



What gets measured
gets managed

CEM Investment Benchmarking Service

A comparative analysis of cost and value

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This benchmarking report compares your cost and return performance to CEM's extensive pension database.

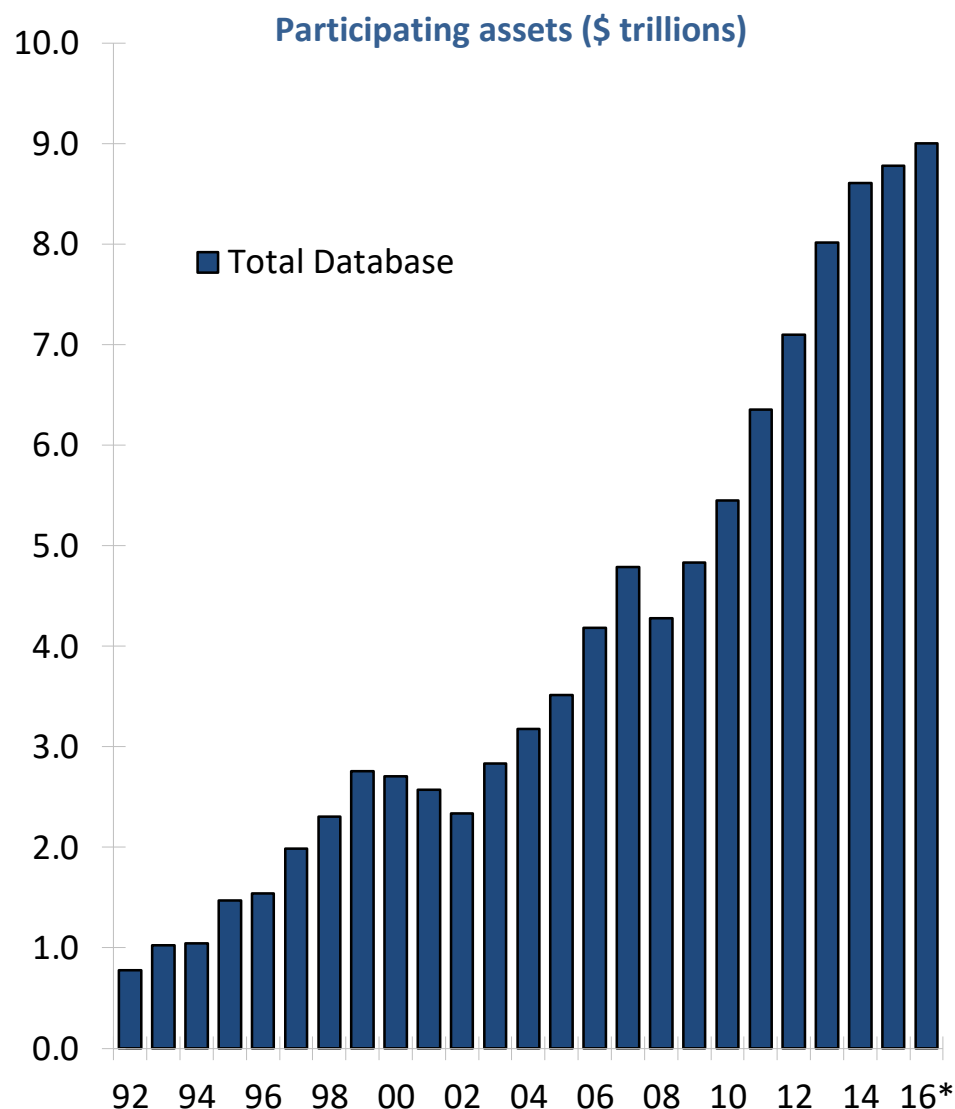
- 155 U.S. pension funds participate. The median U.S. fund had assets of \$9.6 billion and the average U.S. fund had assets of \$21.1 billion. Total participating U.S. assets were \$3.3 trillion.

