Center for State & Local Government Excellence

Issue Brief

A First Look at Alternative Investments and Public Pensions

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Foreword

Over the past decade the Center for State and Local Government Excellence has collaborated with the Center for Retirement Research at Boston College to develop briefs and fact sheets that explore timely and relevant state and local government retirement issues. This brief, "A First Look at Alternative Investments and Public Pensions," authored by Jean-Pierre Aubry, Anqi Chen, and Alicia Munnell, was developed as a preliminary analysis of pension investment outside of traditional equities, bonds, and cash.

While the changing asset allocations of state and local pension plans, with increases in non-traditional investments, has been well documented, there continues to be a lack of clarity about what is included in the alternatives category and whether there should be some standardization. Using data from the Public Plans Database (publicplansdata.org), this brief focuses on state and local pension funds' investments in private equity, hedge funds, real estate, and commodities to explore which plans have the largest allocations in investments outside of public equities, bonds, and cash and the broader impact of aggregate allocation shifts on returns and volatility.

Some of the notable findings of this initial research include smaller plans holding relatively more in hedge funds and commodities, and larger funds holding relatively more in private equity. Also, a negative relationship surfaced between the portion of alternatives in a plan's portfolio and returns – linked primarily to low hedge fund returns. The increased presence of hedge funds in portfolios slightly reduced portfolio volatility.

As public plan asset allocations continue to evolve, additional analyses on the role of alternative investments in public pension portfolios will be needed – especially over longer time horizons and looking more specifically at the role and impact of individual investment types within the alternatives category.

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Joshua M. Franzel, PhD
President/CEO
Center for State and Local Government Excellence

A First Look at Alternative Investments and Public Pensions

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

Introduction

Since the financial crisis, public pension plans – like other large institutional investors – have moved a significant portion of their portfolios into investments outside of traditional equities, bonds, and cash. These alternative investments include a diverse assortment of assets – private equity, hedge funds, real estate, and commodities. This shift reflects a search for greater yields than expected from traditional stocks and bonds, an effort to hedge other investment risks, and a desire to diversify the portfolio. The *Public Plans Database* (PPD), which covers nearly 95 percent of pension assets, shows the allocation to alternatives more than doubling (from 9 percent to 24 percent) between 2005 and 2015.

This *brief* begins to explore the implications for state and local pension plans of moving away from traditional stocks and bonds to other types of assets. The scope of the inquiry is narrow; it does not address fees, disclosure, or administrative issues. Nor does it assess how these alternative assets are utilized within each plan's overall investment strategy. Rather, the analysis investigates two basic questions: 1) which plans have made the largest shift to alternatives? and 2) how has the shift affected investment returns and volatility?

The discussion proceeds as follows. The first section provides a quick overview of alternative investments. The second section documents the extent to which state and local pension plans engage in alternative investing. The third section attempts to find a link between plan characteristics and the proportion of the overall investment portfolio allocated to alternatives, and uncovers no systematic relationship. The fourth section looks at the relationship between alternatives and investment performance, finding lower after-fee returns – primarily due to poor hedge fund performance. Hedge funds do reduce volatility, but their effect is offset by the greater volatility associated with real estate and commodities. The final section concludes that, while the focus on returns and volatility may be too narrow and the time periods analyzed too short to draw any definitive conclusions, the relationship between alternatives and public plan performance merits further analysis.

A Bird's Eye View of Alternatives

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. All other investments are classified as "alternatives." These alternatives fall into four major categories: private equity, hedge funds, real estate, and commodities.[1]

- Private equity involves funds that buy, restructure, and sell companies. The investor earns returns from capital gains as the general partner liquidates its portfolio companies and returns capital to the

* *Jean-Pierre Aubry is associate director of state and local research at the Center for Retirement Research at Boston College (CRR). Anqi Chen is a research associate at the CRR. Alicia H. Munnell is director of the CRR and the Peter F. Drucker Professor of Management Sciences at Boston College's Carroll School of Management.* *The authors thank David Blitzstein, Keith Brainard, Guy Haselmann, Ian Lanoff, Melissa Moye, and Jon Reuter for helpful comments.*

fund's investors. This approach involves a long time horizon, and some characterize the returns on private equity as a "J-curve" where the investment shows losses for several years after purchase followed by strong returns later. Because private equity performance varies dramatically and fees are typically 1-3 percent for management and 20-30 percent for performance, the investor must have the capacity to select the right fund.[2]

- Hedge funds encompass a variety of strategies.[3] Some aim to hedge market risk by providing steady returns regardless of broader market movements, and they invest in vehicles that have low correlations to traditional investments. Others aim to add market risk exposure and produce higher returns. "Funds of hedge funds," which strategically invest in other hedge funds, can alleviate some of the complexity of fund selection and diversify hedge fund strategies.[4] While some experts view hedge funds as trading strategies rather than an asset class, their unique fee structure warrants their consideration as a separate asset class.[5]

- Real estate includes investment in both commercial and residential properties, directly or through publicly traded real estate investment trusts (REITs).[6] Real estate can provide an illiquidity premium relative to traditional assets and can serve as a hedge against inflation. However, analyzing returns for these investments is not straightforward because estimating unrealized returns relies on appraisal pricing procedures, which may not always accurately reflect market value.

