WHAT EXPLAINS DIFFERENCES IN PUBLIC PENSION RETURNS SINCE 2001?

By Jean-Pierre Aubry, Anqi Chen, Alicia H. Munnell, and Kevin Wandrei*

INTRODUCTION

Two key factors underlying the funded status of public pensions are the payment of the annual required contribution by plan sponsors and the investment return earned on pension fund assets. To date, CRR studies have focused on the importance of making the full payment of an appropriately set annual required contribution – highlighting how inadequate contributions can undermine funding progress. However, given that most public pension funds rely heavily on investment returns to fund future benefits, a key component of their long-term sustainability is the ability to achieve adequate returns.

This *brief* documents the investment performance of public plans from 2001-2016 and investigates the two main factors underlying disparities among plans: 1) differences in asset allocation; and 2) differences in the realized returns within each asset class. The analysis is based on newly collected data from the *Public Plans Data* (PPD) website.

The *brief* proceeds as follows. The first section documents differences in the average annualized investment returns for public plans from 2001-2016. On average, the annualized return for public plans during this period was 5.5 percent – well below the

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typical actuarially assumed return. However, the returns for plans in the top and bottom quartiles were 6.3 and 4.6 percent respectively – a difference that could account for roughly a 20-percentage-point disparity in their funded ratios. The second section introduces the two factors that could cause the differences in returns: asset allocation and returns by asset class. The third section investigates the relative role of these factors in explaining differences in plan performance over the 16-year period. The final section concludes that asset allocation across plans is relatively similar while asset class returns show more substantial variation. Therefore, differences in returns turn out to be the major reason that lower-quartile plans underperformed the top-quartile plans over the period.

A Brief Review of Public Pension Performance

On average, the annualized return – net of fees – for public plans was 5.5 percent from 2001-2016. But, variation in the annualized return is meaningful; the top quartile of plans had an average annualized return of 6.3 percent while the bottom quartile had a return of only 4.6 percent.[1] The second and third quartiles had returns of 5.2 percent and 5.6 percent respectively (see Figure 1).[2]

Figure 1. Average Annualized Return for Public Pension Plans, 2001-2016, by Quartile
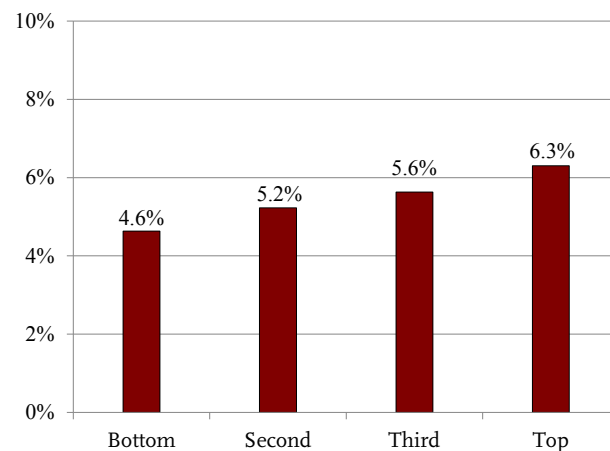
Source: Authors' calculations from the *Public Plans Data* (PPD) website (2001-2016).

Table 1 provides some basic statistics about the plans in each quartile. Interestingly, despite the common narrative that larger plans perform better due to economies of scale, plans in the top quartile were smaller, on average, than those in the lower quartiles.[3] Unsurprisingly, the top quartile plans were better funded than those in the lower quartiles.

Table 1. PPD Plan Details, by Quartile Returns, 2016

Quartile	Average market assets (billions)	Market funded ratio
Bottom	$21.4	62.9%
Second	24.4	69.7
Third	23.2	70.7
Top	13.1	79.6

Note: See Appendix Table A1 for a complete list of plans and their investment performance.
Source: Authors' calculations based on the PPD (2016).

Comparing the actual 2016 funded ratios to a hypothetical scenario suggests that much of the differences in funding between the top and bottom quartiles can be attributed to differences in their investment returns. The hypothetical scenario assumes that plans in the bottom quartile achieve the average returns of the top quartile, and the top-quartile plans achieve the average returns of the bottom quartile. The intent is to approximate the 2016 funded status for the plans in each quartile if they had swapped investment return experience.[4] The results show that the average funded status of plans in the bottom quartile would be about 25 percentage points higher in 2016 if they had achieved the returns of the top quartile, while the average funded ratio of the top quartile would be about 15 percentage points lower (see Figure 2, on the next page).

What Factors Explain the Differences in Returns?

The differences in overall portfolio returns could result from differences in asset allocation and/or asset class returns.[5] To understand how each factor contributed to the lower performance of plans in the bottom three quartiles, the analysis relies on detailed PPD data from 2001-2016 that were collected from plans' Comprehensive Annual Financial Reports

Figure 2. 2016 Market Funded Ratios under Various Return Assumptions, by Quartile
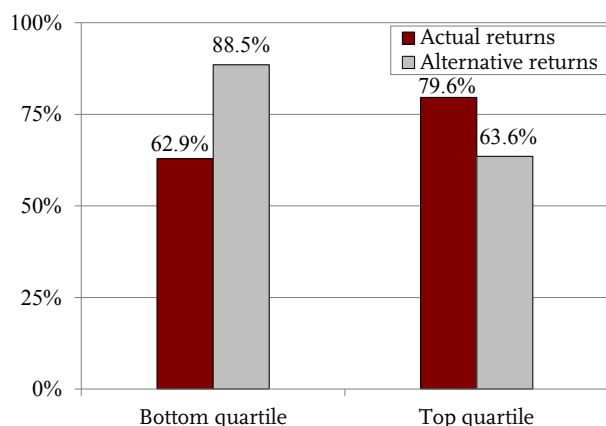
Note: The projection assumes that annual contributions, benefit payments, and liabilities are exactly equal to reported values in the PPD from 2001-2016.
Source: Authors' calculations from the PPD (2001-2016).