- 72 Canadian funds participate with assets totaling \$1,150 billion.

- 37 European funds participate with aggregate assets of \$2.6 trillion. Included are funds from the Netherlands, Norway, Sweden, Finland, Denmark, Switzerland and the U.K.

- 6 Asia-Pacific funds participate with aggregate assets of \$188 billion. Included are funds from Australia, New Zealand, China and South Korea.

The most meaningful comparisons for your returns and value added are to the U.S. Public universe which consists of 56 funds.

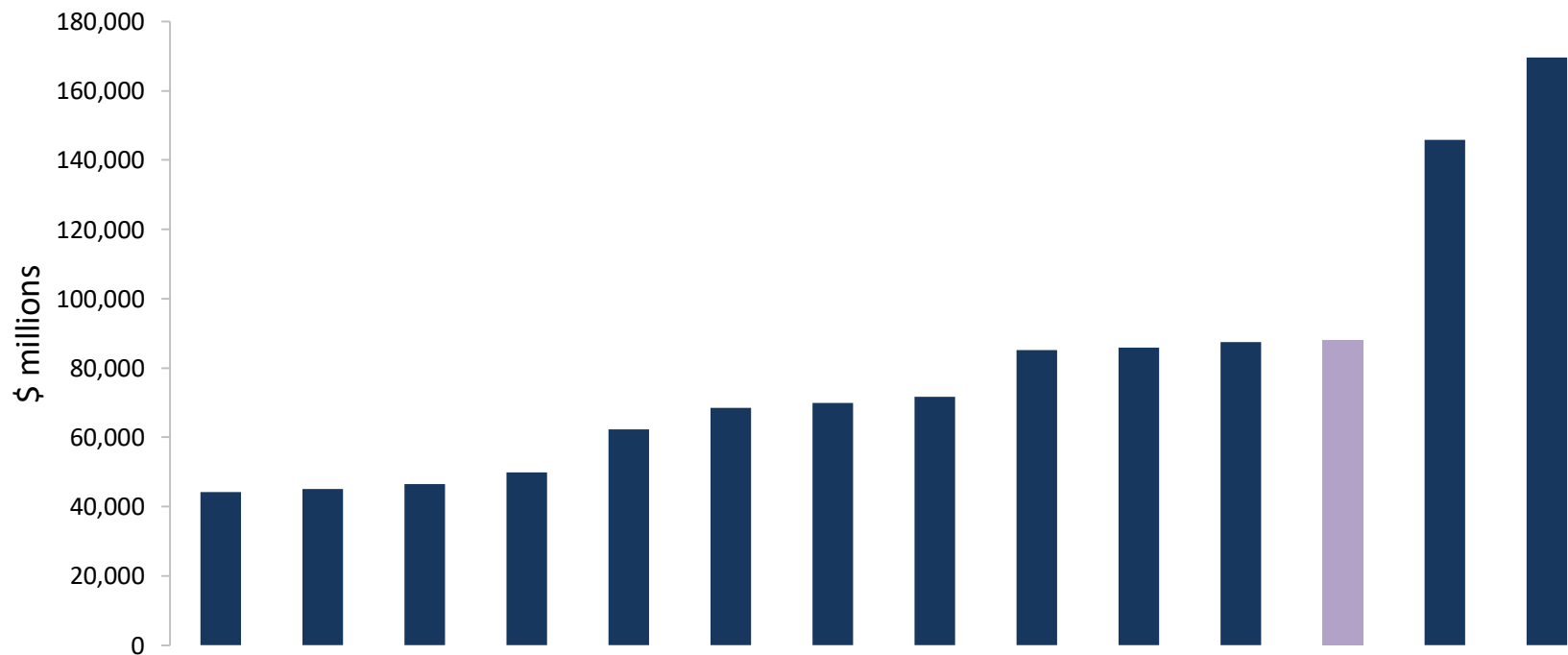


* 2016 reflects both received and expected data.