- Commodities are real assets with intrinsic economic value for consumption (agricultural or livestock products) or for manufacturing (metals or energy). Their value is based on the market dynamics of supply and demand. Commodities generally have low correlation with traditional asset classes and are highly correlated with inflation (and thus offer a hedge against rising price levels). They are also extremely liquid when traded through futures contracts.

In general, alternatives tend to be riskier and less liquid (with the exception of REITs and commodity futures) than traditional equity and fixed income, so investors have the opportunity to earn both a risk premium and a liquidity premium.[7] Proponents of alternative investments also argue that the returns on many alternatives are uncorrelated with those in the stock market, so they can add diversification to a portfolio and help mitigate volatility.[8]

On the other hand, investments in alternatives involve a number of challenges. First, these investments are often complex, and many investors may not fully understand the exact nature of the products and their attendant risks. Second, in many instances, it is difficult to make annual assessments of the value of the investment. Third, complicated investments involve complicated – and high – fees.[9] Finally, the fact that these assets are generally illiquid can pose risks for investors that need liquidity.[10]

Generally, these alternative investments were not a significant component of institutional portfolios 25 years ago; today they are. Their popularity surged after the bursting of the dot.com bubble at the turn of the century and predictions that traditional equities would produce relatively low returns going forward. At the same time, interest rates were heading down, making bonds relatively less attractive as well.[11]

Table 1 presents returns from broad indices of alternatives and traditional equities before, during, and after the financial crisis. (All data presented in this analysis are on a fiscal year basis). These data need to be interpreted cautiously for a number of reasons. First, private equity and real estate returns are shown before fees, while hedge fund and commodity returns are after fees. Second, the data for private equity and hedge funds are supplied on a voluntary basis, and strong performers have a greater incentive to report than those who perform poorly. Third, failed funds are removed from indices, resulting in consistent overweighting toward the better performers (survivorship bias). Finally, when a fund provides data to an index, it can report as much (or as little) of its historical performance as it wants (backfill bias). As

Table 1. *Returns from Alternative Asset Classes and Traditional Equities, 2000-2016*

Asset class	2000-2007	2008-2009	2010-2016
Private equity (before fees)	14.6 %	-13.0 %	25.0 %
Hedge funds (after fees)	10.7	-10.9	1.3
Real estate (before fees)	14.5	-6.3	12.1
Commodities (after fees)	16.2	-4.1	-3.0
Traditional equity	2.7	-21.3	14.9

Sources: Authors' calculations based on Thomson Reuters Private Equity Index, Hedge Fund Research Global Hedge Fund Index, NCREIF Property Index, S&P GSCI Index, and Wilshire 5000 Index (Total Return).

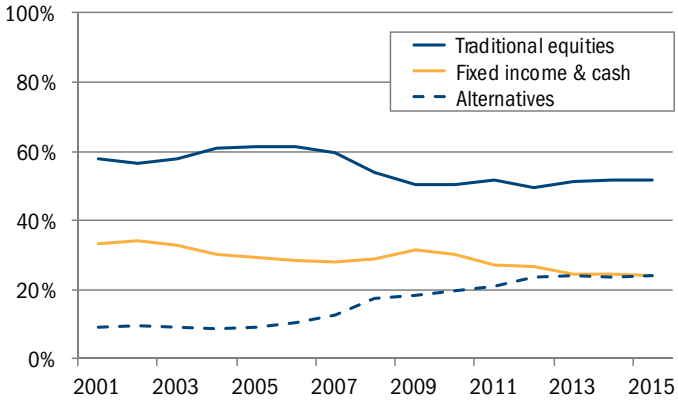
a result, the benchmarks tend to overstate the actual returns that are earned.[12]

Even with these limitations, however, it is fair to conclude that alternative investments had robust returns between 2000 and 2007 – substantially outpacing traditional equities – and they lost substantially less than traditional equities during the financial crisis. This performance, combined with a desire to diversify away from poorly performing stocks and lower yielding bonds, led state and local pension plans to increase their interest in alternatives. However, the performance of alternatives has been mixed since the crisis, with private equity and real estate rebounding while hedge funds and commodities continue to provide low returns.

