



# Trends in Maturity Metrics, Asset Allocations and Expected Rates of Return for Large U.S. Public Pension Plans





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# Trends in Maturity Metrics, Asset Allocations and Assumed Rates of Return for Large U.S. Public Pension Plans

## Executive Summary

As part of its work, the Society of Actuaries (SOA) seeks to inform public policy development and public understanding through research. In that context, this report considers trends in public defined benefit plan maturity metrics, asset allocations and assumed rates of return among 139 state-based and large local defined benefit pension systems or plans<sup>1</sup> in the United States from 2001 to 2018.

Plan maturity is one indicator of a plan's sensitivity to risk. In general, the greater a plan's maturity, the more significant the impact of financial shocks, whether beneficial or detrimental, on the plan's sponsors. Financial shocks can stem from any plan experience that differs from the actuarial assumptions, as well as from changes to the plan's benefit structures or actuarial assumptions, which can unexpectedly change plan assets, liability measurements or both.

Investment returns are a common source of shocks—beneficial and detrimental—and are often significant. Asset allocations roughly indicate the general risk undertaken by a plan's assets. As a result, this study also looks at trends in asset allocations.

Because public pension plans typically use expected long-term rates of return on assets to discount liabilities, a plan's assumed rate of return may be one indication of the level of investment risk inherent in funding the plan. At any given point in time, greater assumed rates of return generally signal a riskier approach to plan funding due to either greater investment risk or more optimistic expectations.

## Key Take-Aways

Here are some highlights of findings:

- Large public plans generally matured significantly from 2001 to 2018 and appear to be continuing to mature. In general:
  - Local plans were slightly more mature than state plans.
  - Plans that were less than 60% funded in 2018 tended to be more mature than plans that were more than 60% funded in 2018.
- While plans steadily matured, hence becoming more sensitive to the effects of financial shocks, whether beneficial or detrimental, their asset allocations typically shifted toward riskier, more complex and less transparent assets.
- Plans also typically lowered their assumed rates of return on assets. The median rate of return for all plans studied dropped from 8.00% in 2001 to 7.25% in 2018. However, during the same period, risk-free rates of return dropped by more than the drop in assumed rates of returns.<sup>2</sup> Consequently, the sensitivity to market volatility increased from 2001 to 2018.

<sup>1</sup> Large public-sector pension plans are also known as systems, which may or may not comprise multiple plans. This study uses the shorter term "plan," each of which has its own actuarial valuation results.

<sup>2</sup> During the same time period, the annual average 10-year Treasury yield fell from 4.9% to 2.5%.

- Plans that were less than 60% funded in 2018 tended to be more mature than plans that were greater than 60% funded in 2018. They also shifted a greater share of assets from public equities and public fixed income to private equity, hedge funds, commodities and alternative investments than did better funded plans.
- Plans that were less than 60% funded in 2018 generally had greater-than-typical assumed rates of return in 2001 but less-than-typical assumed rates of return in 2018. The median 2001 assumed rate of return for plans less than 60% funded in 2018 was 8.50%, compared to 8.00% for plans that were at least 60% funded in 2018. In 2018, the median rate was 7.00% for plans less than 60% funded in 2018, while it was 7.25% and 7.32% for plans at least 80% funded in 2018 and plans 60%–80% funded in 2018, respectively.

## Introduction

Funding a defined benefit pension plan is a long-term, complicated process that involves financial risk. Measuring actuarial liabilities and computing contribution needs for a defined benefit pension plan typically involve assumptions about future uncertainties such as returns on assets, longevity, retirement dates, pay increases, etc. Consequently, funding a pension plan inherently involves risk that future events will occur differently than assumed, causing the plan's future funded status to be better or worse than expected.

Assessing the overall risk to which a plan is exposed entails considering the plan from a wide variety of perspectives. Maturity metrics are one tool for assessing certain types of risk. Maturity metrics typically provide some indication of the severity with which a plan experiences the effects of various types of financial shocks—beneficial or detrimental. Different maturity metrics can examine different ways that financial shocks affect plans. In addition, some maturity metrics may indicate the level of difficulty that a plan may have recovering from a detrimental financial shock.

Overall, more mature plans generally have greater difficulty recovering from an adverse financial shock than do less mature plans, because the increase in contributions needed to fund the plan are generally greater for a more mature plan than for a less mature plan relative to the plan sponsor's resources.

This study explores various measures of pension plan maturity across 139 large public defined benefit pension plans in the United States. Because investment returns are a common source of significant financial shocks to pension plans, this study also explores asset allocations and assumed rates of return during the same period. The body of this report examines plans by their sponsoring government type (state or local) as well as by their funded status. Appendix A provides more information about the plans studied. Appendices B and C examine the same plans by participant job category and region, respectively. Appendix D provides asset class distributions by each category of plan.

### Plan Maturity: A Concept

Pension plan maturity is a general concept rather than a specific definition of a single metric or set of metrics. New plans are by nature immature, while ongoing plans with predominantly retiree membership, are very mature. Between those two stages, a plan's age may or may not indicate its maturity. Nor are plan size or funded status indicators of maturity. The authors find it most effective and efficient to explain the concept through examples of what plan maturity means for plans near the extremes of either end of the continuum of plan maturity. Note that this study and discussion considers only ongoing plans; it excludes plans that have been frozen or closed to new entrants.

A very immature plan has no or few retirees, and the overwhelming majority of its liabilities are attributable to participants who are currently active employees. In addition, the costs of the plan are entirely or nearly entirely comprised of the cost attributed to current employees. In addition, the accrued liabilities are typically relatively small compared to the plan sponsor's basis of contributions, such as payroll, and projected benefit durations are relatively long.

One clear example of a very immature plan is a brand-new plan that provides benefits only for service rendered after the plan's inception date. Barring legal, benefit or assumption changes, very few events could occur that would cause dramatic increases in the contributions relative to payroll.

At the other end of the continuum, an ongoing, extremely mature plan has many more retirees than active employees, and most of the liabilities are attributable to retirees. In addition, the plan's financial size

is usually large relative to its sponsoring government, perhaps much larger relative to the government than it had been several decades ago. A capital market downturn could dramatically increase the contributions needed to fund the plan, and the additional costs are more likely to strain the sponsoring government because the plan liabilities have grown relative to its sponsor.

### **Maturity and Risk**

Adverse financial shocks generally increase a plan's unfunded benefit liabilities significantly, which increases the need for contributions. All other things being equal, the needed contributions for more mature plans will usually increase more—relative to the sponsoring government's resources—than the needed contributions for less mature plans. Similarly, beneficial financial shocks will generally significantly reduce unfunded liabilities and the contributions needed to fund the plan. All other things being equal, after a beneficial financial shock, the needed contributions for more mature plans are likely to fall more than for less mature plans.

More mature plans also tend to be much larger, relative to their sponsoring government's resources, than are less mature plans. Very large liabilities relative to the sponsoring government's resources indicate significant risk that an increase in the unfunded liability could dramatically increase contribution needs, therefore dramatically increasing the demand on the sponsoring government's resources. In addition, the sponsoring government's resources may have suffered a blow from the same financial shock. Or the sponsoring government may experience a blow to its resources in a delayed impact of the financial shock.

Consequently, the risk that a detrimental financial shock will have a significant negative impact on a plan is generally greater for more mature plans than for less mature plans. Recovering from adverse financial shocks may be more difficult and could take longer for a more mature plan than a less mature plan. For further explanation on pension plan maturity and risk, refer to *Pension Plan Maturity—Why Big Plans Mean Big Risk*, an Issue Brief prepared by the American Academy of Actuaries.<sup>3</sup>

### **Assessing Public Plan Maturity Trends**

Assessing a plan's maturity generally requires considering several maturity metrics collectively in conjunction with professional judgment. It is possible for a plan to have one maturity metric indicate significant maturity while other maturity metrics indicate less maturity.

This study explores trends in several maturity metrics across 139 large public defined benefit pension plans in the United States during 2001–2018. In addition, trends across the 102 state-based plans are considered separately from trends across the 37 local plans. Also, because plan maturity is linked to the level of risk that a plan faces, which may affect a plan's ability to recover from detrimental financial shocks, the study considers metric trends based on plans' 2018 funded status as reported for funding purposes:

- Greater than 80% funded in 2018,
- 60%–80% funded in 2018, and
- Less than 60% funded in 2018.

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<sup>3</sup> American Academy of Actuaries, *Pension Plan Maturity—Why Big Plans Mean Big Risk*, September 2019, <https://www.actuary.org/sites/default/files/2019-09/maturity.pdf>



The selection of these funded ratio groups is not intended to represent significance for any other purpose or reason. Figure 21 in Appendix A shows the aggregated funded status from 2001 through 2018 for each of the three funded status groups.

For more information about the plans studied, see Appendix A. In addition, Appendix B shows by region the same metrics covered in the body of the report, and Appendix C shows them by the job category that plans cover.

## Maturity Metrics

This study analyzes the plans using the following maturity metrics:

- Dependency ratio
- Liability-to-payroll ratio
- Asset-to-payroll ratio
- Net cash flow-to-assets ratio

### Dependency Ratio

A plan's dependency ratio is equal to the number of people currently receiving benefits divided by the number of active participants. Active participants are those who are currently accruing benefits—typically, active employees covered by the plan. The people who are currently receiving benefits are typically retirees, surviving spouses and other beneficiaries.

To consider participants in economic terms, active employees represent a proxy for revenue-generating units,<sup>4</sup> and retirees and beneficiaries represent a proxy for revenue-spending units who have no means of generating revenue. In this context, the dependency ratio represents the number of people who depend on each active participant to generate the revenues needed to fund the plan. The dependency ratio is sometimes also known as the support ratio.<sup>5</sup>

$$\text{Dependency Ratio} = \frac{\text{Number of Retirees and Beneficiaries Receiving Benefits}}{\text{Number of Active Participants}}$$

Former employees and their beneficiaries who are not yet receiving benefits are excluded from this ratio. They often have relatively small accrued benefits and small liabilities, and to include them in the numerator may distort the ratio, leaving the impression that the plan may be more mature than it actually is.

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<sup>4</sup> A plan's tax base depends on the number of taxpayers associated with the plan together with their income and wealth as relevant to taxation formulas. Neither data are readily available across all pension plans in the dataset. As a proxy, the number of active employees covered by a plan generally bears some proportionality to the plan's tax base. In general, the more active employees that a plan covers, the more employees the governing entity can afford to support. Hence, the number of employees represents a rough proxy for tax-paying units.

<sup>5</sup> The dependency or support ratio is of greater significance to a pay-as-you go plan, such as Social Security, than to a pre-funded plan, such as the plans considered in this study.

In general, an increasing dependency ratio indicates that a plan is maturing. Increasing maturity signals that a plan may be becoming more sensitive to risk. Figure 1 shows that dependency ratios of the plans studied steadily increased from 2001 to 2018.

The median dependency ratio for all plans studied increased from 0.44 in 2001 to 0.79 in 2018. Across the span of 17 years, plan demographics moved from a median 2.3 active participants for every retiree and beneficiary receiving benefits, to about 1.3 active participants for every benefit recipient. These plans were clearly maturing at a rapid rate.

Considering plans by government type, dependency ratios of the 37 local plans generally exceeded those of state plans, indicating greater maturity among local plans. And plans that were less well-funded in 2018 generally had greater dependency ratios than better funded plans in 2018, indicating greater maturity among less-well-funded plans.

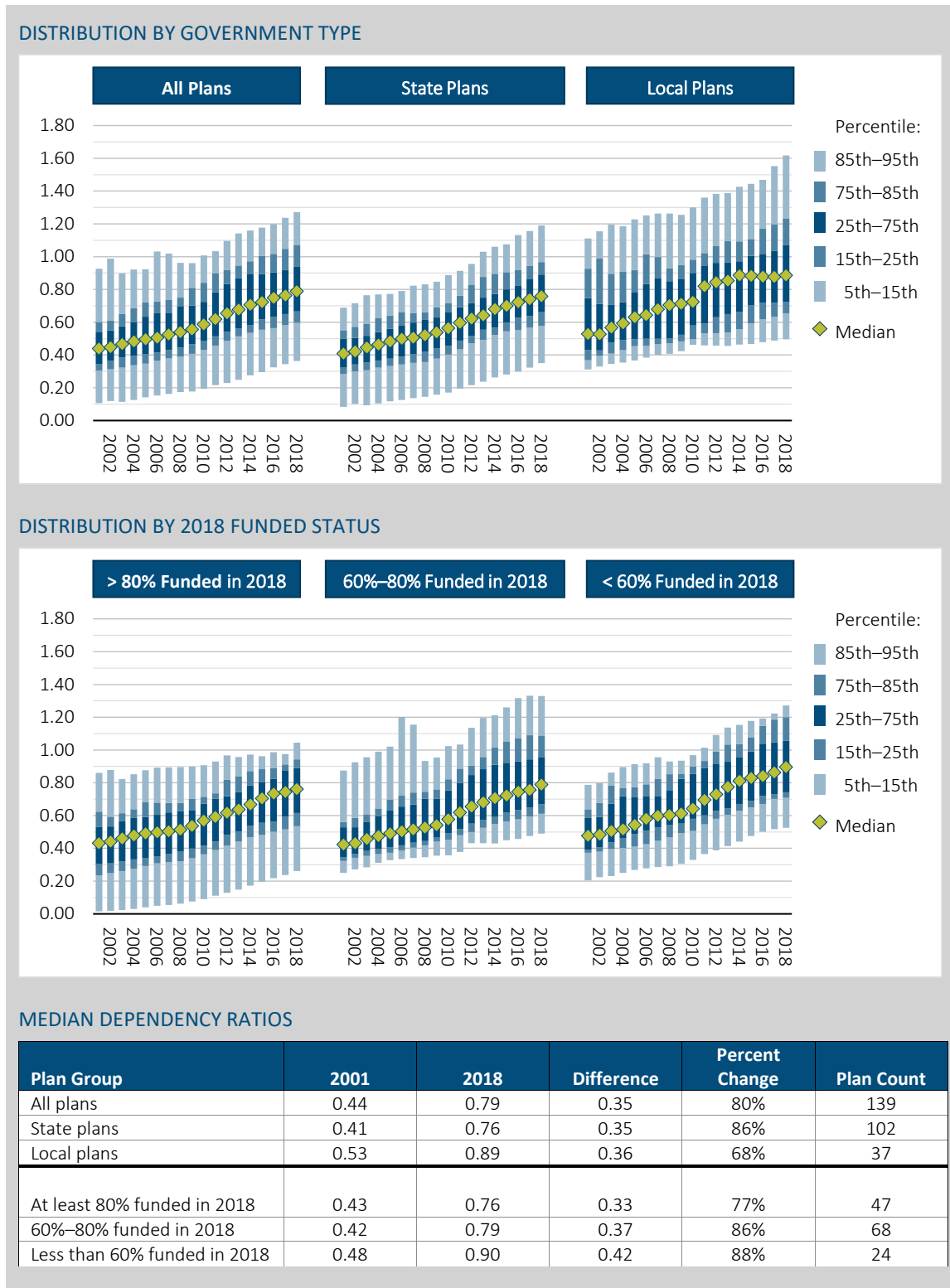
Looking deeper, dependency ratios increased largely because the number of retirees increased significantly while the number of active employees increased only slightly (Figure 2). Across all 139 plans, the number of active employees increased approximately 3% from 2001 to 2018, from 11.99 million to 12.35 million. During the same period, the number of retirees and beneficiaries increased 85%, from 4.97 million to 9.20 million.

While local plans tend to have greater dependency ratios than state plans, the dependency ratios of state plans generally grew faster. The number of active employees in state plans increased 3% from 2001 to 2018, while the number of retirees and beneficiaries in the same plans increased 90%. Across local plans, the number of actives grew 10%, significantly more than across state plans, while the number of local plan retirees and beneficiaries grew 44%, much less than across state plans.

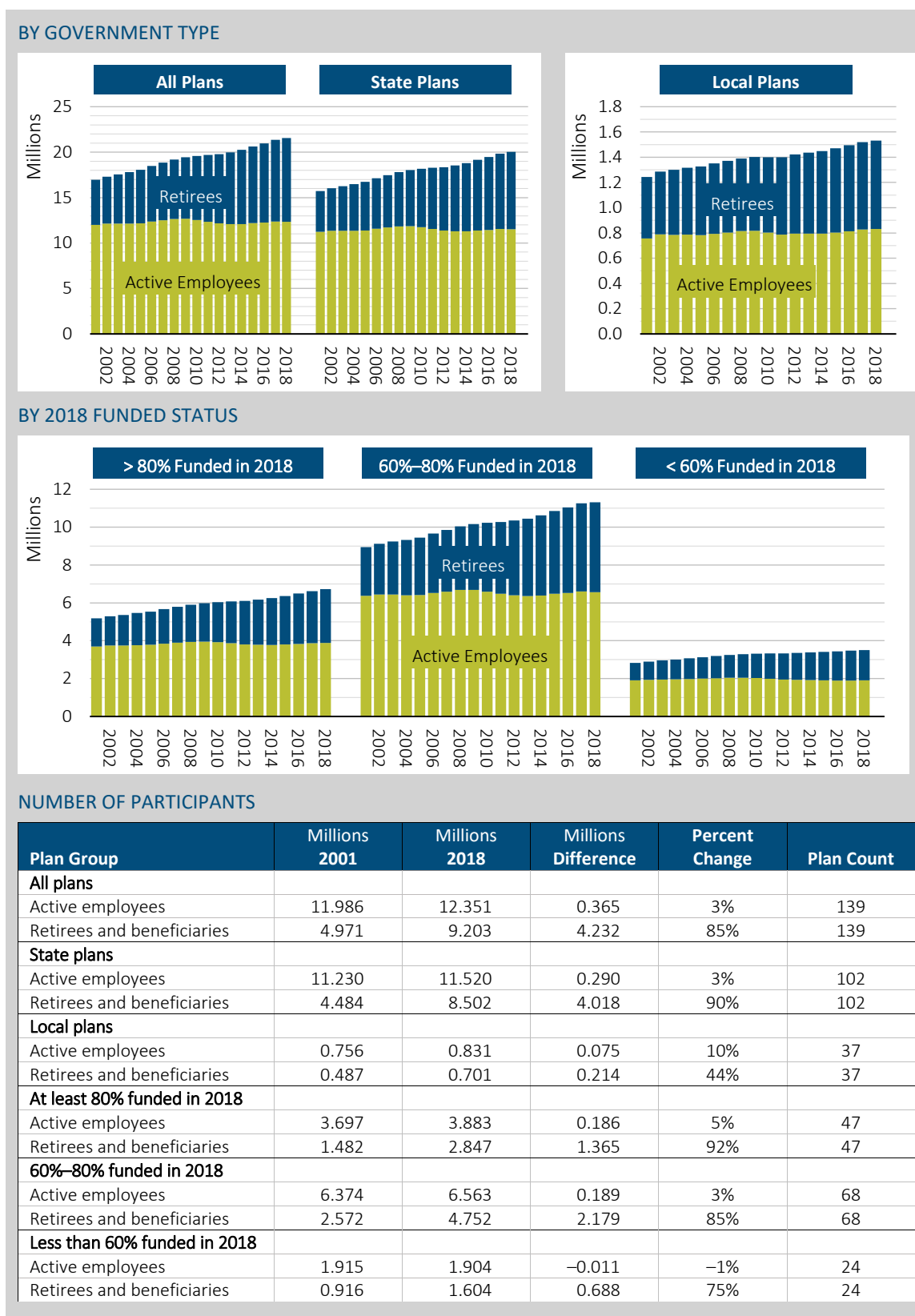
When considered by funded status in 2018:

- Twenty-four (24) plans were less than 60% funded, and they tended to have greater dependency ratios than did plans that were more than 60% funded. From 2001 to 2018, the median dependency ratio for plans that were less than 60% funded in 2018 increased from 0.48 to 0.90 (in the inverse: from 2.1 to 1.1 active employees per benefit recipient). The number of active employees fell 1%, while the number of retirees and beneficiaries grew 75%.
- Sixty-eight (68) plans were between 60%–80% funded. During the same period, their the median dependency ratio increased from 0.43 to 0.76 (the inverse: 2.3 to 1.3 active employees per benefit recipient).
- Forty-seven (47) plans were at least 80% funded. Their median dependency ratio increased from 0.42 to 0.79 (the inverse: from 2.4 to 1.3 active employees per benefit recipient). The number of active employees increased 5% from 2001 to 2018, while the number of retirees and beneficiaries rose 92%.

**Figure 1**  
**DEPENDENCY RATIO**



**Figure 2**  
NUMBER OF PARTICIPANTS



## Asset-to-Payroll Ratios

Comparing assets to payroll may facilitate understanding the sensitivity of contribution need to the impact of investment risk. Using this metric as an indicator of maturity requires caution because this metric reflects many factors that may not be related to maturity, such as the plan’s funded status.

Another factor, which may not be obvious, is the value of benefits. Consider two plans of the same maturity and funded ratio with participant populations of the size and demographic and payroll profiles. The plan with more valuable benefits will have greater liabilities, hence greater assets, and therefore, a greater asset-to-payroll ratio. But it is no more mature than the plan with less valuable benefits.

Further, the plan’s asset allocation and hence the discount rate play a role in the amount of assets that have accumulated over time, which will affect the asset-to-payroll ratio. For an open, ongoing plan, plan maturity typically plays a limited role in the trustees’ choice of a discount rate for measuring liabilities.

The ratio of assets to payroll provides a rough indicator for how sensitive contribution rates might be to investment return volatility.<sup>6</sup> In general, the higher the asset-to-payroll ratio, the more contribution rates would need to increase (or decrease) if investment returns fall short of (or exceed) the assumption.

$$\text{Assets-to-Payroll Ratio} = \frac{\text{Plan Assets}}{\text{Active Participant Payroll}}$$

The ratio also provides a context for understanding the amount of assets that a plan needs relative to another benchmark that may be more familiar for some sponsors: payroll. For example, an assets-to-payroll ratio of 5 means that plan assets are currently 5 times the amount of payroll. If the plan needs 10% more assets to reach its funding goal, the amount of additional assets needed is equal to 50% of payroll.

Note that as a plan approaches 100% funding, its asset-to-payroll and liability-to-payroll ratios converge. Thus, the liability-to-payroll ratio is a long-term indicator of the asset-to payroll ratio.

When funding pension plans, investment gains and losses are often smoothed over time to limit short-term fluctuations in contributions because of them. Smoothed assets are commonly known as the actuarial value of assets. Consequently, using the market value of assets in the asset-to-payroll ratio generally provides a better understanding of short-term sensitivity to investment risk at any given time, but the metric is highly volatile. The ratio of actuarial value of assets to payroll, when considered over time, may provide a better sense of trends in sensitivity to investment risk sensitivity. This study explores both, but comments focus on trends.

Figure 3 shows trends in the *market-value-of-assets-to-payroll* ratio, and Figure 4 shows trends in the *actuarial-value-of-assets-to-payroll* ratio. During 2001–2018, the ratios of actuarial value of assets to payroll generally exceeded the ratios of market value of assets to payroll because most plans phased in asset losses over time, rather than recognizing them immediately.<sup>7</sup> When plan assets earn more than the

<sup>6</sup> Pension plans may mitigate investment risk through a variety of strategies. Investment risk mitigation is beyond the scope of this analysis.

<sup>7</sup> Many plans use an actuarial value of assets in plan funding formulas. In general, the purpose of using an actuarial value of assets is to smooth assets relative to market fluctuations.

assumed rate of return, the opposite occurs, and the actuarial value of assets are generally less than the market value of assets.

The ratio of market value of assets to payroll commonly fluctuates as the market value of assets fluctuates, and the market value of assets may fluctuate significantly. During 2001–2018, the median market-value-of-assets-to-payroll ratio fluctuated significantly (Figure 3), but it trended up from 3.93 in 2001 to 5.00 in 2018. The upward trend was clear for both for state and local plans, although the ratios were greater for local plans than for state plans.

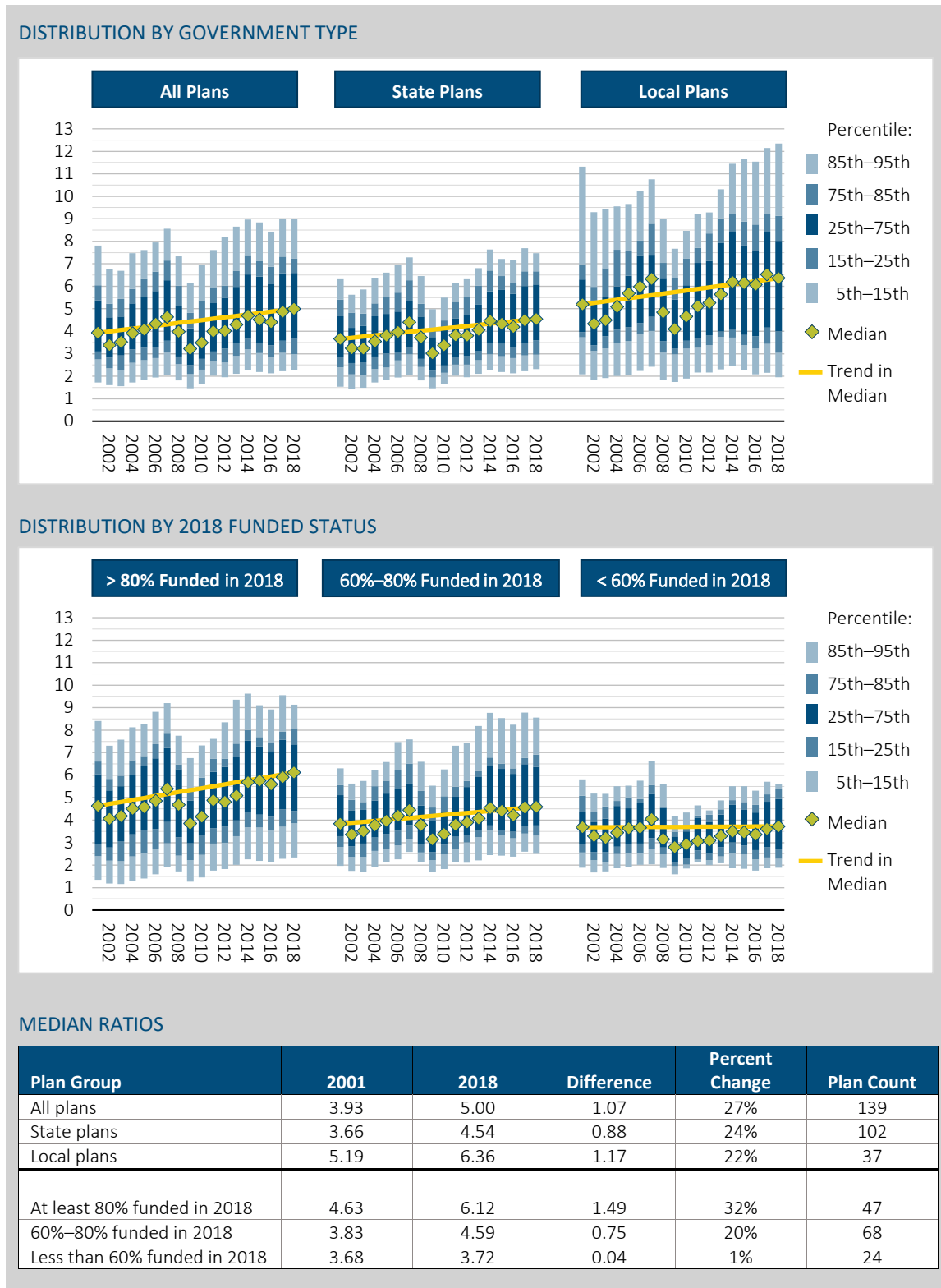
However, trends in ratios of assets to payroll differed by funded status grouping. For plans that were more than 60% funded in 2018, the average market value of asset-to-payroll ratios followed the overall increasing trend during 2001–2018. But for plans that were less than 60% funded in 2018, the overall trend was essentially flat during the same period. The lack of increase is likely at least partially attributable to generally declining funded ratios among these plans during this period (Figure 21 in Appendix A).