(CAFRs) and investment reports. A plan is included in the analysis if data on allocations and investment returns for corresponding asset classes are reported for at least 90 percent of its plan portfolio.[6] Over 60 percent of plans, representing 75 percent of the assets in the PPD, met this requirement.[7] The sample is representative – the average returns for the sample of plans in each quartile are nearly identical to the quartile returns for the full PPD (see Table 2).[8]

Table 2. Average Annualized Returns, 2001-2016, by PPD Quartile

PPD quartile	Total PPD	Analysis sample
Bottom	4.6%	4.7%
Second	5.2	5.2
Third	5.6	5.6
Top	6.3	6.2

Source: Authors' calculations based on the PPD (2001-2016).

Asset Allocation

Figures 3 presents the average allocation to equities, fixed income, and alternatives for each quartile in 2016.[9] The key takeaway from this chart is that the asset allocations across quartiles are relatively similar – allocations to the three broad asset classes differ by less than 10 percentage points.

Figure 3. Asset Allocation by Quartile of Returns, 2016
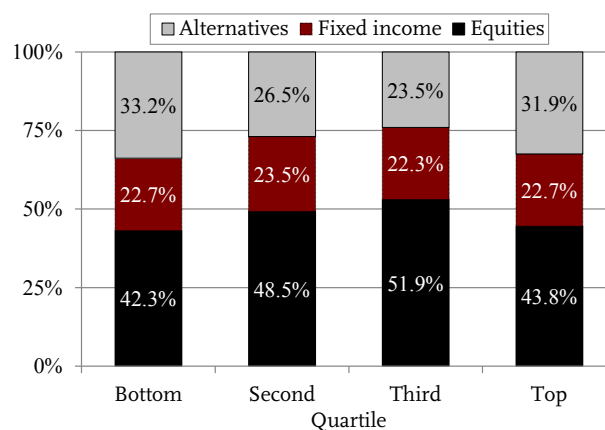
Source: Authors' calculations from the PPD (2016).

Figures 4, 5, and 6 (on the next page) show how the annual allocation for each quartile has evolved from 2001 to 2016. The y-axis for each of the figures spans only 30 percentage points in order to magnify the difference in allocation patterns.

Figure 4 shows the annual allocation to equities. For each quartile, the allocation to equities has declined over time. However, the patterns of decline differ slightly for each group. From 2001-2008, plans in the top quartile held comparatively less in equities than the other quartiles. However, in the years following the financial crisis (after equity values dropped), equity holdings of the bottom quartile fell dramatically to the level of the top quartile. The decline in equity holdings for the second and third quartiles was less dramatic. As of 2016, the quartile allocations to equities fell into two groups. Both the top and bottom quartiles held similar allocations – 44 percent and 42 percent, respectively – while the second and third quartiles held 49 percent and 52 percent, respectively.

FIGURE 4. ALLOCATION TO EQUITIES BY QUARTILE OF
RETURNS, 2001-2016
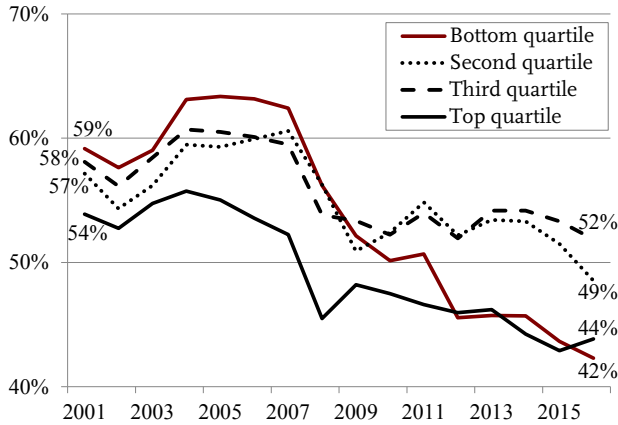
Source: Authors' calculations from the PPD (2001-2016).

Figure 5 shows the annual allocation to fixed income over time. Similar to the equity holdings, allocations to fixed income have decreased, likely in response to the secular decline in interest rates. Allocations to fixed income across quartiles have also converged over this period. In 2001, the allocation to fixed income ranged from 29-35 percent across the four quartiles. Today, they all hold about 23 percent.

FIGURE 5. ALLOCATION TO FIXED INCOME BY QUARTILE
OF RETURNS, 2001-2016
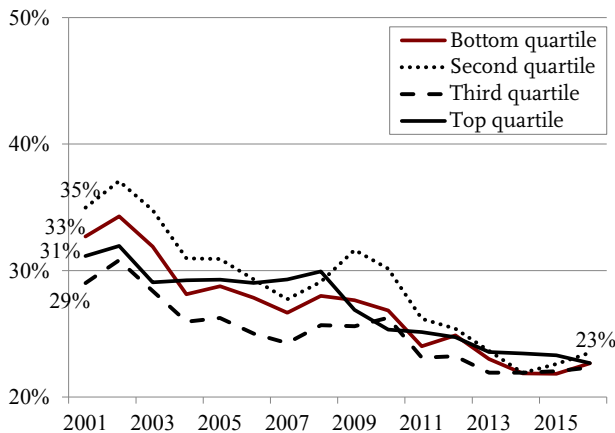
Source: Authors' calculations from the PPD (2001-2016).

Figure 6 shows the annual allocation to alternatives over time. As equity and fixed-income allocations have declined, the allocations to alternatives have increased for all quartiles. In earlier years, allocations to alternatives fell into two groups. The top two quartiles each held about 12 percent of their assets in alternatives, while the bottom two quartiles each held about 7 percent. The allocation of the bottom quartile increased dramatically – from 7 percent in 2001 to 33 percent today – and now aligns with the top quartile's allocation of 32 percent.[10] The second quartile increased from 6 percent to 27 percent and aligns closely with the third quartile's allocation of 24 percent.