The most valuable comparisons for cost performance are to your custom peer group because size impacts costs.

Peer group for North Carolina Retirement Systems

- 14 U.S. public sponsors from \$44 billion to \$170 billion
- Median size of \$71 billion versus your \$88 billion



To preserve client confidentiality, given potential access to documents as permitted by the Freedom of Information Act, we do not disclose your peers' names in this document.

What gets measured gets managed, so it is critical that you measure and compare the right things:

1. Returns

Why do total returns differ from other funds? What was the impact of your policy mix decisions versus implementation decisions?

2. Net value added

Are your implementation decisions adding value (i.e., mostly the effectiveness of active management, as well as the amount of active management versus passive management)?

3. Costs

Are your costs reasonable? Costs matter and can be managed.

4. Cost effectiveness

Net implementation value added versus excess cost. Does paying more get you more?

5. Risk

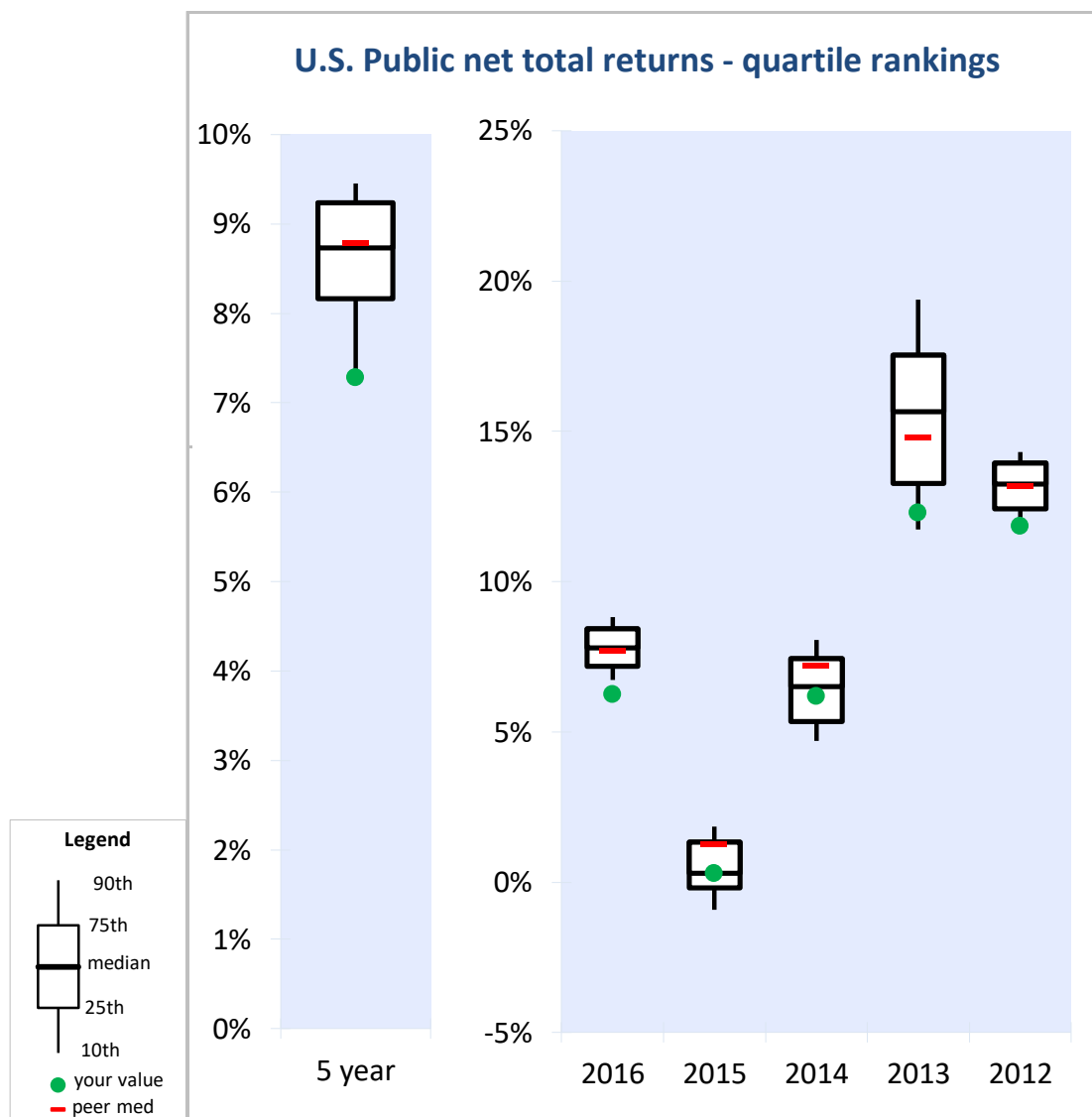
How much risk was taken to obtain your value added?
What is the risk of your policy mix?

