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Sources of America's Public Pension Debt

How actuarial gain/loss data can help us understand the scope of what has caused unfunded liability growth in America's defined benefit plans

AUTHORS: ANTHONY RANDAZZO, JONATHAN MOODY, AND DAVID HENGERER





Part 1: Introducing the Sources of America's Public Pension Debt

America's state defined benefit plans have not always been underfunded. At the start of the 2000s statewide retirement systems were collectively around \$40 billion overfunded and nearly all plans were 100% funded (or close). However, by the end of fiscal 2019 statewide defined benefit plans held a collective \$1.39 trillion in unfunded liabilities, on an actuarial basis.¹ There is no shortage of academic literature analyzing the general political, institutional, and economic reasons why this has happened. But what are the specific financial reasons that the defined benefit plans say has caused this underfunding phenomenon?

State-administrated plans publish data each year showing what factors led their funded status to increase or decrease, typically known as actuarial gain/loss analysis. Based on our analyses of these data, the primary factors that contributed to the growth in state defined benefit plan unfunded liabilities over the past two decades were underperforming investment experience, changes to actuarial assumptions, and interest on unfunded liabilities growing faster than contributions.

Specifically, the data indicate that 40.85% of the change in unfunded liabilities can be attributed to Investment Experience. That is, some \$540 billion of the growth in unfunded liabilities since 2000 is due to plans' actual investment returns underperforming their assumed rates of return, plus related asset experience. Much of the remaining change in unfunded liabilities can be attributed to Assumption Changes (27.5%) and Contribution Experience & Interest on the Debt (25.9%).

Notably, factors like individuals living longer than expected and retirement patterns varying from expectations were not significant contributors to unfunded liability growth. Moreover, while benefit design improvements and unfunded COLAs did contribute to an increase in unfunded liabilities overall, COLA reductions in the past few years reduced unfunded liabilities by a greater amount, such that benefit experience was also not a significant contributor to unfunded liability growth.

This report is the first comprehensive assessment of detailed actuarial gain/loss data across all major stateadministrated retirement systems. It is designed to provide specific attribution to different factors that have contributed to the growth in state pension debt over the past two decades. While each of these sources have been long known to be contributing factors to the growth in pension debt, until now there has not been an estimate of the specific share that each has provided to the expansion of unfunded liabilities.

A full breakdown of the sources of unfunded state defined benefit liabilities can be found in the next section.



¹ According to our tabulation of their actuarial valuations and other financial reports. These figures are generally on an actuarial value of asset basis, but in some select instances include net pension liability based numbers (where that is consistent with the actuarial gain/loss data being provided).



1.1. ABOUT THE PROJECT

The fundamental goal of this research project is to explain the specific source of each dollar of the unfunded liabilities in America's public retirement plans.

The factors that have led to the \$1.39 trillion in actuarially valued underfunding have previously been well documented, including statutory contribution rates being less than actuarially required, investment performance being less than expected, and benefit enhancements not being fully paid for at the time of authorization. What this project aims to show is the specific dollar amounts behind each of these causes and others, providing a clear picture of how much any one of these factors contributed to the total level of unfunded liabilities. For example, just how much of the \$1.39 trillion level of unfunded liabilities is because investments have underperformed assumed rates of return? Or how much of that number is a legacy of the lack of appropriate pre-funding of benefits in the 20th century?

1.2. WHY THIS PROJECT IS IMPORTANT

A frequent challenge for any state wrestling with how to manage its public pension plans or other retirement systems is a lack of agreement over what problems they are really trying to solve. The data we have compiled for this project can help offer clarity to those debates. Consider the following common arguments related to pension policy:

- 'States have unfunded pension liabilities because governments provide overly generous benefits and increased those benefits without paying for the changes.' This argument is often associated with Republicans, conservatives, or others who advocate in opposition to public labor unions.
- *States have unfunded pension liabilities because governments have not paid their required contributions, leaving them shortchanged.'* This argument is often associated with Democrats, progressives, or labor union leaders.

Irrespective of whether either of these arguments are made in good-faith, or are just part of broader political debates, we can directly address them both in this project. We can look at what share of the \$1.39 trillion shortfall in 2019 is because of benefit increases and/or because of contribution rate deficiencies.

We can also dive deeper into these categories by looking at what share of benefit experience is related to changes to benefit formulas and what is related to cost-of-living adjustments. We can even assess whether many of the benefit value reductions adopted over the past decade have offset the benefit enhancements seen at the beginning of the decade. We can even differentiate between contribution shortfalls due to legislatures explicitly not paying required contribution rates, and implicit funding shortfalls where the interest on unfunded liabilities is growing at a faster rate than contribution inflows— even when legislatures fully fund actuarially determined rates.

Another reason why this project is important is that it can help with policy questions related to pension funding in the future. Consider these two questions:

- Between FYE 2009 and 2019 (e.g., after accounting for the losses of the financial crisis), the reported level of unfunded liabilities for state defined benefit plans increased by roughly \$260 billion, despite financial markets experiencing a historic bull run. At the same time, the average assumed rate of return used by those same plans fell from 8% to 7.2%. What share of that \$260 billion increase in unfunded liabilities is associated with changes to assumptions (which were generally made to adopt more realistic expectations about the future and reflect responsible policy decisions) as opposed to underperforming investment returns? If we control for changes to assumptions, did state defined benefit funding status actually improve over the decade after the financial crisis?
- At the end of FYE 2001 only a few state pension plans had unfunded liabilities, and many were overfunded or around 100% funded. For states that entered this century with those unfunded liabilities, what share of their funding shortfalls today are actually a legacy of 20th century funding policy decisions as opposed to being related to policies and experiences over the past two decades?



Understanding answers to these questions could help inform how funding policies should be designed going forward, such as whether or not "legacy" unfunded liabilities should be paid off using a different time frame than contemporarily developed funding shortfalls.

1.3. ORGANIZATION OF THIS PAPER

The primary purpose of this paper is to present these gain/loss data, describe the structure and organization of those data, and share preliminary observations about the dataset. There are more analyses that can be done using these data that we intend to publish in the future. Along with this paper we will also publish these data for other scholars to use to address their own research questions. Following this introduction, the rest of the paper is structured as follows:

Part 2: **Organization of Gain/Loss Data** Part 3: **Topline Findings and Preliminary Analysis** Part 4: **Conclusion**





Part 2: Organization of Gain/Loss Data

This analysis is focused on data published by defined benefit plans related to the actuarial gains and losses experienced each year. These "gain/loss" data are typically presented in tables showing different factors and a corresponding dollar amount of how much each factor has caused an increase or decrease in the level of unfunded liabilities in a given year.

Defined benefit plans always have changes from year-to-year in their actuarially accrued liabilities (AAL), whether from normal cost accrued to actuarial experience differing from assumptions — such as payroll growing less than expected, leading to less AAL than expected, effectively reducing unfunded liabilities (all else being constant). There are also changes in the actuarial value of assets (AVA) from year to year. When investment returns added to those assets are less than expected, this creates an actuarial "loss" that will cause unfunded liabilities to increase (all else being constant).

The difference between growth in the unfunded actuarially accrued liability (UAAL) from year-to-year is a combination of expected changes, actuarial experience relative to assumptions, and asset experience relative to assumptions, all of which can be collectively thought of as "actuarial gain/loss" for a defined benefit plan.

By compiling and standardizing actuarial gain/loss data across state-administrated defined benefit plans, we can calculate how much any one factor caused collective unfunded liabilities to increase for each year. We can then add those annual factors together over time to show how much each contributed to the change in unfunded liabilities.

2.1 DATA SCOPE AND COVERAGE

Our dataset is focused on measuring the change in unfunded liabilities on an AVA basis at the end of fiscal year 2000 up through FYE 2019, the most recent year for which complete gain/loss data are available. We use publicly available actuarial valuations and other financial reports to build our dataset, and, as such, some plans do not have data for all of these years.

It is noteworthy that by capturing AVA based data up through FYE 2019 our dataset will account for exactly 20 years of data, and it will fully account for any phased-in losses associated with the financial crisis. At the end of that fiscal year, the market value of assets was largely aligned with the actuarial value of assets for most plans, meaning the fiscal year is a particularly clean point to assess all factors contributing to the unfunded liability.

For complete data organization details on scope and coverage, see Appendix 1.

2.2. DATA MEASURED

We focused on the largest state-administrated defined benefit plans, including pension plans, guaranteed return plans (often known as cash balance plans), and hybrid plans that include a defined benefit element. Our dataset covers the vast majority of state unfunded liabilities, and only leaves out small pension plans that have less than \$1 billion in AAL.

However, there were 15 plans (of which six are Washington Department of Retirement Systems plans) that either did not provide complete data or only provided gain/loss data showing changes to contribution rates (where we could not infer estimated dollar changes).

One of these plans is a portion of California Public Employees Retirement Fund A.² PERF A, as a whole, is a large agent multiple-employer plan that represents three-quarters of CalPERS unfunded liabilities. Gain/loss data are provided for PERF



² CalPERS is actually three separate funds known as Public Employees Retirement Funds (PERF). PERF A is a large agent multiple-employer plan that represents 73.1% of CalPERS accrued liabilities, and covers most city and county units (e.g., PERF A, Local Public Agency), as well as state agencies (e.g., PERF A, State Agency). PERF A Local is not formally a separate plan but has separate reporting from five State Agency "plans." Each represents about half of



A "State Agency" unfunded liabilities (53% of PERF A), but not for "Local Public Agency" unfunded liabilities (47% of PERF A). As a result, our data only capture about half of the total unfunded liabilities for PERF A. Practically speaking, this means we were unable to record gain/loss data that would account for \$54.4 billion from FYE 2019's measured unfunded liabilities (or 4.3% of the total). The other 14 plans we had to remove from our dataset account for 1.6% of the total 2019 unfunded liability figure.

Finally, in select instances, actuarial valuation reports provided slightly different unfunded liability figures in their actuarial gain/loss tables as opposed to other tables that report aggregate asset, liability, and funding shortfall data. Or data in gain/loss tables were rounded whereas unfunded liability data elsewhere were provided in actuals. We used the actuarially valued unfunded liability data from the gain/loss tables resulting in minor differences in the 2019 unfunded liability included in this analysis versus the measurements that have been reported elsewhere.