Alternative Investments By State and Local Plans

Investment in alternatives by state and local pension plans began to rise in 2005 (see Figure 1). Almost by definition, the precipitous drop in equity values compared to other assets in 2008 and 2009 led to further increases in the shares held in all other asset classes. As the stock market recovered, however, the allocation to traditional equity remained depressed, suggesting that plans were making deliberate shifts towards alternative investments.

Figure 1. *Investment Allocation for State and Local Pension Plans, 2001-2015*



Source: Authors' calculations from *Public Plans Database* (2001-2015).

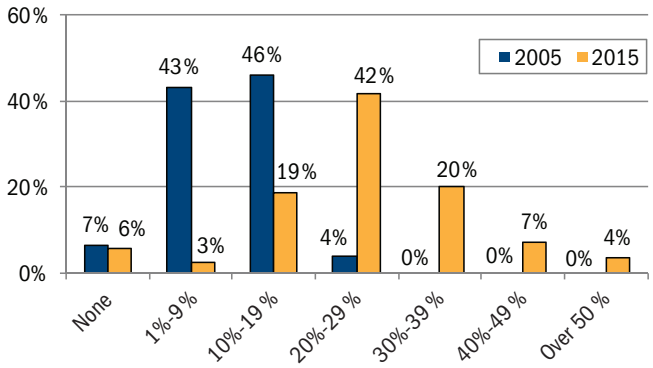
The fact that state and local plans were somewhat late to embrace alternatives is not surprising. As noted, these products are often complicated, and the process of adoption can take several years.[13] But, once comfortable with the idea of alternatives, state and local plans steadily increased their holdings from 9 percent in 2005 to 24 percent in 2015.

Aggregate allocations, however, hide some significant variation among plans, so Figure 2 (on the next page) shows both how holdings have increased between 2005 and 2015 and how they vary among plans in each year. In 2005, the maximum share held in alternatives by any plan was under 30 percent and half of plans held less than 10 percent. As of 2015, the maximum allocation among plans was over 50 percent, and only 9 percent of plans held less than 10 percent in alternatives.

Not only have alternatives become a much larger share of public plans' portfolios, but their composition has also changed. As shown in Figure 3, between 2005 and 2015, the allocation to real estate dropped sharply, while investments in hedge funds rose sharply. As shown earlier, hedge funds, in aggregate, have not performed well since the financial crisis, relative to other asset classes.

The allocation of alternatives has varied not only over time, but also by plan size. One would expect bigger plans to have a larger investment staff

Figure 2. *Distribution of State and Local Plans by Percentage of Portfolio Invested in Alternatives, 2005 and 2015*

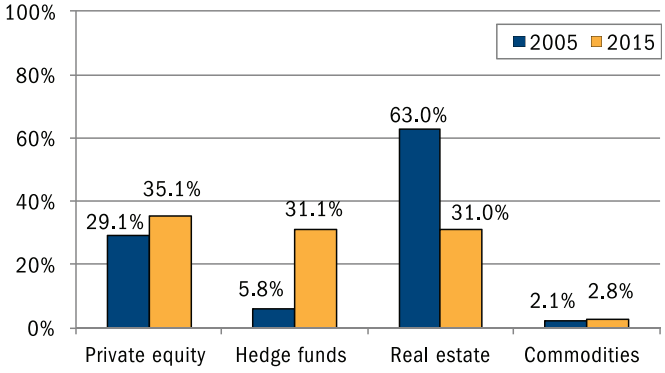


Source: Authors' calculations from *Public Plans Database* (2005, 2015).

and access to more sophisticated financial advice, including information about non-traditional investment opportunities. Indeed, as shown in Table 2, plans in the lowest quartile in terms of plan assets have a higher percentage of their alternative investments in hedge funds and commodities, which have not performed well recently, and much less in private equity, which has shown stronger returns.[14]

The significant increase in alternatives, the variation in the allocation to alternatives among plans, and the allocation to different assets within alternatives all raise the questions of why some plans invest more in alternatives than others and how alternatives have affected their returns and volatility.

Figure 3. *Distribution of Alternative Investments by Asset Class, 2005 and 2015*



Source: Authors' calculations from *Public Plans Database* (2005, 2015).

Table 2. *Distribution of Alternative Investments by Asset Class and Plan Size, 2015*

Plan asset quartile	Private equity	Hedge funds	Real estate	Commodities
Highest	35.8%	30.5 %	31.3 %	2.4 %
Second	33.3	33.7	29.7	3.3
Third	32.6	31.8	28.9	6.7
Lowest	19.8	40.9	33.6	5.7

Source: Authors' calculations from *Public Plans Database* (2005, 2015).

