZATION

Starting Unfunded Liability
Level-Percent Amortization
Level-Dollar Amortization
14%
12%
10%
8%
6%
4%
2%
0%
Year
Based on 7.0% interest and 3.0% payroll increases.
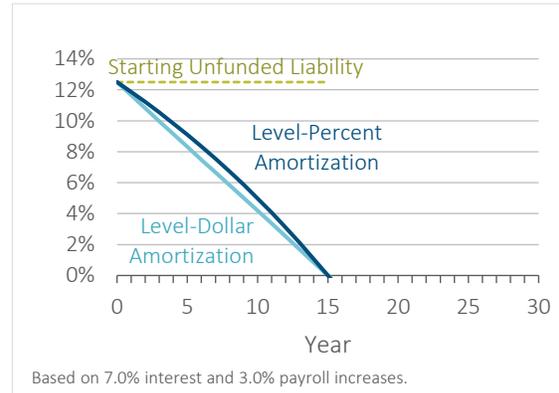
While negative amortization is generally a concern, the CCA white paper on funding policies advises that, in some situations, negative amortization may be consistent with policy objectives, but it should be explicitly considered in the policy.[22]

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[22] Conference of Consulting Actuaries' Public Plans Community, *Actuarial Funding Policies and Practices for Public Pension Plans*, Oct. 2014, p. 21, *https://www.ccactuaries.org/Portals/0/pdf/CCA_PPC_White_Paper_on_Public_Pension_Funding_Policy.pdf*.

Appendix E: Year-Over-Year Contribution Analysis

This appendix presents, without commentary, year-over-year analysis graphs of 133 plans with sufficient data in each year 2005-2016. These graphs parallel those in the Contribution Analysis, Sources of Insufficient Contributions and Frequency of Insufficient Contributions sections.

Figure 27

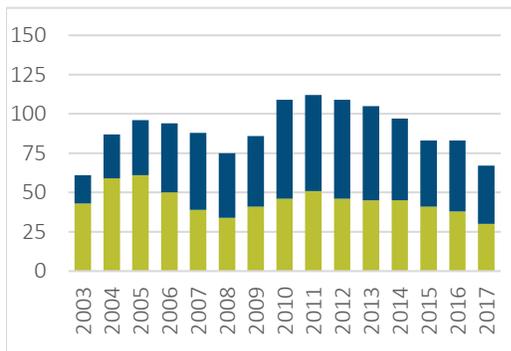DISTRIBUTION OF CONTRIBUTION-TO-BENCHMARK RATIOS, 2005-2016
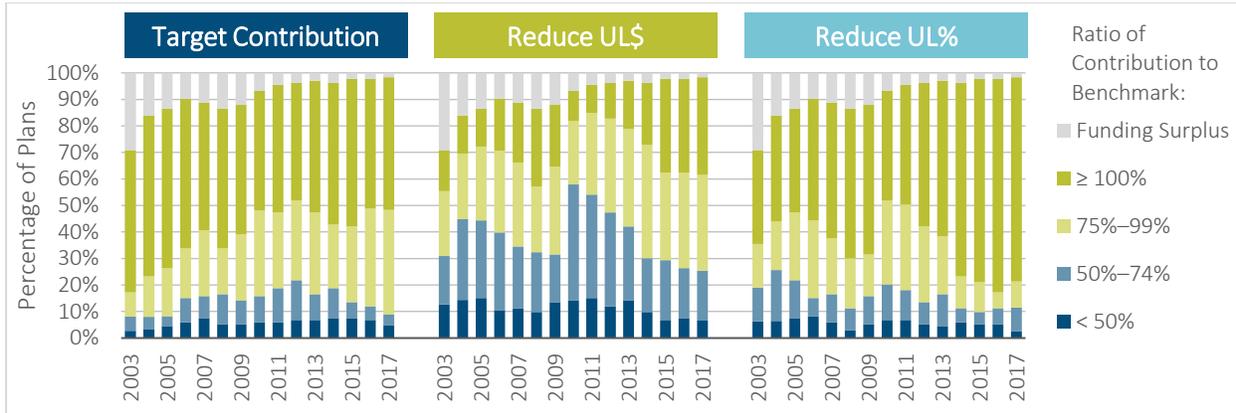
Figure 28