Your 5-year net total return of 7.3% was below both the U.S. Public median of 8.7% and the peer median of 8.8%.

Total returns, by themselves, provide little insight into the reasons behind relative performance. Therefore, we separate total return into its more meaningful components: policy return and value added.

	Your 5-year
Net total fund return	7.3%
- Policy return	6.5%
= Net value added	0.8%

This approach enables you to understand the contribution from both policy mix decisions (which tend to be the board's responsibility) and implementation decisions (which tend to be management's responsibility).



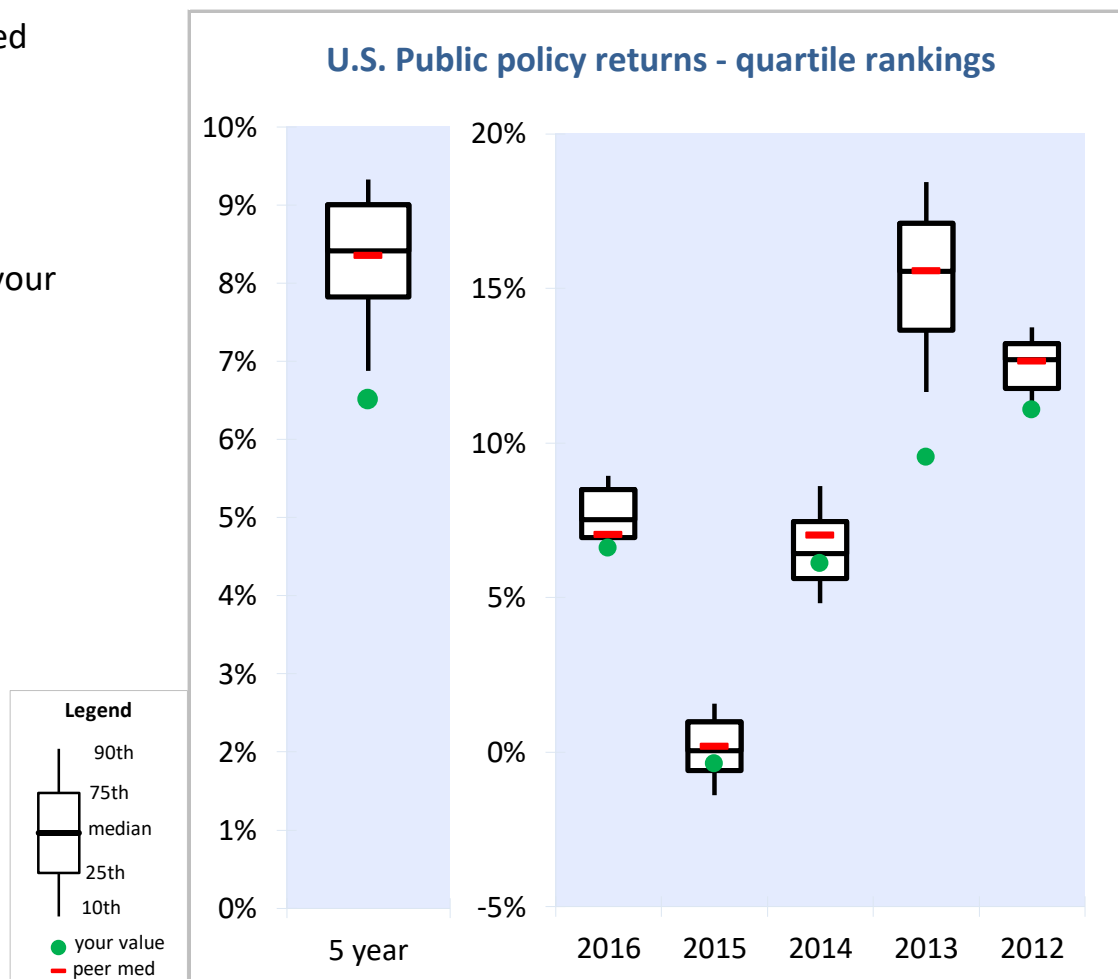
Your 5-year policy return of 6.5% was below both the U.S. Public median of 8.4% and the peer median of 8.4%.