Because the actuarial value of assets smooths market fluctuations over time, this metric using actuarial value of assets is less volatile than the metric using market value of assets. But trends over time are about the same. Figure 4 shows a steadily increasing trend for most plans, signaling increased sensitivity in contribution rates to market performances. From 2001 to 2018 the median state plan ratio increased from 3.91 to 4.54, while the median local plan ratio increased from 5.09 to 6.53, indicating that contribution rates of local plans are generally more sensitive to market performance than those of state plans. Plans that were at least 60% funded in 2018 saw increasing ratios of actuarial value of asset to payroll, but the median ratio decreased slightly for plans less than 60% funded in 2018.

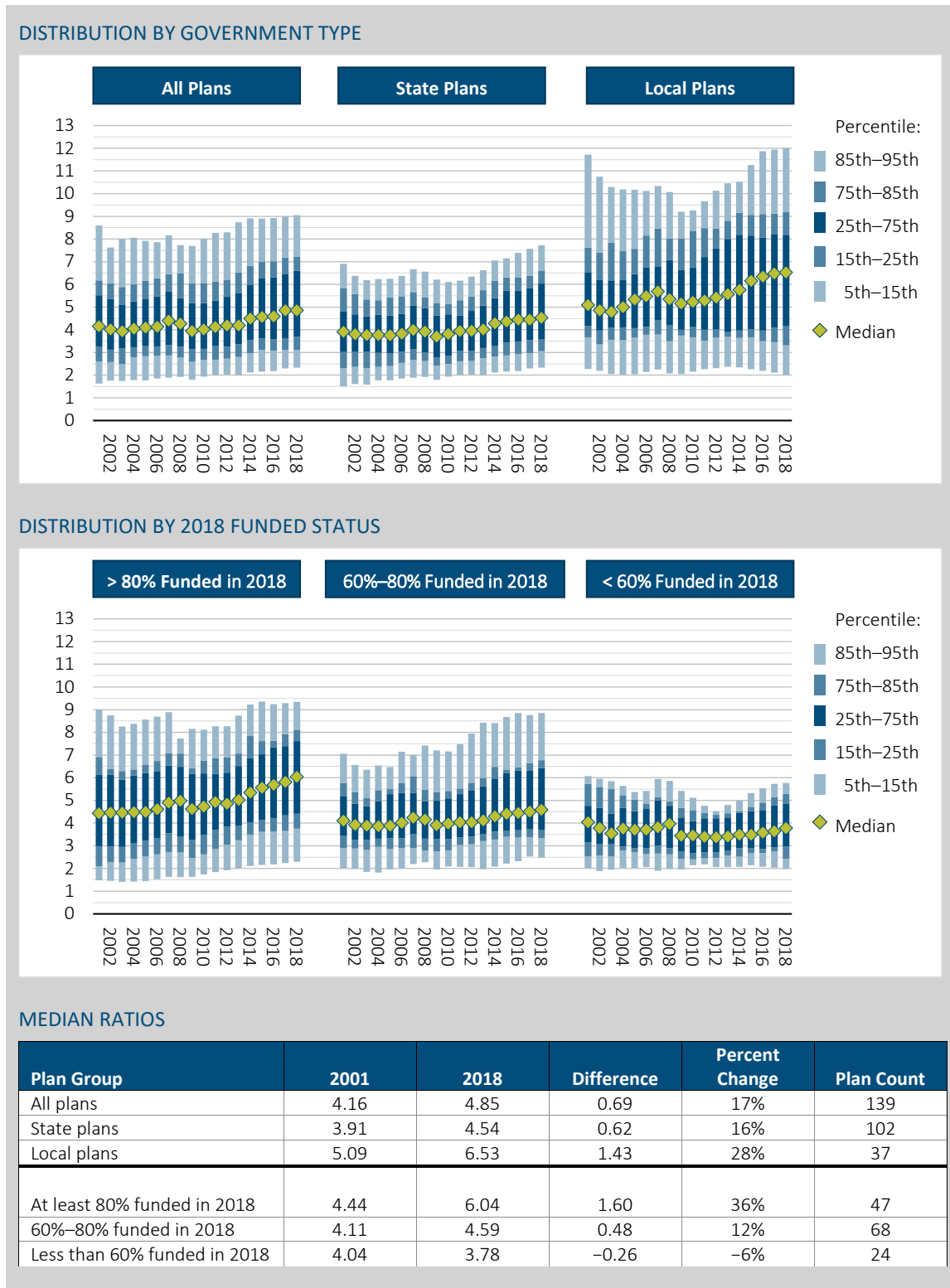
These results mean that when facing the same shortfall in investment performance compared to the assumed rate of return, local plan contribution rates would increase significantly more than would state plan contribution rates. And plans that were better funded in 2018 would see greater contribution rate increases than plans that were less well-funded in 2018. After better-than-assumed investment performance, contribution rates of local plans and better-funded plans would likely fall more than contribution rates of state plans and less-well funded plans.

While the authors observe the asset-to-payroll ratios relative to 2018 funded status, the authors imply neither correlation nor causation between asset-to-payroll ratios and funded status. In addition, the authors note that based on a cursory review of asset methods during the period studied, it appears that several plans changed asset smoothing approaches. This may be at least a partial explanation of why the percent increase of the two metrics from 2001 to 2018 differed significantly. Analysis of additional reasons for the difference is beyond the scope of this study, but these results are a good example of the need for caution when using asset-to-payroll ratios to gauge a plan's sensitivity to risk.

**Figure 3**  
**MARKET-VALUE-OF-ASSETS-TO-PAYROLL RATIO**



**Figure 4**  
ACTUARIAL-VALUE-OF-ASSETS-TO-PAYROLL RATIO





## Liability-to-Payroll Ratio

The ratio of a plan’s actuarial accrued liability to the payroll of its active participants can indicate how sensitive a plan’s contribution rate needs are to changes in its liability.<sup>8</sup> A greater liability-to-payroll ratio generally indicates a greater increase in contribution rates needed to fund certain types of liability increase. All else equal, a greater liability-to-payroll ratio indicates greater sensitivity to risk.

The liability-to-payroll ratio is affected by both plan maturity and plan benefit levels. For two plans of identical maturity that have sponsoring governments of equal resources, the plan with richer benefits will have a greater liability-to-payroll ratio. Nonetheless, this metric provides a loose way to compare a plan’s size to its sponsor’s ongoing economic resources.<sup>9</sup>

$$\text{Liability-to-Payroll Ratio} = \frac{\text{Actuarial Accrued Liability}}{\text{Active Participant Payroll}}$$

A plan’s liability changes in two situations. One is when experience—typically excluding investment experience—varies from the actuarial assumptions (for example, when participants live longer or shorter than assumed). The second is when those actuarial assumptions or benefit provisions change.

Liability-to-payroll ratios generally increased during 2001–2018 (see Figure 5). Throughout the period, the ratios for local plans were consistently greater than those for state plans, and they increased faster than those for state plans.

- State plans: the median liability-to-payroll ratio grew 52%, from 4.40 to 6.85.
- Local plans: the median liability-to-payroll ratio grew 67%, from 5.14 to 8.59. Relative to their sponsors, local plan liabilities were markedly larger than state plan liabilities.

The median liability-to-payroll ratio in 2001 was similar across all plans. However, when categorized by 2018 funded status, distinctions emerged across time.

- In 2018, plans that were less than 60% funded had a median liability-to-payroll ratio of 7.84, compared to 4.58 in 2001.
- For plans that were 60%–80% funded in 2018, the 2018 median liability-to-payroll ratio was 6.50, compared to 4.33 in 2001.
- Plans that were at least 80% funded in 2018 had a 2018 median liability-to-payroll ratio of 6.77, up from 4.36 in 2001.

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<sup>8</sup> Actuarial accrued liability is the actuarial present value of benefits payable in the future, based on service earned, or accrued, as of the valuation date. Actuarial accrued liability, or liability for short, may be computed using one of various actuarial methods for spreading the value of projected benefits at retirement across employees’ active working lifetimes.

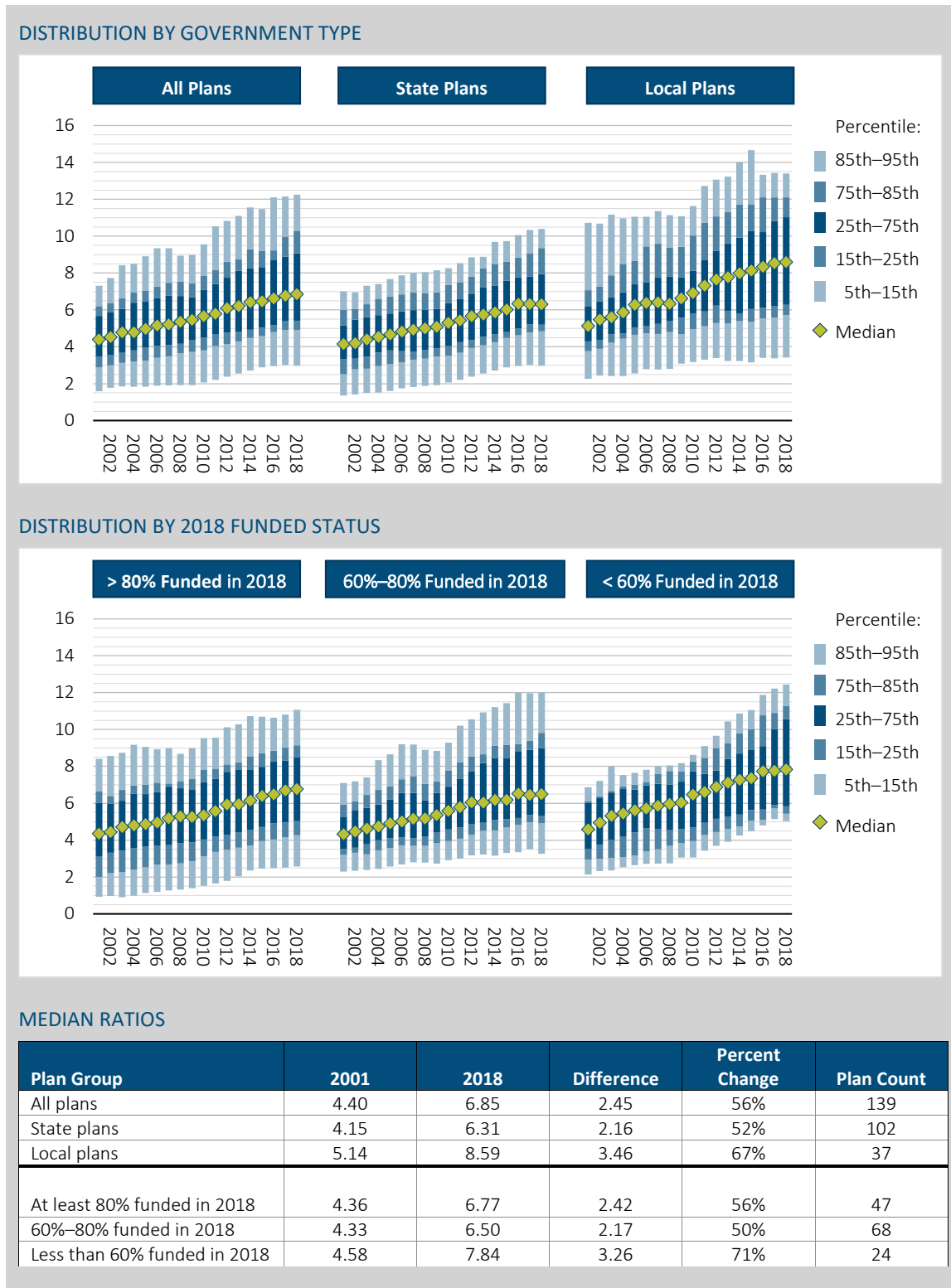
<sup>9</sup> Payroll may be considered a proxy for the sponsoring government’s size. However, while it is typically a large expenditure, payroll is only one of the sponsoring government’s many expenditures. In addition, payroll may be slower to reflect changes in the sponsoring government’s financial resources than other expenditures.

Plans that were less than 60% funded in 2018 generally had slightly higher liability-to-payroll ratios during 2001–2018 than did plans that were at least 60% funded in 2018. These results suggest that plans funded less than 60% in 2018 were more mature than better-funded plans.

In addition, ratios of plans that were better-funded in 2018 increased more slowly than ratios of plans that were less-well-funded in 2018, suggesting that better-funded plans matured more slowly than less-well-funded plans. It is worth further investigation.

Growing liability-to-payroll ratios signify that plan liabilities likely grew relative to the size of their sponsoring governments.

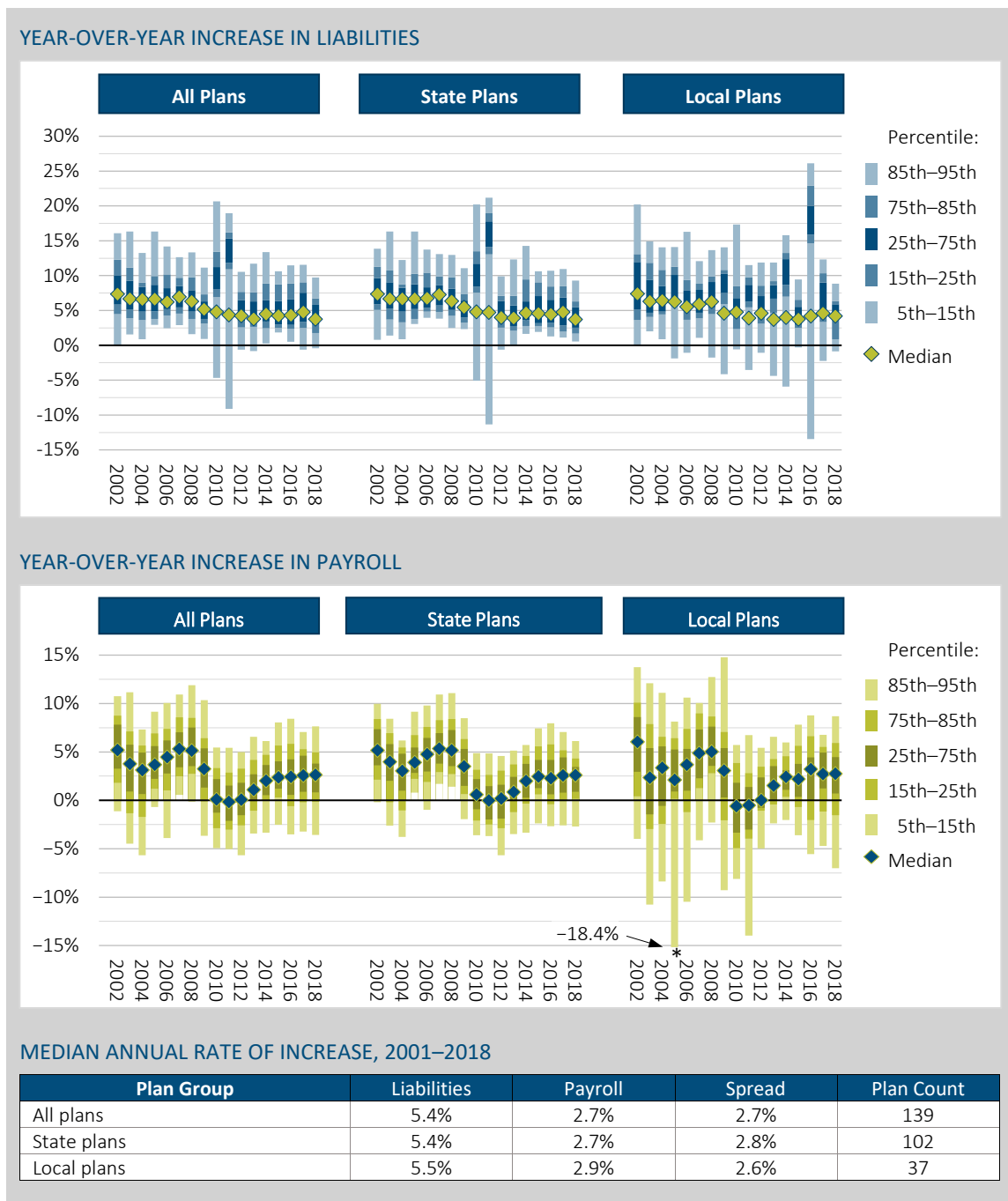
**Figure 5**  
**LIABILITY-TO-PAYROLL RATIO**



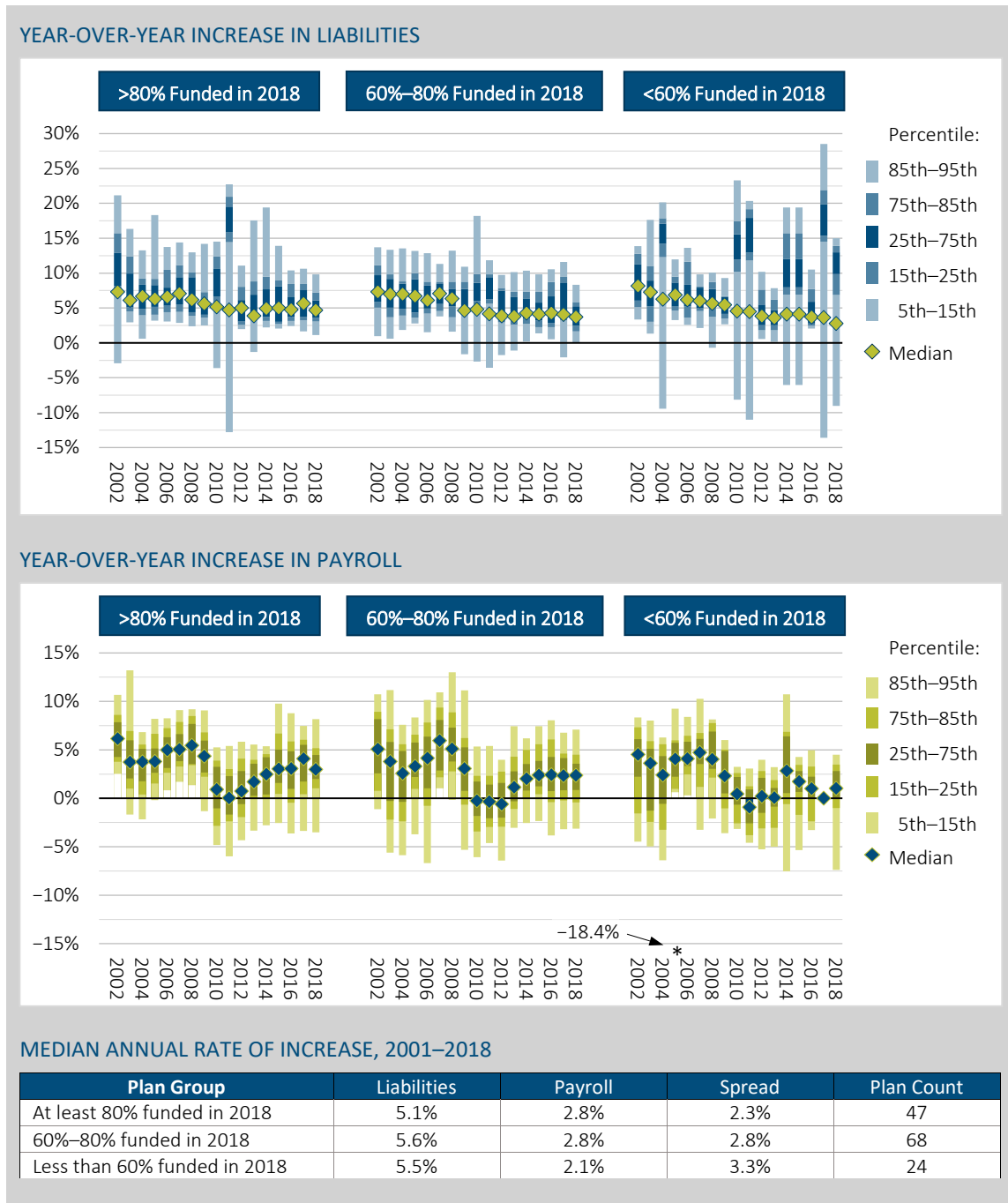
### Increases in Liabilities Compared to Increases in Payroll

To investigate further, consider separately the rates at which liability measurements and payroll increased by government type (Figure 6) and by funded status in 2018 (Figure 7).

**Figure 6**  
DISTRIBUTION OF INCREASE IN LIABILITIES AND PAYROLL BY GOVERNMENT TYPE



**Figure 7**  
**DISTRIBUTION OF INCREASE IN LIABILITIES AND PAYROLL BY 2018 FUNDED STATUS**



From 2001 to 2018, liability measurements and payroll generally increased more steeply near the start of the period than toward the end of the period. However, in most years, liability measurements for some plans increased significantly enough that one would suspect an increase in plan benefits or significant changes to actuarial assumptions that would cause liability measurements to jump. While many of the details needed to explain increases in liability measurements are not available in the database, most plans lowered the assumed rates of return used to discount liabilities during these years and lengthened

mortality assumptions.<sup>10</sup> Decreased assumed rates of return likely account for some of the significant liability increases in any given year. In addition, liability measurements decreased for some plans in some years, but payroll decreased for a significant number of plans in several years.

In general, the liability-to-payroll ratios increased from 2001 to 2018 primarily because liability measurements increased much faster than payroll from 2001 to 2018. The median annual rate of increase in liability measurements from 2001 to 2018 was 5.4% across all plans, compared to only 2.7% for payroll, a difference of 2.7% per year. The compounded effect of the difference is clear in in In general, liability measurements of the plans studied were increasing significantly faster than their payroll—an indication of increasing maturity. In addition, when considering payroll as a proxy for plans’ economic tax base (similar to considering the number of active employees as a proxy for the same), it would appear that these plans’ liability measurements are growing faster than the economic strength of their tax bases. For plans with unfunded liabilities, this could indicate increasing difficulty to fund the plans.

Figure 8, where the increasing slope of liability measurements is much steeper than the increasing slope of payroll.

Further, from 2001 to 2018, aggregate payroll increased at an annual rate of 2.67%, while the aggregate number of active employees barely increased at an annual rate of 0.18%. In other words, payrolls grew because salaries grew, rather than because the active workforce grew.

### Aggregate Liabilities and Payroll

While aggregate state plan liability measurements increased at nearly the same rate as local plans (5.42% and 5.45%, respectively), aggregate state payroll increased markedly slower than aggregate local payroll, 2.65% versus 2.89%.

Plans that were less than 60% funded in 2018 saw aggregate liability measurements increase more faster than plans that were more than 60% funded in 2018. Aggregate liabilities grew at annual rates of:

- 5.47% for plans less than 60% funded in 2018,
- 5.58% for plans 60%–80% funded in 2018, and
- 5.12% for at least 80% funded in 2018.

At the same time, plans that were less than 60% funded in 2018 saw lesser payroll increases than plans that were better funded in 2018. Aggregate payroll increased at annual rates of:

- 2.12% for plans less than 60% funded in 2018,
- 2.76% for plans 60%–80% funded in 2018, and
- 2.82% for plans at least 80% funded in 2018.

In general, liability measurements of the plans studied were increasing significantly faster than their payroll—an indication of increasing maturity. In addition, when considering payroll as a proxy for plans’ economic tax base (similar to considering the number of active employees as a proxy for the same), it would appear that these plans’ liability measurements are growing faster than the economic strength of their tax bases. For plans with unfunded liabilities, this could indicate increasing difficulty to fund the plans.

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<sup>10</sup> In addition, changes in benefit provisions or in other economic or demographic assumptions may also have contributed to increased liabilities.

**Figure 8**  
**AGGREGATE LIABILITIES AND PAYROLL**



## Net Cash Flow-to-Assets Ratio

The net cash flow to assets ratio indicates the rate at which plan assets are increasing or decreasing, absent investment returns. Net cash flow is the difference between monies coming into the plan (contributions) and monies leaving the plan (benefit payments and administrative expenses).<sup>11</sup> When net cash flow is negative, more cash is going out than coming in, and the ratio is sometimes known as the burn rate. For example, a ratio of net cash flow to assets that is –3% means that if there were no investment returns, the market value of assets would drop by 3% over the course of a year, because more cash left the plan than came in. Positive asset returns would offset some or all of that drop, but negative returns would worsen it.

### *Net Cash Flow-to-Assets Ratio*

$$= \frac{\text{Contributions} - \text{Benefit Payments} - \text{Administrative Expenses}}{\text{Market Value of Assets}}$$

The net cash flow-to-assets ratio can be useful for understanding sensitivity to short-term asset returns, as well as some aspects of plan maturity. For this metric, *lower* ratios<sup>12</sup> of net cash flow to assets generally indicate *more* mature plans, *provided that the ratio is not artificially low because of a contribution holiday*. For ongoing plans, using this metric to gauge maturity requires extreme caution. This metric is very sensitive to both a plan’s funding policy and its funded status. For example, a plan that is over 100% funded and taking a contribution holiday may not be especially mature even though its net cash flow-to-assets ratio is extremely negative. Or a plan that is nearly but not yet 100% funded plan may have negative cash flow because needed contributions are very low. Additionally, if a plan’s contribution policy is insufficient to fund the plan over time,<sup>13</sup> its net cash flow-to-assets ratio may be quite low even though the plan may not be very mature. In the absence of contribution holidays, consistently negative ratios of net cash flow to assets may be a sign of maturity.

During 2001–2018, the ratio of net cash flow to assets varied greatly among plans, but there is a clear general downward trend, including among local plans where it appears that contribution holidays may have been more common in the early 2000’s. Figure 9 shows that in every year studied, more than half of the plans studied had negative ratios of net cash flow to assets. And since 2008, at least three-quarters of the plans studied had negative cash flow ratios. Median ratios of net cash flow to assets were similar for state plans and local plans, although the top 15% and bottom 15% of the distributions showed more extreme values for local plans than for state plans.

Plans that were less than 60% funded in 2018 generally had lower ratios of net cash flow to assets than did plans that were 60%–80% funded in 2018, which generally lower than for plans at least 80% funded in 2018. The median 2018 net cash flow ratio of plans that were less than 60% funded in 2018 fell significantly below the median ratio of plans that were better than 60% funded in 2018.