What Types of Plans Allocate More to Alternatives?

One way to start is to look at plans with the largest holdings of alternative investments (see Table 3, on the next page). On average, these plans allocated 56 percent of their assets to alternatives compared to an average of 25 percent overall. Strikingly, in 2015, these plans – with the exception of Texas County & District and Pennsylvania School Employees – are relatively small in asset size. In terms of their financial status, they tend to be slightly more conscientious than average in the percentage they pay of their Annual Required Contributions (ARC), but are less well funded.

Despite the apparent lack of any clear relationship between investment in alternatives and plan characteristics, it is useful to estimate a regression to see if any relationship exists for the 160 plans in the PPD. The dependent variable is the percentage of assets in alternatives in 2015. The values for the independent variables are for 2005, the year when public plans started to increase their allocation in alternatives. The specific variables are as follows:

- *Lowest asset quartile:* One would think that large plans with more access to financial services firms would hold more of their assets in alternatives, but

Table 3. *State and Local Plans with Largest Allocation to Alternatives, 2015*

Plan name	% Alt.	Assets ($mil)	% ARC paid	Funded ratio
Dallas Police and Fire	68%	$3	99%	64%
MO State Employees	67	9	100	75
AZ State Correction Officers	59	1	95	57
AZ Public Safety Personnel	59	6	96	49
TX County & District	56	25	104	89
Nashville-Davidson Metro	55	3	118	91
PA School Employees	51	52	78	61
San Diego County	51	10	100	81
MO DOT & Highway Patrol	47	2	100	53
IN PERF	46	14	104	79
Top 10 average	56	12	99	67
Average for all PPD plans	25	21	97	73

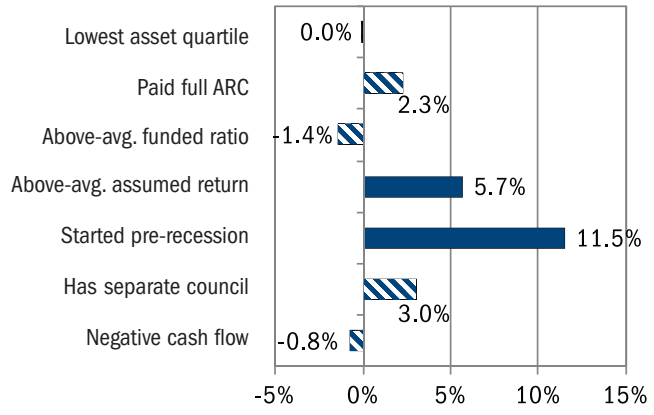
Source: Authors' calculations from Public Plans Database (2005, 2015).

the data in Table 3 suggest that the biggest holders are small plans.[15]

- *Paid full ARC:* The data presented so far suggest that plans with significant alternative investments are conscientious about paying their ARCs.
- *Above-average funded ratio:* On one hand, if alternatives are viewed primarily as high risk and return, well-funded plans may be better positioned to accept the risks that come with alternatives. On the other hand, poorly funded plans may be more desperate for high returns and willing to take on the additional risk of alternatives. The data so far support the latter notion.
- *Above-average assumed return:* To the extent that plans expect alternatives to produce higher returns, those with higher return assumptions may be expected to hold more of their portfolio in alternatives.
- *Started investing pre-recession:* Plans that invested in alternatives before the Great Recession showed early enthusiasm for these products and therefore would be expected to hold more of them.
- *Has separate investment council:* If a plan has an independent board that makes investment decisions and chooses financial advisors and asset managers, the plan would be expected to have a greater interest in investing in alternatives.
- *Negative cash flow:* Since alternatives are generally less liquid than traditional investments, plans with a more negative cash flow would be expected to have a smaller share of their portfolio in alternatives. On the other hand, the cash flow numbers for public plans are generally not dangerously high.

The results in Figure 4 show that few plan characteristics are related to holdings of alternatives. (Full results are in Appendix Table A1.)[16] The two exceptions – the solid bars in Figure 4 – are an above-average assumed return and an early start investing in alternatives.[17] Plans with an above-average assumed return and plans that started investing before the recession are estimated to hold 5.7 percent and 11.5 percent more in alternatives, respectively. The conclusion, however, is that plans of all types have been drawn to alternative investments. The remaining question is how investing in alternatives has affected the returns and volatility.

Figure 4. *Estimated Effect of 2005 Plan Characteristics on Percentage of Assets Allocated to Alternatives in 2015*



Note: Solid bars are statistically significant.
Source: Authors' calculations from *Public Plans Database* (2005, 2015).