Your policy return is the return you could have earned passively by indexing your investments according to your policy mix.

Having a higher or lower relative policy return is not necessarily good or bad. Your policy return reflects your investment policy, which should reflect your:

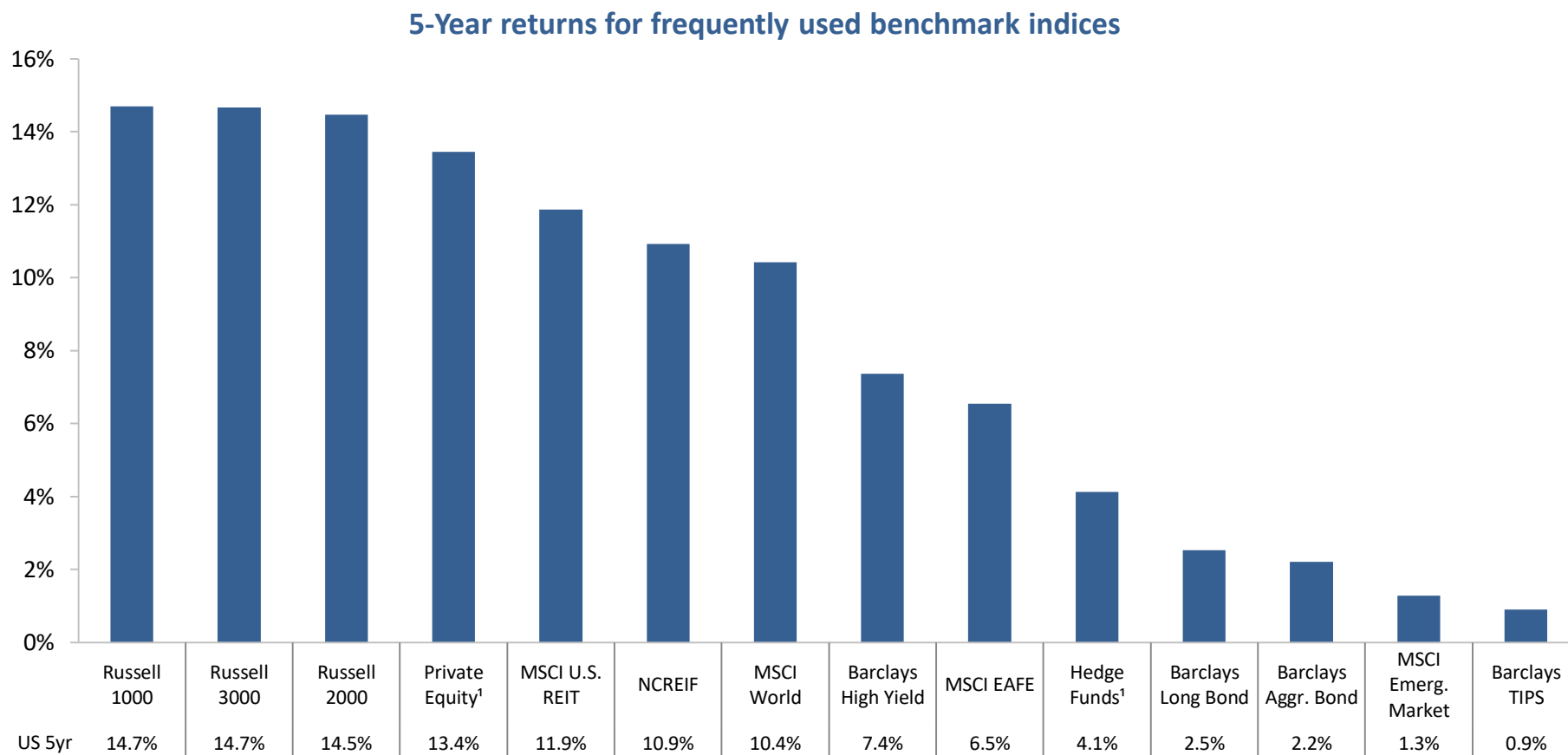
- Long term capital market expectations
- Liabilities
- Appetite for risk