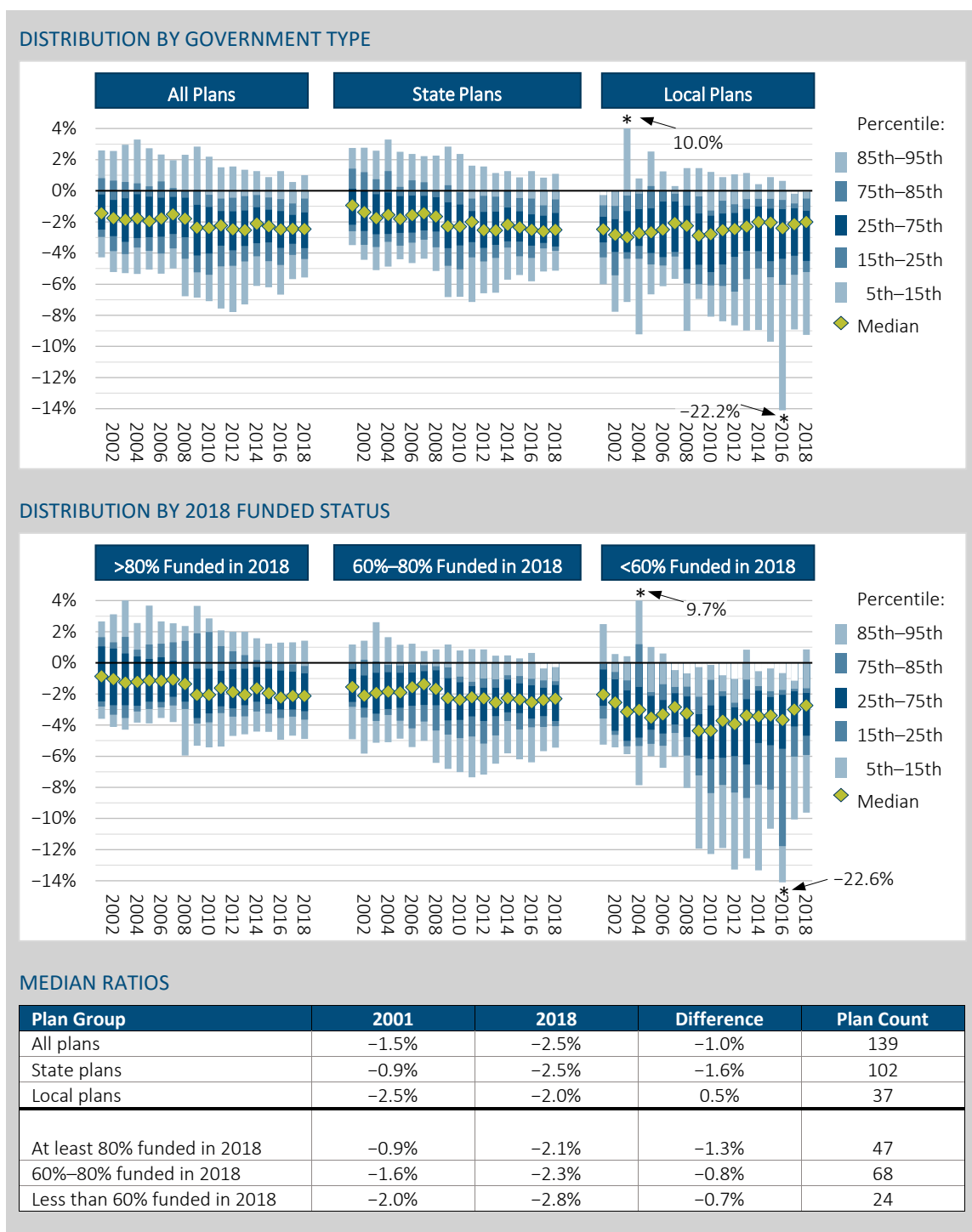
<sup>11</sup> For this purpose, investment expenses are assumed to effectively reduce investment returns.

<sup>12</sup> In the case of negative net cash flow-to-assets ratios, greater negative ratios are lower than less negative ratios. For example, a ratio of –8% is considered lower than a ratio of –3%.

<sup>13</sup> The authors note that the actuarial valuation reports of some public plans included in this study include a statement by the undersigned actuaries that the plan’s funding policy, which may be specified by state law, is insufficient to fund the plan’s benefits.



**Figure 9**  
NET CASH FLOW-TO-MARKET-VALUE-OF-ASSETS RATIOS



Some observers may expect that less well-funded plans would have higher (or less negative) net cash flow ratios than better funded plans because contributions needed to fund less well-funded plans would be greater than if the plans were better funded. However, the authors’ analysis shows the opposite. It is important to keep in mind that the net cash flow ratio reflects actual contributions, rather than the amount

of contributions needed to fund the plan over time. The authors’ analysis of the data and previous research indicate that contributions to many plans are significantly less than the amount needed to fund the plan.<sup>14</sup>

Further, starting in 2008, net cash flow ratios fell below –7% for several plans that were less than 60% funded in 2018. This observation is worth additional investigation.

Analyzing each of the four components of the ratio of net cash flow to market value of assets may provide insight about the cause of differing results by funded status in 2018: contributions, benefit payments, administrative expenses and the market value of assets.

### Contributions and Benefit Payments

Benefit payments generally exceeded contributions across all three plan groups based on their 2018 funded status. The gap was most pronounced for the plans less than 60% funded in 2018—refer to Figure 10 and Table 1, which compare distributions of plans’ contributions and benefit payments to their market value of assets (MVA). It would appear that the lowest net cash flow ratios in that group was more likely a result of high benefit payments rather than low contributions. However, understanding how assets have evolved may provide further insight.

**Table 1**  
MEDIAN VALUES FROM FIGURE 10

Plan Group	2001	2018	Increase	Plan Count
<b>Contributions / MVA</b>				
At least 80% funded in 2018	2.7%	3.5%	31%	47
60%–80% funded in 2018	3.2%	5.5%	70%	68
Less than 60% funded in 2018	4.3%	9.6%	121%	24
<b>Benefit Payments / MVA</b>				
At least 80% funded in 2018	3.8%	5.6%	49%	47
60%–80% funded in 2018	4.8%	8.0%	68%	68
Less than 60% funded in 2018	5.1%	12.8%	149%	24

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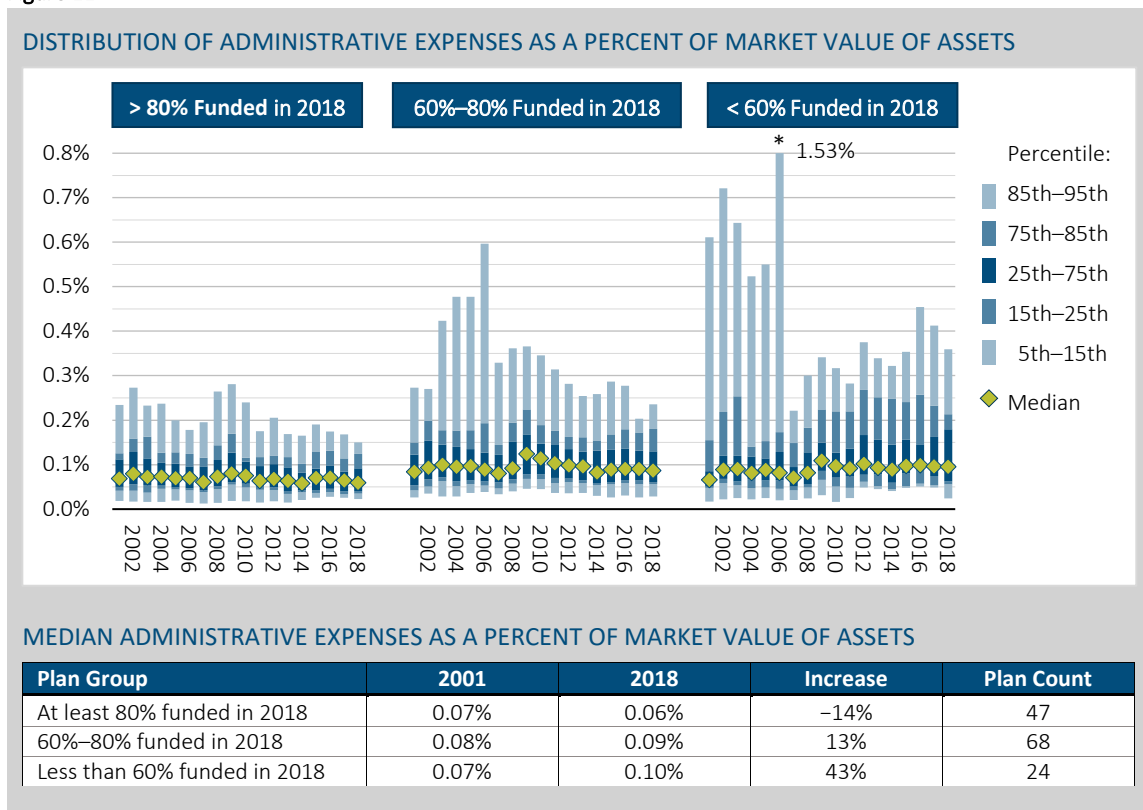
<sup>14</sup>Schilling, Lisa A. and Patrick Wiese. (February 2019). *U.S. Public Pension Plan Contribution Analysis*. Society of Actuaries. <https://www.soa.org/resources/research-reports/2017/public-pension-indices/>.



### Administrative Expenses

Administrative expenses were less than three-tenths of one percent of assets for well over 85% of the plans (Figure 11), an insignificant amount as far as understating most plans' net cash flow ratios. From 2001–2006, administrative expenses exceeded one-half of one percent of assets for a small number of plans that were less than 60% funded in 2018. The role of administrative expenses in the net cash flow-to-assets ratios is insignificant for these plans; this analysis is included in this study for completeness.

Figure 11



### Market Value of Assets

After looking at contributions and benefit payments, consider how assets have changed for the three plan groups by 2018 funded status. The groups include plans of varying numbers and varying sizes. To compare across groups, consider how assets per participant have changed. In aggregate, assets per participant of plans that were less than 60% funded in 2018 grew much less than assets per participant of plans in the better-funded groups (Figure 12). From 2001 to 2018, aggregate assets per participant of plans that were less than 60% funded in 2018 grew 9%, compared to roughly 45% for each of the better-funded groups.

Figure 12

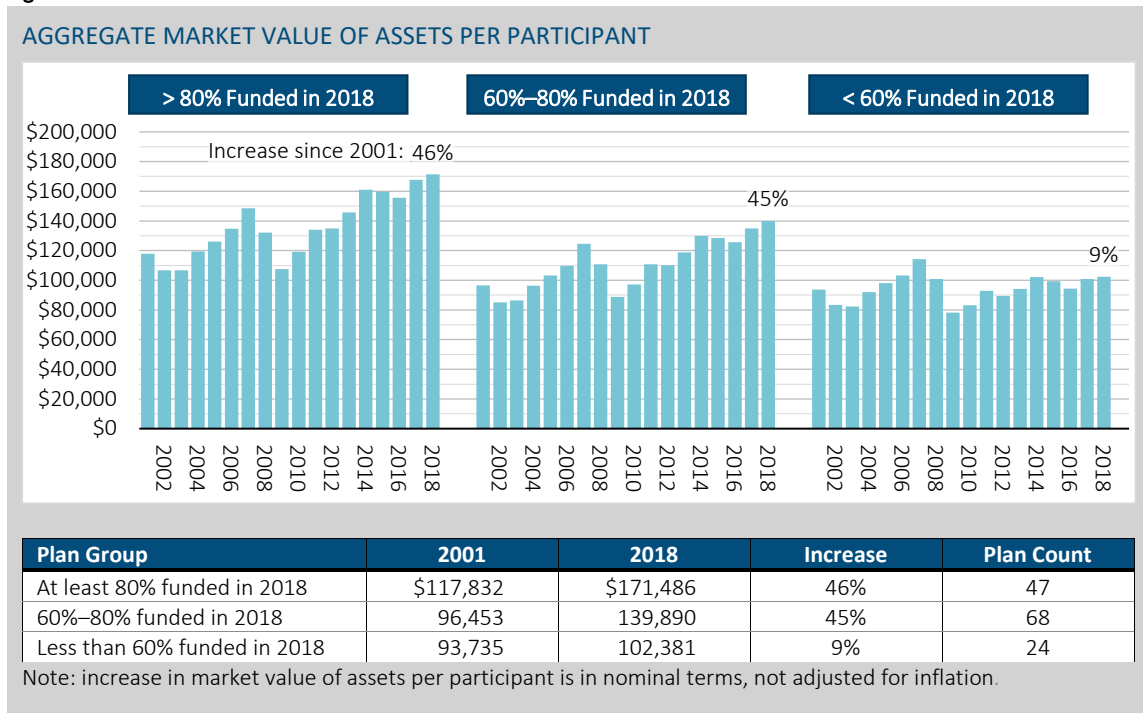
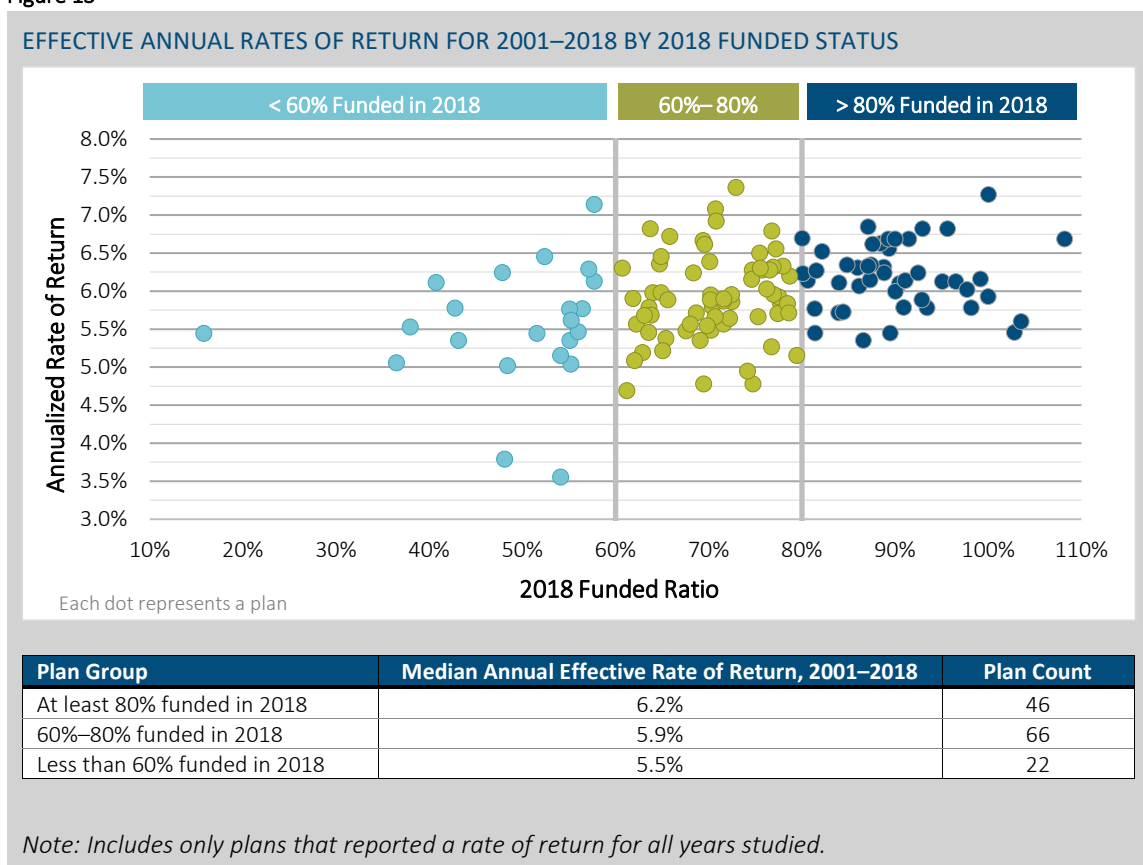


Figure 13



Plans that were less than 60% funded in 2018 tended to have lower cumulative effective annual rates of return for 2001–2018 than did plans that were better funded in 2018 (Figure 13). For this study, effective annual rates of return are the annual equivalent rate of the accumulated annual rates of return reported for the period studied. The period studied is a function of the available data. Rates of return for another period may differ.

The median effective annual rate of return for 2001–2018 for plans less than 60% funded in 2018 was 5.5%, compared to 5.9% for plans 60%–80% funded in 2018 and 6.2% for plans at least 80% funded in 2018. While these returns are generally less than the assumed rates of return, and asset returns have a direct impact on a plan's funded status, this does not mean that lower returns caused of lower funded status.

### Combined Impact

Compared to the two better-funded plan groups, assets grew less, and benefit payments and administrative expenses exceeded contributions by more for plans that were less than 60% funded in 2018. These analyses explain why plans that were less than 60% funded in 2018 generally had lower net cash flow ratios than the two better-funded plan groups. But these analyses shed no insight on the very low net cash flow ratios for some of the plans that were less than 60% funded in 2018. Further analysis for the plans with especially low net cash flow ratios is required.

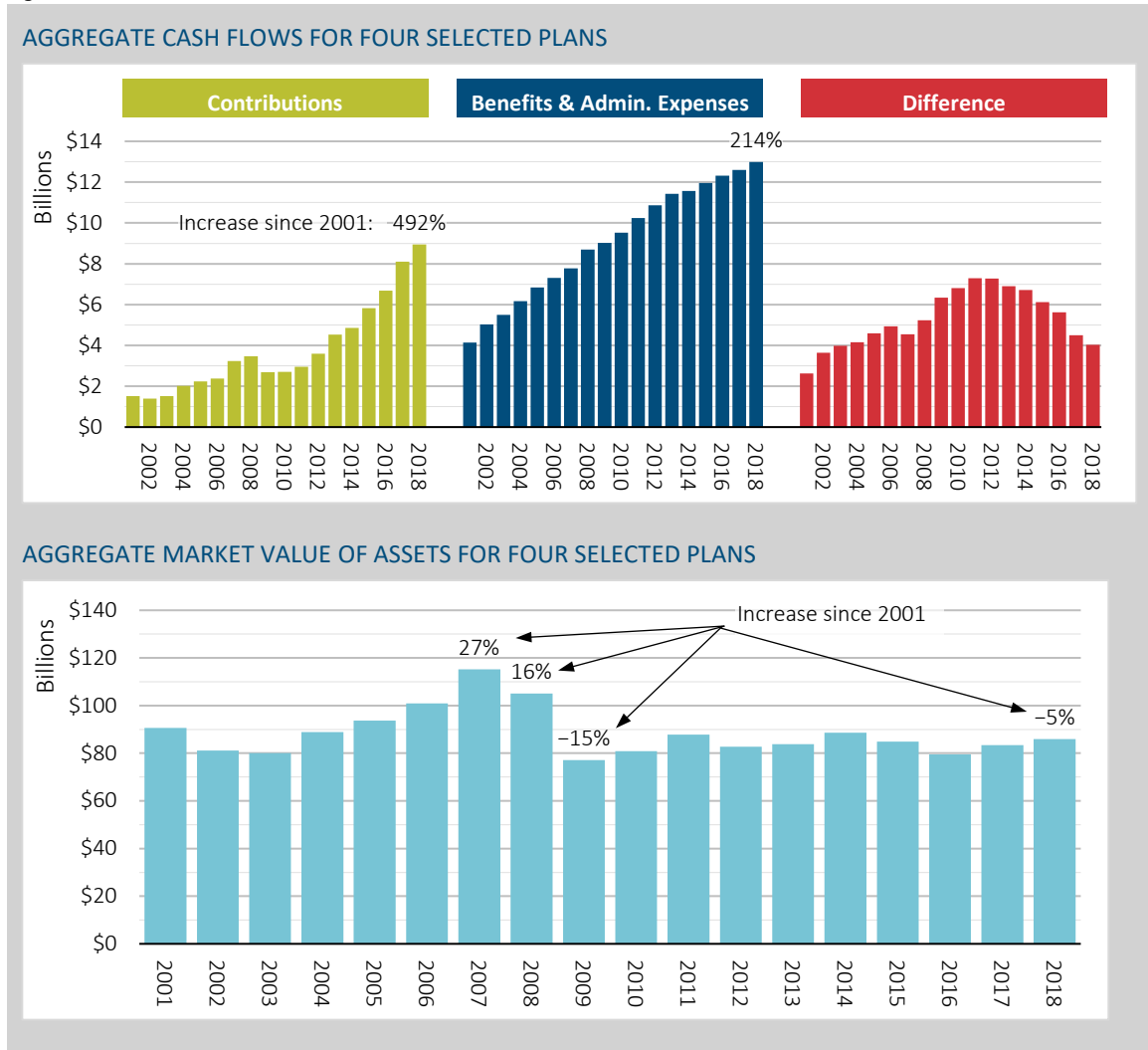
### Four Selected Plans

Four plans that were less than 60% funded in 2018 had five or more years from 2001 to 2018 in which their net cash flow ratio fell below  $-7\%$ . Aggregate contributions in 2018 for those four plans were nearly 5 times their 2001 aggregate contributions. Since 2001, aggregate benefit payments and administrative expenses (outflows) have grown more slowly than contributions (inflows) for these plans, and the gap between cash inflows and outflows has been narrowing since 2012. However, in 2018, outflows were 50% greater than inflows (Figure 14).

In addition, these four plans' aggregate market value of assets were 5% lower in 2018 than in 2001. In contrast, their liability measurements more than doubled from 2001 to 2018 (not shown).

It would appear that these four plans' net cash flow ratios were very low primarily because in addition to significant net outflows, asset values had not been growing while cash outflows were growing. As these four plans' cash flow gaps have narrowed during recent years, their net cash flow ratios have increased, although they remain much lower than other plans' net cash flow ratios.

Figure 14



Reflects the four plans that had a net cash flow ratio of less than -7% for at least five of the years 2001-2018.

## Asset Allocations

Aggregate allocation of the total market value of assets for public plans changed significantly from 2001 to 2018, generally shifting significant allocations from publicly traded assets to privately traded assets (Figure 15).<sup>15</sup> In 2001, 90% of assets were invested in public equity and public fixed income. A total of 7% of assets were invested in private equity and real estate, and allocations to hedge funds and “other” asset classes were nearly negligible. By 2018, allocations to private equity and real estate totaled 19% of aggregate assets, and 15% of aggregate assets were allocated to hedge funds and “other” classes, combined. “Other” assets include all forms of assets that do not have an explicit category in this study, such as, for example, commodities and alternative investments.

Public equity, private equity, real estate, commodities and alternative investments generally are considered to have a higher risk profile than public fixed income assets. Hedge funds may be either riskier or less risky, depending on the specifics of each investment vehicle.<sup>16</sup> In addition, real estate, hedge funds and alternative investments are typically less transparent forms of investment.<sup>17</sup>

State plans shifted a greater proportion of assets than local plans from public equity and public fixed income assets to real estate, private equity, hedge funds and “other” assets. This shift generally reflects a move toward riskier, more complex assets, regardless of whether the hedge fund allocations have high- or low-risk profiles. State plan allocations to public equity and public fixed income assets dropped from 91% in 2001 to 70% in 2018, a drop of 21%, while local plan allocations declined 15% from 88% in 2001 to 75% in 2018.

Aggregate asset allocations differed more significantly between plans that were at least 60% funded in 2018 and those that were less-well-funded. From 2001 to 2018, plans that were less than 60% funded in 2018 reduced allocations to public equity and public fixed income assets from 90% to 64% and redirected them to real estate, private equity, hedge funds and “other” assets. During the same period, plans that were at least 60%–80% funded in 2018 made the same change with 20% of their assets, while plans that were at least 80% funded in 2018 redirected 18% of their assets.

The authors explored percentile distributions of plan asset allocations and found they offer no further insights to those gained by looking at aggregate asset allocations. The percentile distributions may be found in Appendix A.

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<sup>15</sup> Aggregate asset allocations reflect the sum of all plans’ assets allocated to each asset class.

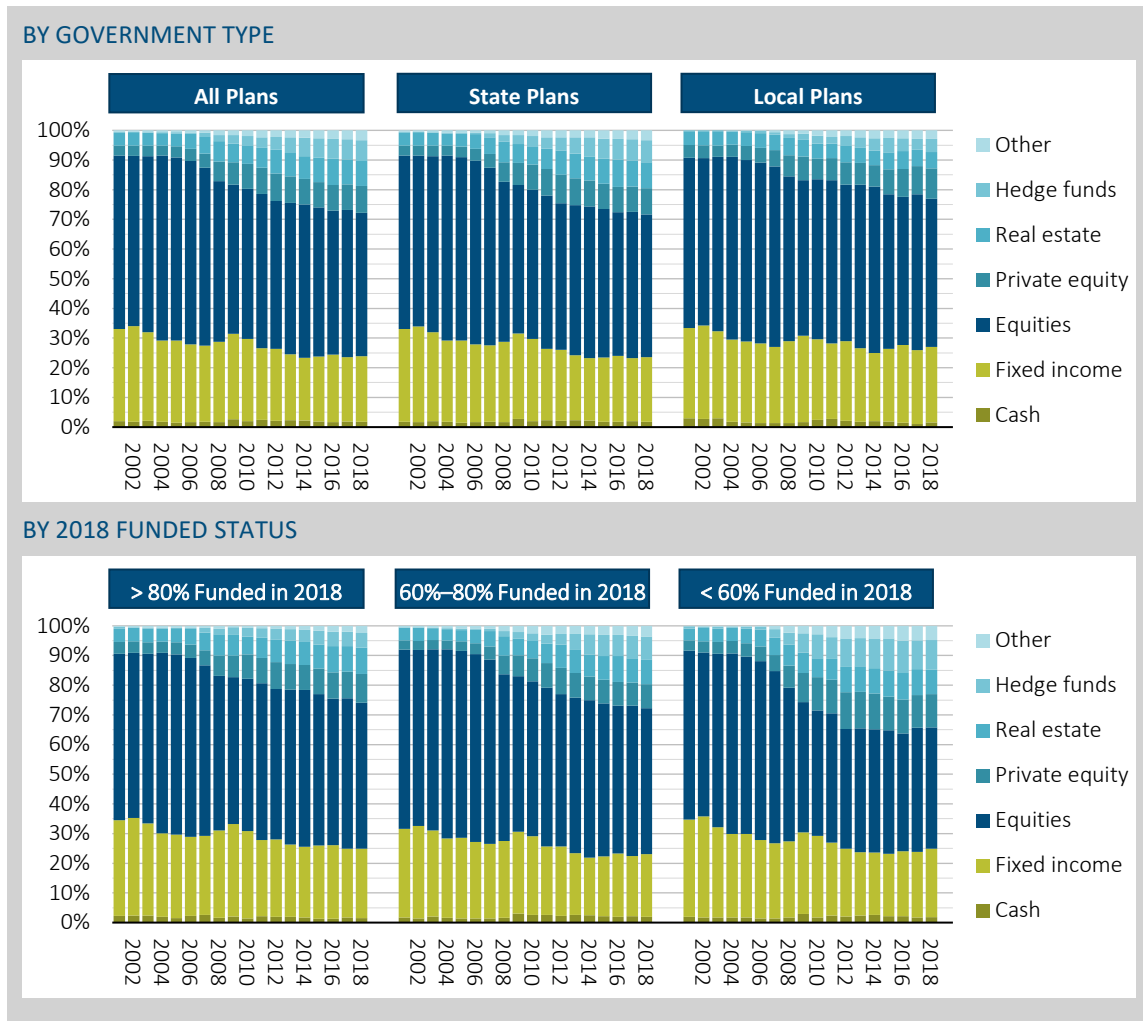
<sup>16</sup>Northern Trust, Capital Market Assumptions Five-Year Outlook: 2019 Edition, <https://www.capitalmarketassumptions.com/>, accessed January 28, 2020.

<sup>17</sup> Hedges IV, James R. “Hedge Fund Transparency,” *The Hedge Fund Journal*, Technical Issue 21, <https://thehedgefundjournal.com/hedge-fund-transparency/>, accessed February 17, 2020.