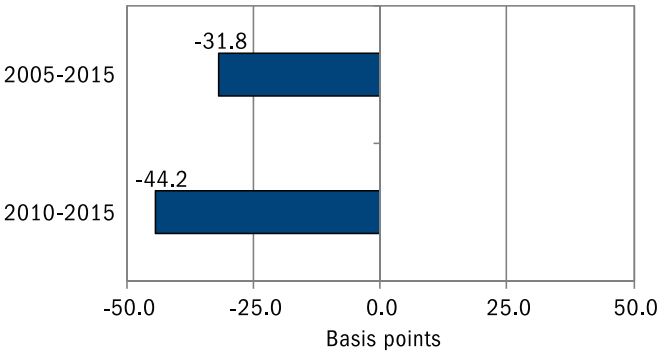
How Have Alternatives Affected Portfolio Returns and Volatility?

An ideal analysis would compare each plan's investment outcomes to its investment strategy. However, given that detailed historical returns are not available for each individual asset in each plan portfolio, this analysis presents four separate equations that test the relationship of alternative investments to observed portfolio returns and volatility. The periods under examination may be too short to fully evaluate the performance of some alternative asset classes. Nonetheless, the results do provide a basic measure of the impact that the shift to alternatives has had on public plan investment performance in recent years.

The first equation relates the average after-fee portfolio returns for the 160 plans in the PPD over the periods 2005-2015 and 2010-2015 to the percentage of the portfolio held in alternatives (see Figure 5). Because plan size and having an investment council could also be important, these two variables are included as controls. The results of the regression equation show that, relative to traditional equities, holding 10 percent more of the plan's portfolio in alternatives is associated with a lower return of 32 to 44 basis points, all else equal. (Full results are in Appendix Table A2.)

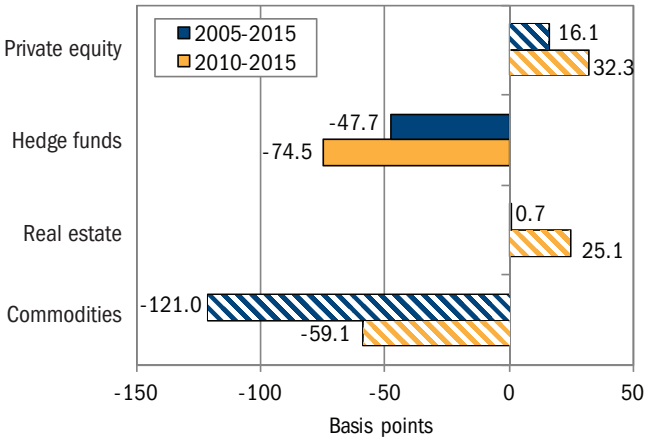
One problem with the above equation is that it treats alternatives as a single asset class – which they clearly are not. Therefore, the second equation relates the average portfolio returns to holdings in the four major alternative asset classes, plus the controls described above. The results show that the negative relationship between alternatives and overall portfolio returns stems primarily from hedge funds, which have experienced low returns relative to other asset classes since the financial crisis (see Figure 6). Plans holding 10 percent more in hedge funds experienced annual returns that were, on average, 48 and 75 basis points lower over the periods 2005-2015 and 2010-2015, respectively. Average portfolio returns were 6.5 percent and 9.8 percent over the same periods. (Full results are in Appendix Table A3.)

Figure 5. *Estimated Effect of a 10-percent Increase in Average Allocations to Alternatives on After-Fee Returns, in Basis Points, 2005-2015 and 2010-2015*



Note: These results are statistically significant.
Source: Authors' calculations from *Public Plans Database* (2005-2015).

Figure 6. *Estimated Effect of a 10-percent Increase in Average Allocations on After-Fee Returns, in Basis Points, 2005-2015 and 2010-2015*



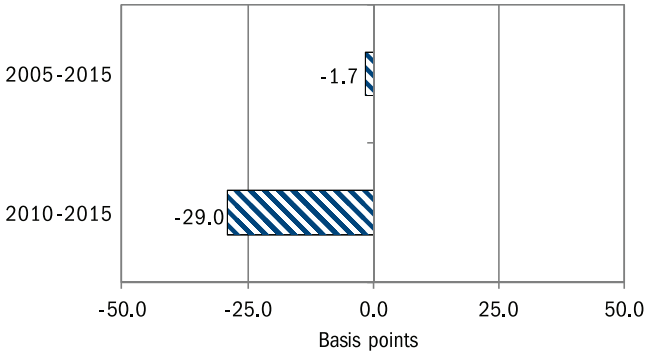
Note: Solid bars are statistically significant.
Source: Authors' calculations from *Public Plans Database* (2005-2015).