Once we removed these plans with incomplete or missing gain/loss data, the 2019 unfunded liability figure we were seeking to understand the source of unfunded liabilities for became \$1.314 trillion across 137 plans. The adjustment of \$76 billion is substantial, but not problematic when considered relative to the broader total. We argue that it is still appropriate to extrapolate to the whole \$1.39 trillion in unfunded liabilities as of 2019.

For complete details on which plans were dropped from the dataset and an extended look at CalPERS PERF A, see Appendix 1.

2.3. METHODOLOGY

We hand collected data on gains and losses to actuarially valued unfunded liabilities from publicly available financial reports, such as actuarial valuations and CAFRs. Occasionally, gain/loss data were provided in separate reports (some of which were not published and were unavailable to us for this research). Data entry was checked by a second pass through plan reports and spreadsheets, and then confirmed during a third stage where all gain/loss data were reconciled with actual reported changes to the UAAL.

Our methodological process involved collecting all gain/loss data as provided by each defined benefit plan, using their own labels, definitions, and terminology. This raw "as-is" data were later transformed to have all figures use a common denomination and measure unfunded liabilities in the same direction.

We then categorized all of the data points using a common classification of terms, which allowed us to simplify the number of categories to review and measure. Versions of the dataset were archived at different steps along the way to allow for future review or adjustments as needed. For complete methodological information, see Appendix 2.

2.4. CATEGORIZING SOURCES OF THE PENSION DEBT

The categorization framework that we designed (shown in Table 1 on the next page) uses seven primary categories and a number of detailed subcategories for different ways to measure the actuarial gains and losses.³

PERF A unfunded liabilities. PERF B is a cost-sharing multiple-employer plan for the non-instructional employees of public schools in California. And PERF C is a cost-sharing multiple-employer plan for small city and county units.

³ For the most part, the categorization only required common sense understanding of terms; in a few cases we needed to check plan actuarial valuation notes to ensure we understood the way a defined benefit plan was intending to define a term. Because we retain the raw "as-is" data we can fairly easily adjust the transformed data at a later point if a change in categorization is necessary for a particular data point or for a particular year.



TABLE 1. DEFINED BENEFIT PLAN GAIN/LOSS CATEGORIZATION

Investment Experience This is any asset related experience, such as investment returns performing better or worse than assumed.	Investment Experience	Other Investment Related	General (Unspecified) Asset Gain/Loss	
Demographic Experience	Payroll or Salary Experience	Turnover or Retirement Experience	General (Unspecified) Actuarial Liability Gain/Loss	
related assumptions.	Disability Experience	Mortality Experience		
Assumption Changes This is any changes to actuarial assumptions that increase or decrease accrued liabilities.	Investment Assumption Change	Mortality Assumption Change	Payroll/Salary Assumption Change	
	General (Unspecified) Assumption Change	Other (Specified) Assumption Change	Other Actuarial Method Change	
Benefit Experience & Legislative Changes This is any benefit experience that changes accrued liabilities or legislative changes that				
Benefit Experience & Legislative Changes This is any benefit experience that changes accrued liabilities or legislative changes that	Benefit Formula Change	Benefit Experience	General (Unspecified) Benefit Design Change	
Benefit Experience & Legislative Changes This is any benefit experience that changes accrued liabilities or legislative changes that adjust benefit values up or down.	Benefit Formula Change COLA Change	Benefit Experience COLA Experience	General (Unspecified) Benefit Design Change Service Purchases	
Benefit Experience & Legislative Changes This is any benefit experience that changes accrued liabilities or legislative changes that adjust benefit values up or down. Contribution Experience & Interest on the Debt This is both explicit and implicit funding experience.	Benefit Formula Change COLA Change Contribution Rate Deficiency / Excess	Benefit Experience COLA Experience Expected Change (or Interest on the Debt	General (Unspecified) Benefit Design Change Service Purchases Funding Policy Change	
Benefit Experience & Legislative Changes This is any benefit experience that changes accrued liabilities or legislative changes that adjust benefit values up or down. Contribution Experience & Interest on the Debt This is both explicit and implicit funding experience. Other & Unspecified This is any unclassified change to accrued liabilities. ^[1]	Benefit Formula ChangeCOLA ChangeContribution Rate Deficiency / ExcessGeneral (Unspecified) Experience Gain/Loss	Benefit ExperienceCOLA ExperienceExpected Change (or Interest on the DebtUnspecified Amendments	General (Unspecified) Benefit Design Change Service Purchases Funding Policy Change Data Corrections	

20th Century Legacy & Starting Status

This is any unfunded liability that was reported by a plan as of FYE 2000 (thus is unmeasured), or the starting level of overfunding or underfunding from a plan's point of measurement.^[2]

Note: See Appendix 2 for complete details about these categories.

¹ A number of plans do not break out complete demographic categories of changes to accrued liabilities, and simply report a cumulative "actuarial gain/loss" change or have an "experience gain/loss." These can reasonably be understood to be demographic experience and/or benefit experience, but we do not classify them as such because the plans did not report the data breakout publicly.

² The sources of 20th Century Legacy unfunded liabilities are typically related to years when states were not explicitly prefunding their defined benefit plans, but they can also be related to unfunded benefit enhancements, investment experience, and other categories. For a few plans we did not have data back to FYE 2000, so we measure changes to unfunded liabilities from their oldest reported data and mark this as such on their specific defined benefit plan chart.



Part 3: Topline Findings and Preliminary Analysis

The largest source of unfunded liabilities in the United States today is Investment Experience, accounting for 40.9% of the \$1.31 trillion funding shortfall of defined benefit plans in our data. The second and third largest contributors are essentially tied, but they are not close to the leading factor. Assumption Changes resulted in \$361.2 billion (27.5%) of the growth in unfunded liabilities, and Contribution Experience & Interest on the Debt caused \$399.7 billion (25.9%) of the funding shortfall growth.

Around \$34.69 billion (2.6%) of the growth in unfunded liabilities was related to Demographic Experience. This is notable for how small of a share in the overall story of why state pension funds became underfunded. Another \$33 billion (2.5%) of the unfunded liability growth was classified as "Other," whether due to rare instances of gain/loss experience — like changes in actuarial firm — or because valuation reports simply did not provide any detail.

Particularly noteworthy is that Benefit Experience was a net positive over the past 20 years, resulting in a \$47 billion actuarial gain (-3.6%). On a state-by-state basis, this story changes, as there are 55 plans where benefit design changes and experience have contributed to unfunded liability growth. But the combination of benefit reductions and COLA reductions over the past few years have outweighed any increases in unfunded liabilities due to benefit provisions that might have occurred in the early 2000s.

Finally, \$55.7 billion (4.2%) of the 2019 unfunded liability is the starting level from our measurement points in this analysis. Primarily this reflects 20th Century Legacy unfunded liabilities, but formally this includes the starting unfunded liability level for plans that didn't provide data back to 2000. For most plans in our data set we have gain/loss data back to 2001 and their FYE 2000 unfunded liability figure to measure changes from. For a handful of plans, publicly available data only starts in years such as 2005, 2009, or 2012. In these cases, we classified whatever their unfunded liability figure was at the start of the available data in a "Starting Status" subcategory — either Starting Unfunded Liability or Starting Overfunding. Any plans with data starting in 2004 or earlier were classified as 20th Century Unfunded Liability.

Figure 1 below provides a breakout of the gain/loss composition of the \$1.31 trillion in unfunded liabilities covered by our dataset. These figures are shown in dollars and percentages of the whole.



FIGURE 1. SOURCES OF CHANGE IN UNFUNDED LIABILITIES FOR DEFINED BENEFIT PLANS IN OUR DATASET, FYE 2000 TO 2019

	Share of 2019 Unfunded Liability	Percentage Share of 2019 Unfunded Liability
Investment Experience This is any asset related experience, such as investment returns performing better or worse than assumed.	\$536.8 Billion	40.9%
Demographic Experience This is any accrued liability experience relative to related assumptions.	\$34.7 Billion	2.6%
Assumption Changes This is any changes to actuarial assumptions that increase or decrease accrued liabilities.	\$361 Billion	27.5%
Benefit Experience & Legislative Changes This is any benefit experience that changes accrued liabilities or legislative changes that adjust benefit values up or down.	-\$47.3 Billion	-3.6%
Contribution Experience & Interest on the Debt This is both explicit and implicit funding experience.	\$339.6 Billion	25.9%
Other & Unspecified This is any unclassified change to accrued liabilities.	\$33.3 Billion	2.54%
20th Century Legacy & Starting Status	\$55.7 Billion	4.24%



3.1 EXTRAPOLATING TO THE WHOLE COUNTRY

The data we compiled for this project includes gain/loss data for 137 defined benefit plans across all 50 states and the District of Columbia, and it represents 94.5% of state-administrated unfunded liabilities in America as of 2019.⁴ We argue it is appropriate to extrapolate from our representative sample to the whole of the country's state-administrated defined benefit plans. Figure 2 below provides a breakout of the complete composition of sources for the \$1.39 trillion in national unfunded liabilities.

FIGURE 2. SOURCES OF UNFUNDED LIABILITIES FOR UNITED STATES DEFINED BENEFIT PLANS, FYE 2000 TO 2019



⁴ Of the 15 plans dropped from our dataset for incomplete information, 10 had a funded ratio of 90% or better in FYE 2019, meaning they did not carry a large amount of unfunded liabilities. This is another reason that dropping these plans does not prevent one from generalizing beyond the plans captured in our data.



3.2 INTERPRETING THE CHANGES IN UNFUNDED LIABILITIES

Our analysis thus far has focused on the topline numbers, and further investigation of the subcategories will be forthcoming in other papers. But there are some clear ways that we can use these seven aggregate categories to understand changes in unfunded liabilities, even at a high-level.

Investment Experience: The largest factor contributing to unfunded liabilities is Investment Experience. This is perhaps the most intuitive of the findings from this analysis. Interest rates were on a downward trajectory for much of the past two decades, and institutional investment returns have been weaker over the last 20 years compared to the 1980s and 1990s. Public plans have been slow to reduce their investment assumptions relative to private sector defined benefit plans, and the net result is that public retirement system investments frequently have not been as strong as assumed.