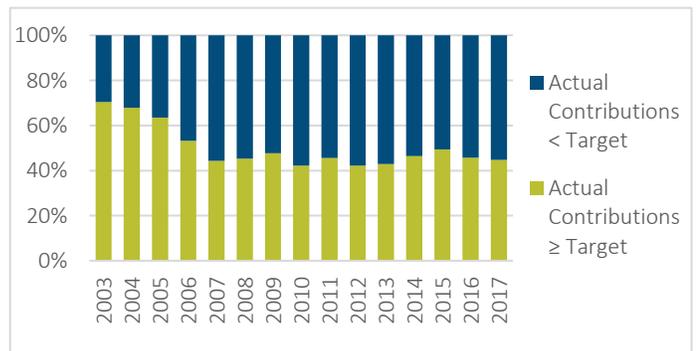PERCENTILE DISTRIBUTION OF CONTRIBUTION-TO-BENCHMARK RATIOS, 2005-2016
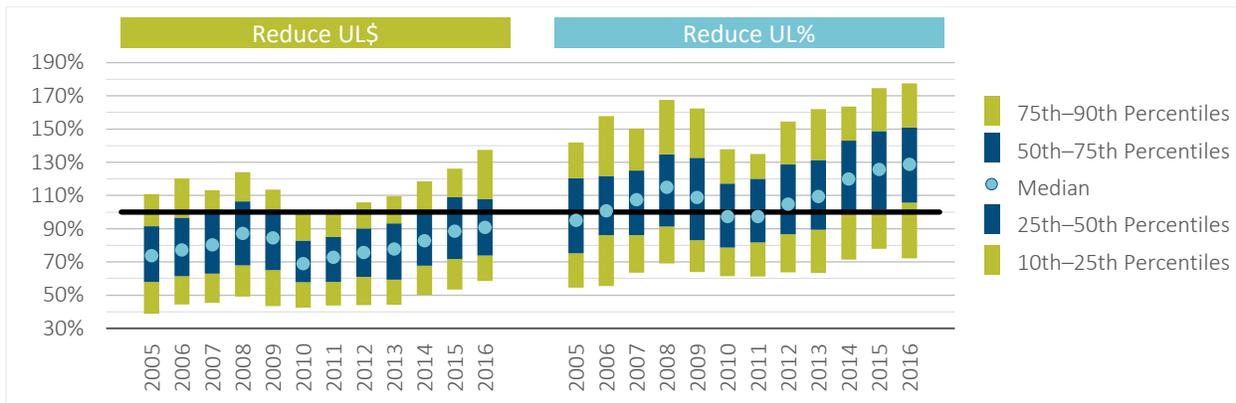
PLANS WITH CONTRIBUTIONS INSUFFICIENT TO REDUCE UL$, 2003–2017

Figure 29
NUMBER OF PLANS

Figure 30
PERCENTAGE OF PLANS

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The SOA supports actuaries and advances knowledge through research and education. As part of its work, the SOA seeks to inform public policy development and public understanding through research. The SOA aspires to be a trusted source of objective, data-driven research and analysis with an actuarial perspective for its members, industry, policymakers and the public. This distinct perspective comes from the SOA as an association of actuaries, who have a rigorous formal education and direct experience as practitioners as they perform applied research. The SOA also welcomes the opportunity to partner with other organizations in our work where appropriate.

The SOA has a history of working with public policymakers and regulators in developing historical experience studies and projection techniques as well as individual reports on health care, retirement and other topics. The SOA's research is intended to aid the work of policymakers and regulators and follow certain core principles:

Objectivity: The SOA's research informs and provides analysis that can be relied upon by other individuals or organizations involved in public policy discussions. The SOA does not take advocacy positions or lobby specific policy proposals.

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