Table 4. *Public Plan After-Fee Returns from Different Asset Classes, 2010-2015*

Asset class	Average annual return
Private equity	18.4 %
Hedge funds	7.8
Real estate	10.3
Commodities	2.9
Traditional equities	13.5

Source: *Public Plans Database* (2010-2015).

Figure 7. *Estimated Effect of a 10-percent Increase in Average Allocations to Alternatives on Volatility, in Basis Points, 2005-2015 and 2010-2015*

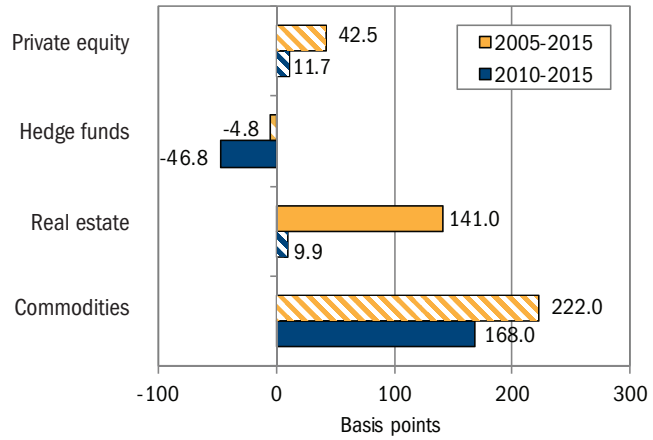


Note: These results are not statistically significant.
Source: Authors' calculations from *Public Plans Database* (2005-2015).

The other interesting result in Figure 6 is that the positive effects of private equity and real estate on portfolio returns are not statistically significant, suggesting that – at least for the periods in question – some plans may have done just as well investing in traditional equities. This finding is consistent with the after-fee return data for public plans shown in Table 4 (on the next page).[18]

Plans, however, may care about more than simple returns; a number of public plans cited reduced volatility as a rationale for investing in alternatives.[19]

Figure 8. *Estimated Effect of a 10-percent Increase in Average Allocations on Volatility, in Basis Points, 2005-2015 and 2010-2015*



Note: Solid bars are statistically significant.
Source: Authors' calculations from *Public Plans Database* (2005-2015).

Hence, the third regression relates holdings in alternatives to the volatility (standard deviation) of overall portfolio returns. The results show that, as a group, alternatives did not have a statistically significant effect on volatility in either the 2005-10 or 2010-15 periods (see Figure 7). (Full results are in Appendix Table A4.)

The reason for the lack of impact on volatility is that while holdings of hedge funds reduce volatility, this effect is offset by the greater volatility associated with real estate and commodities (see Figure 8).[20] (Full results are in Appendix Table A5.)

Conclusion

In the last 10 years, public pension plans – like other large institutional investors – have moved a significant portion of their portfolios into investments outside of traditional equities, bonds, and cash. These alternative investments include a diverse assortment – private equity, hedge funds, real estate, and commodities. This initial foray into the investment patterns of state and local plans focuses on two questions: 1) which plans have made the largest shift to alternatives? and 2) how have alternatives impacted their overall investment performance?

The analysis showed little systematic relationship between plan characteristics and holdings of alternatives generally. The data did show that the allocation of the alternative investments varied by plan size, with small plans holding relatively more in hedge funds and commodities, which have not performed well recently, and large plans holding more in private equity, which has shown stronger returns.

The empirical results revealed a consistently negative and statistically significant relationship between alternative investments and returns on the total investment portfolio. Regression with various asset types showed this relationship stemmed primarily from low hedge fund returns. But, the analysis also found that hedge funds were related to slightly less volatility of the portfolio, while other alternatives were associated with more volatility.

This analysis should be viewed as preliminary. It does not examine the performance of each plan

individually, but rather public plans in aggregate. It also does not incorporate the specific role of alternatives in each plan's investment strategy and therefore cannot determine the extent to which alternatives helped meet a plan's specific objectives. Finally, the analysis does not address fees, disclosure, or administrative issues. Further research is clearly warranted in this area.

Endnotes

1 Most would agree with classifying private equity and hedge funds as alternatives, but some might argue that real estate, which pension plans have been investing in for decades, and commodities, which are traded on exchanges, are not part of the group. But our focus is on the movement away from traditional stocks and bonds, so all other investments are grouped together. Due to the low risk of state and local pension liabilities, some question whether it is prudent for public pensions to allocate large portions of their investment portfolio to higher-risk assets such as traditional equities or alternatives. However, given that public plans do hold a significant proportion of higher-risk assets, this analysis focuses on how the shift from traditional investments to alternatives has impacted overall returns.