Assumption Changes: In the years following the financial crisis of 2008 public plans gradually started reducing their investment assumptions. And during the past decade there have been at least two significant updates to the mortality tables that most public plan actuaries base their analyses from. Along with other assumption changes, all of these adjustments have added \$361 billion to the level of unfunded liabilities. However, this increase in unfunded liabilities should not be viewed as the *creation* of *new* pension debt but could instead be seen as an accounting adjustment that provides a better measurement of costs that have already been incurred.⁵

For example, a reduced investment assumption means that previously determined normal costs weren't sufficient to fund benefits earned, even if they were fully paid by employers. In this sense, the changes to assumptions are a kind of recognition that historic assumptions are no longer appropriate and may even be an admission that they should have been changed sooner. But a more positive outlook would be that the additional unfunded liabilities from assumption changes are the adoption of more responsible funding methods that will ensure defined benefit plans are fully funded.

Contribution Experience & Interest on the Debt: This third largest factor in the growth of unfunded liabilities was primarily driven by the subcategory "Expected Change" — that is, the increase in unfunded liabilities that actuaries expected would happen based on the funding policies under use *even if actual experience matched perfectly with actuarial assumptions.* Further details on this are available in the breakout by subcategory in the next section, but the takeaway is that roughly a quarter of the current unfunded liability problem is due to insufficient funding policies.

Demographic Experience: There is a fairly common narrative that says people are living longer and that is putting more stress on pension funds. It is true that increased longevity is a factor affecting retirement plans (the recent decline in life expectancy not withstanding); however, demographic factors do not appear to be significant drivers of unfunded liabilities nationally. For any given defined benefit plan it might be that this is a key driver, but Demographic Experience has, on average, tracked close enough with assumptions to barely have contributed to unfunded liability growth nationally. In practice, the costs of increased longevity or other demographic changes over time have been felt in the changes to assumptions, where actuaries have adjusted things like mortality tables, thus leading to higher actuarial costs for benefits.

⁵ In addition to this meaning an increase in unfunded liability amortization payments, these adjustments generally have meant higher normal costs of providing benefits. As a result, there was an uptick in the creation of new tiers of benefits between 2011 and 2014, typically with the purpose of creating a lower cost of benefits for new plan members in the future. The cost savings from these benefit reductions for future members won't be captured in actuarial gain/loss data and will only be fully understood in the coming decades.



Benefit Experience: It will come as a surprise to some that Benefit Experiences averaged out to a net reduction in unfunded liabilities over the past 20 years. In part, this is a result of divergent behavior within public plans. For example, there are at least 11 plans where Benefit Experience is 15% or more of 2019 unfunded liabilities. And subcategories such as Benefit Formula Change and COLA Experience did contribute to the growth in unfunded liabilities. However, other subcategories like COLA Change reduced unfunded liabilities. This category in particular warrants further examination of its subcategories for a better understanding of what is going on.

Other: There is an inevitability when gathering data across a large number of plans, over a 20-year period of reporting, across roughly a dozen actuarial firms, that some of the increase in unfunded liabilities will have to be classified as "Other." What is perhaps most important to take away from this category is how small it is. At 2.54% this is the smallest category in terms of net change in unfunded liabilities. That may not be true for any given plan, but with respect to the national figures it is helpful that effectively 97.46% of the 2019 unfunded liability number can be explained using the other more-descriptive topline categories.

Starting Status: There were some public plans that brought substantial unfunded liabilities with them into the 21st Century, such as Illinois TRS with an \$11 billion shortfall at the end of FYE 2000, and similar "legacy" unfunded liabilities for plans in Connecticut and Massachusetts. However, many other plans were overfunded to start the new millennium. Collectively, this has meant just \$56 billion of the total 2019 unfunded liability is related to deeply historic causes. While the story in some states is that legacy debt is a key factor in modern day unfunded liabilities, for the country as a whole this is not a the primary culprit for the current unfunded liabilities (it is only 4.24% of the 2019 UAAL).

3.3 BREAKING OUT THE SUBCATEGORIES OF DATA

Providing data in a limited number of summarized categories is necessary for high-level understanding of the sources of unfunded liabilities. However, there are critical insights that can be gleaned from looking at the subcategory data too. Table 2 below shows a percentage denominated breakout for each subcategory's share of the unfunded liabilities in our dataset. A more thorough exploration of these subcategories will be forthcoming in a future paper.





TABLE 2. SUBCATEGORY SOURCES OF CHANGE IN UNFUNDED LIABILITIES FOR DEFINED BENEFIT PLANS IN OUR DATASET, FYE 2000 TO 2019 — IN PERCENTAGE OF 2019 TOTAL NATIONAL UNFUNDED LIABILITIES

Investment Experience 40.85%	Investment Experience	34.57%	Other Investment Related	-0.04%	General (Unspecified) Asset Gain/Loss	6.06%
Demographic Experience 2.64%	Payroll or Salary Experience	-8.67%	Turnover or Retirement Experience	7.81%	General (Unspecified) Actuarial Liability Gain/Loss	3.24%
	Disability Experience	0.03%	Mortality Experience	0.34%		
Assumption	Investment Assumption Change	2.93%	Mortality Assumption Change	0.14%	Payroll/Salary Assumption Change	-0.04%
Changes 27.49%	General (Unspecified) Assumption Change	26.62%	Other (Specified) Assumption Change	0.11%	Other Actuarial Method Change	-1.06%
Benefit Experience & Legislative Changes	Benefit Formula Change	0.62%	Benefit Experience	-1.33%	General (Unspecified) Benefit Design Change	-3.42%
-3.6%	COLA Change	-1.33%	COLA Experience	0.21%	Service Purchases	0.14%
Contribution Experience & Interest on the Debt 25.85%	Contribution Rate Deficiency / Excess	1.51%	Expected Change (or Interest on the Debt	25.28%	Funding Policy Change	0.20%
Other & Unspecified 2.54%	General (Unspecified) Experience Gain/Loss	1.41%	Unspecified Amendments	0.27%	Data Corrections	-0.55%
	Actuarial Firm Change	0.04%	Undeclared or Other	1.48%		
20th Century Le	gacy & Starting Stat	us				
4.24%						



3.4. PLAN SPECIFIC CHARTS AND DATA

We have developed charts showing the sources of unfunded liability change for each defined benefit plan in our dataset. An initial presentation of each of these has been published within a related Equable Institute project called the Retirement Security Report. Visit <u>equable.org/RSR</u>, search for any defined benefit plan of interest, and check out the "Sustainability Scores" section to find a link for their relevant gain/loss information. (For more state specific information see Appendix 3.)







Part 4: Conclusion

This working paper reflects our initial analysis of state defined benefit plan actuarial gain/loss data. Our preliminary findings indicate over the past two decades underperforming investment experience is the primary driver of changes in public unfunded liabilities, while changes to actuarial assumptions and interest growing faster than contribution rates flow into pension funds are, together, about half of the increase in unfunded liabilities since 2000.

4.1 DATA IMPROVEMENTS

The dataset that we compiled is more than representative of defined benefit plans in America as a whole. However, for a number of states there are ways that the data can be expanded to provide greater insights and completeness. For some states this means adding additional years of data. Public plans may be able to provide this information to us directly, allowing us to expand the years in the dataset. For other states there is a lack of specificity with how certain data labels are provided, and further information from those plans could allow us to improve the level of detail in state specific charts (for example, reviewing years where a general category for assumption change might be associated with a specific assumption change, or reviewing whether a general categorization of "liability gain/loss" is exclusively related to demographic changes as opposed to including changes to assumptions and methods).

4.2 REQUEST FOR FEEDBACK AND DATA SHARING

We are releasing this document as a working paper to solicit comments and input from other retirement policy experts on this first-of-its-kind comprehensive analysis. We are interested in comments on our categorization approach, the preliminary findings, the interpretation of terms, and the overall conclusions of this analysis. In requesting input and collaboration from others we are making the data we've collected open to others for review and consideration. After collecting feedback, we will finalize and publish this paper based on FYE 2019 data and may update the data in the future with additional analyses.

4.3 CONCLUSION

Statewide defined benefit retirement systems have experienced a significant decline in their funded status over the past two decades. The reasons for this can be classified generally: politicians do not always adequately fund these plans, interest rates are fundamentally different now than they were in the latter half of the 20th century, institutional investment returns are lower than anticipated, labor units have pushed for benefit increases that weren't fully paid for, retirement boards have not always had appropriate training to make decisions, principle-agent incentives for public plan actuaries have not always led to the best financial advice, and voters generally do not hold leaders to account for pension funding decisions.

In short, there is a tangled web of factors that have resulted in some \$1.39 trillion in unfunded liabilities as of FYE 2019, with some fluctuation on that number over the past two fiscal years.⁶ However, through analysis of actuarial gain/loss data it is possible to understand the specific financial causes of the growth in unfunded statewide defined benefit liabilities.

The primary factor driving unfunded liability growth over the past 20 years has been underperforming investments. Assumed rates of return have been too high for too long, whether established by public retirement system boards of trustees or by state legislatures. Even as public plans have produced positive investment returns, they simply have not kept up with

⁶ See Anthony Randazzo (2017), "<u>There Is a Tangled Web of Factors Causing Inappropriate Pension Funding Behavior</u>," Journal of Law, Economics and Policy



assumed rates, resulting in severely negative Investment Experience. Nearly half (40.9%) of the growth in unfunded liabilities is due to this factor.

Secondary factors include Assumption Changes (27.5%) and Contribution Experience & Interest on the Debt (25.9%). Each of these has its own implications for policy going forward and interpretation of the past. As do the absence of certain dominating factors, such as Benefit Experience and Demographic Experience not being serious drivers of unfunded liability growth.

We welcome input on this paper by contacting the authors at <u>anthony@equable.org</u>.









Terms and Definitions

Actuarial Accrued Liability (AAL): Total amount of promised benefits that are payable in the future, discounted back to today's dollars, using an actuarial cost method selected by the retirement system trustees.

Actuarial Value of Assets (AVA): A "smoothed" value of assets, typically used for the purposes of determining contribution rates and measuring unfunded liabilities. Actuaries "smooth" any gains and losses of a particular number of years to minimize year-to-year changes in the value of the AVA. For example, actuaries typically smooth investment gains and losses over a five-year period, only recognizing 20% of the market valued return each year for the purposes of determining the AVA. This is distinct from assets that are valued based on prevailing market conditions (considered "market value of assets").