FIGURE 6. ALLOCATION TO ALTERNATIVES BY QUARTILE
OF RETURNS, 2001-2016
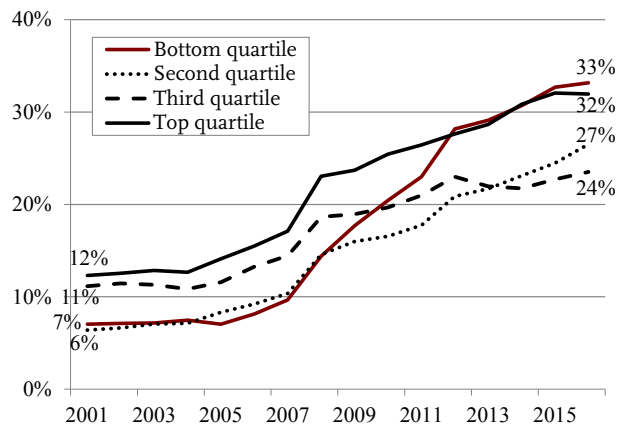
Source: Authors' calculations from the PPD (2001-2016).

When considering the change and level of allocations to alternatives, it is important to note that plans also hold different types of alternatives. Although the top and bottom quartiles hold a similar level of alternatives in aggregate, the bottom quartile holds slightly more in commodities and hedge funds and less in private equity and real estate (see Figure 7, on the next page). And, between the second and third quartiles, the second quartile holds more in real estate, hedge funds, and private equity.

FIGURE 7. PERCENTAGE OF PLAN HOLDINGS IN
ALTERNATIVE ASSET CLASSES BY TYPE OF ALTERNATIVE
AND QUARTILE OF RETURNS, 2016
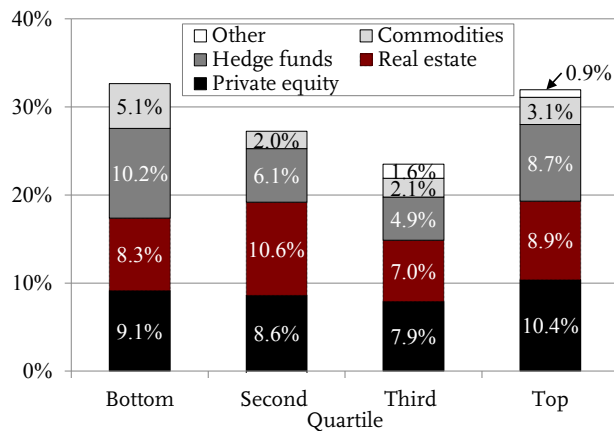
Source: Authors' calculations from the PPD (2016).

RETURNS BY ASSET CLASS

Next, the analysis looks at returns by asset class.
Table 3 shows the annualized average return of each
asset class from 2001-2016, by quartile.[11] Two key
takeaways emerge. First, long-term returns for each
asset class differ.[12] For example, private equity and

TABLE 3. ANNUALIZED ASSET CLASS RETURNS BY
QUARTILE, 2001-2016

Asset class	Top	Third	Second	Bottom
Public equities	6.2%	5.1%	4.1%	4.1%
Fixed income	6.2	6.2	6.3	6.1
Alternatives				
Private equity	8.8	8.5	6.6	8.5
Hedge funds	5.7	4.5	6.3	5.0
Real estate	10.2	9.3	8.2	7.0
Commodities	5.0	6.6	-2.8	4.8

Note: See endnote 10.
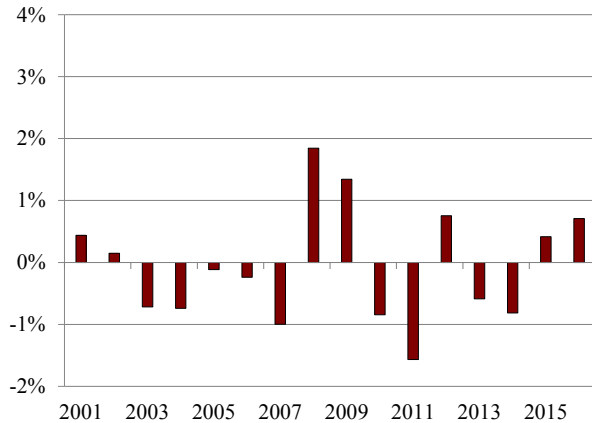*Source*: Authors' calculations from the PPD (2001-2016).

real estate had higher average returns than public
equities over the period.[13] This variability suggests
that the differences in asset allocation shown above,
although small, may be a factor in the quartiles'
different returns. The second takeaway is that the
three lower quartiles underperform the top quartile
in many asset classes – most clearly in public equi-
ties, which is the largest asset class.[14] This finding
suggests that asset class returns are likely an impor-
tant factor in the underperformance of lower-quartile
plans.

WHY LOWER PERFORMERS DO WORSE

To examine the role of allocations and returns in the
underperformance of plans in the lower three quar-
tiles relative to plans in the top quartile, we calculate
how the lower-quartile plans would have performed
if they mimicked the allocation and/or the returns
of the top quartile.[15] First, for each plan in the lower
three quartiles, the annual return in each year is
calculated based on the plan's reported asset alloca-
tion and asset class returns in that year.[16] Then, the
annual return is recalculated under two alternative
scenarios designed to isolate the impact of the two
factors. For the first scenario, the annual return is
recalculated assuming that each plan held the average
allocation of plans in the top quartile, but achieved its
own reported annual return for each asset class.[17] For
the second scenario, the annual return is recalculated
assuming the plan maintains its own asset allocation
each year, but realizes the same annual returns for
each asset class as the top quartile.[18]

Figures 8 and 9 (on the next page) illustrate the
results of the exercise for plans in the bottom quar-
tile only. Figure 8 shows the average change in the
annual return when plans in the bottom quartile use
the average allocation of plans in the top quartile.[19]
Interestingly, no clear pattern emerges – in some
years, using the average allocation of top-quartile
plans produces lower returns for the plans in the bot-
tom quartile and, in other years, it results in higher
returns. On balance, however, the gains appear to be
slightly larger than the losses, suggesting that asset
allocation likely played some role in the poorer perfor-
mance of the bottom-quartile plans from 2001-2016.