Ritholtz, Barry, “Hedge Funds and Private Equity Need Full Disclosure,” *Bloomberg*, <https://www.bloomberg.com/opinion/articles/2019-11-19/hedge-funds-private-equity-venture-capital-need-full-disclosure>, accessed February 17, 2020.



**Figure 15**  
**AGGREGATE ASSET ALLOCATIONS, 2001–2018**



Aggregate asset allocations reflect the sum of all plans' assets allocated to each asset class.

**Figure 16**  
**AGGREGATE 2001 AND 2018 ASSET ALLOCATIONS**

PUBLIC EQUITY AND PUBLIC FIXED INCOME						
Asset Class	Government Type			2018 Funded Status		
	All Plans	State Plans	Local Plans	> 80%	60%–80%	< 60%
Public equity, 2001	60%	60%	58%	57%	60%	57%
Public equity, 2018	49%	48%	50%	50%	49%	41%
Difference	-11%	-12%	-8%	-7%	-11%	-16%
Public fixed income, 2001	31%	31%	30%	32%	30%	33%
Public fixed income, 2018	22%	22%	25%	23%	21%	23%
Difference	-9%	-9%	-5%	-9%	-9%	-10%
Cash, 2001	2%	2%	3%	2%	2%	2%
Cash, 2018	2%	2%	2%	1%	2%	2%
Difference	0%	0%	-1%	-1%	0%	0%
Subtotal, 2001	93%	93%	91%	91%	92%	92%
Subtotal, 2018	73%	72%	77%	74%	72%	66%
Difference	-20%	-21%	-14%	-17%	-20%	-26%
Number of Plans	139	102	37	47	68	24

REMAINING ASSET CLASSES						
Asset Class	Government Type			2018 Funded Status		
	All Plans	State Plans	Local Plans	> 80%	60%–80%	< 60%
Private equity, 2001	3%	3%	4%	4%	3%	3%
Private equity, 2018	9%	9%	10%	10%	8%	11%
Difference	+6%	+6%	+6%	+6%	+5%	+8%
Real estate, 2001	4%	4%	5%	4%	4%	4%
Real estate, 2018	8%	9%	6%	9%	8%	8%
Difference	+4%	+5%	+1%	+5%	+4%	+4%
Hedge funds, 2001	0%	0%	0%	1%	0%	1%
Hedge funds, 2018	7%	7%	4%	5%	8%	10%
Difference	+7%	+7%	+4%	+4%	+8%	+9%
Other, 2001	0%	0%	0%	0%	1%	0%
Other, 2018	3%	3%	3%	2%	4%	5%
Difference	+3%	+3%	+3%	+2%	+3%	+5%
Subtotal, 2001	7%	7%	9%	9%	8%	8%
Subtotal, 2018	27%	28%	23%	26%	28%	34%
Difference	+20%	+21%	+14%	+17%	+20%	+26%
Number of Plans	139	102	37	47	68	24

Aggregate asset allocations reflect the sum of all plans' assets allocated to each asset class. Values may not add because of rounding.

## Assumed Rates of Return on Assets

Looking at trends in assumed rates of return on assets is a natural follow-up to examining trends in asset allocations. Further, because benefit liabilities for most public pension plans are valued using a discount rate that represents a long-term expected rate of return on plan assets, the assumed rate of return may be one indication of the level of investment risk inherent in a plan's funding processes. It may also reflect the degree of optimism or pessimism in the plan trustees' economic outlook.<sup>18</sup>

Figure 17 shows a clear downward trend in assumed rates of return, especially after 2009. All other things being equal, lower assumed rates of return result in greater liability measurements and greater contributions necessary to fully fund the plan.

Distributions of assumed rates of return vary little between most state-based and local plans—median rates of return were the same for the two sets of plans in both 2001 and 2018. In 2001, the median rate of return was 8.00%. By 2018, the median rate of return had dropped to 7.25%.

But when considered by 2018 funded status, distributions differ. Assumed rates of return dropped much more for plans that were less than 60% in 2018 than for plans that were more than 60% funded in 2018. From 2001 to 2018, the median assumed rate of return fell:

- From 8.50% to 7.00% for plans that were less than 60% funded in 2018,
- From 8.00% to 7.32% for plans 60%–80% funded in 2018, and
- From 8.00% to 7.25% for plans at least 80% funded in 2018,

If all other things are equal, higher discount rates produce lower liability measurements, and therefore higher funded status. Plans that were lesser-funded in 2018 tended to have lower discount rates in 2018 and higher discount rates in 2001. In other words, some, but not all, of the slower funding progress among the less well-funded plans in 2018 is likely attributable to their discount rate trends. In the current economic environment, many actuaries and investment professionals consider the lower assumed rates of return, which are used to discount liabilities, in use to be more realistic than the higher discount rates.<sup>19</sup>

The difference between the assumed rate of return and the risk-free rate generally indicates the level of risk inherent in the assumed rate of return. Inherent investment risk reflects both the intended riskiness of assets and the level of optimism among plan trustees. From 2001 to 2018, the spread between the assumed rate of return and the risk-free rate widened among the plans studied (Figure 18). Although plans generally reduced their assumed rates of return, the annual average 10-year Treasury yield fell by an even greater amount during the same period (Figure 19).

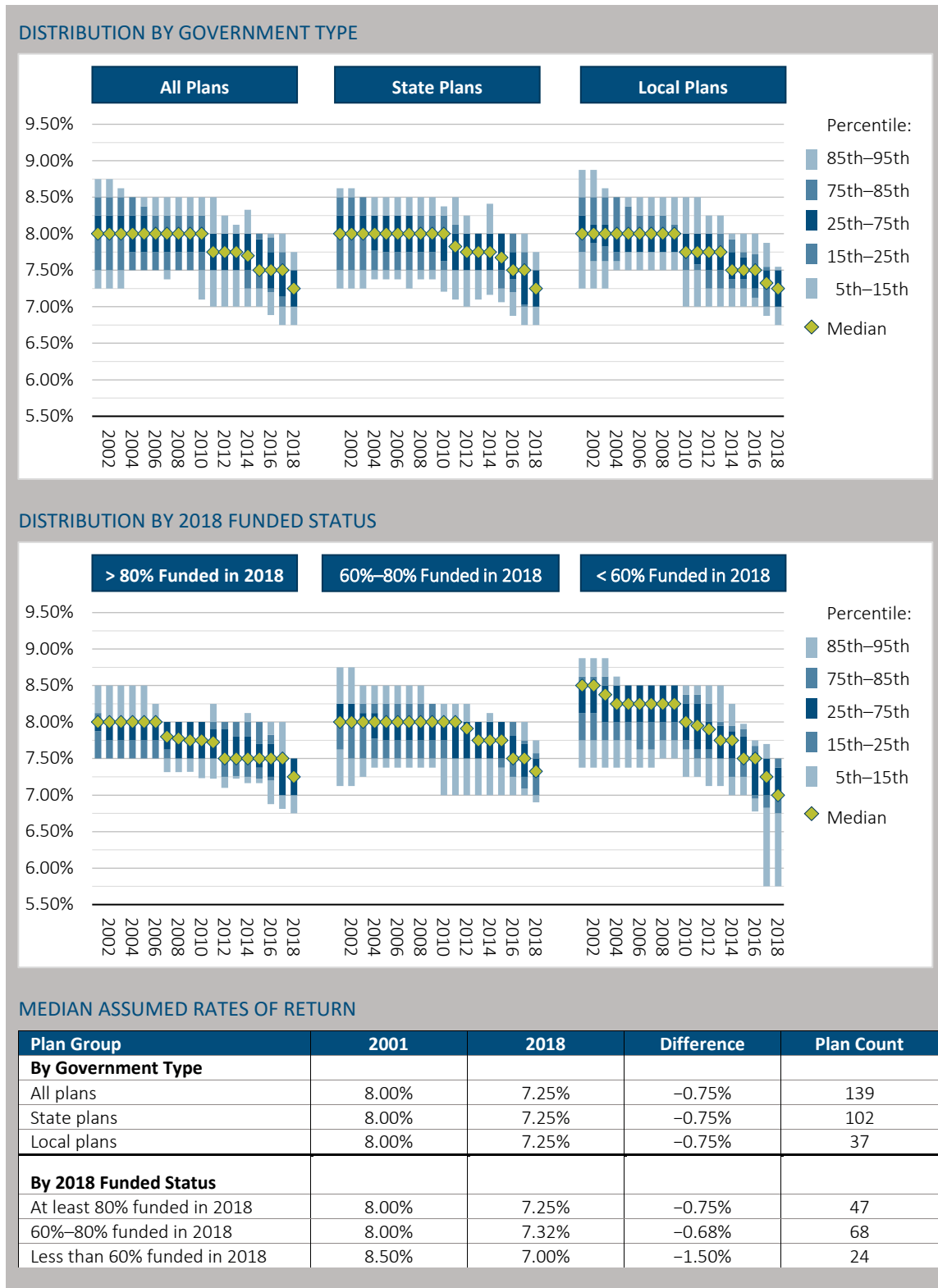
In 2001, the median spread was 3.13% across all plans, and in 2018 the spread had increased 167 basis points (bps) to 4.80%. When considered by 2018 funded status, the spread widened:

- 120 bps for plans that were less than 60% funded in 2018, from 3.39% in 2001 to 4.59% in 2018,
- 179 bps for plans that were 60%–80% funded in 2018, from 3.09% to 4.88%, and
- 174 bps for plans that were at least 80% funded in 2018, from 3.04% to 4.78%.

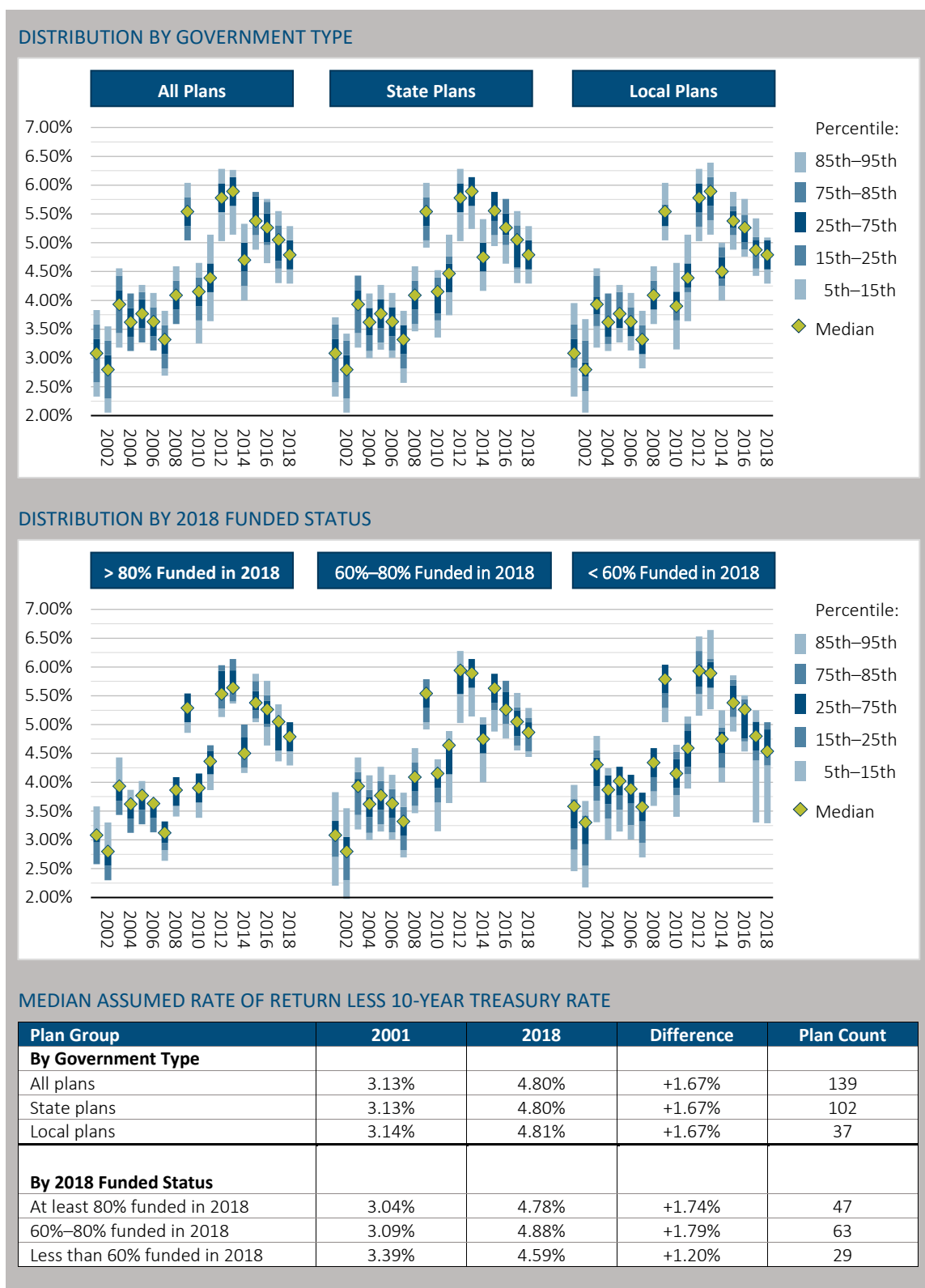
<sup>18</sup> In some situations, plan trustees do not set the discount rate. For example, in some states, the discount rate is set forth in state law.

<sup>19</sup> This should not be construed to mean that many actuaries and investment professionals consider the lower assumed rates of return to be realistic in the current environment, only more realistic than the rates of earlier years. The SOA is not opining on the appropriateness of the assumed rates of return or any other actuarial assumptions for these plans.

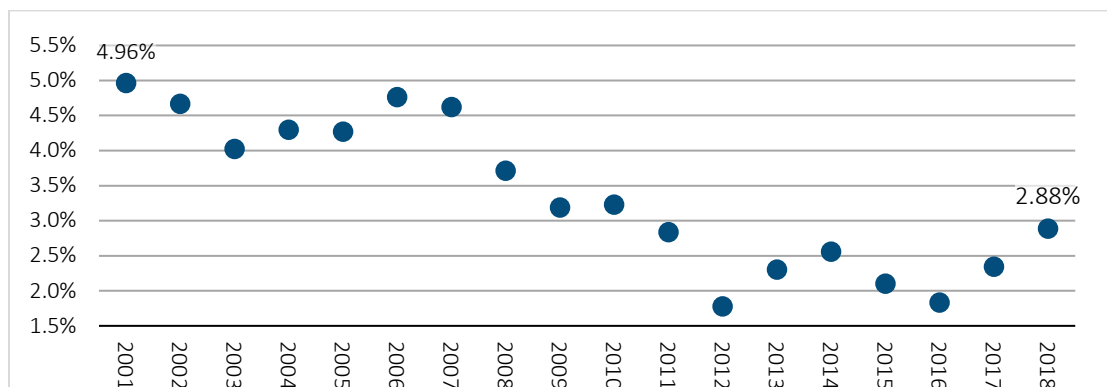
**Figure 17**  
ASSUMED RATE OF RETURN



**Figure 18**  
**ASSUMED RATE OF RETURN LESS 10-YEAR TREASURY RATE**



**Figure 19**  
**AVERAGE 10-YEAR TREASURY RATE**



## Summary

Public plans generally matured from 2001 to 2018. Greater maturity typically indicates a riskier financial position compared to less mature plans. In general, greater maturity signifies greater sensitivity to financial shocks—beneficial and detrimental—as well as greater difficulty recovering from detrimental financial shocks.

Local plans are generally more mature than state plans. In addition, plans that were less than 60% funded in 2018 are generally more mature than plans that were better funded in 2018.

During the same period that the plans grew more sensitive to risk, they increased the risk profile and increased the complexity of their asset allocations. In aggregate, the plans shifted 20% of assets from public equity and public fixed income assets to private equity, real estate, hedge funds, commodities and alternative investments.

Trends in their assumed rates of return, which are typically used to discount benefit liabilities, also reflected an increased risk sensitivity. From 2001 to 2018, plans generally lowered their assumed rates of return on assets. In 2001, the median assumed rate of return was 8.00%; by 2018 it was 7.25%. However, risk-free returns fell during the same years by more than the assumed rates of return dropped. As a result, investment risk sensitivity inherent in plan funding increased. The spread between the median rate of return and 10-year Treasury rates increased from 3.13% in 2001 to 4.80% in 2018.

## Acknowledgments

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 Thomas G. Vicente, FSA, EA, FCA, MAAA

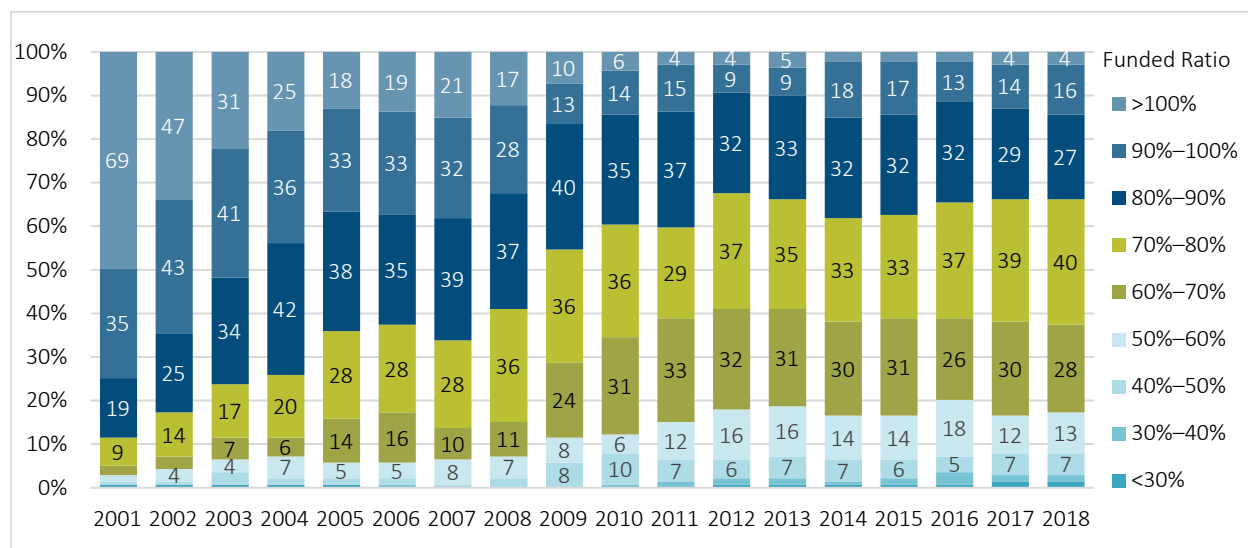
## Appendix A: Plans Studied

This study analyzes ongoing state-based and large-city defined benefit pension plans that had consistently-available relevant data for 2001–2018 in the Public Plans Data (PPD) database on September 3, 2020. The Center for Retirement Research at Boston College produces the PPD in partnership with the Center for State & Local Government Excellence and the National Association of State Retirement Administrators and purports to account for 95 percent of state and local pension assets and members in the US.<sup>20</sup> The study excludes from analysis plans that have been frozen or closed.

In general, data were used as reported except for adjustments for obvious errors. Some plans were on a biennial actuarial valuation cycle and show some data elements every other year. For those plans, the authors imputed some key data elements in the off-valuation years. Neither the authors nor the SOA intends the use of reported values as commentary on their appropriateness for funding, financial reporting or any other purpose, for these plans or for any other plans.

The 139 plans studied cover nearly 25 million participants. In 2018, they reported for funding purposes assets totaling roughly \$3.5 trillion, benefit obligations of approximately \$4.8 trillion, and a total unfunded liability of about \$1.3 trillion. Plan funded ratios for 2018 ranged from 108% to 16%; 40 plans had 2018 funded ratios in the 70%–80% range, more plans than in any other decile range. (Figure 20). In contrast, 69 plans had 2001 funded ratios above 100%, far more plans than in any decile range below 100%. Contributions in 2018 from employees, employers and all other sources totaled \$179 billion, and 2018 benefit payments totaled \$261 billion. Figure 21 shows the progression of aggregate funded status for each funding group of plans explored in the study.

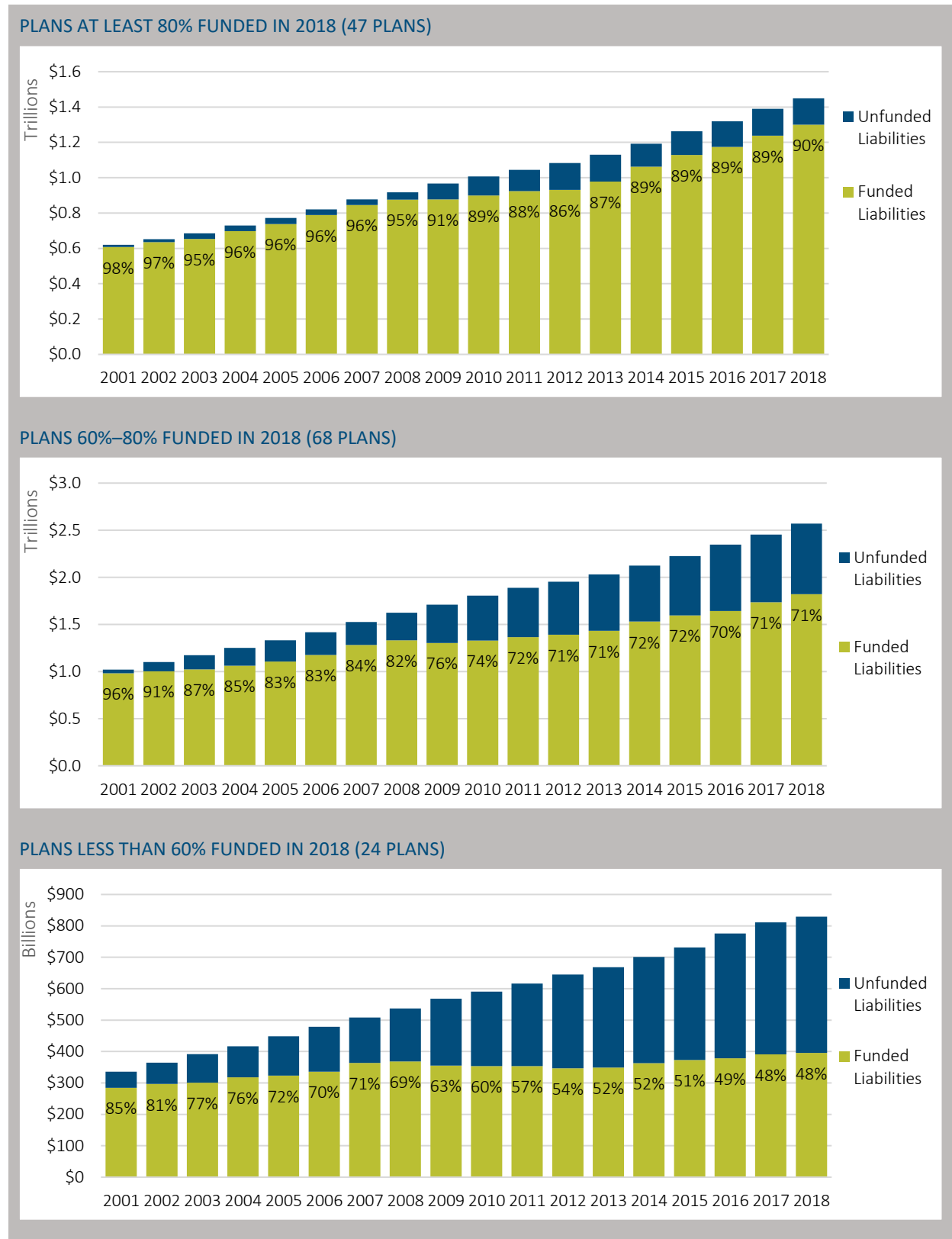
**Figure 20**  
NUMBER OF PLANS STUDIED BY FUNDED STATUS



<sup>20</sup> Center for Retirement Research at Boston College and the Center for State & Local Government Excellence, Public Plans Data, <http://publicplansdata.org/public-plans-database/>.

Figure 21

AGGREGATE FUNDED STATUS BY FUNDED STATUS IN 2018





## Appendix B: Metrics by Job Category

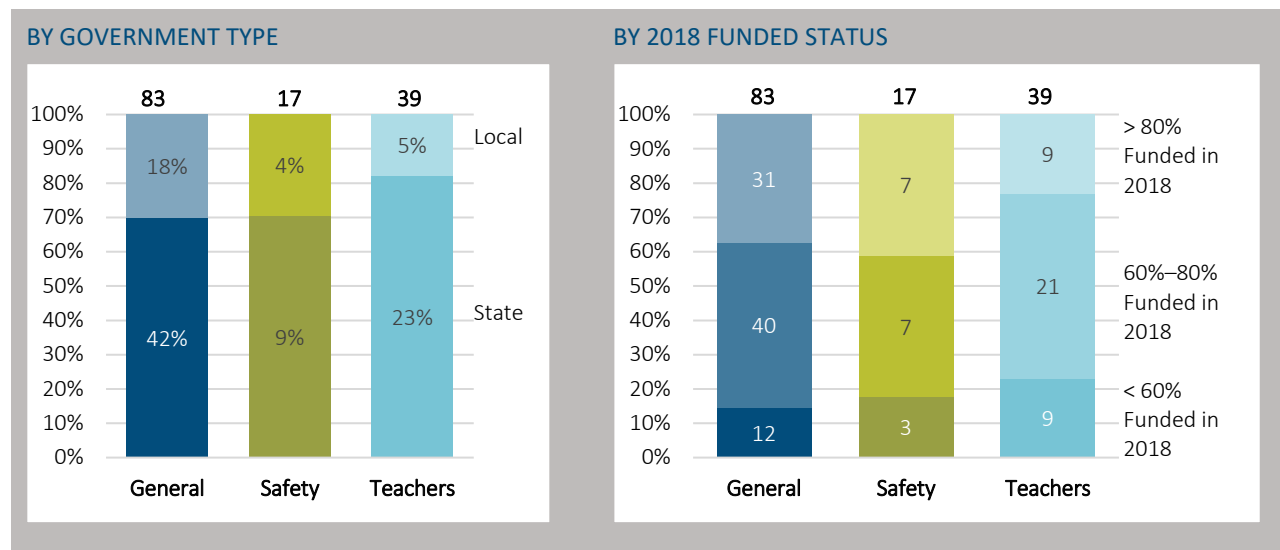
This appendix presents the metrics and data shown in the body of this report by the plans that cover participants in the following three job categories, without commentary on results.

- General employees
- Safety employees
- Teachers and educational employees

The authors categorized plans as safety employee plans (or teachers plans) when the participant population is entirely or nearly entirely public safety employees (teachers or teachers and educational employees). When a plan covers many types of employees, including safety employees, (teachers and educational employees) the authors categorized the plan as a plan for general employees.