Unfunded Actuarial Accrued Liabilities (UAAL): The difference between the AAL and AVA.

Total Pension Liability (TPL): Total value of promised benefits that are payable in the future, based on prescribed Government Accounting Standards Board methodology.

Fiduciary Net Position (FNP): The value of assets held by a retirement system, generally equal to the market value of assets (formally this is assets, plus deferred outflows, minus deferred inflows, minus liabilities).

Net Pension Liability (NPL): The difference between the total pension liability and fiduciary net position. This is a figure that is similar to the UAAL, except based on prescribed Government Accounting Standards Board methodology.

Actuarial Assumptions: Estimates used to forecast uncertain future events affecting future benefits or costs associated with a pension fund. Examples of these assumptions include investment rate of return, inflation, payroll growth, mortality, retirement patterns, and other demographic data.

Actuarially Determined Employer Contribution: Annual amount that is determined by actuaries to be necessary to paying normal cost and amortization payments, based on the funding policy adopted by the retirement system and after accounting for employee contributions.

Gain/Loss: any increases or decreases from actual experience relative to assumptions that affect accrued liabilities and actuarially valued assets, plus any increases in accrued liabilities resulting from changes to plan benefit provisions or assumptions.

Cost-of-Living Adjustment (COLA): A periodic adjustment of benefits to account for changes in inflation.

Defined Benefit Plan: A retirement plan that determines benefits by a formula in advance of your retirement. This term is often used to refer to pensions, but technically it can refer to a range of retirement plan designs.

Pension Plan: A retirement plan that provides fixed, guaranteed monthly income based on two factors: years worked, increased by a benefit accrual percentage, and multiplied by average salary during final working years.

Guaranteed Return Plan: A retirement plan where employers and employees make contributions to a fund, where assets are managed by the retirement system, and certain returns are guaranteed in notional accounts for members. The plan can provide for gain-sharing on returns above the minimum, and annuitize the accumulated account balance upon retirement to pay out guaranteed income.

Expected Change to UAAL: The change in unfunded liabilities that is expected to occur based on the application of funding policy before accounting for any Gain/Loss data. Formally, this is how much the unfunded liability is expected to increase or decrease, after accounting for additional normal cost, additional interest on accrued liabilities, and the reduction of amortization payments. Therefore, we also refer to this category as "interest on the debt."





Appendix 1: Data Organization

A1.1 SCOPE OF ANALYSIS

This analysis is based on the collection of defined benefit plans in the Equable Finance Database for public retirement systems, which publishes its figures in Equable's "State of Pensions" annual report. These data cover all state-administrated defined benefit plans with accrued liabilities of at least \$1 billion. The 143 plans measured there reflect more than 90% of the actuarially accrued liabilities for state-administrated retirement plans in the United States and are thus a fully representative sample of public plans with unfunded liabilities.

Defined benefit plans in this context include traditional final average salary-based "pension" plans, guaranteed return plans (typically known as "cash balance" plans), and so-called "hybrid" plans that include a defined benefit portion of the plan. Our dataset also includes a few defined benefit plans with smaller accrued liabilities if they are:

- (a) recently created tiers or classes of benefits related to a larger legacy plan (ex. Utah Retirement System's "Tier 2" plans created in 2011); or
- (b) small plans that are typically included in the topline finances of a large system of plans (ex. the Kansas Retirement System for Judges which is managed by the Kansas Public Employees Retirement System).

Large municipally administrated retirement systems, such as those managed by the city of Chicago and New York City, are *not* covered in the scope of this analysis. The benefit provisions for those plans typically align with benefits provided by related state-administrated plans, though the investment and actuarial experience does not always align. A future version of this analysis could be expanded to include large municipal plans.

At the time of our data collection for this project, there were complete publicly available reports through fiscal year ending 2019.⁷ For that year, state-administrated defined benefit plans reported \$1.39 trillion in unfunded liabilities on an actuarial value of assets basis.

A1.2 CONTRIBUTION RATE COMPOSITION PLANS

There are eight plans (six in Washington State) that only report how their actuarial gain/loss experience changes overall contribution rates. In these instances, there is a breakdown of the component change in contribution rates from year to year, with attributions made related to typical sources of unfunded liability change. But it is not clear in these instances how these figures could be adjusted in a reasonable way to tease out the dollar change in unfunded liabilities. As a result, these plans were removed from our dataset:

⁷ Due to the Covid-19 pandemic, the Massachusetts Public Employee Retirement Administration Commission did not publish valuation reports for state plans in early 2020 for their fiscal year ending December 31, 2019. There is a similar missing report for the Pennsylvania Municipal Retirement System. It is unclear when these plans will make public FYE 2019 data. For all of these plans we have data reported through 2018, which means they are dropped for any analysis that reports changes up through FYE 2019.



TABLE A1.1 PLANS THAT ONLY REPORT GAIN/LOSS CHANGES TO CONTRIBUTION RATES

Plan Name	2019 Unfunded Liability (AVA Basis)	
New York State Teachers' Retirement System	\$0.46 billion	
Tennessee Consolidated Retirement System*	\$1.3 billion	
Washington Public Employees' Retirement System	\$6.2 billion	
Washington Public Safety Employees' Retirement System	\$5 million overfunded	
Washington School Employees' Retirement System	\$0.66 billion	
Washington State Patrol Retirement System	\$0.07 billion	
Washington Teachers Retirement System Plan	\$4.5 billion	
Washington Law Enforcement Officers' and Firefighters Retirement System	\$2.95 billion overfunded	
*Note: Only the legacy plans and tiers of benefits within TCRS (e.g., Tennessee Public Employees Retirement Plan, Teacher Legacy Pension Plan, Closed State and Higher Education Plan, and Political Subdivisions Plan) have been excluded; the state's hybrid plans open to new hires are included in the dataset.		

This removed just 0.8% of the 2019 unfunded actuarially accrued liabilities from our dataset.

A1.3 PLANS WITH INCOMPLETE OR UNAVAILABLE DATA

There are four defined benefit plans that either do not publish any data related to the sources of change to their unfunded liabilities or provide such incomplete information that no conclusions can be drawn from the data that is available.

The reasons for incomplete historic gain/loss data are not always clear, but generally they are related to decisions by different plan actuaries on what data to present in their actuarial valuations or what data defined benefit plan trustees released in public reports. In a few states, the publicly published reports refer to gain/loss analysis that was provided to trustees in separate analyses. Plans that only have data going back to 2015 or more recent are not included in the aggregate national figures, unless the plan was created after that point in time.

There are three defined benefit plans who choose to use their status as an "agent multiple-employer plan" (AME plan) to not provide complete actuarial gain/loss data. These AME plans

are effectively umbrella organizations for the purposes of joint management of investments, benefit distribution, and or actuarial services, similar to cost-sharing multiple-employer plans. However, with AME plans a key difference is that for legal purposes there are individual accounts maintained separately for each employer to be able to legally pay out benefits. Occasionally AME retirement systems will tabulate the combined assets and liabilities for the individual employer plans in their network, and report these as a whole, but not always.





Due to incomplete information or a complete lack of available data, we removed the following plans from our dataset:

Plan Name	2019 Unfunded Liability (AVA Basis)
Alabama Public Employees' Retirement System, Local Agency Employers Only*	\$2.61 billion
CalPERS Public Employees Retirement Fund A, Local Public Agency Employers Only*	\$54.39 billion
Louisiana State Parochial Employees Retirement System	\$0.11 billion
Michigan Municipal Employees' Retirement System*	\$5.23 billion
North Carolina Local Government Employees' Retirement System	\$2.23 billion
North Dakota Public Employees' Retirement System	\$1.19 billion
Pennsylvania Municipal Retirement System	\$0.04 billion
*Note: Indicates the plan is an agent multiple-employer plan.	

This removed roughly 5.15% of the 2019 unfunded actuarially accrued liabilities from our dataset, most of which is related to PERF A Local Public Agency.

A1.4 CALPERS "PERF A" ADJUSTED METRICS

Notable on the list above is the largest portion of the largest retirement system in the country.

The California Public Employees' Retirement System (CalPERS) is actually comprised of multiple separate fund trusts. The largest of these are three defined benefit funds known as PERF A, PERF B, and PERF C (with the acronym standing for Public Employees Retirement Fund).

PERF B (18.7% of CalPERS actuarially accrued liabilities and 19.8% of unfunded liabilities) is a cost-sharing plan for school districts and educational employers in California. The costs of investment performance and other actuarial experience are shared equally among the employers, and they do not have the option of contribution rate deficiency. PERF C is also a cost-sharing plan, but for local city and county employers that are small with an employee headcount below a certain threshold. They share evenly the gains or losses related to factors like mortality experience, payroll experience, and disability rate experience.

PERF A is the largest share of CalPERS and is an agent multiple employer plan. Their \$115.7 billion in 2019 unfunded liabilities are 73% of CalPERS \$158.4 billion in unfunded liabilities. Each individual employer-sponsored plan within PERF A is participating in a pooled fund for investment management purposes, but otherwise is responsible for all gains and losses associated with their plan, including contribution rate deficiency, experience related to mortality and demographic assumptions, and decisions related to employee salaries. PERF A has two subdivisions, one for state agency employers (described formally as "State" in the CalPERS CAFR but also referred to as State Agency in this report) and another for local public agency employers (described in CAFRS as simply Public Agencies and referred to as Local Public Agency in this report). CalPERS chooses not to report for PERF A combined GASB 67 data with the total pension liability, fiduciary net position, or net pension liability. Similarly, they do not report actuarial gain/loss data for PERF A Local Agencies either, though they do provide gain/loss data for PERF A State Agencies. Therefore, consistent with our overall methodology we are measuring the changes to national unfunded liabilities without PERF A local agency employers.

Given the size of PERF A Local Public Agency, with \$54.39 billion in unfunded liabilities, this means removing 4.3% of the unfunded liability from our overall dataset. This is a substantial amount, but it is not so large as to undermine the overall analysis.