FIGURE 8. AVERAGE CHANGE IN BOTTOM QUARTILE'S ANNUAL RETURN BY ASSUMING TOP QUARTILE'S ASSET ALLOCATION, 2001-2016

Note: See Appendix Figure A5 for the results by quartile.
Source: Authors' calculations from the PPD (2001-2016).

Figure 9 shows the average change in the annual return when plans in the bottom quartile keep their own asset allocation but achieve the average asset class returns of plans in the top quartile. The consistently higher outcome suggests that differences in returns within asset classes are a major factor in the poorer overall performance of the bottom quartile relative to the top.[20]

FIGURE 9. AVERAGE CHANGE IN BOTTOM QUARTILE'S ANNUAL RETURN BY ASSUMING TOP QUARTILE'S ASSET CLASS RETURNS, 2001-2016
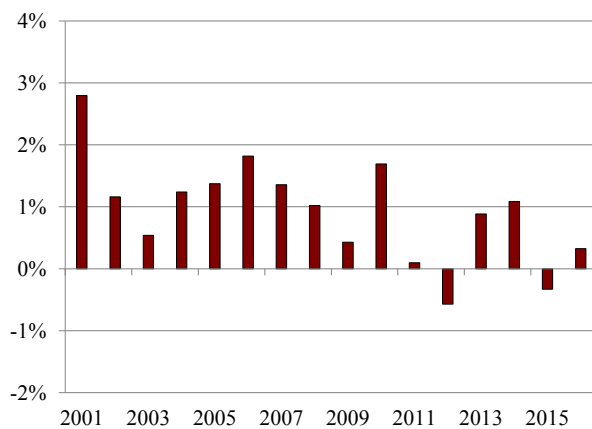

Note: See Appendix Figure A6 for results by quartile.
Source: Authors' calculations from the PPD (2001-2016).

Moving from the impact on year-to-year returns to the impact on the annualized 16-year return requires two additional steps. First, for each plan in the lower three quartiles, a new 16-year return is calculated based on the plan's own asset class returns, but assuming the plan mimics the average asset allocation of plans in the top quartile. The difference between this new 16-year return and the plan's actual 16-year return captures the impact that asset allocation has had on the plan's long-term return. Second, any remaining difference between this new 16-year return and the average 16-year return for plans in the top quartile is assumed to be the impact of differences in asset class returns.[21]

Figure 10 presents the results of this exercise for each of the lower quartiles separately and for all lower-quartile plans in aggregate.[22] The results for the bottom quartile show that the annualized 16-year return for the top quartile was 1.54 percentage points greater than the average annualized return for plans in the bottom quartile. Applying the top quartile's

FIGURE 10. ROLE OF ALLOCATION AND RETURNS ON THE DIFFERENCE FROM TOP QUARTILE
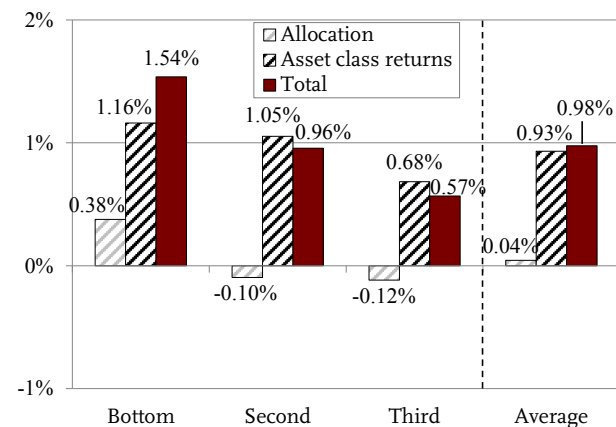
Source: Authors' calculations from the PPD (2001-2016).

allocation to the bottom quartile increases the bottom quartile's 16-year return by 0.38 percentage points – accounting for about 25 percent of the overall difference. Applying the top quartile's asset class returns to the bottom quartile increases the 16-year return by the remaining 1.16 percentage points (1.54 - 0.38 = 1.16). For plans in the second and third quartiles, applying the top quartile's allocation lowered their return slightly, but most of the difference was due to asset class returns.

Conclusion

Given that public pension plans rely heavily on invest-ment gains to meet future benefit payments, a key component of their long-term sustainability is the ability to achieve adequate returns. Newly collected data show meaningful differences among plans in annualized returns from 2001-2016. The average returns for plans in the top and bottom quartiles were 6.3 percent and 4.6 percent, respectively. This differ-ence in returns could amount to roughly a 20-percent-age-point difference in the funded ratio over a 16-year period.

A closer look at the asset allocation for each quar-tile shows that, at a high level, public plans invest very similarly. Generally, from 2001-2016, they all shifted a portion of their assets out of equities and fixed income and into alternatives, though the magnitude and timing of this transition differed for each quar-tile. However, in terms of explaining the underper-formance of plans in the lower quartiles, the small differences in allocation among plans were secondary to the differences in asset class returns. While al-location did account for about one-quarter of the total 16-year underperformance for bottom quartile plans (with returns accounting for the remaining three quarters), returns accounted for almost the entire underperformance for the middle two quartiles.

Endnotes

1 A closer look at the plans currently in the top and bottom quartiles reveals that the rankings have shifted over time. While only 5 percent of plans in the top quartile in 2016 were in the lower two quartiles in 2007, almost 20 percent of plans in the bottom quartile in 2016 were in the top two quartiles in 2007.

2 Because the volatility in annual returns over the 16-year period was about the same for plans in all four quartiles, the plan rankings are similar for risk-adjusted returns (i.e., the average return divided by the standard deviation). The average risk-adjusted return for the top, third, second, and bottom quartiles were 0.59, 0.54, 0.54, and 0.47, respectively.

3 The smaller average asset size of the top quartile is due mainly to the absence of any extremely large plans. Each of the bottom three quartiles has at least one extremely large plan such as Florida RS, California PERS, New York ERS, or Texas Teachers.

4 This simplified projection does not account for the impact of actuarial asset smoothing (delayed accounting of annual investment gains and losses) nor the likelihood that a plan's contributions would change in the event of better or worse investment performance.