Each of these three factors is different across funds. Therefore, it is not surprising that policy returns often vary widely between funds.



To enable fairer comparisons, the policy returns of all participants except your fund were adjusted to reflect private equity benchmarks based on lagged, investable, public-market indices. If CEM used this same adjustment for your fund, your 5-year policy return would be 6.7%, 0.2% higher than your actual 5-year policy return of 6.5%. Mirroring this, your 5-year total fund net value added would be 0.2% lower. Refer to the Research section pages 6-7 for details.

Differences in policy returns are caused by differences in benchmarks and policy mix. The two best performing asset classes for the 5 years ending 2016 were large cap stock (Russell 1000) and stock (Russell 3000).



1. The private equity benchmark is the average of the default private equity benchmark returns applied to U.S. participants. The hedge fund benchmark is the average of benchmark returns reported by U.S. participants.

Your 5-year policy return was below the U.S. Public median primarily because of:

- The negative impact of your higher weight in one of the poorer performing asset classes of the past 5 years: U.S. Bonds. Your 29% 5-year average weight is notably higher than the U.S. average of 17%.
- The negative impact of your lower weight in one of the better performing asset classes of the past 5 years: Stock. Your 42% 5-year average weight is lower than the U.S. average of 48%. Within your stock portfolio, you have a notably higher weight in ACWIXUS Stock. This lowered your total stock return compared to others, as the 5-year return of ACWIXUS (5.5%) was well below the weighted 5-year total stock return (10.5%) of the U.S. universe.
- The benchmarks for your real assets were low compared to the U.S. Public universe: A weighted 5-year average of 7.1% versus 8.8% for the universe.