2 Rauch and Wahrenburg (2013).

3 These strategies include long/short strategies, arbitrage strategies, event-driven strategies, macro strategies, and relative value strategies, among many others. For an analysis of the various strategies, see Connor and Lasarte (2005).

4 Smaller plans may use a fund of funds approach to gain investment expertise or access to larger hedge funds.

5 Because hedge funds are often simply a trading strategy involving either equities or bonds, some argue that they should be grouped among either a portfolio's equity or fixed income asset classes. In fact, about 10 percent of the public equity portfolio for Maryland PERS is actually hedge funds. Nonetheless, most analyses continue to separately track hedge funds due to their unique fee structure in comparison to directly investing in their underlying asset classes. Hedge fund fees currently average about 1.5 percent for management and 18 percent for performance (Bit 2015).

6 REITS can be listed as part of broad equity indices, are more liquid, and move very much like traditional publicly traded equities.

7 See Andonov, Bauer, and Cremers (2016); Sadka (2010); Fung et al. (2008); and Phalippou and Gottschalg (2009).

8 Aberdeen Asset Management (2017).

9 For a discussion of public pensions, alternative investments, and fees, see The Pew Charitable Trusts (2017).

10 The future cash flow needs of a pension fund are fairly predictable. The primary liquidity risk stems from the need to sell holdings in alternative investments during a market downturn. This risk is less worrisome if the pension fund also holds sufficient liquid assets.

11 In addition, David Swensen, Yale University's influential endowment fund manager, was promoting Yale's success at using alternatives to hedge risk and boost returns (Swensen 2009).

12 These biases can have a large effect. Ibbotson, Chen, and Zhu (2011) found that accounting for survivorship and backfill bias in the average return for hedge funds reduced the return from 14.9 percent to 7.7 percent over the period 1995-2009. Of course, since these data represent averages, some individual funds may have had much better returns. For a detailed overview of the different types of biases, see Ilmanen (2012).

13 The initiators of new investment vehicles are often Wall Street firms that design products to fill the vacuum left by the prospect of low equity and bond returns and the desire for greater diversification. These firms promote their products to state and local pension plans by meeting with a plan's finance director and its consultants. As these plan representatives become more comfortable with the idea of non-traditional investments, they may encour-

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age the plan's board to put out a request for proposal for different offerings. The consultants will then select two or three firms to make presentations. In the wake of such presentations, the plan may start to change its investment strategy. In some cases, new legislation or investment policies may be required to permit plan investments in the new investment classes. Today, 18 states mention alternative assets specifically in statutes designed to guide pension investments.

14 One explanation for the lower allocation to private equity by smaller plans may be that the minimum investment thresholds for participating in private equity funds are too high for many of them.

15 Other asset quartiles were also tested, but the only statistically significant result was for plans in the lowest quartile.

16 To avoid overstating the estimates, all of the regression results exclude Dallas Police & Fire due to their extreme investment allocations.

17 The result for assumed returns aligns with analysis by Andonov, Bauer, and Cremers (2016), which finds that greater investment in risky assets is correlated with higher assumed returns by state and local plans.

18 These returns are significantly lower than the before-fee returns for private equity and real estate reported in Table 1. As previously discussed, the returns of the broad indices presented in Table 1 may not represent the experience of public plans because of fees, where plans are on the returns curve, and various survival and reporting biases inherent in industry-level indices.

19 Sixty-two plans provided an explicit rationale in their Comprehensive Annual Financial Report for their movement into alternatives as they began to make the shift. The vast majority cited a desire for increased diversification, while eight plans mentioned lower equity exposure and nine mentioned volatility. Only one explicitly cited maximizing returns.

20 It is important to note that accounting delays or infrequent pricing can also understate the impact of hedge funds on volatility as well as their correlation with other assets in the portfolio, such as traditional equities.

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Appendix

Table A1. *Estimated Effect of 2005 Plan Characteristics on Percentage of Assets Allocated to Alternatives in 2015*

Plan characteristics in 2005	
Lowest asset quartile	-0.000367
	(0.0239)
Paid full ARC	0.0226
	(0.0210)
Above-avg. funded ratio	-0.0143
	(0.0222)
Above-avg. assumed return	0.0569**
	(0.0220)
Started investing pre-recession	0.115***
	(0.0272)
Has separate investment council	0.0302
	(0.0196)
Negative cash flow	-0.00796
	(0.0202)
Constant	0.0945**
	(0.0364)
Observations	169
R-squared	0.178

Notes: Statistically significant at 5-percent (**) or 1-percent level (***). Robust standard errors in parentheses. The results exclude Dallas Police & Fire, due to their extreme investment allocations, to avoid overstating the estimates.