5 Many prior studies have researched the impact of allocation and returns (see Brinson (1986 and 1991), Andonov, Bauer, and Cremers (2012 and 2016), Ibbotson and Kaplan (2000), Xiong et al. (2010), and Brown, Garlappib, and Tiuc (2010)). This analysis differs from existing research in two ways. First, this analysis focuses on U.S. state and local pension plans only. Second, while prior studies focused on the impact of policy (target allocations and benchmark returns) versus active management (deviations from target allocation and benchmark returns), this study focuses on the impact of differences in allocation versus returns, remaining agnostic as to whether a difference in allocation and/or returns is due to differences in policy or active management.

6 For the analysis, it is necessary for a plan to report allocation and performance for the same asset classes. For example, if a plan reports the investment performance for domestic and international equities separately but provides the allocation to total equities (without any data on how much is held in domestic and/or international), it is impossible to assess the impact of either the total, domestic, or international equity on overall portfolio performance. As such, plans were excluded from the analysis if there were fewer than 10 years of data for which 90 percent of the portfolio was aligned in terms of the asset allocation and performance data provided.

7 Due to data limitations, the analysis in this *brief* does not include 2017. Extending the analysis one additional year results in a sample that includes less than half of all PPD plans and about 70 percent of total PPD assets. Internal analysis based on the available 2017 data showed slightly higher annualized returns due to the relatively strong FY 2017 investment performance, but did not change the relative performance among plans – the quartile position for most plans remained unchanged and the difference in average annualized returns between each quartile was nearly identical.

8 Additionally, the sample is relatively well distributed across the quartiles – 24.5, 20.4, 32.7, 22.4 percent of the sample fell into the bottom, second, third, and top quartiles, respectively.

9 The definition of alternative investments is somewhat fluid. For that reason, we define them by what they are not: they are not traditional stocks, bonds, and cash – held directly or in mutual funds.

10 See Appendix Figures A1 to A4 for data on plan allocations to four specific alternative asset classes: private equity, real estate, hedge funds, and commodities.

11 For most plans, calculating a 16-year return for each asset class is not possible because the plans do not hold many of the asset classes consistently over the entire period. Instead, the 16-year return for each asset class reflects the geometric mean of the average annual return calculated for the asset class from 2001-2016.

12 Returns by asset class from the PPD data are generally consistent with returns reported in other studies on pension investment performance, see Beath (2014) and Beath and Flynn (2017).

13 Differences in performance for private equity investments may be due to the age of the private equity portfolio. Private equity investments may sustain low returns (sometimes losses) in the initial years and increased returns as the investment matures – the so-called J-curve. While the performance of private equity investments is best compared to others with the same vintage, data on the vintage of private equity funds is not consistently available in public plan reports.

14 The observed differences in equity performance are partly due to differences in allocation to domestic versus international equities. For plans that report on their domestic and international equity holdings, the data show that the equity portfolios of top quartile plans were more heavily weighted towards international equity prior to the financial crisis – a period when international equities outperformed domestic equities. After the crisis, when domestic equities outperformed international equities, top quartile plans were more heavily weighted towards domestic equities.

15 When assessing the impact of allocation and returns, a key consideration is how narrowly or broadly to define asset classes. If an asset class is defined too broadly, then differences in returns within an asset class may actually reflect differences in allocation. On the other hand, defining an asset class too narrowly risks making the asset too unique for comparison. This analysis separately tracks allocation and returns for seven broad asset classes: equities, fixed income, and five categories of alternatives – private equity, hedge funds, real estate, commodities, and other alternatives. These asset classes reflected the most commonly presented categories among public plans. See Appendix Table A2 for an exhaustive list of the individual asset classes that were included in each category.

16 On average, the constructed annual returns differed from the reported returns by about one percent. Reasons for the difference are: 1) many plans do not report the allocation and return data for 100 percent of their portfolio in each year; and 2) plans rebalance their portfolios throughout the year, while data collected from the CAFRs provide a snapshot of allocation at the fiscal year end. Differences between the calculated and reported annual returns are addressed

in two ways. For those that do not report returns for 100 percent of their portfolio, we solve for the return of the unknown portion using the plan's reported return for the whole portfolio. For those that do provide returns for 100 percent of their portfolio, we scale the calculated return to a plan's reported annual return for the whole portfolio.

17 If a plan does not report a return for one of the asset classes held by the top quartile, we assume the plan achieves the average return for that asset class.

18 This methodology is similar to that used by Brinson (1986), which compared the actual returns for U.S. corporate pension plans to the return they would have had if they: 1) held a portfolio reflecting their average allocation over 10 years but realized their actual returns; and 2) held their own portfolio and achieved benchmark returns.

19 Because annual returns are sensitive to the specific reporting cycle, comparisons are made among plans with the same reporting date. The majority of plans report investment data on a calendar-year-end (December) or fiscal-year-end (June) basis.

20 Differences in returns within an asset class are generally the product of manager selection, individual holdings within the asset class, and/or higher fees.

21 Generally, a plan invests to meet a target return and determines an optimal asset allocation to minimize the fund's risk given its return objective. After the asset allocation is set, asset managers choose specific investment strategies for each asset class. Given this process, the analysis first estimates the impact of allocation and assumes any residual difference stems from asset class returns. In doing so, the analysis includes the joint impact of returns *and* allocation in the measure for allocation. The results do not change materially if the impact of asset class returns is measured first and asset allocation afterward.

22 Internal analysis based on the available 2017 data produces similar results. On average, the annualized return for the top quartile was about 1 percent greater than the average annualized return for the lower-quartile plans and almost all of the difference was attributed to asset class returns.