### Plans Studied by Job Category

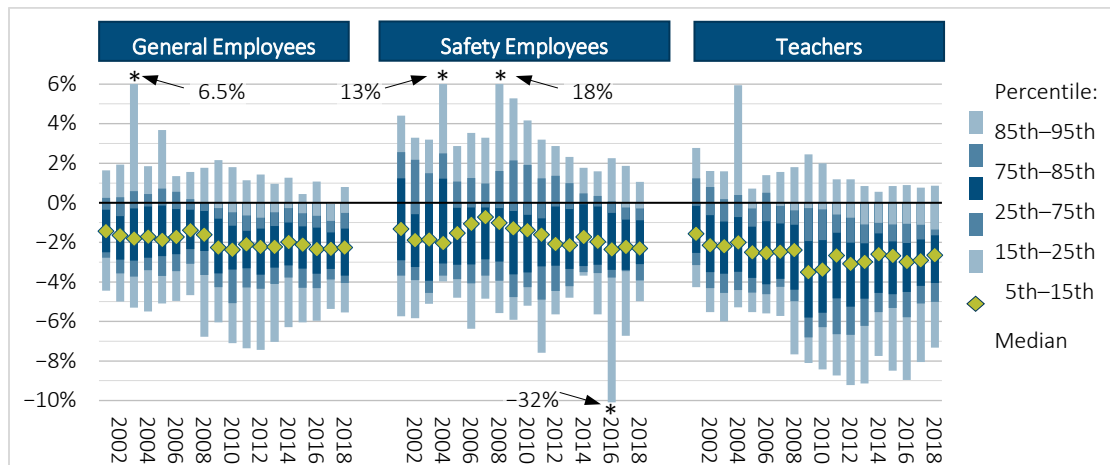
#### NUMBER OF PLANS



## Maturity Metrics by Job Category

### Net Cash Flow-to-Asset Ratios

DISTRIBUTION OF NET CASH FLOW-TO-MARKET-VALUE-OF-ASSETS RATIO BY JOB CATEGORY

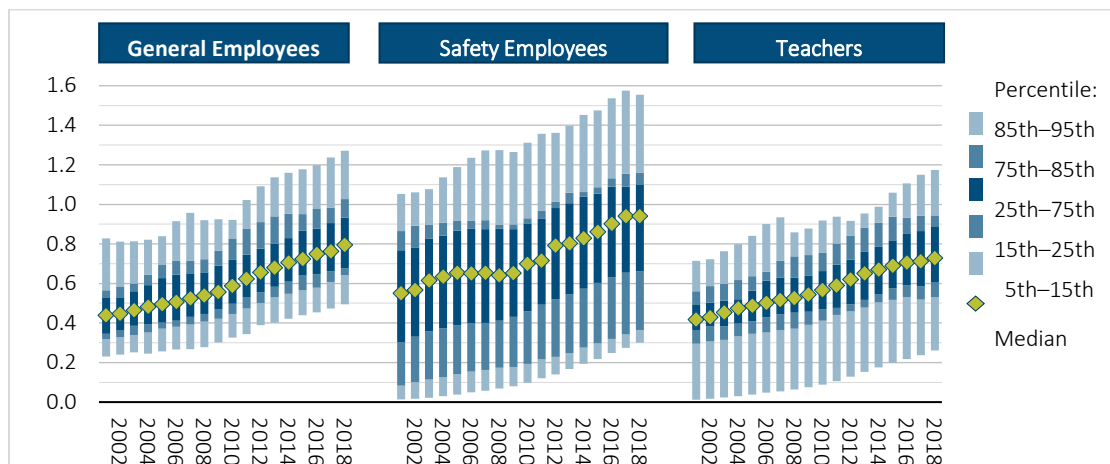


MEDIAN NET CASH FLOW-TO-MARKET-VALUE-OF-ASSETS RATIOS BY JOB CATEGORY

Plan Job Type	2001	2018	Difference	Plan Count
General Employees	-1.4%	-2.3%	-0.8%	83
Safety Employees	-1.3%	-2.3%	-1.0%	17
Teachers	-1.6%	-2.7%	-1.1%	39

### Dependency Ratio

DEPENDENCY RATIO DISTRIBUTION BY JOB CATEGORY

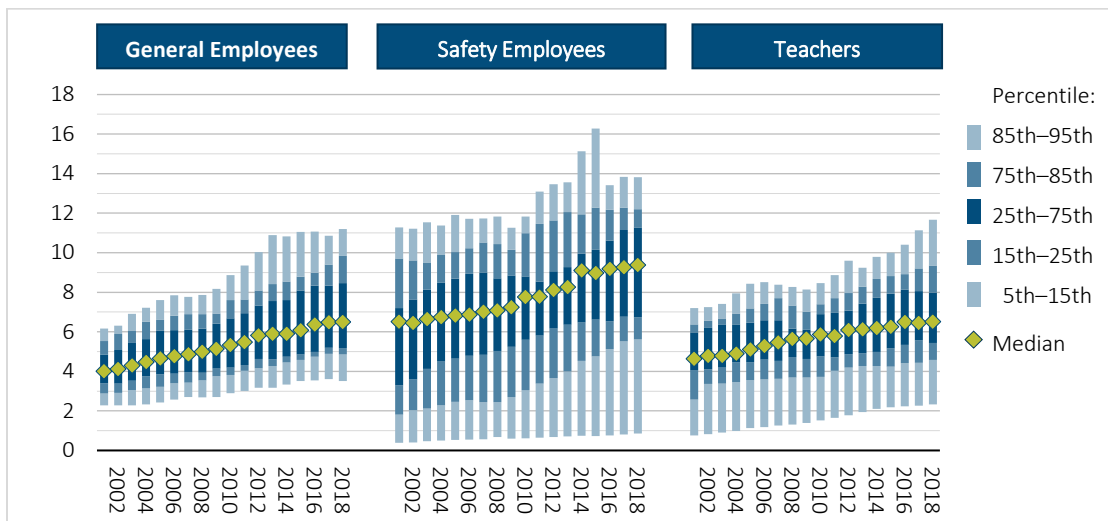


MEDIAN DEPENDENCY RATIOS BY JOB CATEGORY

Plan Job Type	2001	2018	Difference	Percent Change	Plan Count
General Employees	0.44	0.79	0.36	81%	83
Safety Employees	0.55	0.94	0.39	71%	17
Teachers	0.42	0.73	0.31	74%	39

## Liability-to-Payroll Ratios

### DISTRIBUTION OF LIABILITY-TO-PAYROLL RATIOS BY JOB CATEGORY

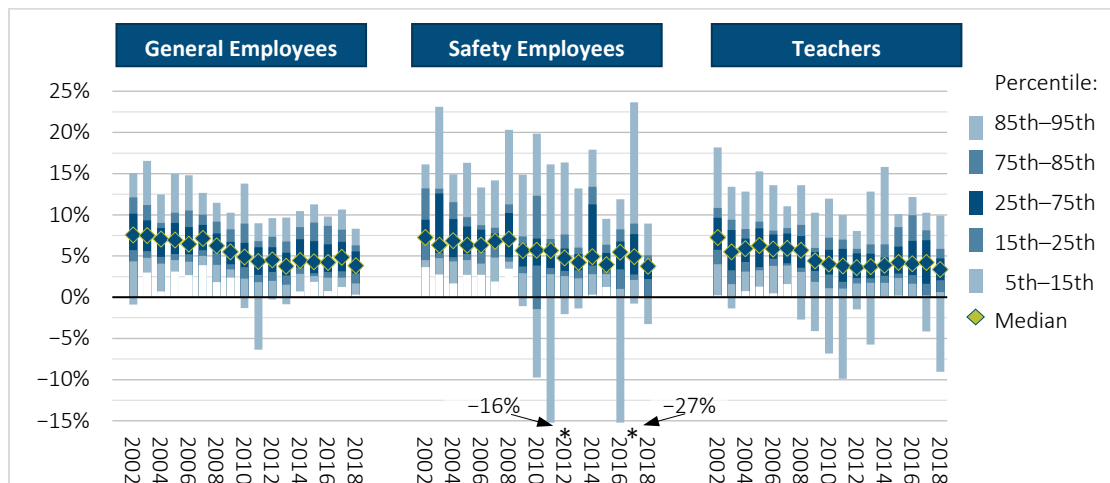


### MEDIAN LIABILITY-TO-PAYROLL RATIOS BY JOB CATEGORY

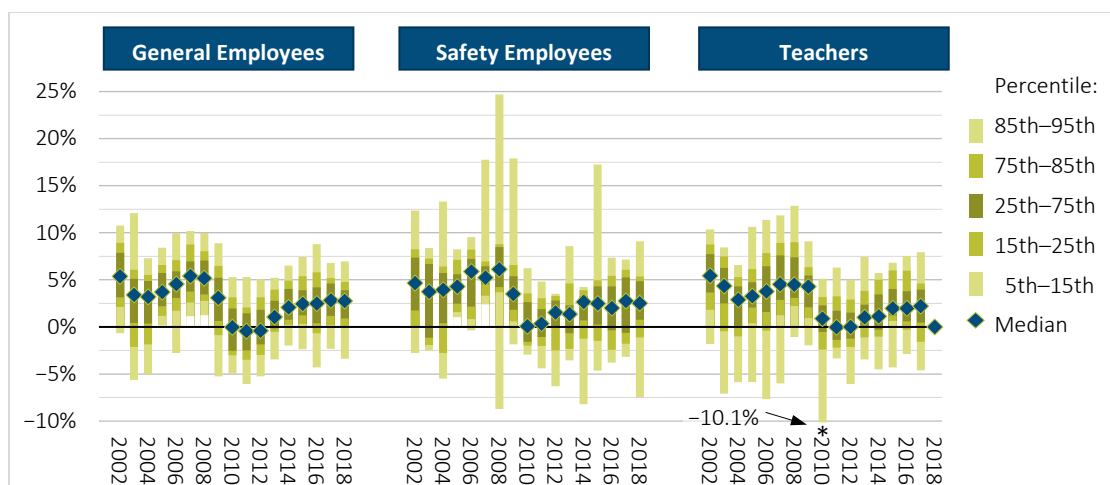
Plan Job Type	2001	2018	Difference	Percent Change	Plan Count
General Employees	4.01	6.50	2.49	62%	83
Safety Employees	6.52	9.38	2.86	44%	17
Teachers	4.65	6.52	1.87	40%	39

### Increases in Liabilities Compared to Increases in Payroll

DISTRIBUTION OF YEAR-OVER-YEAR INCREASE IN LIABILITIES BY JOB CATEGORY



DISTRIBUTION OF YEAR-OVER-YEAR INCREASE IN PAYROLL BY JOB CATEGORY

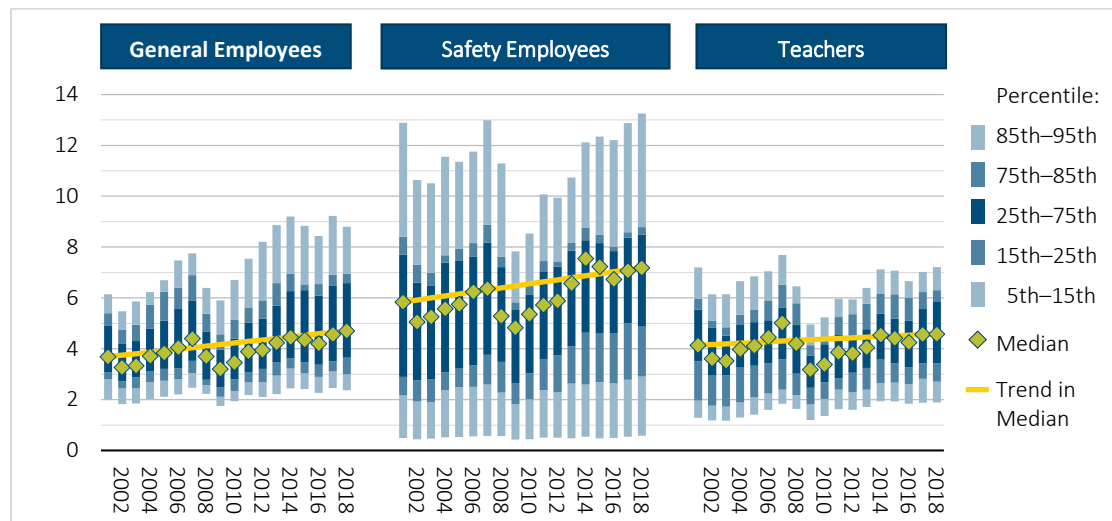


MEDIAN ANNUAL RATE OF INCREASE, 2001–2018, BY JOB CATEGORY

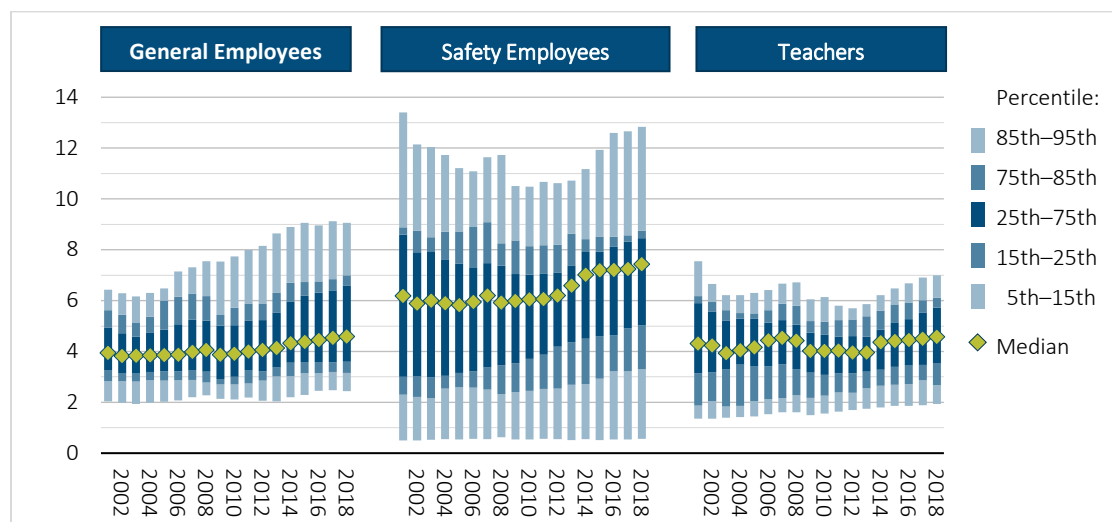
Plan Group	Liabilities	Payroll	Spread:	Plan Count
General Employees	5.8%	2.5%	3.2%	117
Safety Employees	6.0%	2.6%	3.4%	35
Teachers	5.3%	2.6%	2.7%	47

### Assets-to-Payroll Ratios

DISTRIBUTION OF MARKET-VALUE-OF-ASSETS-TO-PAYROLL RATIOS BY JOB CATEGORY



DISTRIBUTION OF ACTUARIAL-VALUE-OF-ASSETS-TO-PAYROLL RATIOS BY JOB CATEGORY

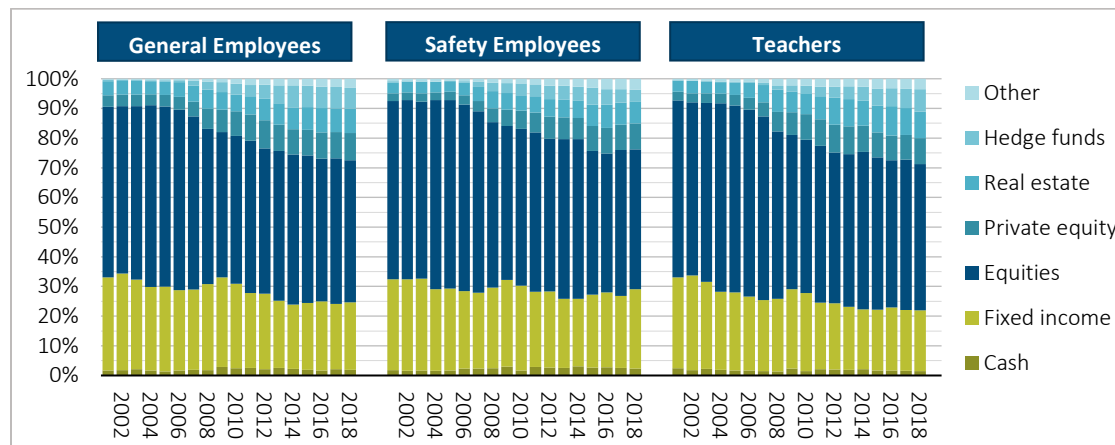


MEDIAN RATIOS ASSETS-TO-PAYROLL RATIOS BY JOB CATEGORY

Plan Job Type	2001	2018	Difference	Percent Change	Plan Count
<b>Market Value of Assets to Payroll</b>					
General Employees	3.68	4.71	1.02	28%	83
Safety Employees	5.84	7.19	1.35	23%	17
Teachers	4.14	4.58	0.44	11%	39
<b>Actuarial Value of Assets to Payroll</b>					
General Employees	3.95	4.59	0.64	16%	83
Safety Employees	6.20	7.44	1.24	20%	17
Teachers	4.31	4.58	0.27	6%	39

### Aggregate Asset Allocations by Job Category

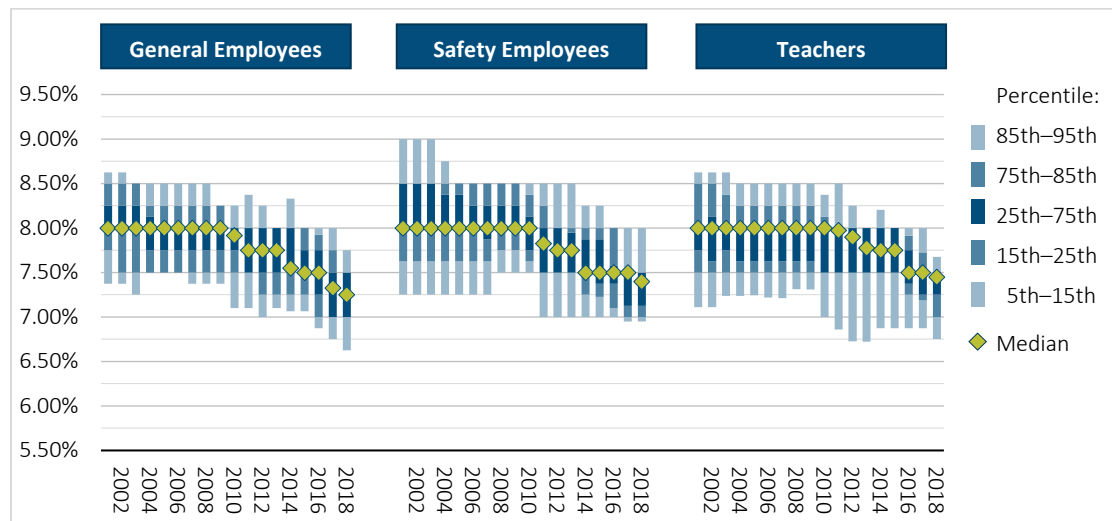
#### AGGREGATE ASSET ALLOCATION BY JOB CATEGORY



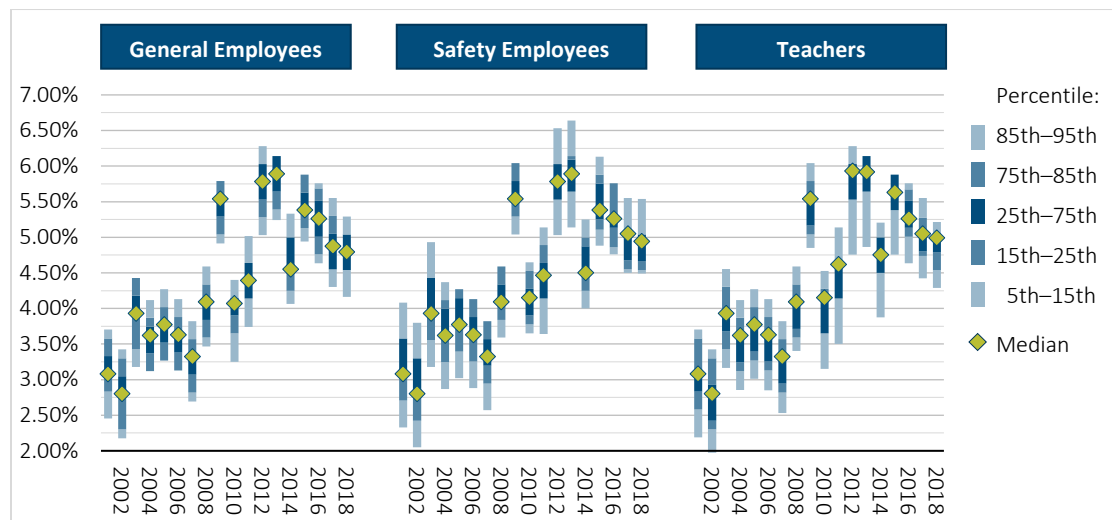
Asset Class	General Employees	Safety Employees	Teachers
Cash, 2001	2%	2%	2%
Cash, 2018	2%	2%	1%
Difference	0%	0%	-1%
Public fixed income, 2001	31%	31%	31%
Public fixed income, 2018	23%	27%	21%
Difference	-8%	-4%	-10%
Public equity, 2001	57%	58%	59%
Public equity, 2018	48%	47%	48%
Difference	-9%	-11%	-11%
Private equity, 2001	4%	3%	3%
Private equity, 2018	9%	9%	9%
Difference	5%	6%	6%
Real estate, 2001	5%	4%	4%
Real estate, 2018	8%	7%	9%
Difference	3%	3%	5%
Hedge funds, 2001	1%	1%	0%
Hedge funds, 2018	7%	4%	8%
Difference	6%	3%	8%
Other, 2001	0%	1%	1%
Other, 2018	3%	4%	4%
Difference	3%	3%	3%
Number of Plans	83	17	39

### Assumed Rates of Return by Job Category

#### RATE OF RETURN: DISTRIBUTION



#### RATE OF RETURN LESS 10-YR TREASURY RATE: DISTRIBUTION



#### MEDIAN RATES

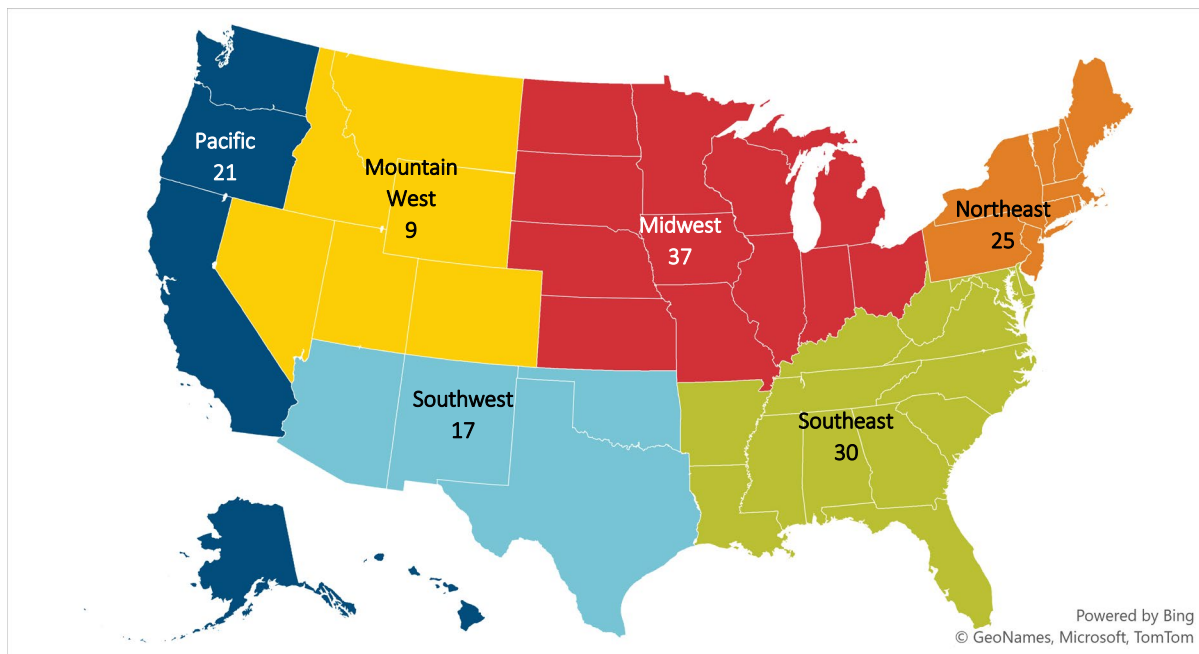
Plan Job Type	2001	2018	Difference	Number of Plans
<b>Assumed Rate of Return</b>				
General Employees	8.00%	7.25%	-0.75%	83
Safety Employees	8.00%	7.40%	-0.60%	17
Teachers	8.00%	7.45%	-0.55%	39
<b>Rate of Return Less 10-Year Treasury Rate</b>				
General Employees	3.08%	4.79%	1.71%	83
Safety Employees	3.08%	4.94%	1.86%	17
Teachers	3.08%	4.99%	1.91%	39

## Appendix C: Metrics by Region

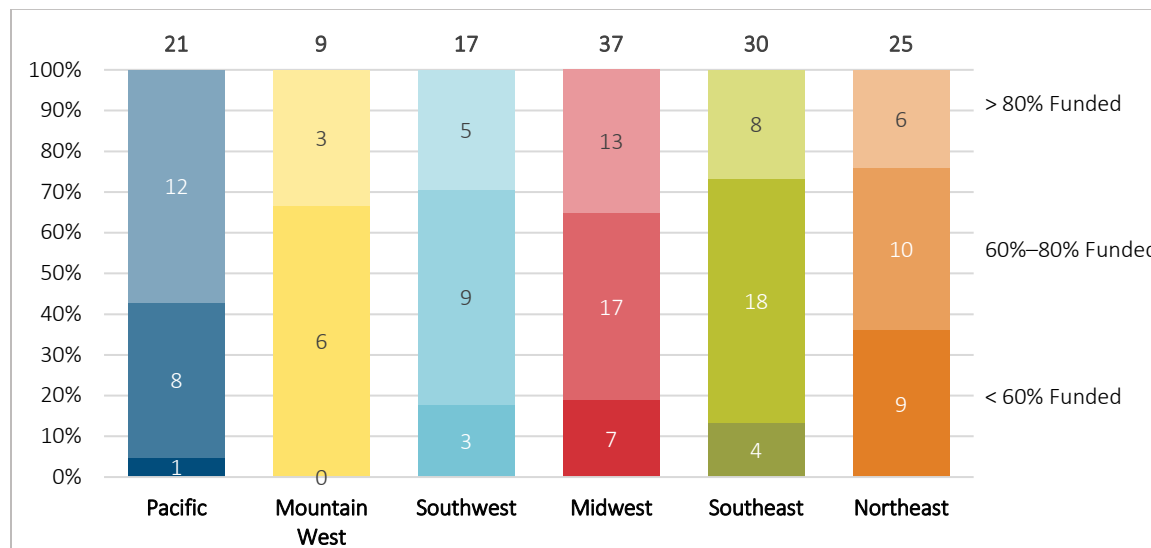
This appendix presents the metrics and data shown in the body of this report by region, without commentary on results.