A1.5 TOTAL UNFUNDED LIABILITY CHANGE BEING MEASURED

Once we removed the plans which only show changes to contribution rates and plans with incomplete gain/loss data and adjusted our baseline unfunded liability figures to use the data from gain/loss tables instead of elsewhere in plan CAFRs or valuation reports, the total national unfunded liability in FYE 2019 we were seeking to explain became \$1.31 billion. This is 94% of the total unfunded liability for FYE 2019 from the state-administrated defined benefit plans in the United States. This remains a well-qualified representative sample of unfunded liabilities for public plans.

In our summary report, we publish the percentage that each category of gain/loss represents from this total. We are inferring that this is the same relevant source of unfunded liability growth for all state-administrated defined benefit plans, including the ones that were removed from our dataset.

A1.6 YEARS COVERED

Public defined benefit plans have considerable variance in the style and details of their public reporting, including when files have been made available to the public. Generally, most plans have actuarial valuations and/or comprehensive annual financial reports that are digitized in the public domain dating back to FYE 2001. Some plans have published documents on their websites going back further. In other cases, efforts have been made to digitize documents available in public libraries.⁸ In still other cases, plans only keep a limited number of files on their website, but historic efforts to download them and make them available have kept them in the public domain.⁹

Despite various efforts to expand historically available reports, there are still a number of defined benefit plans without complete data going back to at least 2001. We made every effort to gather data covering FYE 2020 through 2001 for each plan in our dataset.

Because data were not complete for FYE 2020 (even as of spring 2021), the formal ending point of our collective analysis is FYE 2019 — while some specific state plans have data we can show through FYE 2020.

Formally, measuring the actuarial gain/loss for FYE 2001 means we are measuring the change in unfunded liability levels from FYE 2000 to FYE 2001. So, any reference to collecting data back to 2001 means that we are measuring the actuarial gain/loss data for that fiscal year, plus gathering the actuarially valued unfunded liability figure for 2000.

The starting point of our analysis for each defined benefit plan is the earliest year of gain/loss data on record. Most plans provide unfunded liability data back to 2000 or 2001 but gain/loss data is not always in the earliest available defined benefit plan reports. There have also been a number new defined benefit plans created within the past decade.

Of the 137 defined benefit plans in our dataset (after removing the plans discussed above from our starting dataset), 63 have complete 2001 to 2019 gain/loss data and another 33 have complete for 2004 to 2019 gain/loss data. There are 28 plans where we have data back to between 2005 and 2009, and the remaining 14 plans have data going back to some year between 2010 and 2015.

⁸ For example, one of this report's authors once worked with the Michigan State Library to finance the digitization of physical copies of actuarial valuations for state sponsored retirement plans going back into the 1940s. These are now available through the state's library, even though they are not on the retirement system's website.

⁹ For example, PublicPlans.org has a feature that allows for the download of various state actuarial valuations and CAFRs that they have downloaded from state websites, sometimes making certain documents available that are not longer provided by a pension plan because they only provide most the most recent year's actuarial valuation or CAFR.



Appendix 2: Methodology for Data Collection, Categorization, and Measurement

A2.1 GATHERING THE DATA

We gathered actuarial valuation reports, comprehensive annual financial reports, experience studies, and other similar documents published by public retirement systems. The authors of this report reviewed these files extensively to find references to actuarial gain/loss data using a wide range of search terms. There is considerable inconsistency in how these data are reported and defined across report types, actuarial firms, and years that data are presented. There are some commonalities in reporting structure within reports produced by the same actuarial firm even for different states. But actuarial firms often changed their reporting approach and terminology over the course of the last two decades, and sometimes at the request of the retirement system that had preferred terminology.

After identifying in each defined benefit plan's report, the appropriate data (or determining that it did not exist), the information was scraped by hand into individual spreadsheets for each plan. We have preserved the raw, "as-is" data that were collected in our first pass and can make these available to other researchers who are interested in these data.

During the process of gathering the as-is data we collected the information exactly as presented, including the phrases and terminology for the gain/loss sources being presented and the figures in the denomination provided. Our spreadsheets indicated for each value what denomination it was in (e.g., actual, in thousands, in millions, in billions), and whether the figure was reflecting an increase in unfunded liabilities or decrease in unfunded liabilities.

A2.2 STANDARDIZING THE DATA

After collecting and saving a copy of the as-is data, we standardized all of the information such that it all reflected actual dollars, and such that positive figures reflected an increase in the unfunded liability, whereas negative figures indicated a decrease in change to the unfunded liability.

Of particular importance was interpreting what a "gain" or "loss" meant in the context of the tables that it was reported. Some plans report gain/loss related to the unfunded liability where a "gain" is an increase in the UAAL, and a "loss" is a decrease in the UAAL; other plans use gain and loss for the UAAL in the opposite direction. Sometimes, plan reports show gain/loss related to the actuarially accrued liability, such that a "gain" will increase the AAL, and by extension will mean an increase in the UAAL if there aren't offsetting increases in assets via contributions or investment returns.

Reports can use various framings around these data, including "(gain)/loss" or "gain/(loss)" or even "gain(loss)" depending on the actuarial firm and year of reporting. For the purposes of this report, we just use the simplified "gain/loss" without other modifiers as a catch-all for however different retirement systems choose to use the phrase.

Figuring out the direction that a given data point moved the UAAL was the most time intensive aspect of the data collection. It was not always clear at first glance whether positive or negative numbers mean an increase or decrease in the unfunded liability. Sometimes tables of data had all positive numbers, but they were being added and subtracted in different ways, meaning some of them increased the UAAL and some of them decreased the UAAL. Fortunately, nearly every plan has summary rows in their gain/loss tables showing totals meaning we could confirm whether we were standardizing the raw as-is data using plan provided data.







A2.3 CATEGORIZING THE DATA

Given the wide range of terminology for sources of unfunded liability gains and losses, it was necessary to classify all of the data into common categories. We developed a framework of categories and subcategories that could be applied to all gain/loss data. The specific groupings were chosen to balance an analytical need to reflect a range of possible sources of gain/loss changes while also not being so detailed as to make it difficult to interpret the information.¹⁰

We went through each defined benefit plan's reported actuarial gain/loss data and assigned it a subcategory name. These subcategories are bundled up into seven overarching categories that give us a clear snapshot of the sources of change to unfunded liabilities:

1. Investment Experience

- Investment Experience
- Other Investment Related
- General (Unspecified) Asset Gain/Loss

2. Demographic Experience

- Payroll or Salary Experience
- o Turnover or Retirement Experience
- o Disability Experience
- o Mortality Experience

3. Assumption Changes

- General (Unspecified) Assumption Change
- o Investment Assumption Change
- Mortality Assumption Change
- Payroll or Salary Assumption Change
- Other (Specified) Assumption Change
- $\circ \quad \text{Other Actuarial Method Change}$

4. Benefit Experience & Legislative Changes

- o Benefit Formula Change
- Benefit Experience
- o General (Unspecified) Benefit Design Change
- o COLA Experience
- o COLA Change
- o Service Purchases

5. Contribution Experience & Interest on the Debt

- o Contribution Rate Deficiency or Excess
- o Expected Change in UAAL
- Funding Policy Change

6. Other & Unspecified

- General (Unspecified) Actuarial Liability Gain or Loss
- General (Unspecified) Experience Gain or Loss
- Unspecified Amendments
- Data Corrections
- o Actuarial Firm Change
- Undeclared or Other
- 7. 20th Century Legacy & Starting Status
 - o 20th Century Legacy
 - o Starting Overfunding
 - o Starting Unfunded Liability

A2.4 CATEGORY: INVESTMENT EXPERIENCE

This is any asset related experience, such as investment returns performing better or worse than assumed. The "Investment Experience" subcategory is any reported gains or losses from actual investment returns compared to assumed investment returns. Other subcategories reflected a range of experiences to assets such as lump sum transfers in or out of the defined benefit plan, pension obligation bond revenues, lottery revenues not counted in investment return experience, etc.

¹⁰ We recognize there is some subjectivity to this process, which is why we've preserved all of our standardized data such that it could all be reclassified at a later point based on other intuition or definitions.



A2.5 CATEGORY: DEMOGRAPHIC EXPERIENCE

This is any demographic experience affecting accrued liabilities relative to related assumptions. For example, the subcategory "Mortality Experience" is any actuarial gains or losses from experiences labeled mortality, death-in-service, death-after-service, etc. compared to assumptions about mortality rates. And the subcategory "Payroll or Salary Experience" is any actuarial gains or losses related to deviations from payroll growth assumptions and salary growth assumptions.

A2.6 CATEGORY: ASSUMPTION CHANGES

This is any changes to actuarial assumptions that increase or decrease accrued liabilities. Most of the time that this was reported, it was a general, unspecified classification of "assumptions," even for years where it was possible to infer that the unfunded liability increase being sourced was due to a change in the assumed rate of return (which in effect changed the discount rate used to measure accrued liabilities).

In instances where defined benefit plans specifically indicated what assumption changes led to an increase or decrease in assumptions, we classified them as described in the relevant subcategory.

A2.7 CATEGORY: BENEFIT EXPERIENCE & LEGISLATIVE CHANGES

This is any benefit experience that changed accrued liabilities or legislative changes that adjust benefit values up or down, changing the value of accrued liabilities, and thus changing the value of unfunded liabilities (all else holding constant).

When the actuarial firms reporting the data included notes specifying that the change to unfunded liabilities was as a result of a benefit formula change — such as an increase to the benefit multiplier, change to final average salary calculations, or adjustment to retirement eligibility age — we grouped that data into a specific subcategory. When the benefit experience was vague, it was classified under a more general heading (even if in practice it is likely that the changes were to benefit formulas).

This category is also where we capture how changes to cost-of-living adjustments influence the unfunded liability. Whenever there was a change to COLA policy that created a gain or loss different from what was assumed by the plan actuary, this was put under "COLA Experience." And when COLAs were issued on an ad hoc basis or otherwise changed, this was put under "COLA Change."

A2.8 CATEGORY: CONTRIBUTION EXPERIENCE & INTEREST ON THE DEBT

This is both explicit and implicit funding experience. We think about "explicit" increases in the unfunded liability as experience when the legislature sets a contribution rate on its own that is less than the actuarially determination. We consider an increase (or decrease) in the unfunded liability as "implicit" when funding policy adopted by the board leads to an actuarially determined contribution rate that, even if fully paid by the legislature, will result in growing UAAL because interest is growing faster than contributions.