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APPENDIX

Figure A1. Allocation to Private Equities by Quartile of Returns, 2001-2016
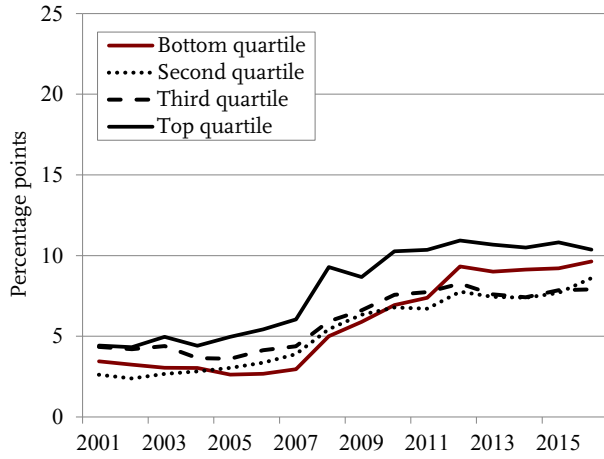
Source: Authors' calculations from the PPD (2001-2016).

Figure A3. Allocation to Hedge Funds by Quartile of Returns, 2001-2016
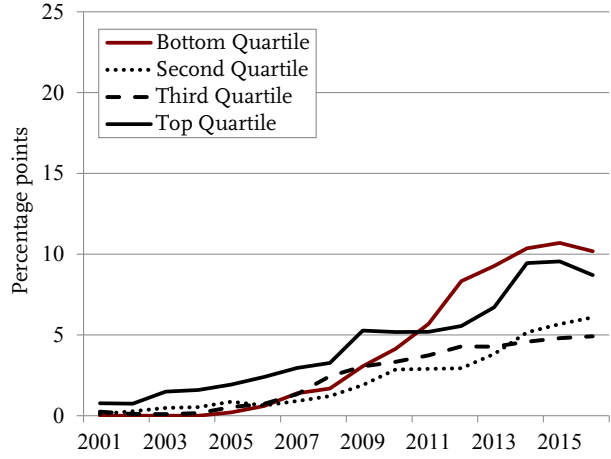
Source: Authors' calculations from the PPD (2001-2016).

Figure A2. Allocation to Real Estate by Quartile of Returns, 2001-2016
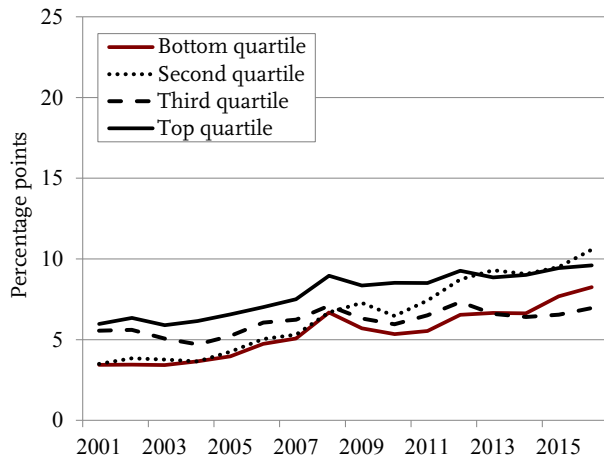
Source: Authors' calculations from the PPD (2001-2016).

Figure A4. Allocation to Commodities by Quartile of Returns, 2001-2016
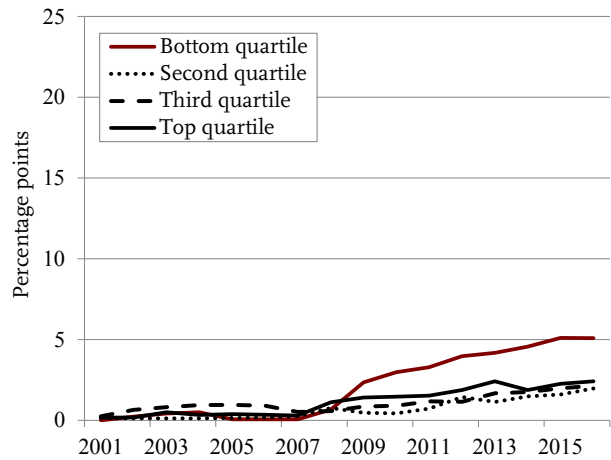
Source: Authors' calculations from the PPD (2001-2016).

FIGURE A5. AVERAGE CHANGE IN ANNUAL RETURN BY ASSUMING TOP QUARTILE'S ASSET ALLOCATION, 2001-2016
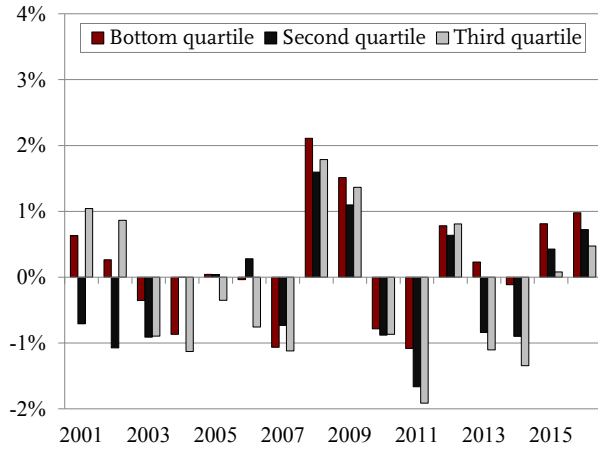
Source: Authors' calculations from the PPD (2001-2016).

FIGURE A6. AVERAGE CHANGE IN ANNUAL RETURN BY ASSUMING TOP QUARTILE'S ASSET CLASS RETURNS, 2001-2016

Source: Authors' calculations from the PPD (2001-2016).