### Plans Studied by Region

NUMBER OF PLANS STUDIED BY REGION



BY REGION AND 2018 FUNDED STATUS

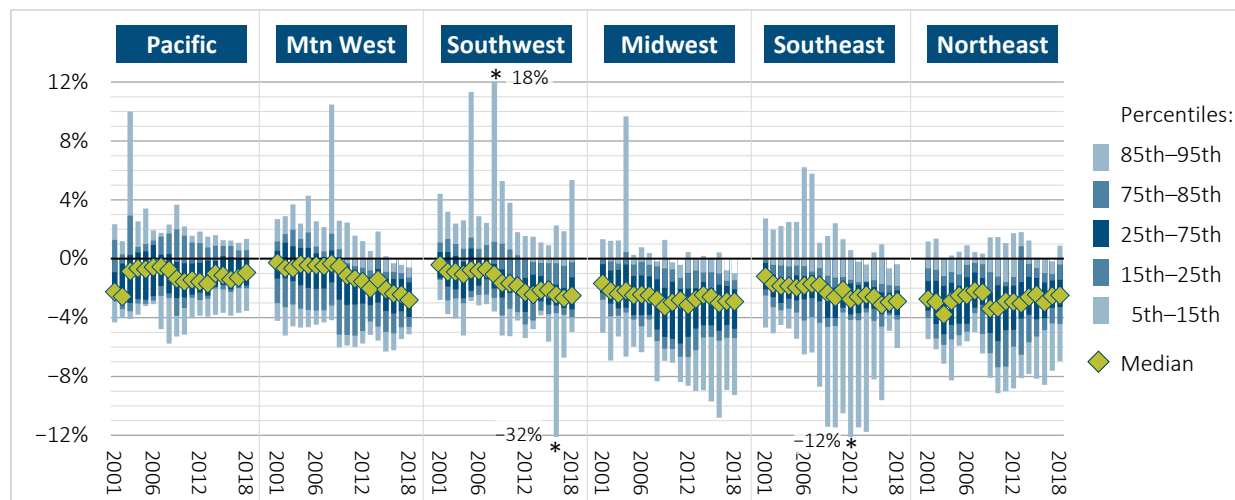




## Maturity Metrics by Region

### Net Cash Flow-to-Asset Ratios

DISTRIBUTION OF NET CASH FLOW-TO-MARKET-VALUE-OF-ASSETS RATIOS BY REGION

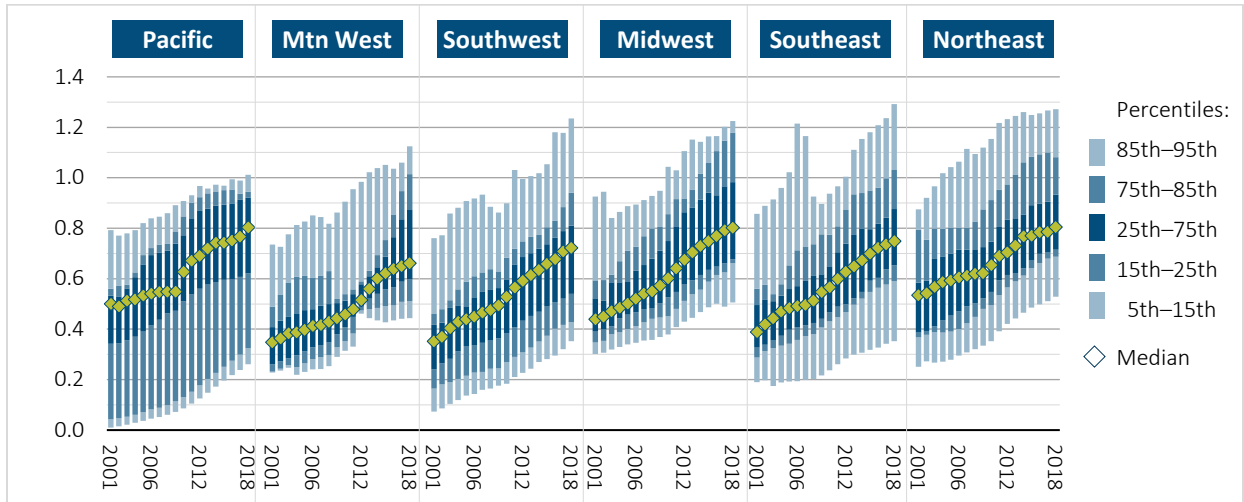


MEDIAN NET-CASH-FLOW-TO-MARKET-VALUE-OF-ASSETS RATIOS BY REGION

Region	2001	2018	Difference	Plan Count
Pacific	-1.26%	-0.78%	0.48%	21
Mountain West	-0.25%	-2.63%	-2.38%	9
Southwest	-0.13%	-1.85%	-1.72%	17
Midwest	-1.34%	-3.38%	-2.04%	37
Southeast	-0.91%	-2.78%	-1.87%	30
Northeast	-2.30%	-2.29%	0.01%	25

## Dependency Ratios

### DISTRIBUTION OF DEPENDENCY RATIOS DISTRIBUTION BY REGION

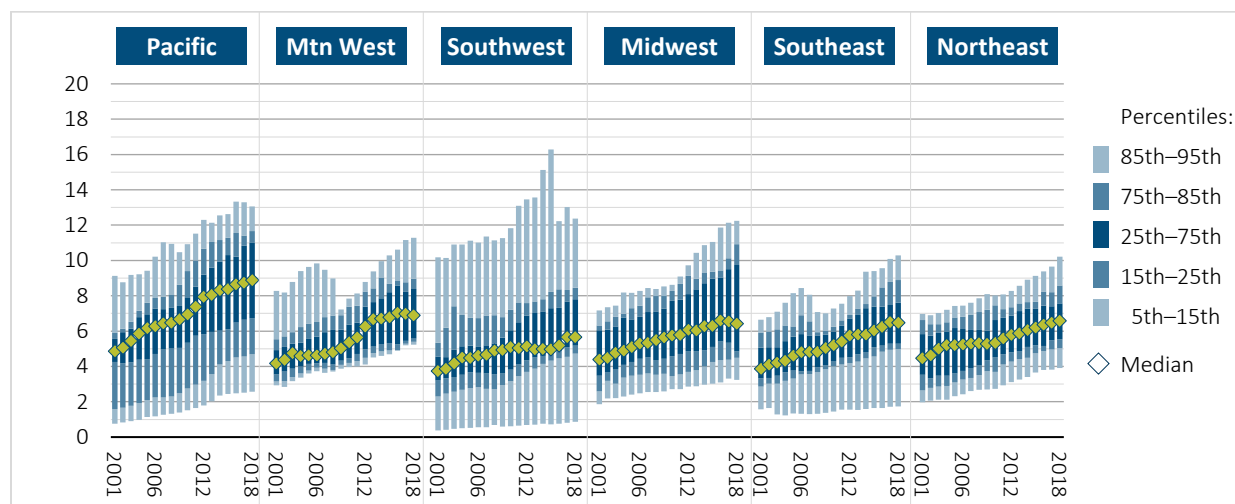


### MEDIAN DEPENDENCY RATIOS BY REGION

Region	Pacific	Mountain West	Southwest	Midwest	Southeast	Northeast
2001	0.5	0.4	0.4	0.5	0.4	0.6
2018	0.8	0.8	0.7	0.9	0.8	0.9
Difference	0.3	0.4	0.3	0.4	0.4	0.3
% Change	60%	100%	75%	80%	100%	50%
Plan Count	21	9	17	37	30	25

## Liability-to-Payroll Ratios

### DISTRIBUTION OF LIABILITY-TO-PAYROLL RATIOS BY REGION

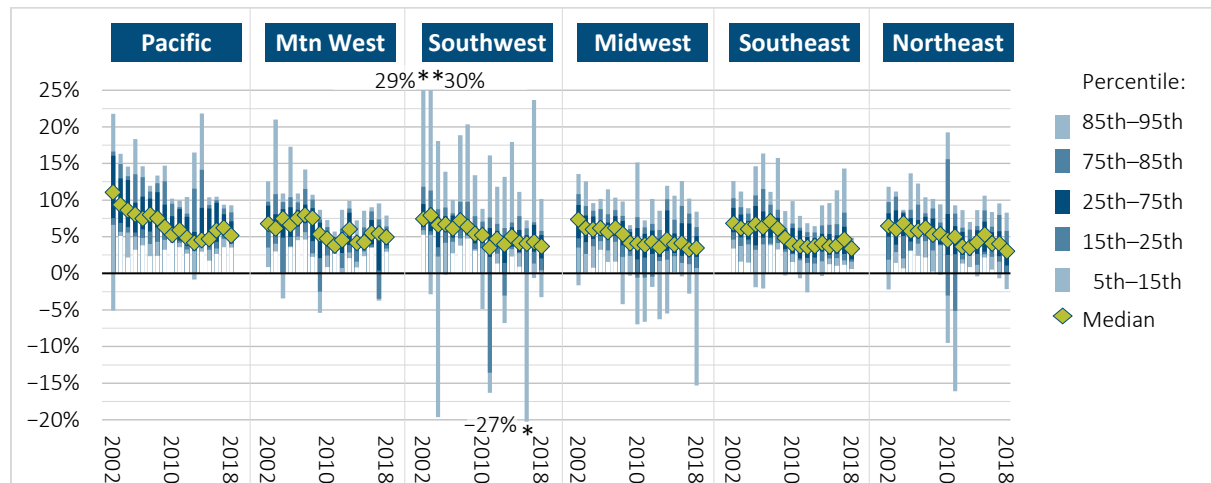


### MEDIAN LIABILITY-TO-PAYROLL RATIOS BY REGION

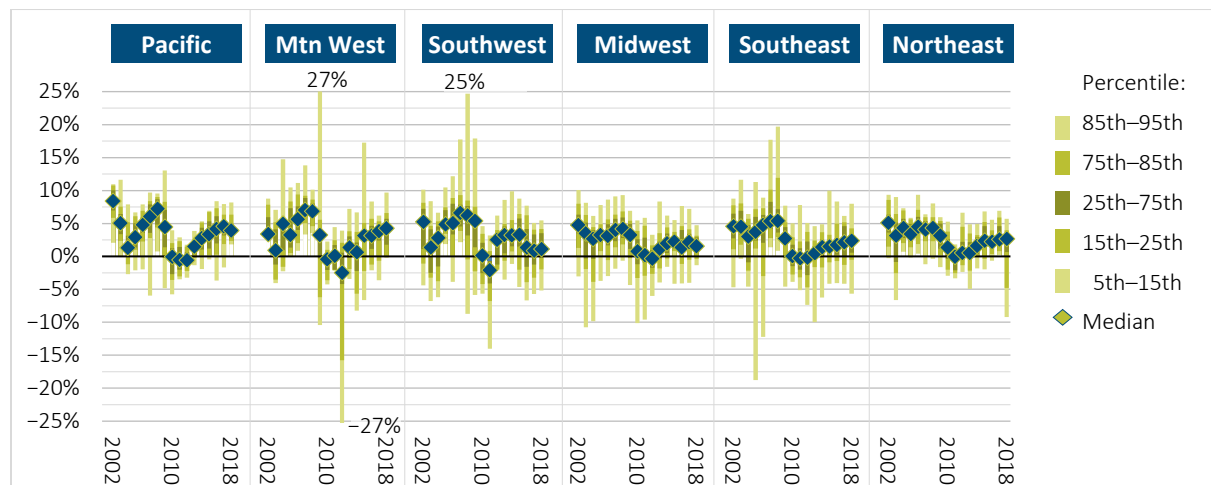
Region	Pacific	Mountain West	Southwest	Midwest	Southeast	Northeast
2001	5.1	4.7	4.3	4.6	4.3	4.7
2018	9.2	7.5	6.4	7.4	6.7	6.9
Difference	4.1	2.8	2.1	2.8	2.4	2.2
% Change	80%	60%	49%	61%	56%	47%
Plan Count	21	9	17	37	30	25

### Increases in Liabilities Compared to Increases in Payroll

DISTRIBUTION OF YEAR-OVER-YEAR INCREASE IN LIABILITIES BY REGION



DISTRIBUTION OF YEAR-OVER-YEAR INCREASE IN PAYROLL BY REGION

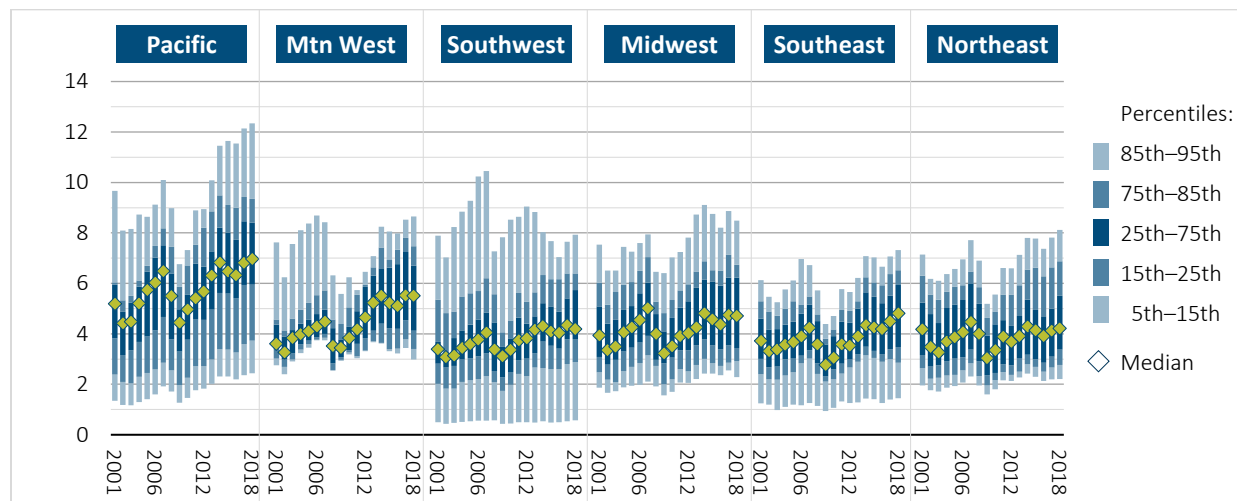


MEDIAN ANNUAL RATES OF INCREASE, 2001–2018, BY REGION

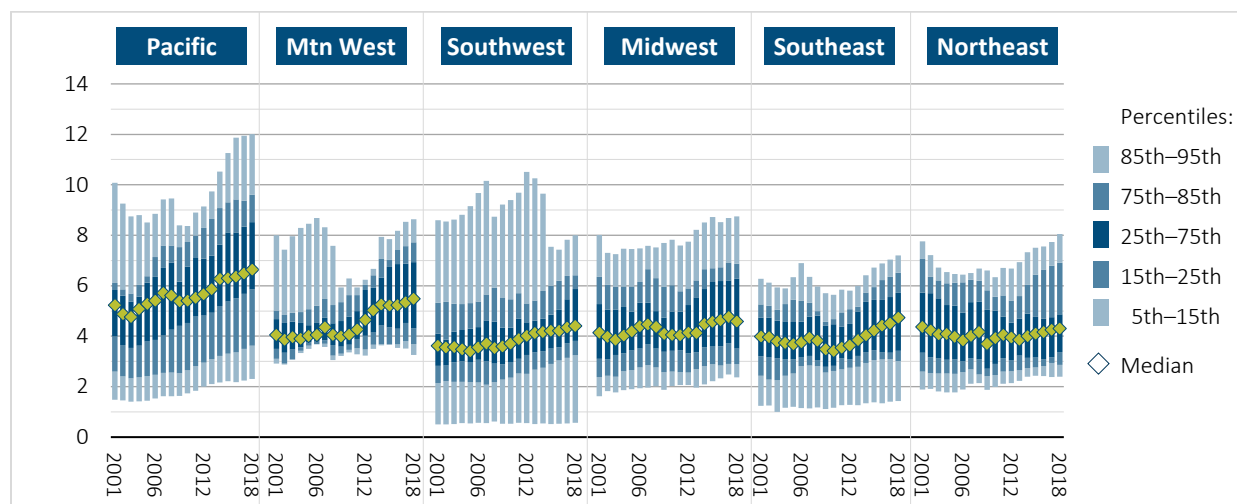
Region	Pacific	Mountain West	Southwest	Midwest	Southeast	Northeast
Increase in Liabilities	6.7%	6.4%	5.5%	4.9%	5.1%	4.6%
Increase in Payroll	3.3%	2.8%	3.4%	2.2%	2.3%	2.4%
Difference	3.4%	3.6%	2.1%	2.8%	2.8%	2.2%
Plan Count	21	9	17	37	30	25

### Assets-to-Payroll Ratios

DISTRIBUTION OF MARKET-VALUE-OF-ASSETS-TO-PAYROLL RATIOS BY REGION



DISTRIBUTION OF ACTUARIAL-VALUE-OF-ASSETS-TO-PAYROLL RATIOS BY REGION

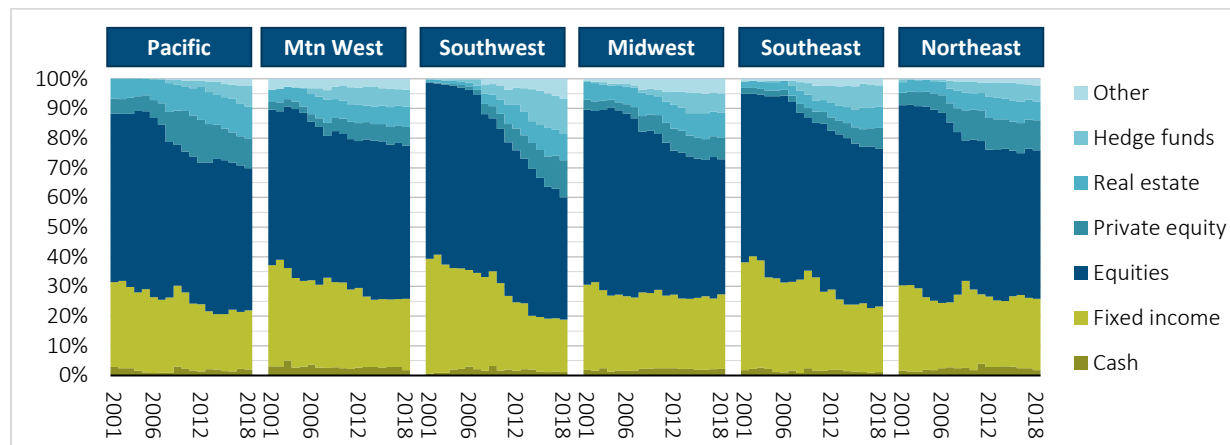


MEDIAN ASSETS-TO-PAYROLL RATIOS BY REGION

Region	Pacific	Mountain West	Southwest	Midwest	Southeast	Northeast
<b>MVA to Payroll</b>						
2001	5.5	4.2	3.8	4.3	4.0	4.4
2018	7.5	5.8	4.7	5.0	4.7	4.8
Difference	2.0	1.6	0.9	0.7	0.7	0.4
% Change	36%	38%	24%	16%	18%	9%
<b>AVA to Payroll</b>						
2001	5.6	4.5	4.0	4.4	4.1	4.8
2018	7.3	5.9	4.7	5.1	4.7	4.7
Difference	1.7	1.4	0.7	0.7	0.6	-0.1
% Change	30%	31%	18%	16%	15%	-2%
<b>Plan Count</b>	21	9	17	37	30	25

### Asset Allocations by Region

AGGREGATE ASSET ALLOCATION, 2001–2018, BY REGION

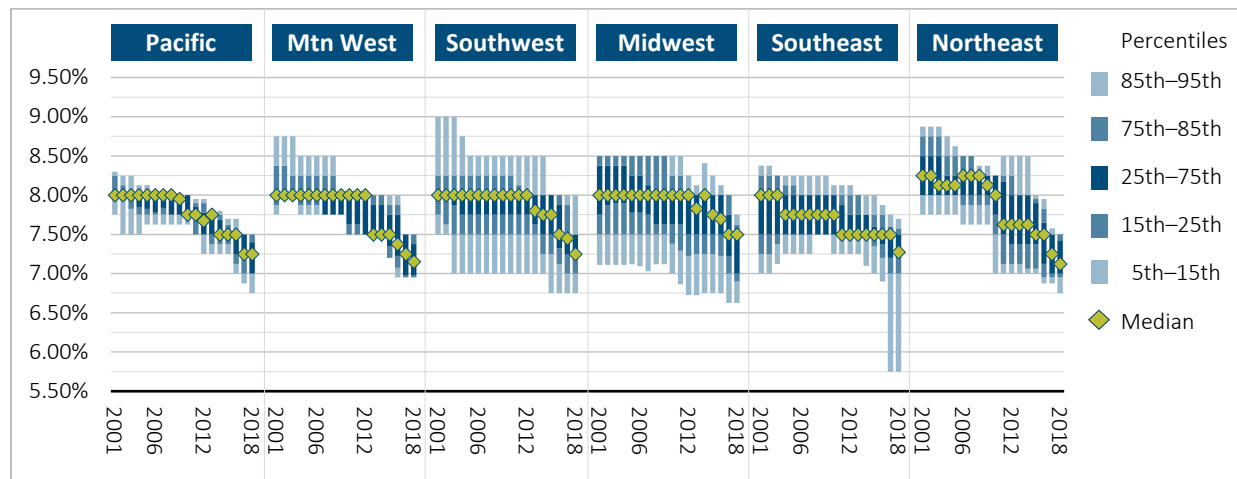


AGGREGATE ASSET ALLOCATION, 2001 COMPARED TO 2018, BY REGION

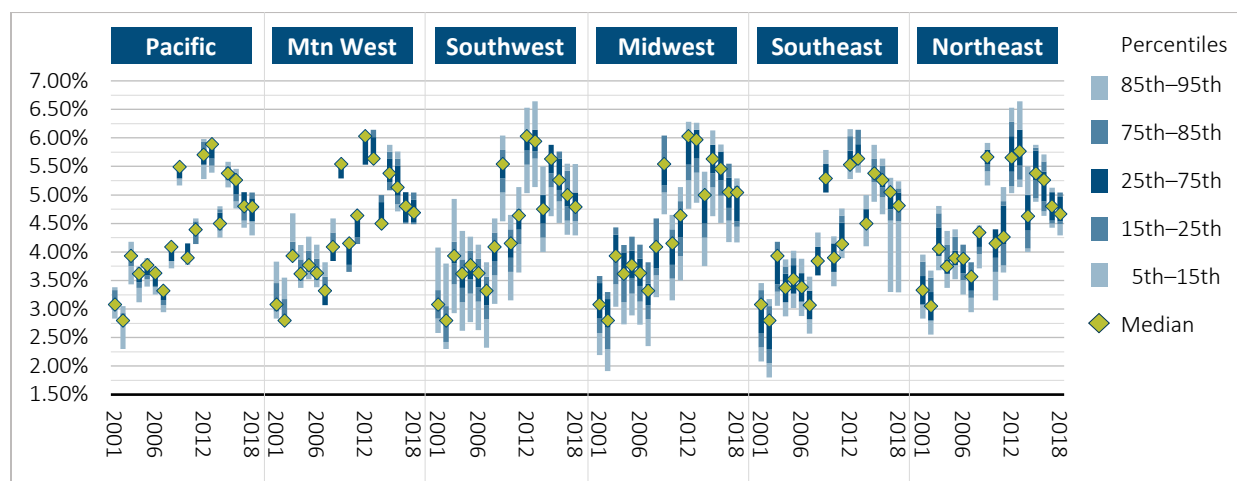
Asset Class	Pacific		Mtn West		Southwest		Midwest		Southeast		Northeast	
	2001	2018	2001	2018	2001	2018	2001	2018	2001	2018	2001	2018
Cash	3%	2%	3%	2%	1%	1%	2%	2%	2%	1%	2%	2%
Other	29%	20%	34%	24%	39%	18%	29%	25%	36%	22%	29%	24%
Hedge funds	56%	48%	52%	51%	59%	41%	59%	46%	57%	54%	60%	51%
Private equity	5%	10%	3%	6%	0%	12%	3%	7%	2%	7%	4%	10%
Real estate	7%	11%	4%	7%	1%	9%	6%	8%	2%	7%	4%	6%
Public fixed income	0%	7%	0%	6%	0%	12%	0%	7%	0%	7%	1%	5%
Public equity	0%	2%	4%	4%	0%	7%	1%	5%	1%	2%	0%	2%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Plan count	21		9		17		37		30		25	

### Assumed Rates of Return by Region

DISTRIBUTION OF ASSUMED RATE OF RETURN



DISTRIBUTION OF ASSUMED RATE OF RETURN LESS 10-YEAR TREASURY RATE



### MEDIANS

	Pacific	Mtn West	Southwest	Midwest	Southeast	Northeast
<b>Assumed Return</b>						
2001	8.00%	8.00%	8.00%	8.00%	8.00%	8.25%
2018	7.25%	7.15%	7.25%	7.50%	7.27%	7.12%
Difference	-0.75%	-0.85%	-0.75%	-0.50%	-0.73%	-1.13%
<b>Assumed Return Less 10-Yr Treas. Rate</b>						
2001	3.08%	3.08%	3.08%	3.08%	3.08%	3.33%
2018	4.79%	4.69%	4.79%	5.04%	4.81%	4.66%
Difference	1.71%	1.61%	1.71%	1.96%	1.73%	1.33%
Plan Count	21	9	17	37	30	25

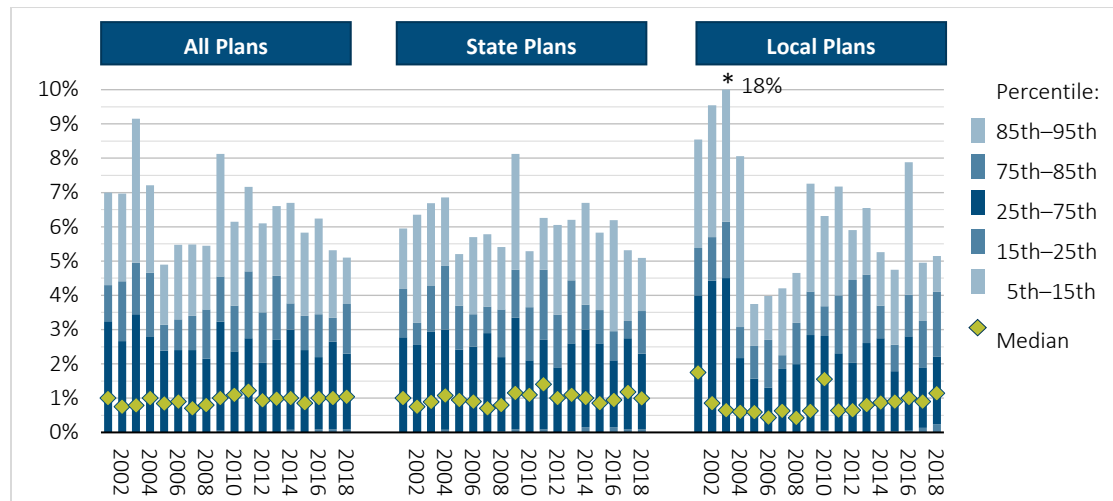
## Appendix D: Asset Allocation Distributions

This appendix displays without commentary the percentile distributions of the asset allocations by sponsoring government type, 2018 funded status, job type and region, as explored in aggregate in the body of this study.