A2.8.1 SUBCATEGORY: CONTRIBUTION RATE DEFICIENCY / EXCESS

When legislatures set contribution rates below the actuarially determined contribution rate, some plans report this figure broken out as "contribution deficiency" or a similar phrase. When legislatures overfund required contributions, whether via a contribution rate as a percentage of payroll that all employers will pay or through direct supplemental contributions, these figures are classified as "contribution excess." Since all figures are standardized such that positive numbers in our dataset



mean the unfunded liability is going up and negative figures mean the unfunded liability is going down, the deficiency and excess gain/loss data related to contributions are put within the same subcategory.

A2.8.2 SUBCATEGORY: EXPECTED CHANGE IN UNFUNDED LIABILITY

This is an implicit deficiency or excess of contributions, based on the funding policy established by the retirement plan. A common language way to think about the category is "interest on the debt."

In technical terms, the "expected change" of unfunded liabilities is the difference between normal cost for benefits accrued during the measurement year (increasing the AAL), plus interest on existing unfunded liabilities (increasing the AAL), minus contributions for the measurement year (increasing the AVA). The result is the amount that actuaries are expecting the unfunded liability to change, before considering whether actual experience matched actuarial assumptions.

In other words, if actual experience matches all actuarial assumptions exactly (including investment return assumptions and demographic experience assumptions), and if employers contribute the exact actuarially determined rate, it is still possible that the unfunded liability will change (up or down) based on this "expected change" calculation.

Many defined benefit plans explicitly reported their "expected change" data or used similar language and terminology that meant the same thing. In some instances, plans reported their starting year unfunded liability value and expected unfunded liability value before gains or losses were measured, making it easy to calculate the expected change figure.

Most other plans reported data from which we could infer the expected change by adding together reported interest accumulation and amortization payments, or by putting together data about prior year AAL and AVA along with reported data about the expected AAL and expected AVA for the year being measured and backed into the expected change to the UAAL.

For the few defined benefit plans that did not report any data related to their expected change (or only reported it in select fiscal years), we backed into the amount of expected change to unfunded liabilities by inferring it from the change to the unfunded liability that was not shown in reported data. This method was used for the following plans and following fiscal years (which reflect about 5% of the total fiscal years of data covered in our dataset):

TABLE A2.1. PLANS WITH INFERRED EXPECTED CHANGE DATA IN OUR DATASET

Plan Name	Fiscal Year for Inferred Expected Change	Total Years
Arizona State Retirement System	2001	1
Arkansas Teachers' Retirement System	2001-2019	19
Colorado PERA Denver Public School Division	2018-2019	2
Kentucky Retirement Systems	2003-2005	3
Illinois Municipal Employees' Retirement System	2001-2019	19
Michigan State Police Retirement System	2014-2019	6
Montana Public Employees' Retirement System	2002-2009	8
Montana Teachers' Retirement System	2003-2004, 2006-2016	13
New Hampshire Retirement System	2011-2012	2
Public Employees' Retirement System of Nevada	2007-2010	4
North Dakota Teachers' Fund for Retirement	2011-2020	10
Ohio State Teachers' Retirement System	2001-2010, 2018-2020	13
Oklahoma Law Enforcement	2008-2010	3
South Dakota Public Employees	2005-2012	8
Wisconsin Retirement System	2001-2011	11
Wyoming Retirement System	2007-2008	2



Some plans include changes to assumptions or benefit provisions in their calculation of expected unfunded liability, but we removed those from the total expected change and accounted for them separately so that we could properly categorize each change in the unfunded liability. For example, if a plan reported a \$1 billion starting year unfunded liability, plus \$50 million increase in the UAAL due to an assumption change, and then reported an expected UAAL of \$1.2 billion, we would consider that \$150 million of expected change and \$50 million of assumption change.

A2.9 OTHER & UNSPECIFIED DATA

Inevitably with datasets at this scale there will be certain data points that are unknown. There might be overly broad category names that cannot be attributable to any narrow classification, or simply no data definition provided beyond the phrase "other." This category is any unclassified change to accrued liabilities, however the subcategories reflected in this group of data do have considerably different meanings.

A2.9.1 SUBCATEGORY: GENERAL (UNSPECIFIED) ACTUARIAL LIABILITY GAIN OR LOSS

There is a modest number of states that do not break out any demographic gain/loss data and simply report an aggregate "actuarial gain/loss" or "liability gain/loss" category. For example, a state pension plan might show that its unfunded liability increased by \$100 million from one year to the next, with \$20 million of that as expected growth due to funding policy, and then just report \$40 million in "asset gain/loss" and \$40 million in "liability gain/loss." It is easy to infer from this that the asset gain/loss is investment experience (in this case reflecting actual returns generated \$40 million less than assumed for the year, on a smoothed actuarial value of assets basis). However, it is impossible to infer from this what portion of the liability gain/loss is due to mortality, payroll, turnover, or other demographic related experience being different than assumptions.

Plans that reported catch-all summary categories like "liability gain/loss" usually also included rows of data for gain/loss related to assumption changes and other factors (like data corrections). But not always. We can reasonably conclude that most of the data points we classified as "General (Unspecified) Actuarial Liability Gain or Loss" is really demographic experience data, but without certainty it was safer to classify it in this "Other" category.

A2.9.2 SUBCATEGORY: GENERAL (UNSPECIFIED) EXPERIENCE GAIN OR LOSS

In certain instances, plans explicitly used the phrase "experience gain/loss" without much detail. Potential meanings, depending on the defined benefit plan and actuarial firm, include: contributions being greater or less than actuarially determined, demographic experience relative to assumptions, or other actual financial outcomes that differed from what was expected. We chose to group these within their own subcategory, rather than attempt to interpret them all during this first reporting of the data, to highlight how vague public plan reporting can be about sources of change to unfunded liability. At a later juncture we may attempt to disaggregate the category or work with plans to provide more detail about these gains and losses.

A2.9.3 SUBCATEGORY: DATA CORRECTION

When public plans changed actuaries there were times that the new actuary could not resolve their accounting with the previous actuary, and this amount was listed in gain/loss tables. In a small number of cases corrections to previous years of data were provided but accounted for in the current year's gain/loss data. There were also several instances where plans reported gain/loss figures rounded in thousands or millions but separately provided unfunded liability data in actuals, meaning there was a minor discrepancy between the gain/loss data reported and the actual dollar figure of unfunded liabilities. In these cases, we classified the rounded amount as a "Data Correction."



A2.9.4 SUBCATEGORY: UNDECLARED OR OTHER

While not common, it there were several instances where states simply reported a category as "Other" without detail. In a small number of cases, we were unable to resolve discrepancies between the reported change to unfunded actuarially accrued liabilities from year to year, and the gain/loss data shown. In these cases, we classified the unknown difference as "Undeclared or Other" (which was also the category we used for when a plan specifically just classified a source to change in the UAAL as "other").

A2.10 20TH CENTURY LEGACY & STARTING STATUS

This is any unfunded liability that was reported by a plan as of FYE 2000, and thus the source of which is not being measured. The cumulative funded status for all state administrated defined benefit plans in 2001 was around \$35 billion overfunded, reflecting a funded ratio of nearly 102% (similarly, the 63 plans in our dataset with gain/loss data going back to 2001 have a \$6 billion overfunded status). This relatively strong funded ratio accounts for some plans being overfunded where a few were underfunded.

Any defined benefit plan that bought unfunded liabilities into the 21st Century had a starting level of "pension debt" that is not being measured in our analysis. The causes of these unfunded liabilities will be attributable to a mix of the usual causes — contribution deficiency, changes to assumptions, benefit design changes, and actuarial experience. In particular, states that were not explicitly prefunding their defined benefit plans from the date of founding suffered from large contribution rate deficiencies. States that were prefunding and experienced large investment returns in the 1990s had sizeable benefit enhancements. However, because we don't have comprehensive detailed data before 2001, we do not measure these specifics for any one defined benefit plan and instead classify all of this pension debt on the books as of FYE 2000 as "20th Century Legacy" unfunded liabilities.

In certain instances, gain/loss data and unfunded liability figures were only available starting with FYE 2001 or 2002. In these cases, we classified the starting level of unfunded liabilities we were measuring from as "20th Century Legacy." Beginning with FYE 2005, any plan's individual data chart that measures data beyond that year has this category renamed to "Starting Unfunded Liability" or "Starting Overfunding."





Appendix 3: State Specific Information

A3.1 THREE PERIODS OF MEASUREMENT FOR STATE CHARTS

This study tabulates the sources of changes of unfunded liabilities over the two-decade period of FYE 2000 to 2019 and reports the aggregate national data for state-administrated defined benefit plans. For any given state defined benefit plan, though, there are three periods that we could be measuring, depending on the available data.

- 1. 2000 to 2019 (or 2020) these are plans that are reporting an unfunded liability figure for FYE 2000 and showing actuarial gain/loss data for FYE 2001. These plans may have a 20th Century Legacy unfunded liability, or they may be overfunded as of that year. If they have pension debt as of FYE 2000 then that will be denoted as its own column of data in a state chart, showing the share of today's unfunded liability that is attributable to 20th Century funding policy decisions and actuarial experience. If they have an overfunded status as of FYE 2000 then there will be a negative figure reported, effectively showing how experience since then has not just created unfunded liabilities but wiped out a level of overfunding. Any plan with data back to 2004 also classifies its starting status as "20th Century Legacy" unfunded liabilities.
- 2. Any-Year-After-2004 to 2019 (or 2020), with starting unfunded liability these are plans that do not actuarial gain/loss data going back to 2001, so we have to start with the furthest back year on record. These plans also have some starting unfunded liability, which could be attributable in part to 20th Century Legacy pension debt or could be entirely a byproduct of experience between 2001 and the first measurement year. We unfortunately don't know, so these charts are listed with a "Starting Unfunded Liability" in the column where we'd typically show "20th Century Unfunded Liabilities."
- 3. Any-Year-After-2004 to 2019 (or 2020), with starting overfunded status these are also plans that do not actuarial gain/loss data going back to 2001, so we have to start with the furthest back year on record. These plans have a starting overfunded status, which is noted with a negative figure in a column marked "Starting Overfunding" in the column where we'd typically show "20th Century Unfunded Liabilities."