Table A1. Annualized Return, Funded Ratio, and Market Assets for PPD Plans, 2016
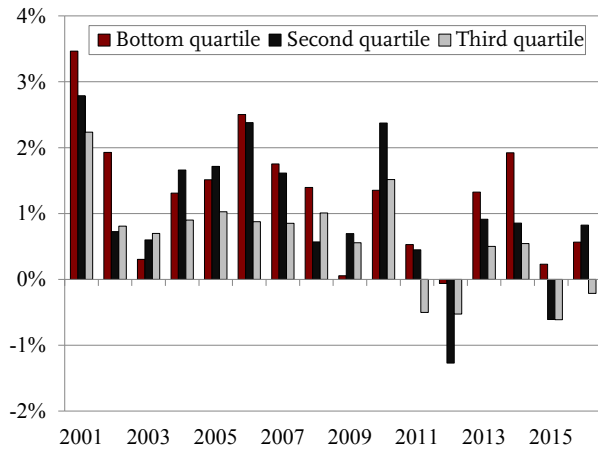
Plan	Fiscal year end	Annualized return, 2001-2016	GASB funded ratio, 2016	Market assets (billions), 2016
Alabama ERS	Sept	5.1%	66.2%	$11.2
Alabama Teachers	Sept	5.4	68.3	22.9
Alameda County Employees	Dec	6.5	78.1	6.1
Alaska PERS	June	5.1	66.4	8.2
Alaska Teachers	June	5.1	75.8	4.9
Arizona Public Safety Personnel	June	2.9	46.0	6.0
Arizona SRS	June	5.1	77.6	32.9
Arizona State Corrections Officers	June	2.8	57.3	1.2
Arkansas PERS	June	5.6	80.4	7.4
Arkansas Teachers	June	5.8	81.0	14.6
Atlanta General Employees	June	5.2	60.4	1.2
Baltimore Fire and Police	June	5.0	71.5	2.4
Baton Rouge City Parish	Dec	5.9	67.9	1.1
California PERF	June	4.9	68.3	298.7
California Teachers	June	5.3	63.7	189.1
Chicago Municipal Employees	Dec	5.1	30.5	4.4
Chicago Teachers	June	5.6	52.4	10.1
Cincinnati Employees	June	5.3	76.9	1.7
City of Austin ERS	Dec	5.6	67.5	2.3
Colorado Municipal	Dec	5.7	74.4	3.8
Colorado School	Dec	5.7	56.3	22.6
Colorado State	Dec	5.7	54.6	13.6
Connecticut Municipal Employees	June	4.7	86.1	2.2
Connecticut SERS	June	4.9	36.9	10.6
Connecticut Teachers	June	4.9	56.0	15.6
Contra Costa County	Dec	6.8	86.5	7.4
DC Police & Fire	Sept	4.7	110.8	5.0
DC Teachers	Sept	4.7	90.9	1.8
Dallas Police and Fire Pension System	Dec	4.0	49.4	2.2
Delaware State Employees	June	5.7	89.0	8.0
Denver Employees	Dec	5.5	71.0	2.0
Denver Schools	Dec	6.8	75.9	3.1
Detroit Police and Fire	June	6.8	73.5	3.0
Detroit RS	June	4.6	63.3	2.0
Fairfax County ERS	June	6.3	70.2	3.6
Fairfax County Schools	June	5.8	76.0	2.1
Florida RS	June	5.0	85.4	141.8

Plan	Fiscal year end	Annualized return, 2001-2016	GASB funded ratio, 2016	Market assets (billions), 2016
Georgia ERS	June	5.0%	74.7%	$12.4
Georgia Teachers	June	5.1	74.3	65.6
Hawaii ERS	June	5.2	54.7	14.1
Houston Firefighters	June	7.3	80.6	3.7
Idaho PERS	June	5.5	86.3	13.9
Illinois Municipal	Dec	6.2	88.9	36.5
Illinois SERS	June	4.5	34.4	15.0
Illinois Teachers	June	5.6	39.8	45.3
Illinois Universities	June	5.2	43.3	17.0
Indiana PERF	June	4.4	79.1	13.9
Indiana Teachers	June	4.9	46.8	10.4
Iowa Municipal Fire and Police	June	5.9	81.4	2.2
Iowa PERS	June	5.8	83.9	28.3
Jacksonville General Employees	Sept	6.3	64.6	1.8
Kansas PERS	June	5.7	66.8	17.2
Kentucky County	June	4.8	58.7	8.2
Kentucky ERS	June	4.8	18.9	2.5
Kentucky Teachers	June	5.3	54.6	16.8
Kern County Employees	June	4.7	63.4	3.6
LA County ERS	June	5.6	79.4	47.8
Los Angeles City Employees	June	5.8	71.4	11.9
Los Angeles Fire and Police	June	5.2	93.9	17.1
Los Angeles Water and Power	June	5.6	84.2	10.1
Louisiana Municipal Police	June	5.2	70.6	1.8
Louisiana SERS	June	5.6	62.6	10.7
Louisiana School Employees	June	5.6	72.5	1.8
Louisiana State Parochial Employees	Dec	5.1	99.3	3.6
Louisiana Teachers	June	5.8	62.4	17.5
Maine Local	June	4.7	86.1	2.4
Maine State and Teacher	June	4.7	80.4	10.0
Maryland PERS	June	4.3	67.7	15.3
Maryland Teachers	June	4.3	72.7	27.5
Massachusetts SERS	June	5.8	63.5	24.0
Massachusetts Teachers	June	5.8	52.8	24.9
Michigan Municipal	Dec	5.7	66.8	8.5
Michigan Public Schools	Sept	5.5	62.7	43.5
Michigan SERS	Sept	5.5	67.1	11.0
Milwaukee City Employees	Dec	6.3	96.1	4.9
Milwaukee County ERS	Dec	6.3	77.1	1.7
Minnesota PERF	June	5.6	75.5	$18.0