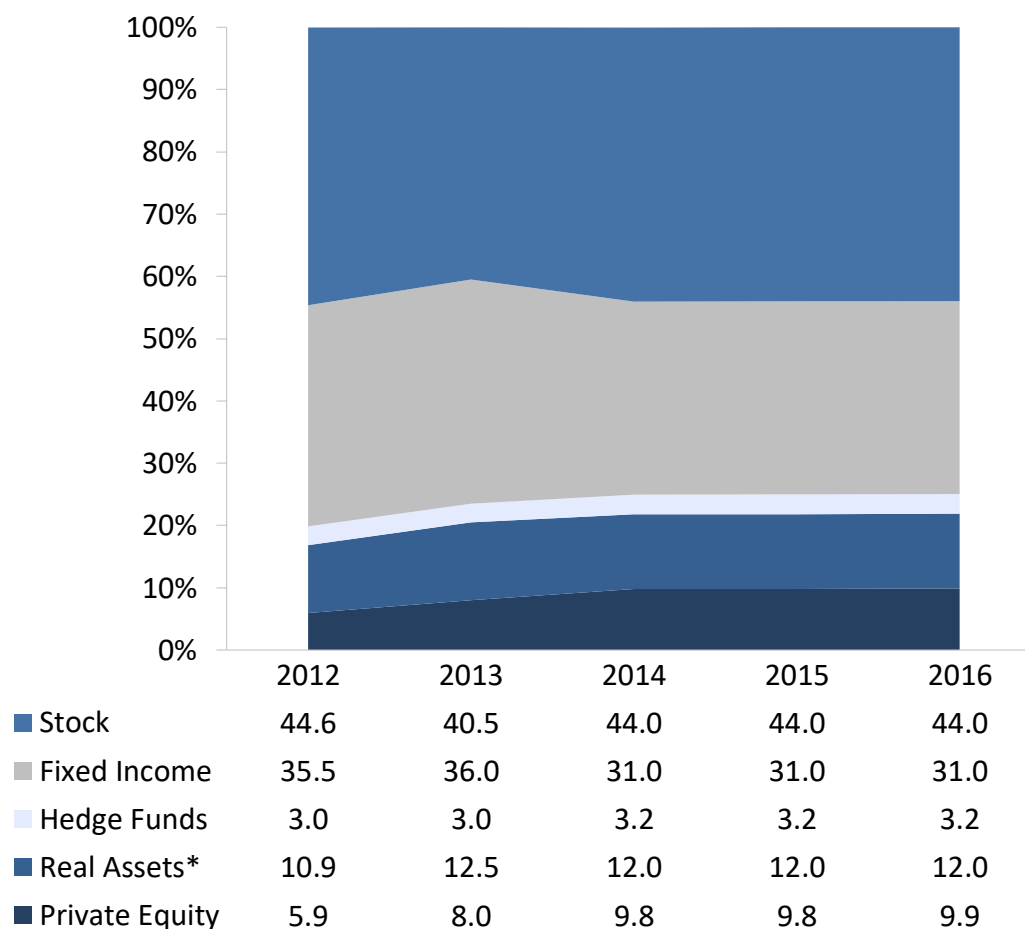
5-year average policy mix

	Your Fund	Peer Avg.	U.S. Public Avg.
U.S. Stock	20%	19%	23%
EAFE Stock	4%	7%	6%
Emerging Market Stock	1%	2%	2%
ACWIXUS Stock	14%	6%	9%
Global Stock	1%	12%	8%
Other Stock	2%	0%	1%
Total Stock	42%	46%	48%
U.S. Bonds	29%	17%	17%
Inflation Indexed Bonds	1%	2%	2%
Cash	2%	0%	0%
Other Fixed Income	0%	7%	7%
Total Fixed Income	33%	26%	26%
Global TAA	1%	1%	2%
Hedge Funds	3%	4%	5%
Commodities	1%	1%	1%
Natural Resources	3%	0%	1%
Real Estate incl. REITS	8%	10%	8%
Other Real Assets ¹	0%	1%	1%
Private Equity	9%	11%	9%
Total	100%	100%	100%

Your policy mix changed slightly over the last 5 years:

- Private equity grew from 5.9% of your portfolio in 2012 to 9.9% in 2016.
- Fixed income was reduced from 36% in 2012-2013 to 31% in later years.
- Your holdings in stock varied between 40.5% and 44.6% of your policy mix.