Source: Authors' calculations using Public Plans Database (2005, 2015).

Table A2. *Estimated Effect of Average Allocations on After-Fee Returns, 2005-2015 and 2010-2015*

	(1) 2005-2015	(2) 2010-2015
Avg. allocation to alternatives	-0.0318***	-0.0442**
	(0.0110)	(0.0209)
Avg. allocation to fixed-income	-0.0431***	-0.0942***
	(0.0117)	(0.0326)
Has separate investment council	0.00533***	0.0129***
	(0.00203)	(0.00278)
Lowest asset quartile	-0.00543***	-0.0128***
	(0.00184)	(0.00465)
Constant	0.0816***	0.130***
	(0.00446)	(0.0109)
Observations	157	159
R-squared	0.164	0.187

Notes: Statistically significant at 5-percent (**) or 1-percent level (***). Robust standard errors in parentheses. The results exclude Dallas Police & Fire, due to their extreme investment allocations, to avoid overstating the estimates.

Source: Authors' calculations using Public Plans Database (2005-2015).

Table A3. *Estimated Effect of Average Allocations on After-Fee Returns, 2005-2015 and 2010-2015*

	(1) 2005-2015	(2) 2010-2015
Avg. allocation to private equity	0.0161	0.0323
	(0.0138)	(0.0270)
Avg. allocation to hedge funds	-0.0477***	-0.0745***
	(0.0138)	(0.0196)
Avg. allocation to real estate	0.000717	0.0251
	(0.0181)	(0.0392)
Avg. allocation to commodities	-0.121	-0.0591
	(0.109)	(0.117)
Avg. allocation to fixed-income	-0.0101	0.00379
	(0.00931)	(0.0189)
Has separate investment council	0.0037*	0.00878***
	(0.00205)	(0.00285)
Lowest asset quartile	-0.00458**	-0.00866**
	(0.00200)	(0.00384)
Constant	0.0684***	0.0984***
	(0.00276)	(0.00460)
Observations	156	159
R-squared	0.253	0.234

Notes: Statistically significant at 10-percent (*), 5-percent (**) or 1-percent level (***). Robust standard errors in parentheses.The results exclude Dallas Police & Fire, due to their extreme investment allocations, to avoid overstating the estimates.

Source: Authors' calculations using *Public Plans Database* (2005-2015).

Table A4. *Estimated Effect of Average Allocations on Volatility, 2005-2015 and 2010-2015*

	(1) 2005-2015	(2) 2010-2015
Avg. allocation to alternatives	-0.00166	-0.029
	(0.0162)	(0.0123)
Avg. allocation to fixed-income	-0.118***	-0.0668***
	(0.0326)	(0.0247)
Has separate investment council	-0.00345	0.00131
	(0.00319)	(0.00244)
Lowest asset quartile	-0.00212	-0.000465
	(0.00401)	(0.00313)
Constant	0.155***	0.105***
	(0.0100)	(0.00780)
Observations	160	160
R-squared	0.160	0.068

Notes: Statistically significant at 1-percent level (***). The results exclude Dallas Police & Fire, due to their extreme investment allocations, to avoid overstating the estimates.

Source: Authors' calculations using *Public Plans Database* (2005-2015).

Table A5. *Estimated Effect of Average Allocations on Volatility, 2005-2015 and 2010-2015*

	(1) 2005-2015	(2) 2010-2015
Avg. allocation to private equity	0.0425	0.0117
	(0.0293)	(0.0229)
Avg. allocation to hedge funds	-0.00482	-0.0468***
	(0.0273)	(0.0151)
Avg. allocation to real estate	0.141***	0.00992
	(0.0391)	(0.0320)
Avg. allocation to commodities	0.222	0.168**
	(0.212)	(0.0796)
Avg. allocation to fixed-income	-0.0226	-0.00645
	(0.0207)	(0.0136)
Has separate investment council	-0.00485	-0.000204
	(0.00349)	(0.00257)
Lowest asset quartile	-0.00438	-0.00290
	(0.00379)	(0.00278)
Constant	0.121***	0.0842***
	(0.00503)	(0.00337)
Observations	156	159
R-squared	0.253	0.234

Notes: Statistically significant at 5-percent (**) or 1-percent level (***). Robust standard errors in parentheses. The results exclude Dallas Police & Fire, due to their extreme investment allocations, to avoid overstating the estimates.

Source: Authors' calculations using *Public Plans Database* (2005-15).



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