A3.2 LIST OF RETIREMENT SYSTEM IN THE DATASET AND PLAN SPECIFIC NOTES

Given the way that states have evolved their retirement systems over time, there are a number of ways that data was combined or adjusted for specific defined benefit plans. Here are notes related to specific state plans:

- Alabama Employees' Retirement System: This retirement system breaks out gain/loss data for two groups of employees, defined as General State and State Police. These groups do not reflect all of the unfunded liabilities for Alabama ERS, though. There are also municipal employers who participate in this retirement system, and the collective actuarial valuation reports do not provide gain/loss data for these local agencies.
- Alabama Teachers' Retirement System: N/A.
- Alaska Public Employees' Retirement System: N/A.
- Alaska Teachers' Retirement System: N/A.
- Arizona Corrections Officers Retirement Plan: N/A.
- Arizona Elected Officials Retirement Plan: N/A.
- Arizona Public Safety Personnel Retirement System: N/A.
- Arizona State Retirement System: N/A.
- Arkansas Public Employees Retirement System: N/A.
- Arkansas State Highway Employees Retirement System: There are only seven years of gain/loss data available in the publicly released reports for this system (2014-2020). These limited data are presented in an individual chart for general interest purposes.

- Arkansas Teacher Retirement System: For FYE 2001-2013 this system only reports demographic and investment related gain/loss data, without specific data related to assumptions, method changes, expected change, or other experience. We classify the unreported change in UAAL as Other due to this lack of detail. Starting with FYE 2014, this retirement system also reports its gain/loss data relative to the Total Pension Liability figures (as defined under the GASB 67 rules). Because this provided more complete data, we switched our point of measurement at that year and have adjusted the Arkansas TRS unfunded liability figures being accounted for in our totals for 2014 to 2019 to reflect the Net Pension Liability instead of the Unfunded Actuarially Accrued Liability.
- California Judges Retirement Fund: N/A.
- California Judges Retirement Fund II: N/A.
- California Public Employees Retirement System: There are three divisions of CalPERS, known as Public Employee Retirement Funds (PERF). PERF B covers non-instructional public school employees. PERF C covers city and county employees with small plans where the employer-sponsors are in a cost-sharing arrangement. The largest of the divisions is PERF A, which is an agent multiple-employer plan for state agencies and local public employees. Actuarial gain/loss data is available for the PERF A State Agency -employers, but not the PERF A Local Public Agency plan. Details on how we handled this subdivision are provided at length in the methodology found in Appendix A.
- California State Teachers' Retirement System: N/A.
- University of California Retirement System: N/A.
- Colorado Fire and Police Pension Association: N/A.
- **Colorado Public Employees' Retirement Association:** Our dataset coverage for this retirement system includes gain/loss for four divisions of PERA, including the State, Schools, Local, and Denver Public Schools Divisions.
 - State Division & Schools Division: Our charts for these two Divisions include a modification on 2001-2004 data. PERA reported combined gain/loss data across those four years for these two Divisions, which were then provided in separate financial data starting in 2005. For each gain/loss variable we determined its percentage share of year over year change in aggregate unfunded liabilities, and then used this as a weight for assigning a portion of the aggregate gain/loss data across these two classes based on the individual actual change in unfunded liability from the prior year. These figures are rough estimates, but directionally reasonable for measuring a change to unfunded liabilities for each of the two classes from FYE 2001 to 2004. This data transformation is not relevant for the national figures since all of the data is included in the aggregate, no matter how the division data were reported. It is only relevant when looking at a plan specific chart for the State Division or Schools Division.
 - Denver Public Schools Division: Our charts for this Division includes 2010 to 2019 gain/loss data. The city of Denver previously ran this as a separate defined benefit plan, before merging it with PERA effective for the FYE 2010 year. We have marked this plan has having "Pre-Merger Unfunded Liabilities" in place of 20th Century Legacy pension debt.
- Connecticut Municipal Employees Retirement System: N/A.
- Connecticut State Employees Retirement System: N/A.
- Connecticut State Teachers' Retirement System: N/A.
- Delaware State Employees' Pension Plan: N/A.
- District of Columbia Police Officers and Fire Fighters' Retirement Fund: N/A.
- District of Columbia Teachers' Retirement Fund: N/A.
- Florida Retirement System: N/A.
- Georgia Employees' Retirement System: N/A.
- Georgia Teachers Retirement System: N/A.
- Employees' Retirement System of the State of Hawaii: N/A.
- Public Employee Retirement System of Idaho: N/A.
- Illinois State Employees Retirement System: N/A.
- Illinois State Teachers' Retirement System: N/A.
- Illinois State University Retirement System: N/A.
- Judges' Retirement System of Illinois: N/A.
- Indiana 1977 Police Officers' and Firefighters' Pension and Disability Fund: N/A.
- Indiana Public Employees Retirement Fund: N/A.
- Indiana State Teachers Retirement Fund:





- DC Account Balances: The retirement system managing this fund, which has separate accounts for benefits earned before and after 1996, changed the way it reported assets twice between FYE 2005 and 2019. During this time Indiana began offering the option of a defined contribution retirement plan to individuals who qualified for Indiana TRF, and in some years the defined benefit plan included those assets in its reported balance. When gathering data for our analysis, we captured information that was "net of DC account balances," meaning the reported change to unfunded liabilities reflects only the assets attributable to defined benefit plans.
- 1996 Account and Closed Plan: There are two separately accounted for retirement plans managed by ISTRF, a closed plan referenced as Pre-1996 and the current plan, called the 1996 Account. ISTRF reported separate data for these two classes for 2006 to 2019 but provided combined gain/loss data for 2003-2005. For each gain/loss variable we determined its percentage share of year over year change in aggregate unfunded liabilities, and then used this as a weight for assigning a portion of the aggregate gain/loss data across these two classes based on the individual actual change in unfunded liability from the prior year. These figures are rough estimates, but directionally reasonable for measuring a change to unfunded liabilities for each of the two classes from FYE 2003 to 2005. This data transformation is not relevant for the national figures since all of the data is included in the aggregate, no matter how the division data were reported. It is only relevant when looking at a plan specific chart for the 1996 Account Plan or Pre-1996 Closed Plan.
- **Iowa Municipal Fire and Police Retirement System:** Starting with FYE 2012, this retirement system only reports its gain/loss data relative to the Total Pension Liability figures, instead of the actuarially accrued liability. For the fiscal years that data is provided, we measure the sources of changes to the Net Pension Liability instead of the Unfunded Actuarially Accrued Liability.
- Iowa Public Employees' Retirement System: N/A.
- Kansas Police and Firefighter's Retirement System: N/A.
- Kansas Public Employees Retirement System: Our charts for the State Employees division and School Employees division include a modification on 2001-2003 data. KPERS reported combined gain/loss data across those three years for these two groups of members, which were then provided in financial data starting in 2004. For each gain/loss variable we determined its percentage share of year over year change in aggregate unfunded liabilities, and then used this as a weight for assigning a portion of the aggregate gain/loss data across these two classes based on the individual actual change in unfunded liability from the prior year. These figures are rough estimates, but directionally reasonable for measuring a change to unfunded liabilities for each of the two classes from FYE 2001 to 2003. This data transformation is not relevant for the national figures since all of the data is included in the aggregate, no matter how the division data were reported. It is only relevant when looking at a plan specific chart for the State Employees or School Employees groups.
- Kansas Retirement System for Judges: N/A.
- Kentucky County Employees' Retirement System: N/A.
- Kentucky Employees' Retirement System: N/A.
- Kentucky State Police Retirement System: N/A.
- Kentucky Teachers' Retirement System: N/A.
- Louisiana Municipal Police: N/A.
- Louisiana School Employees' Retirement System: N/A.
- Louisiana State Employees' Retirement System: N/A.
- Louisiana State Parochial Employees Retirement System: There is no gain/loss data published in publicly available reports.
- Louisiana State Police Retirement System: N/A.
- Louisiana Teachers' Retirement System: N/A.
- Maine Public Employees Retirement System: N/A.
- Maryland State Retirement and Pension System: There is separate gain/loss data in some years for the municipal retirement plan from state-level systems (include combined data from plans for state employees, teachers, and judges), but it is not consistent across all years. It was most accurate to report all data on a combined basis for the entire Maryland SRPS in the absence of a good method for ensure separated out information was accurate.
- Massachusetts State Employees' Retirement System: N/A.
- Massachusetts Teachers' Retirement System: N/A.





- Michigan Municipal Employees Retirement System: This retirement system is a collection of individual defined benefit plans for separate cities and counties across the state that pool their assets for investment purposes but set their own rules for benefit provisions. There are a limited range of benefit provisions that can be provided, but the permutations work out to be dozens of combinations. Individual employer-sponsors can also select from options for how to set their investment return assumptions and other actuarial assumptions, all for the purposes of having a customized actuarially determined contribution. Given this unique set of particulars, the MERS board does not report the total actuarial gain/loss data for the 745 defined benefit plans within its system.
- Michigan Public School Employees' Retirement System: N/A.
- Michigan State Employees' Retirement System: N/A.
- Michigan State Police Retirement System: N/A.
- Minnesota General Employees Retirement Plan: N/A.
- Minnesota Public Employees Police & Fire Plan: N/A.
- Minnesota State Employees Retirement Fund: N/A.
- Minnesota Teachers Retirement Association: N/A.
- Public Employees' Retirement System of Mississippi: N/A.
- Missouri Department of Transportation and Highway Patrol Employees' Retirement System: N/A.
- Missouri Local Government Employees Retirement System: N/A.
- Missouri Public Education Employee Retirement System: N/A.
- Missouri Public School Retirement System: N/A.
- Missouri State Employees' Retirement System: N/A.
- Montana Public Employees' Retirement System: N/A.
- Montana Teachers' Retirement System: N/A.
- Nebraska Public Employees Retirement System: N/A.
- Public Employees' Retirement System of Nevada: N/A.
- New Hampshire Retirement System: Prior to 2007, this retirement system did not use an actuarial method that produced an unfunded actuarially accrued liability measurement, so there is no publicly available gain/loss data for this plan prior to that year. We have included this plan in our overall analytics, starting from FYE 2007.
- New Jersey Police & Firemen's Retirement System: N/A.
- New Jersey Public Employees' Retirement System: Our dataset coverage for this retirement system includes two separate divisions of benefits called State Plan and Local Plan. Both plans the retirement system reports an aggregate dollar amount of gains and losses related to liability and asset experience. The retirement system also reports a percentage of change set of numbers related to specific categories, such as investment performance and demographic experience. We used the percentage figures to estimate how the dollar denominated aggregated gain/loss category should be broken out into specific sources.
- New Jersey Teachers' Pension & Annuity Fund: N/A.
- State Police Retirement System of New Jersey: N/A.
- New Mexico Educational Retirement Board: N/A.
- New Mexico Public Employees Retirement Association: N/A.
- New York State and Local Retirement System: Our dataset coverage for this retirement system includes two separate divisions of benefits called the Employees' Retirement System and Police and Fire Retirement System. For both divisions there is no actuarially accrued liability-based gain/loss data available from this retirement system. For FYE 2015-2020 there is data showing the sources of change to net pension liabilities (based on GASB 67 reporting standards). This limited data is presented in an individual chart for each retirement system for general interest purposes.
- New York State Teachers Retirement System: This state does not directly report its actuarial gain/loss data change in dollars, but it does report them in percentage change terms from year to year, as a function of contributions. We could not infer from these data what the dollar amount of changes unfunded liabilities were for each category, so this plan was removed from the cumulative dataset, as noted in the methodology discussion above.
- North Carolina Local Government Employees' Retirement System: There are only three years of gain/loss data available in the publicly released reports for this system. These limited data are presented in an individual chart for general interest purposes. But the data from this plan was removed from the cumulative dataset, as noted in the methodology discussion above.
- North Carolina Teachers' and State Employees' Retirement System: N/A.