Plan	Fiscal year end	Annualized return, 2001-2016	GASB funded ratio, 2016	Market assets (billions), 2016
Minnesota Police and Fire	June	5.6%	87.7%	$7.1
Minnesota State Employees	June	5.5	81.6	11.2
Minnesota Teachers	June	5.5	75.6	19.4
Mississippi PERS	June	5.1	60.0	24.1
Missouri DOT and Highway Patrol	June	5.7	55.5	2.0
Missouri Local	June	6.0	94.7	6.3
Missouri PEERS	June	5.5	86.4	4.0
Missouri State Employees	June	6.0	69.6	8.1
Missouri Teachers	June	5.6	84.8	34.3
Montana PERS	June	5.1	77.0	5.0
Montana Teachers	June	5.1	69.3	3.7
NY State & Local ERS	Mar	5.5	94.1	156.3
NY State & Local Police & Fire	Mar	5.5	92.6	27.4
Nebraska Schools	Dec	5.4	89.6	9.7
Nevada Police Officer and Firefighter	June	5.8	77.1	7.8
Nevada Regular Employees	June	5.8	73.2	27.2
New Hampshire Retirement System	June	5.1	60.0	7.4
New Jersey PERS	June	4.7	57.2	26.8
New Jersey Police & Fire	June	4.7	70.3	24.0
New Jersey Teachers	June	4.7	47.0	22.7
New Mexico PERF	June	5.2	75.3	13.8
New Mexico Teachers	June	4.9	64.2	11.5
New York City ERS	June	5.0	69.9	55.5
New York City Police	June	5.2	68.6	33.5
New York City Teachers	June	5.1	56.4	43.6
New York State Teachers	June	5.6	97.9	107.5
North Carolina Local Government	June	5.3	95.2	22.8
North Carolina State and Teachers	June	5.3	90.4	63.3
North Dakota PERS	June	5.2	66.7	2.4
North Dakota Teachers	June	4.7	62.1	2.1
Ohio PERS	Dec	5.9	80.1	77.1
Ohio Police & Fire	Dec	6.8	69.8	13.7
Ohio School Employees	June	5.0	67.3	12.3
Ohio Teachers	June	5.8	69.6	66.3
Oklahoma PERS	June	5.5	93.2	8.4
Oklahoma Police	June	4.9	98.7	2.2
Oklahoma Teachers	June	6.8	65.7	14.0
Omaha School Employees	Aug	5.0	65.3	1.2
Orange County Employees	Dec	5.9	73.1	12.8
Oregon PERS	June	5.7	78.7	$62.1

Plan	Fiscal year end	Annualized return, 2001-2016	GASB funded ratio, 2016	Market assets (billions), 2016
Pennsylvania Municipal	Dec	5.9%	100.1%	$2.2
Pennsylvania Schools	June	5.3	57.3	49.8
Pennsylvania State ERS	Dec	5.5	58.1	26.4
Philadelphia Municipal	June	4.3	44.8	4.4
Phoenix ERS	June	4.6	57.3	2.2
Rhode Island ERS	June	4.6	57.4	5.8
Rhode Island Municipal	June	4.6	83.0	1.4
Sacramento County	June	5.6	87.3	7.7
San Diego City Employees	June	6.4	71.6	6.8
San Francisco City & County	June	5.4	85.0	20.2
South Carolina Police	June	5.2	66.3	3.9
South Carolina RS	June	5.3	59.5	24.0
South Dakota PERS	June	6.6	100.0	10.5
St. Louis School Employees	Dec	6.0	73.7	0.9
St. Paul Teachers	June	6.1	63.3	1.0
TN Political Subdivisions	June	5.3	99.5	22.0
TN State and Teachers	June	5.3	95.4	21.2
Texas County & District	Dec	6.7	88.4	26.3
Texas ERS	Aug	5.3	75.2	24.5
Texas LECOS	Aug	5.3	71.1	0.9
Texas Municipal	Dec	7.0	86.3	25.2
Texas Teachers	June	5.3	79.7	134.0
University of California	June	4.7	82.6	54.2
Utah Noncontributory	Dec	6.3	86.5	22.6
Utah Public Safety	Dec	6.3	84.8	3.2
Vermont State Employees	June	6.9	74.6	1.6
Vermont Teachers	June	5.3	58.3	1.6
Virginia Retirement System	June	5.2	74.8	64.0
Washington LEOFF Plan 2	June	6.1	104.7	10.2
Washington PERS	June	6.1	87.1	30.5
Washington School Employees 2/3	June	6.1	86.6	4.2
Washington Teachers Plan 2/3	June	6.1	89.5	10.8
West Virginia PERS	June	6.1	89.0	5.7
West Virginia Teachers	June	5.9	65.4	6.5
Wisconsin Retirement System	Dec	5.9	100.0	92.6
Wyoming Public Employees	Dec	4.9	78.1	6.7

Source: Authors' calculations from the PPD (2001-2016).

Table A2. Asset Class Organizational Chart

Equity Total
Equity Miscellaneous
Equity Core
Equity Large-cap
Equity Micro-cap
Equity Opportunistic
Equity Small-cap
Equity Socially Responsible
Equity Securities Lending
Equity Domestic
    Equity Domestic Miscellaneous
    Equity Domestic Large-cap
    Equity Domestic Mid-cap
    Equity Domestic Small-cap
Equity International
    Equity International Miscellaneous
    Equity Global
    Equity Global Growth
    Equity International Developing
    Equity International Emerging
    Equity International Passive
    Equity International Active

Fixed Income Total
Fixed income Miscellaneous
Fixed income Below Investment Grade
Fixed income Cash
Fixed income Conv
Fixed income Core
Fixed income ETI
Fixed income Investment Grade
Fixed income Loans
Fixed income Funds or Funds
Fixed income Nominal
Fixed income Non-Core
Fixed income Structured
Fixed income TIPS
Fixed income Treasury
Fixed income Corporate Bonds
Fixed income Value
Fixed income Global
Fixed income Domestic
Fixed income Emerging
Fixed income International
Fixed income High Yield
Fixed income Mortgage
Fixed income Alternative
Fixed income Opportunistic
Fixed income GIPS

Alternatives Total
Private Equity
    Equity Private
    Private Debt
    MLP
    Private Placement
Hedge Funds
    Diversified Strategies
    Hedge
    Absolute Return
    Relative Return
    Hedge Equity
    GTAA
    Opportunistic
    Credit Opportunities
    Opportunistic Debt
    Opportunistic Equity
    Distressed Lending
    Distressed Debt
    Alternative Inflation
    Risk Parity
    Covered Call
Commodities
    Real Assets
    Commodities
    Farm
    Natural Resources
    Timber
    Infrastructure
Real Estate
    Real Estate Miscellaneous
    Private Real Estate
    Real Estate Core
    REIT
    Real Estate Non-Core
    Real Estate Triple Lease
Other Alternatives
    Miscellaneous Alternatives

Cash

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