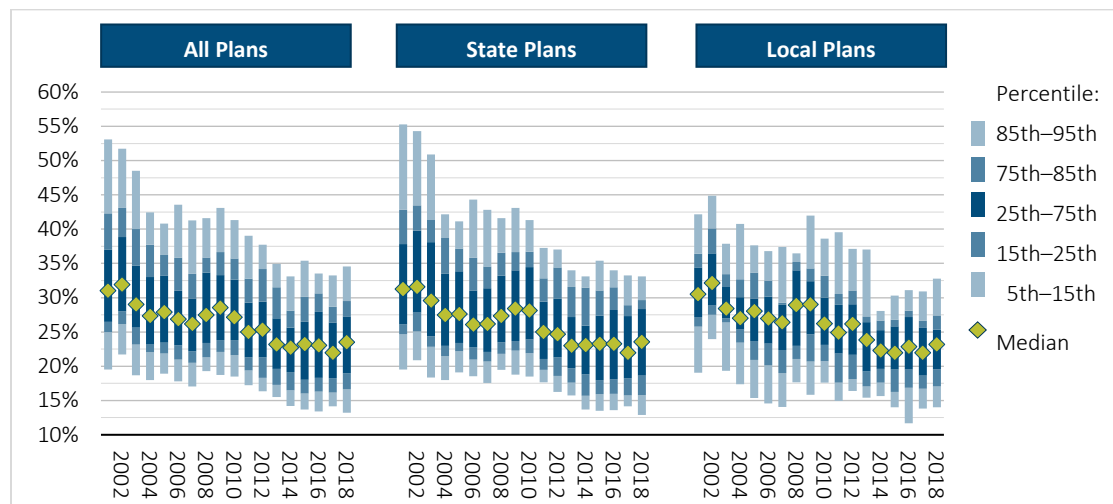
### Asset Allocations by Government Type

#### Allocation Distributions

DISTRIBUTION OF CASH ALLOCATIONS BY GOVERNMENT TYPE

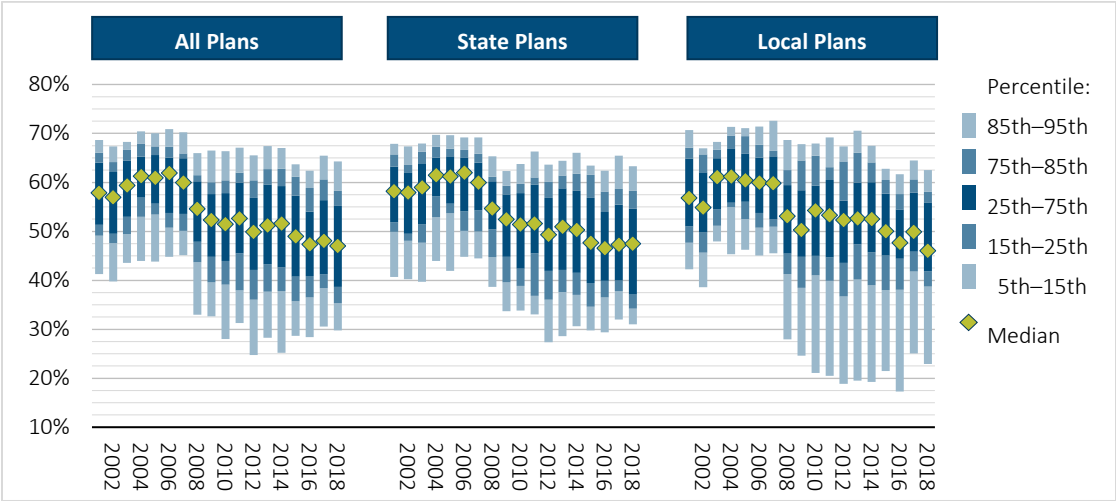


DISTRIBUTION OF PUBLIC FIXED INCOME ALLOCATIONS BY GOVERNMENT TYPE

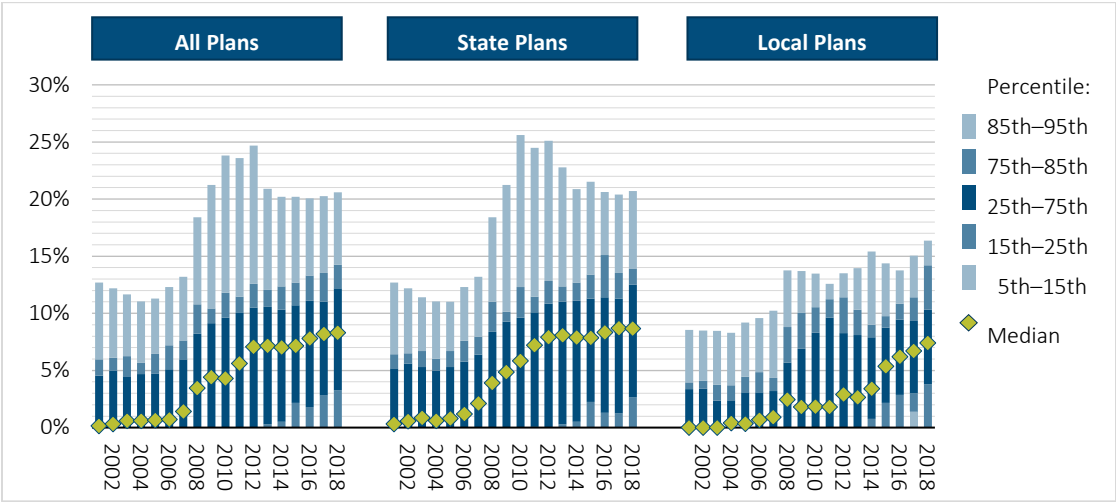




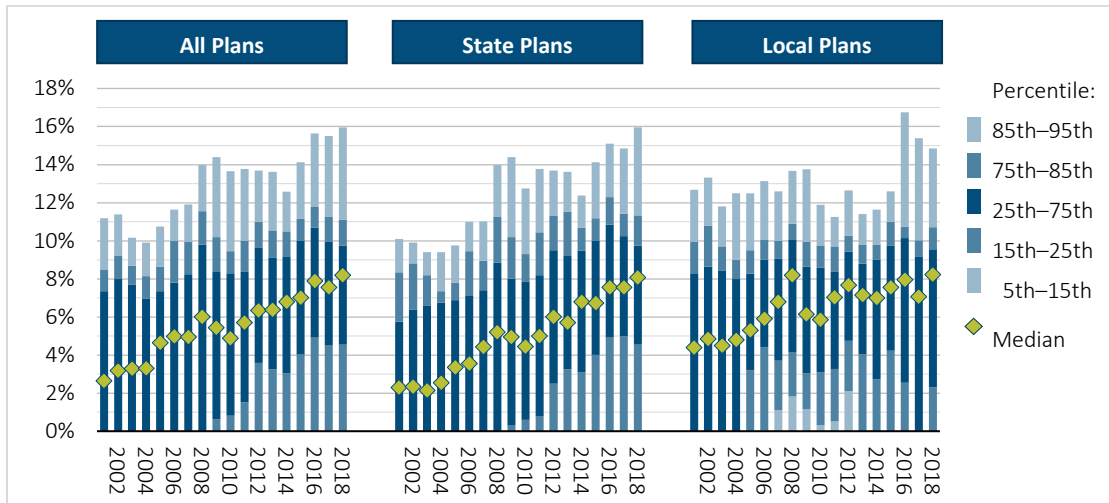
DISTRIBUTION OF PUBLIC EQUITY ALLOCATIONS BY GOVERNMENT TYPE



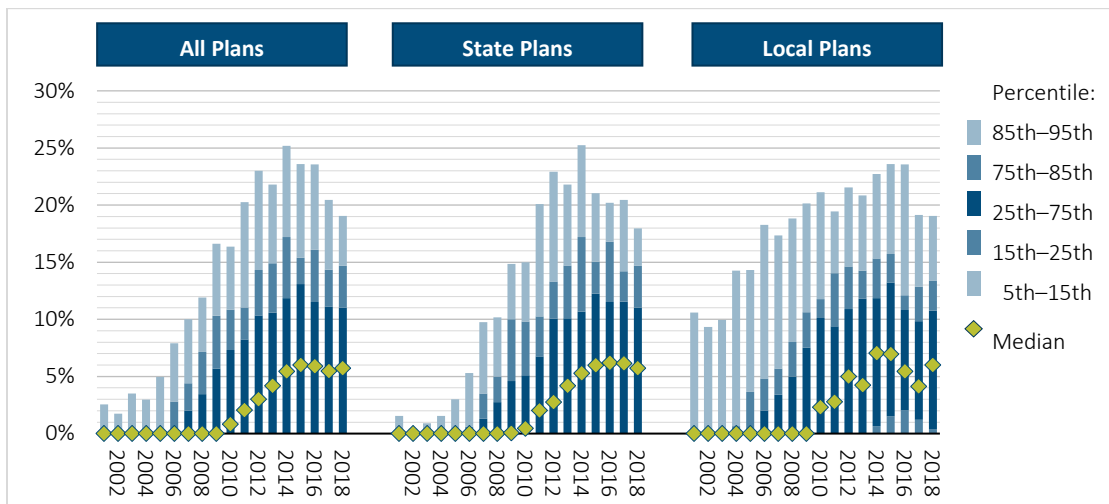
DISTRIBUTION OF PRIVATE EQUITY ALLOCATIONS BY GOVERNMENT TYPE



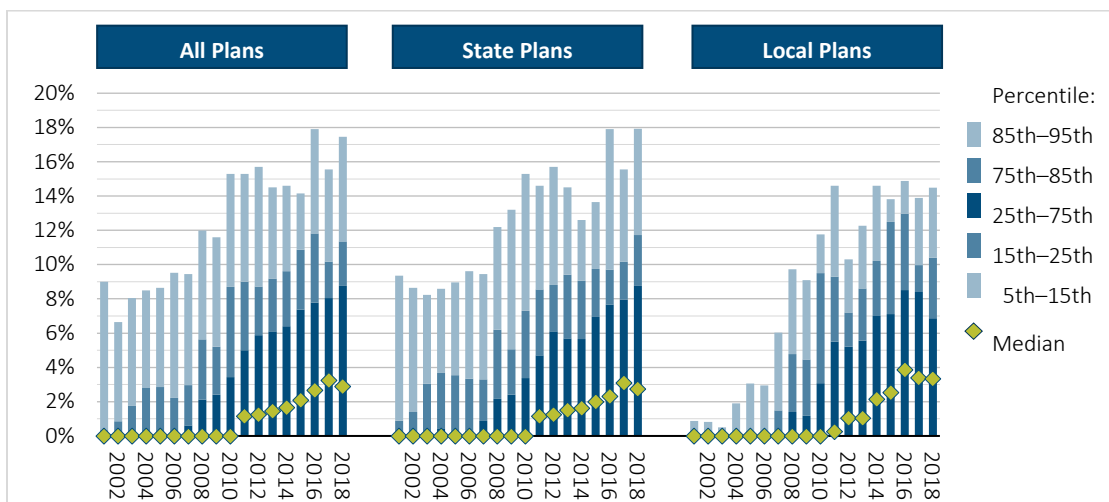
DISTRIBUTION OF REAL ESTATE ALLOCATIONS BY GOVERNMENT TYPE



DISTRIBUTION OF HEDGE FUND ALLOCATIONS BY GOVERNMENT TYPE



DISTRIBUTION OF COMMODITIES, ALTERNATIVES AND OTHER ALLOCATIONS BY GOVERNMENT TYPE



## Median Allocations

### MEDIAN ASSET ALLOCATIONS BY GOVERNMENT TYPE

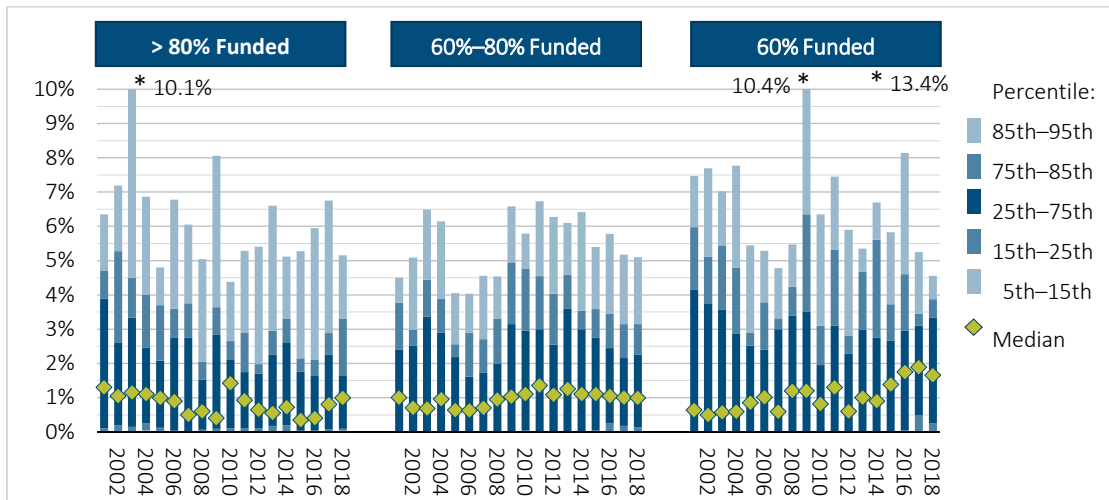
Asset Class	All Plans	State Plans	Local Plans
Cash, 2001	1%	1%	2%
Cash, 2018	1%	1%	1%
Difference	0%	0%	-1%
Public fixed income, 2001	31%	31%	31%
Public fixed income, 2018	24%	24%	23%
Difference	-7%	-8%	-7%
Public equity, 2001	58%	58%	57%
Public equity, 2018	47%	47%	46%
Difference	-11%	-11%	-11%
Private equity, 2001	0%	0%	0%
Private equity, 2018	8%	9%	7%
Difference	8%	8%	7%
Real estate, 2001	3%	2%	4%
Real estate, 2018	8%	8%	8%
Difference	6%	6%	4%
Hedge funds, 2001	0%	0%	0%
Hedge funds, 2018	6%	6%	6%
Difference	6%	6%	6%
Other, 2001	0%	0%	0%
Other, 2018	3%	3%	3%
Difference	3%	3%	3%
<b>Plan count</b>	<b>139</b>	<b>102</b>	<b>37</b>

Percentages may not add to 100% because of rounding.

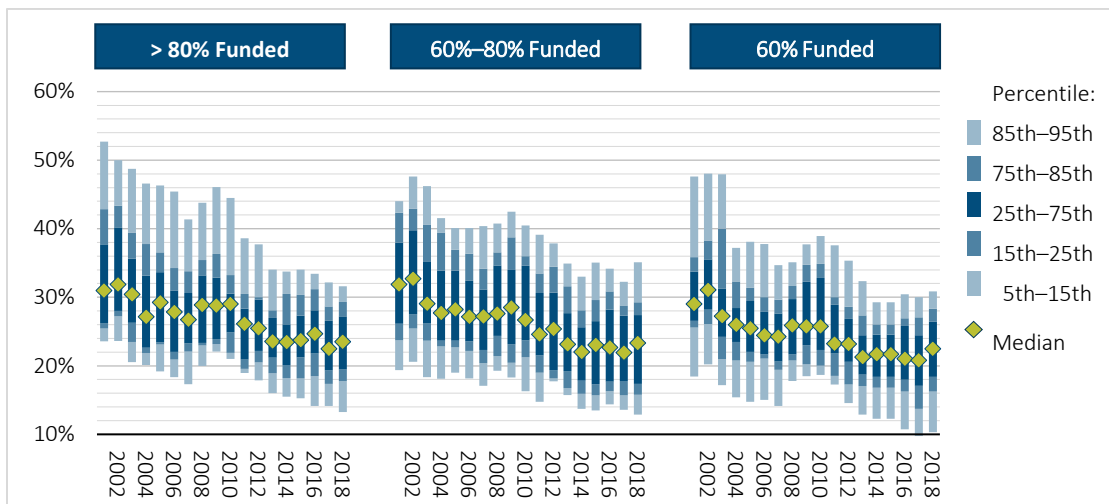
## Asset Allocations by 2018 Funded Status

### Allocation Distributions

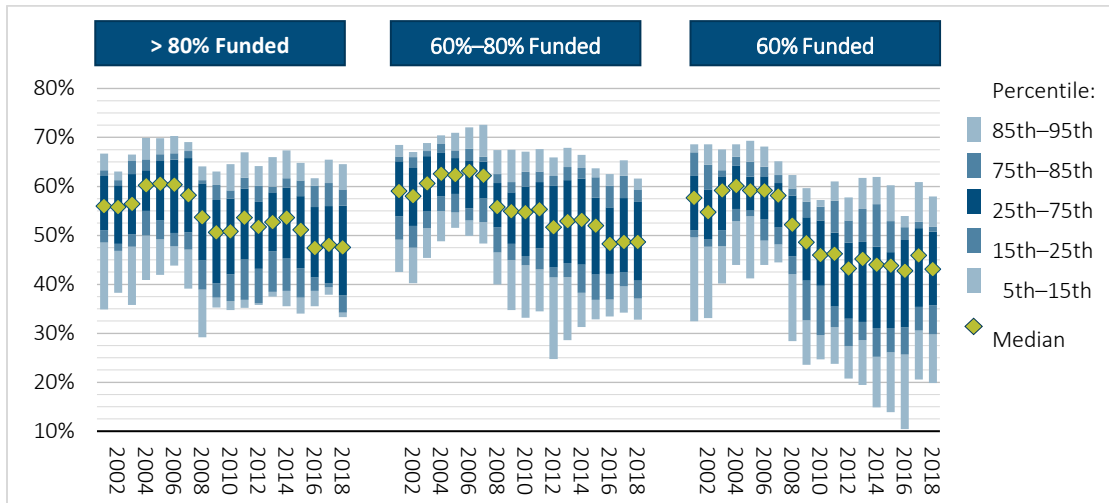
DISTRIBUTION OF CASH ALLOCATIONS BY 2018 FUNDED STATUS



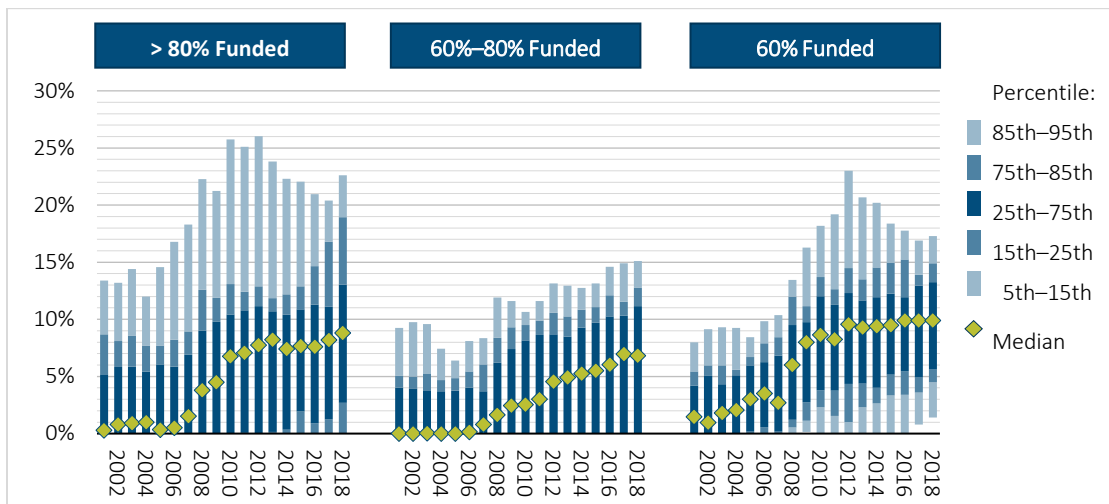
DISTRIBUTION OF PUBLIC FIXED INCOME ALLOCATIONS BY 2018 FUNDED STATUS



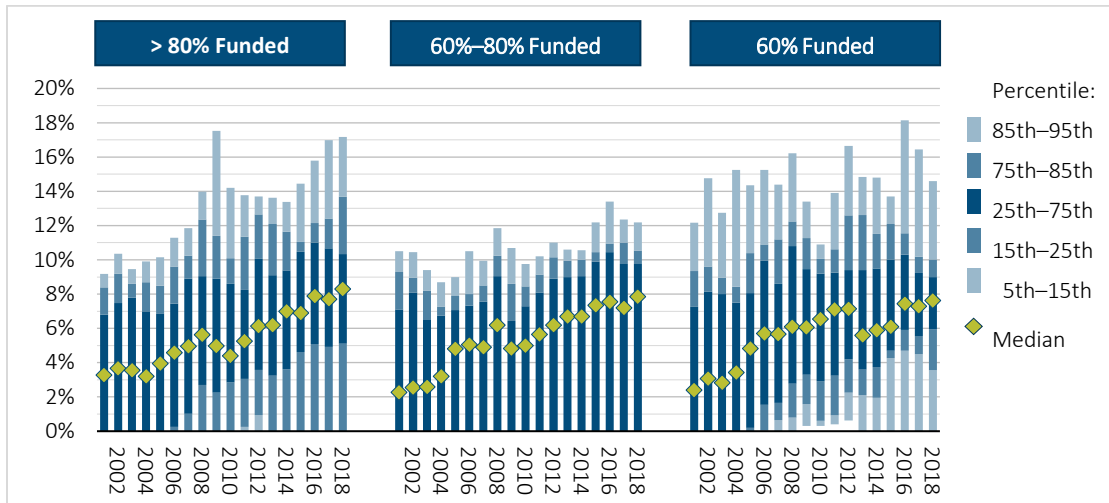
DISTRIBUTION OF PUBLIC EQUITY ALLOCATIONS BY 2018 FUNDED STATUS



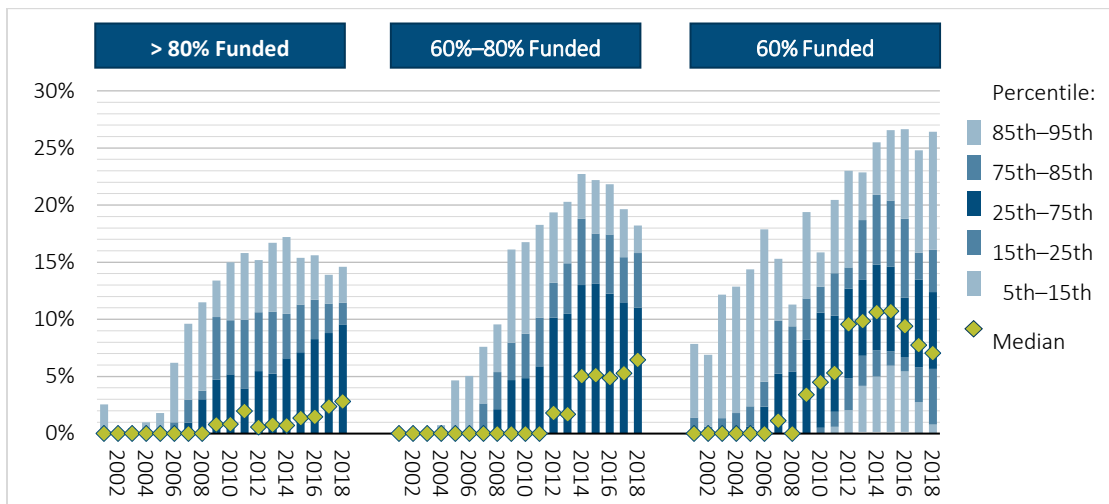
DISTRIBUTION OF PRIVATE EQUITY ALLOCATIONS BY 2018 FUNDED STATUS



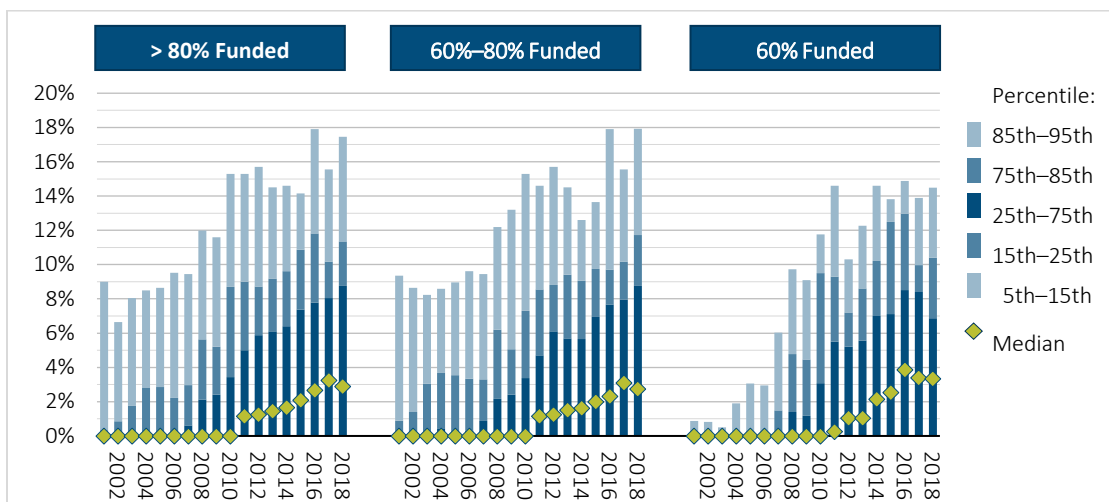
### DISTRIBUTION OF REAL ESTATE ALLOCATIONS BY 2018 FUNDED STATUS



### DISTRIBUTION OF HEDGE FUND ALLOCATIONS BY 2018 FUNDED STATUS



### DISTRIBUTION OF COMMODITIES, ALTERNATIVES AND OTHER ALLOCATIONS BY 2018 FUNDED STATUS



## Median Allocations

### MEDIAN ASSET ALLOCATIONS BY 2018 FUNDED STATUS

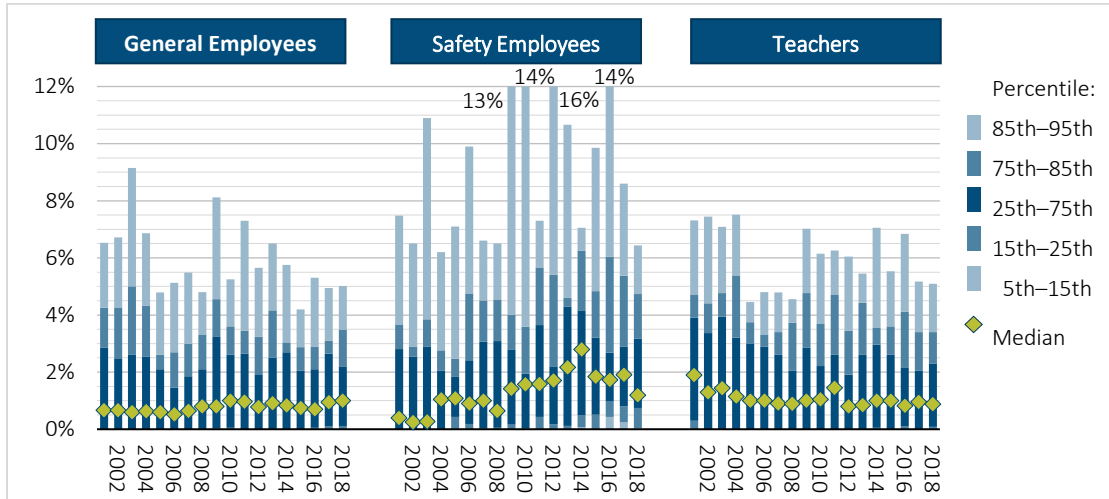
Asset Class	At least 80% Funded in 2018	60%–80% Funded in 2018	Less than 60% Funded in 2018
Cash, 2001	1%	1%	1%
Cash, 2018	1%	1%	2%
Difference	0%	0%	1%
Public fixed income, 2001	31%	32%	29%
Public fixed income, 2018	24%	23%	23%
Difference	-7%	-9%	-7%
Public equity, 2001	56%	59%	58%
Public equity, 2018	48%	49%	43%
Difference	-8%	-10%	-15%
Private equity, 2001	0%	0%	0%
Private equity, 2018	9%	7%	9%
Difference	9%	7%	9%
Real estate, 2001	3%	2%	3%
Real estate, 2018	8%	8%	8%
Difference	5%	6%	5%
Hedge funds, 2001	0%	0%	0%
Hedge funds, 2018	3%	6%	3%
Difference	3%	6%	3%
Other, 2001	0%	0%	0%
Other, 2018	0%	3%	0%
Difference	0%	3%	0%
<b>Plan count</b>	<b>47</b>	<b>63</b>	<b>29</b>

Percentages may not add to 100% because of rounding.