- North Dakota Public Employees' Retirement System: There are only four years of gain/loss data available in the publicly released reports for this system. These limited data are presented in an individual chart for general interest purposes. But the data from this plan was removed from the cumulative dataset, as noted in the methodology discussion above.
- North Dakota Teachers' Fund for Retirement: N/A.
- Ohio Police and Fire Pension Fund: N/A.
- Ohio Public Employees' Retirement System: This retirement system did not report detailed gain/loss data related to changes in assumptions or expected change in the unfunded liability. It was possible to infer the portion of the change in unfunded liability associated with both sources combined, and this column of data was classified as Expected Change. For two years we were able to use the GASB 67 data to infer what portion of the combined sources of data was actually associated with changes to assumptions, and these data were split out and classified as Investment Assumption Change.
- Ohio School Employees' Retirement System: N/A.
- Ohio State Teachers' Retirement System: N/A.
- Oklahoma Law Enforcement Retirement System: N/A.
- Oklahoma Police Pension and Retirement System: N/A.
- Oklahoma Public Employees Retirement System: N/A.
- Oklahoma Teachers' Retirement System: N/A.
- Oregon Public Employees Retirement System: N/A.
- Pennsylvania Municipal Retirement System: N/A.
- Pennsylvania Public School Employees' Retirement System: N/A.
- Pennsylvania State Employees' Retirement System: N/A.
- Rhode Island Employees' Retirement System: N/A.
- **Municipal Employees' Retirement System of Rhode Island:** Up through FYE 2013, this retirement system only reported its gain/loss data based on change to contribution rates. Starting with FYE 2014, this system provides data showing the sources of change to net pension liabilities (based on GASB 67 reporting standards. These data are provided through FYE 2020, drawn from CAFRs. Starting with FYE 2018, the system also provided gain/loss data on an AAL basis in aggregate dollars. These data were captured separately but not used for measurement of the system so that we could use a constant measurement across 2014 to 2020.
- South Carolina Police Officers' Retirement System: N/A.
- South Carolina Retirement System: N/A.
- South Dakota Retirement System: Starting with FYE 2014, this retirement system only reports its gain/loss data relative to the Total Pension Liability figures (as defined under the GASB 67 rules), instead of the actuarially accrued liability. We switched our point of measurement at the same year as well and have adjusted the South Dakota unfunded liability figures being accounted for in our totals for 2014 to 2019 to reflect the Net Pension Liability instead of the Unfunded Actuarially Accrued Liability.
- **Tennessee Consolidated Retirement System:** Publicly available reports only provide information about changes to contribution rates as a result of gain/loss experience, with the exception of limited gain/loss data related to the Hybrid retirement plans managed by the system. These plans launched in 2014 and have only a small amount of data. But we have included them in the total numbers, as with other new plans created within the past few years.
- Texas County and District Retirement System: This defined benefit plan has a "cash balance" design (more colloquially described as a guaranteed return plan) that provides benefits based the accumulation of notional account balances using contributions from employees and employers and a sharing of investment returns. The plan does not provide aggregate dollar denominated gain/loss data for the multi-employer plan, but it did provide data on the sources of change to average contribution rates across those employers and how those factors changed the aggregate funded ratio. We used these annual change figures for different sources (like investment experience and payroll experience) to infer what share they represented of the actual dollar change in aggregate unfunded liability each year. The dollar figures in our chart for this plan are estimates of the dollar values associated with each source of the change in unfunded liabilities but are directionally accurate for the purposes of understanding the scope of each factor.
- Texas Employees Retirement System: N/A.
- Texas Law Enforcement & Custodial Officer Supplemental Retirement Plan: N/A.
- Texas Municipal Retirement System: N/A.





- Texas Teachers Retirement System: N/A.
- Utah Retirement System: N/A.
- Vermont Municipal Employees' Retirement System: N/A.
- Vermont State Employees' Retirement System: N/A.
- Vermont State Teachers' Retirement System: N/A.
- Virginia Retirement System: Our data includes gain/loss from six classes of benefits provided by VRS, each of which cover slightly different years depending on how VRS decided to breakout the data.
 - State & Teacher Classes: Our charts for the VRS State and VRS Teachers classes of benefits include a modification on 2004-2009 data. VRS reported combined gain/loss data across those five years for these two classes, which are normally reported as a combined division of the retirement system. For each gain/loss variable we determined its percentage share of year over year change in aggregate unfunded liabilities, and then used this as a weight for assigning a portion of the aggregate gain/loss data across these two classes based on the individual actual change in unfunded liability from the prior year. These figures are rough estimates, but directionally reasonable for measuring a change to unfunded liabilities for each of the two classes from FYE 2001 to 2003. This data transformation is not relevant for the national figures since all of the data are included in the aggregate, no matter how the division data were reported. It is only relevant when looking at a plan specific chart for the State or Teachers classes of VRS.
 - Legacy Plans: VRS manages legacy defined benefit plans (fully final average salary-based pension plans) as well as defined benefit hybrid plans for new members joining the retirement system. The collective defined benefit liabilities are commingled and managed within a single trust and VRS reports the gains and losses for these plans on a combined basis without any distinction.
- Washington State Department of Retirement Systems: This state does not directly report its actuarial gain/loss data change in dollars, but it does report them in percentage change terms from year to year, as a function of contributions. We could not infer from these data what the dollar amount of changes unfunded liabilities were for each category, so this plan was removed from the cumulative dataset, as noted in the methodology discussion above.
- West Virginia Public Employees' Retirement System: N/A.
- West Virginia Teachers' Retirement System: N/A.
- Wisconsin Retirement System: N/A.
- Wyoming Retirement System: N/A.



Appendix 4. Actuarial Firm Definitions for Gain/(Loss)

CAVANAUGH MACDONALD CONSULTING, LLC:

• Experience Gain/Loss: The difference between actual experience and anticipated experience, based on the actuarial assumptions, during the period between two actuarial valuation dates.¹¹

CHEIRON:

 Actuarial Gain/(Loss): A measure of the difference between actual experience and that expected based upon a set of Actuarial Assumptions during the period between two Actuarial Valuation dates, as determined in accordance with a particular Actuarial Cost Method.¹²

FOSTER & FOSTER:

• Experience Gain/Loss: The difference between actual unfunded actuarial accrued liabilities and anticipated unfunded actuarial accrued liabilities during the period between two valuation dates. It is a measurement of the difference between actual and expected experience and may be related to investment earnings above (or below) those expected or changes in the liability due to fewer (or greater) than expected numbers of retirements, deaths, disabilities, or withdrawals, or variances in pay increases relative to assumed pay increases. The effect of such gains (or losses) is to decrease (or increase) future costs.¹³

GABRIEL ROEDER SMITH & COMPANY:

• Experience Gain/Loss: A measure of the difference between actual experience and that expected based upon a set of actuarial assumptions during the period between two actuarial valuation dates, in accordance with the actuarial cost method being used.¹⁴

MILLIMAN:

 Actuarial Gain(Loss): A measure of the difference between actual experience and that expected based on a set of Actuarial Assumptions during the period between two Actuarial Valuation dates as determined in accordance with a particular Actuarial Cost Method.¹⁵

SEGAL CONSULTING:

• Actuarial Gain/Loss: A measure of the difference between actual experience and expected based upon a set of Actuarial Assumptions, during the period between two Actuarial Valuation dates. Through the actuarial assumptions, rates of decrements, rates of salary increases, and rates of fund earnings have been forecasted. To the extent that actual experience differs from that assumed, Actuarial Accrued Liabilities emerge that may be the same as forecasted, or may be larger or smaller than projected. Actuarial gains are due to favorable experience, e.g., assets earn more than projected, salary increases are less than assumed, members retire later than assumed, etc.

¹¹ Kansas Public Employees Retirement System, 2019 valuation report

¹² State Police Retirement System of New Jersey, 2019 actuarial valuation report

¹³ Teachers' Retirement System of Louisiana, 2020 actuarial valuation

¹⁴ Michigan Public School Employees' Retirement System, 2019 actuarial valuation report

¹⁵ Public Employees' Retirement System of Idaho, 2019 actuarial valuation



Favorable experience means actual results produce actuarial liabilities not as large as projected by the actuarial assumptions. On the other hand, actuarial losses are the result of unfavorable experience, i.e., actual results yield actuarial liabilities that are larger than projected. Actuarial gains will shorten the time required for funding the actuarial balance sheet deficiency while actuarial losses will lengthen the funding period.¹⁶



¹⁶ Vermont Teachers' Retirement System, 2019 actuarial valuation