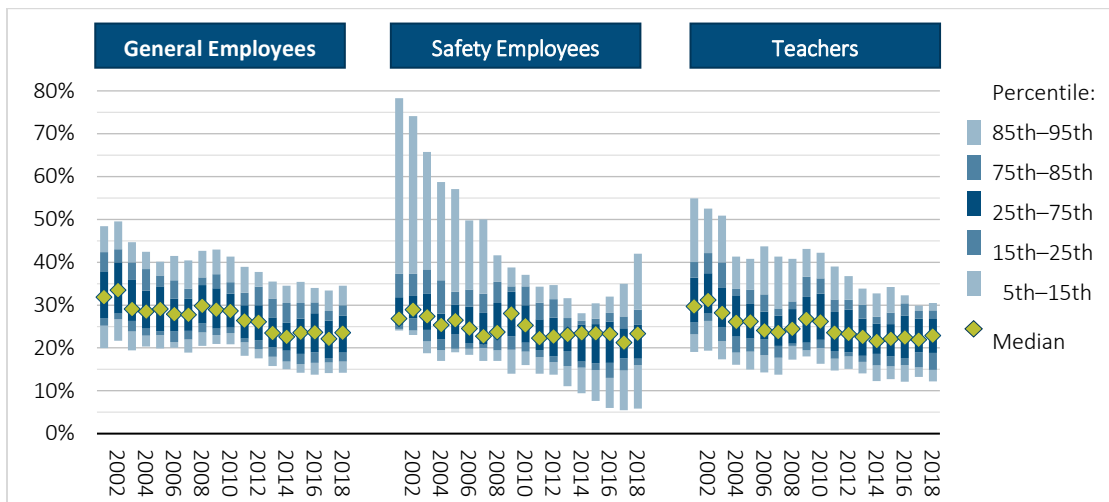
## Asset Allocations by Job Category

### Allocation Distributions

DISTRIBUTION OF CASH ALLOCATIONS BY JOB CATEGORY

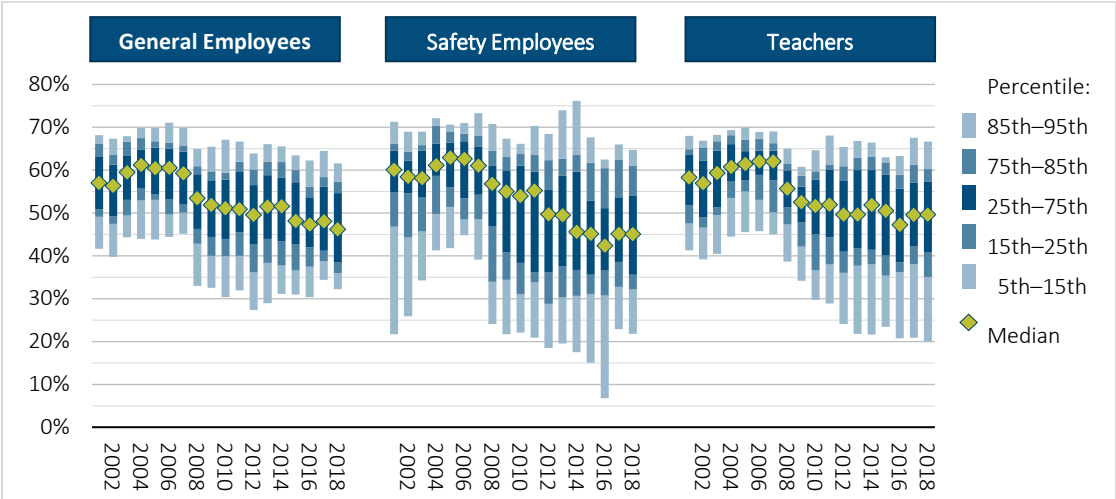


DISTRIBUTION OF PUBLIC FIXED INCOME ALLOCATIONS BY JOB CATEGORY

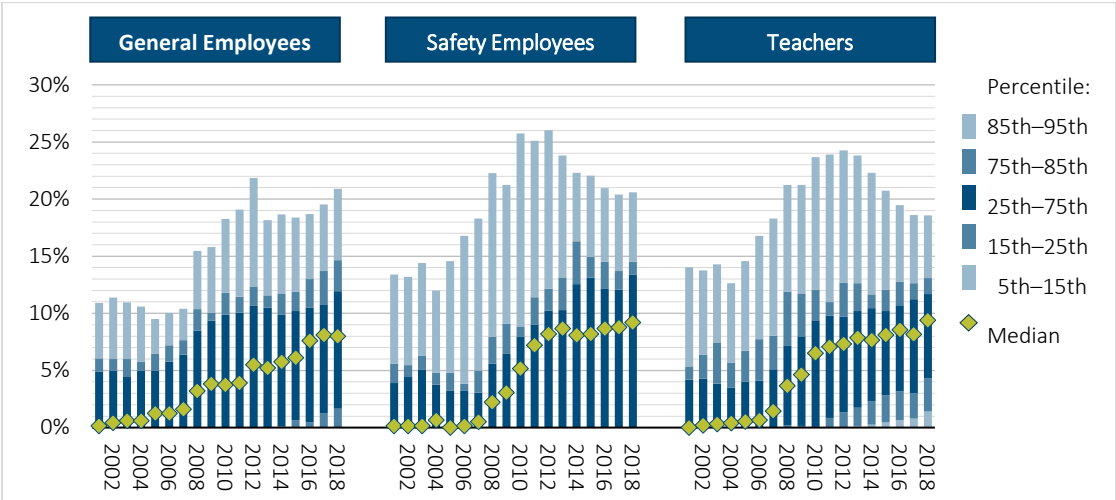




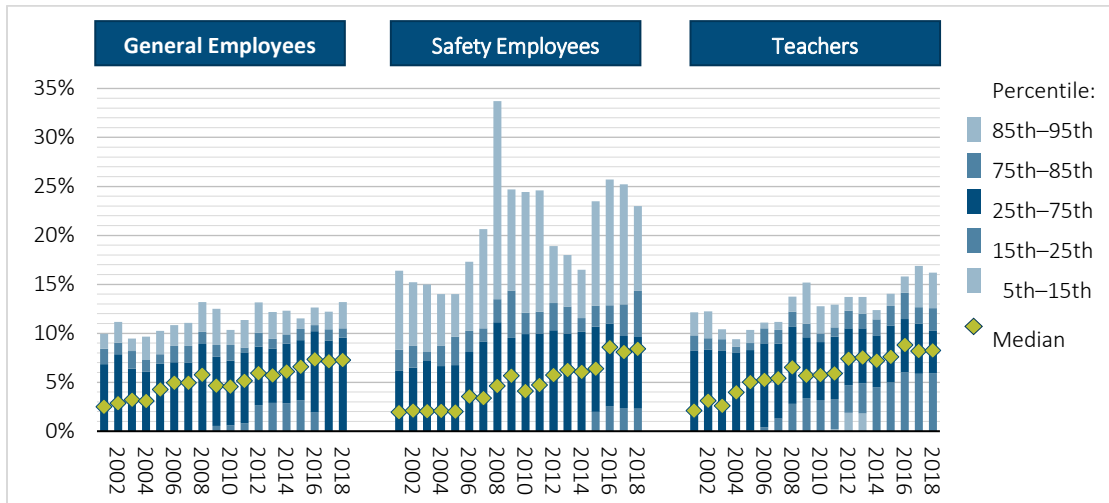
DISTRIBUTION OF PUBLIC EQUITY ALLOCATIONS BY JOB CATEGORY



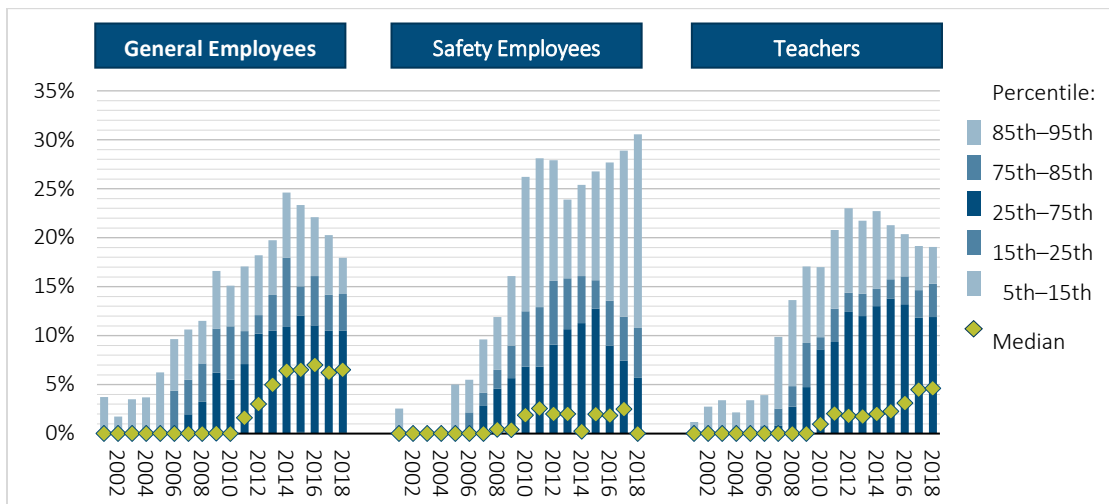
DISTRIBUTION OF PRIVATE EQUITY ALLOCATIONS BY JOB CATEGORY



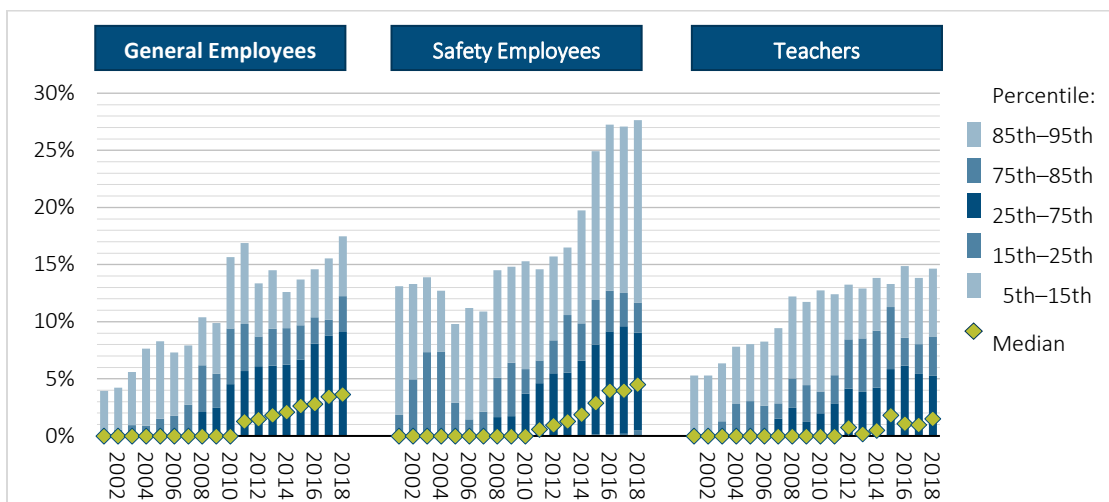
DISTRIBUTION OF REAL ESTATE ALLOCATIONS BY JOB CATEGORY



DISTRIBUTION OF HEDGE FUND ALLOCATIONS BY JOB CATEGORY



DISTRIBUTION OF COMMODITIES, ALTERNATIVES AND OTHER ALLOCATIONS BY JOB CATEGORY



## Median Allocations

### MEDIAN ASSET ALLOCATIONS BY JOB CATEGORY

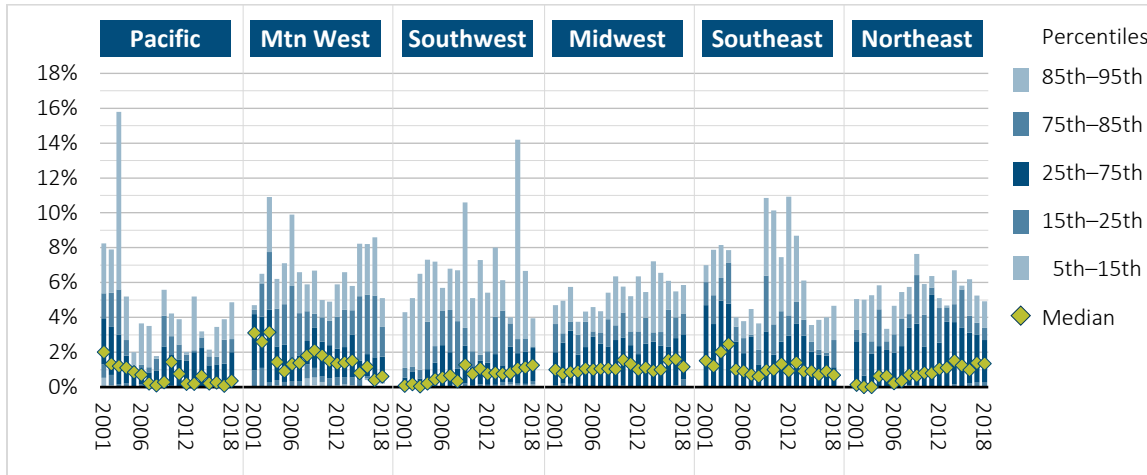
Asset Class	General Employees	Safety Employees	Teachers
Cash, 2001	1%	0%	2%
Cash, 2018	1%	1%	1%
Difference	0%	1%	-1%
Public fixed income, 2001	32%	27%	30%
Public fixed income, 2018	24%	23%	23%
Difference	-8%	-4%	-7%
Public equity, 2001	57%	60%	58%
Public equity, 2018	46%	45%	50%
Difference	-11%	-15%	-9%
Private equity, 2001	0%	0%	0%
Private equity, 2018	8%	9%	9%
Difference	8%	9%	9%
Real estate, 2001	3%	2%	2%
Real estate, 2018	7%	8%	8%
Difference	5%	6%	6%
Hedge funds, 2001	0%	0%	0%
Hedge funds, 2018	7%	0%	5%
Difference	7%	0%	5%
Other, 2001	0%	0%	0%
Other, 2018	4%	5%	2%
Difference	4%	5%	2%
<b>Plan count</b>	<b>83</b>	<b>17</b>	<b>39</b>

Percentages may not add to 100% because of rounding.

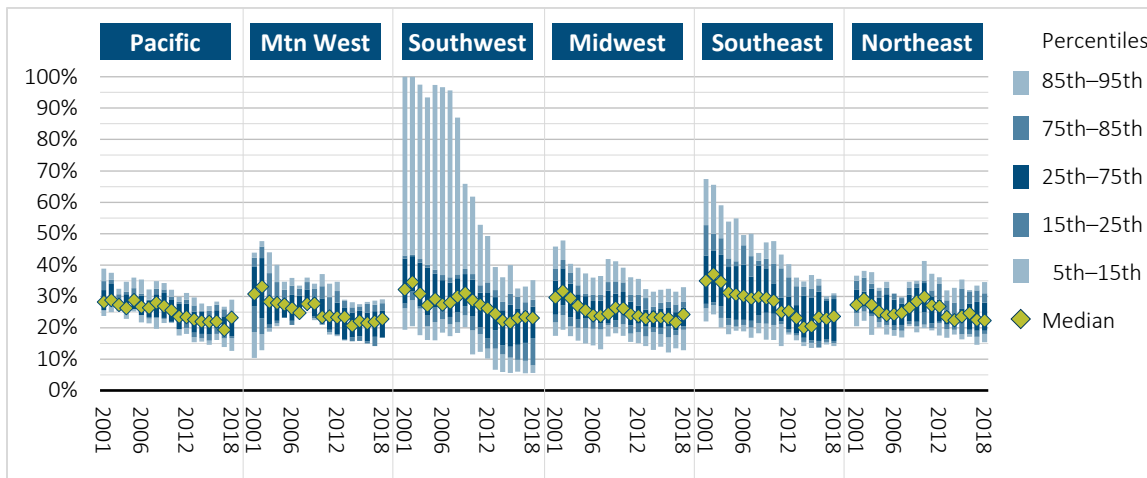
## Asset Allocations by Region

### Allocation Distributions

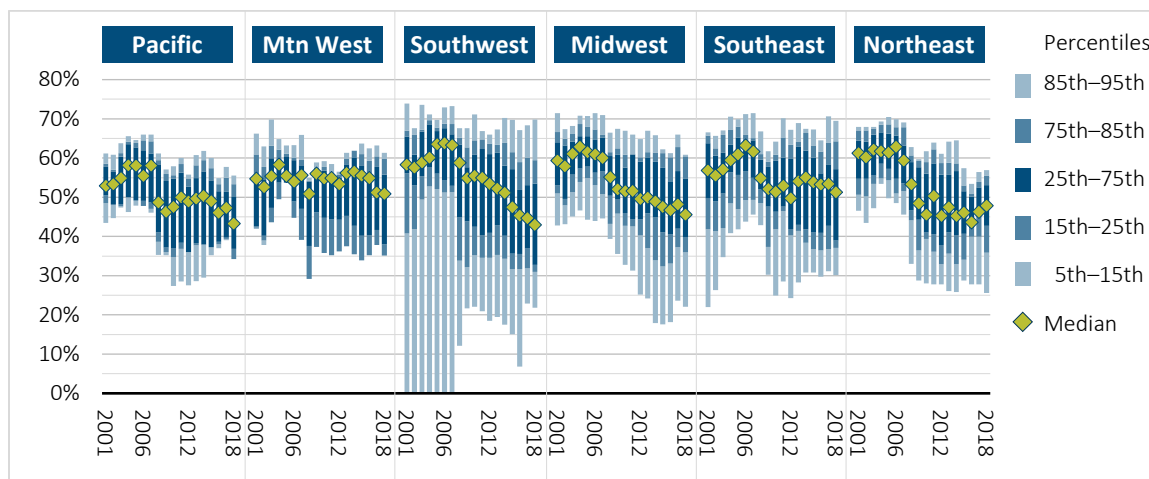
#### CASH DISTRIBUTIONS BY REGION



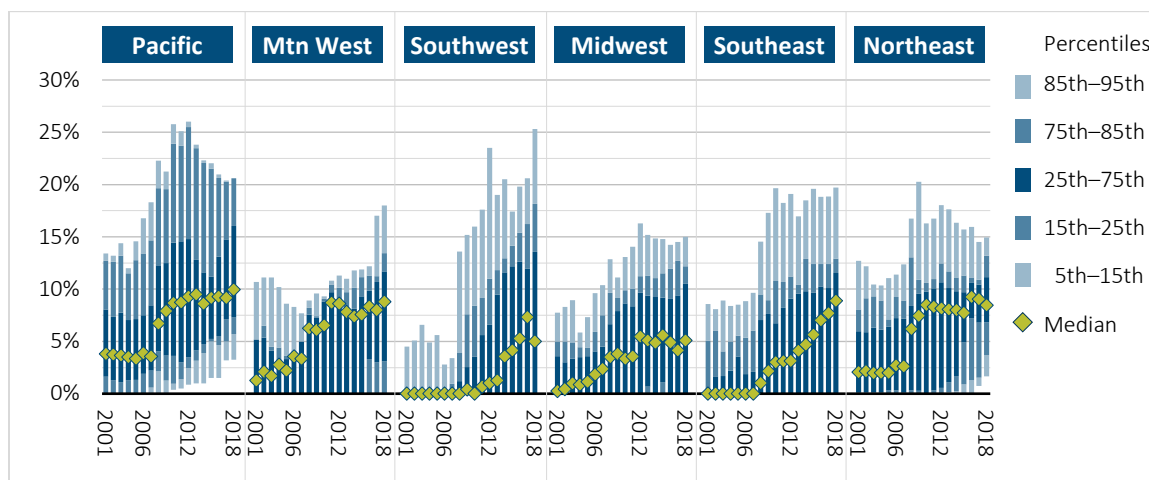
#### PUBLIC FIXED INCOME DISTRIBUTIONS BY REGION



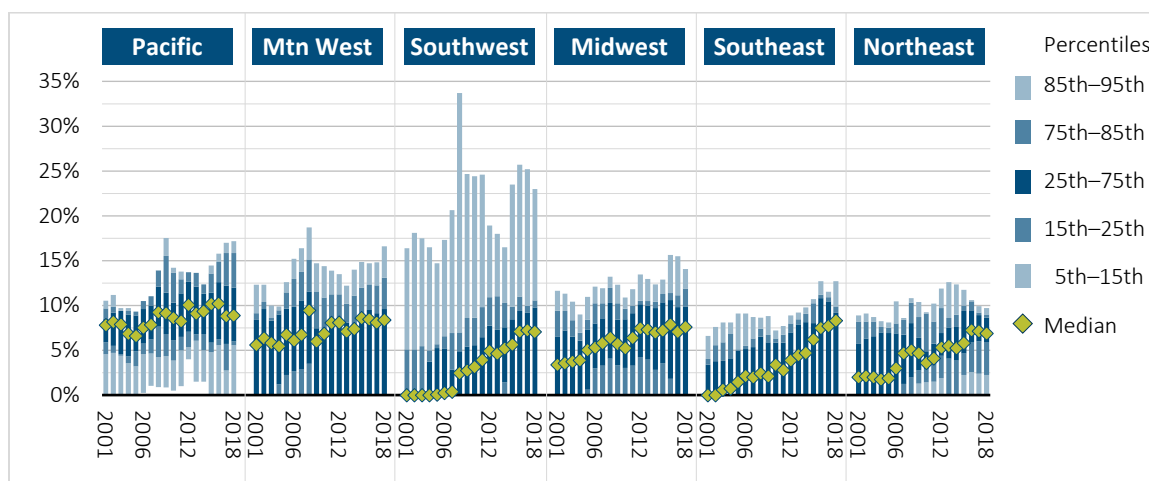
### PUBLIC EQUITY DISTRIBUTIONS BY REGION



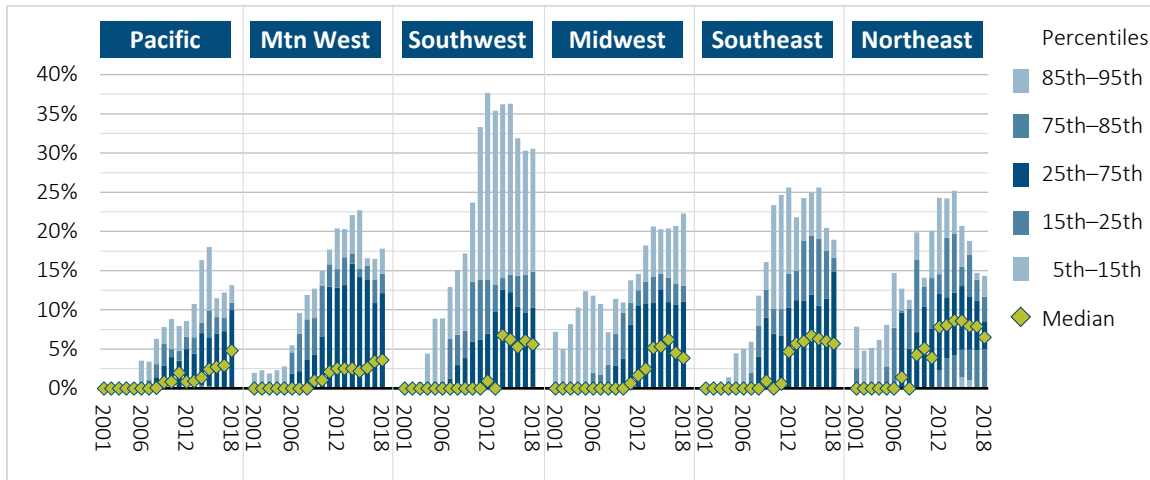
### PRIVATE EQUITY DISTRIBUTIONS BY REGION



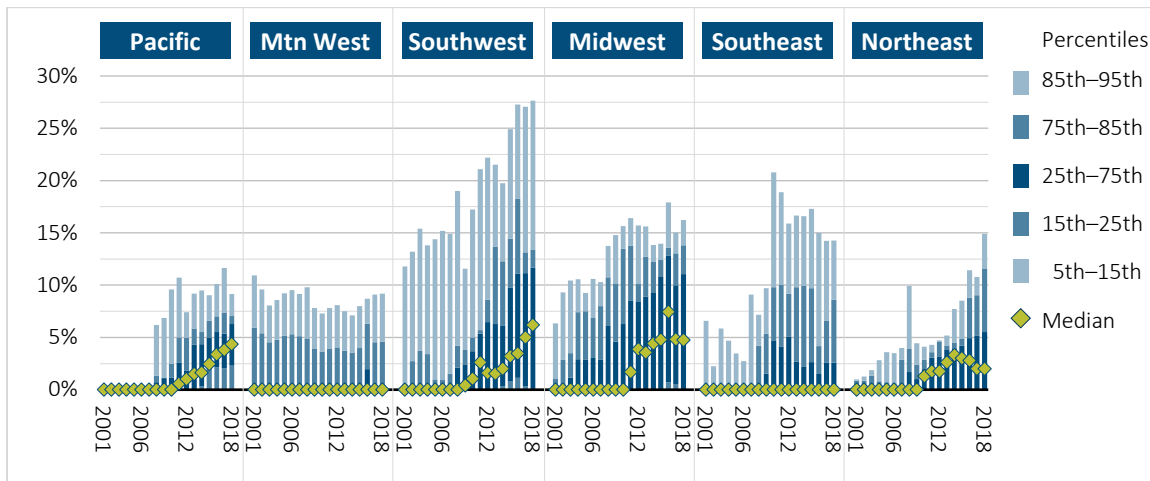
### REAL ESTATE DISTRIBUTIONS BY REGION



HEDGE FUNDS DISTRIBUTIONS BY REGION



OTHER DISTRIBUTIONS BY REGION



## Median Allocations

### MEDIAN ASSET ALLOCATIONS BY REGION

Asset Class	Pacific	Mtn West	Southwest	Midwest	Southeast	Northeast
Cash, 2001	2%	3%	0%	1%	1%	0%
Cash, 2018	0%	1%	1%	1%	1%	1%
Difference	-2%	-2%	1%	0%	0%	1%
Public fixed income, 2001	28%	31%	32%	30%	35%	27%
Public fixed income, 2018	23%	23%	23%	24%	24%	22%
Difference	-5%	-8%	-9%	-6%	-11%	-5%
Public equity, 2001	53%	55%	58%	59%	57%	61%
Public equity, 2018	43%	51%	43%	46%	51%	48%
Difference	-10%	-4%	-15%	-13%	-6%	-13%
Private equity, 2001	8%	6%	0%	3%	0%	2%
Private equity, 2018	9%	8%	7%	8%	8%	7%
Difference	1%	2%	7%	5%	8%	5%
Real estate, 2001	0%	0%	0%	0%	0%	0%
Real estate, 2018	5%	4%	6%	4%	6%	6%
Difference	5%	4%	6%	4%	6%	6%
Hedge funds, 2001	0%	0%	0%	0%	0%	0%
Hedge funds, 2018	5%	4%	6%	4%	6%	6%
Difference	5%	4%	6%	4%	6%	6%
Other, 2001	0%	0%	0%	0%	0%	0%
Other, 2018	4%	0%	6%	5%	0%	2%
Difference	4%	0%	6%	5%	0%	2%
<b>Plan count</b>	<b>21</b>	<b>9</b>	<b>17</b>	<b>37</b>	<b>30</b>	<b>25</b>

Percentages may not add to 100% because of rounding.

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