Trend in your policy asset mix



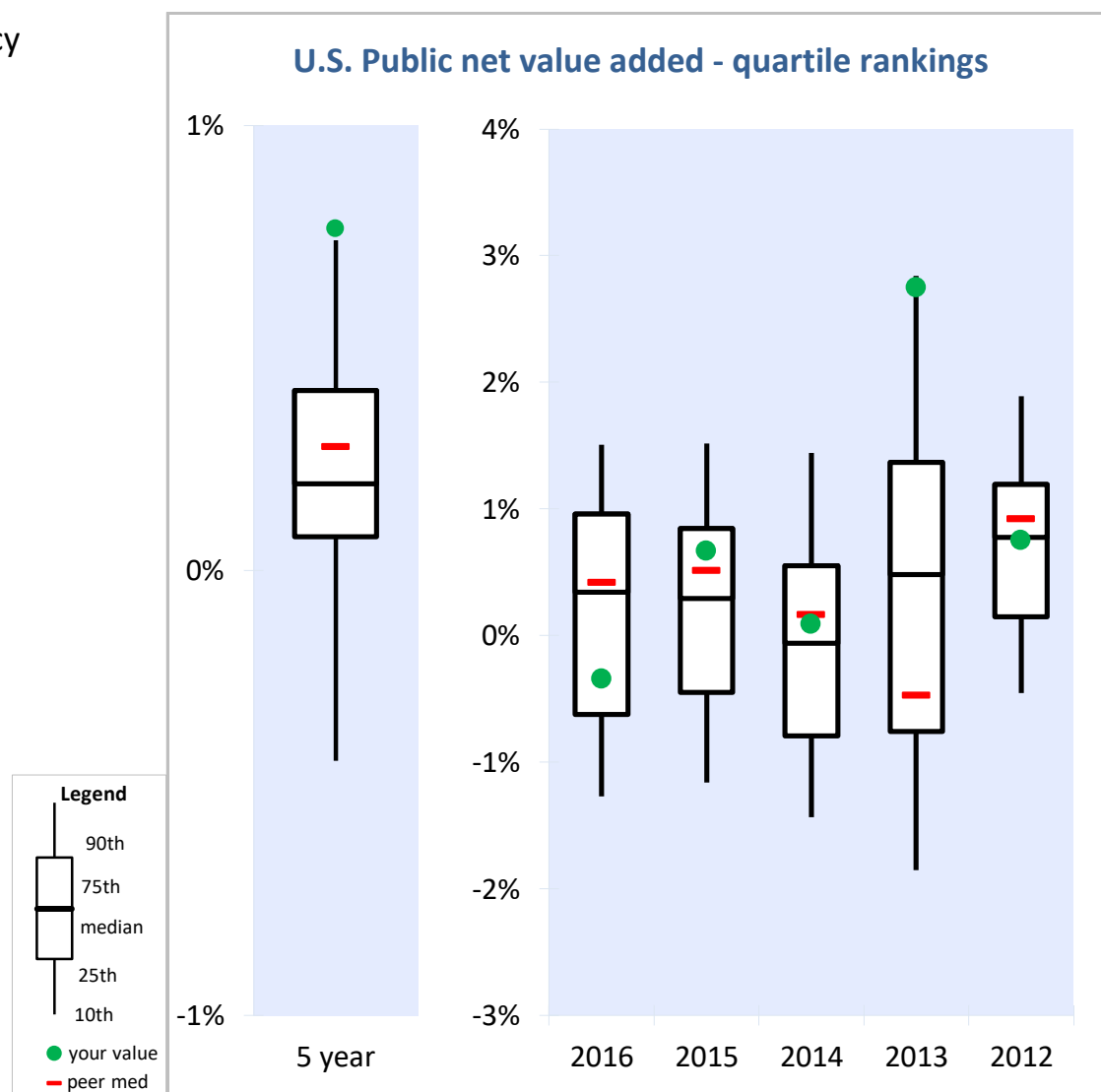
Net value added is the component of total return from active management. Your 5-year net value added was 0.8%.

Net value added equals total net return minus policy return.

Value added for North Carolina Retirement Systems

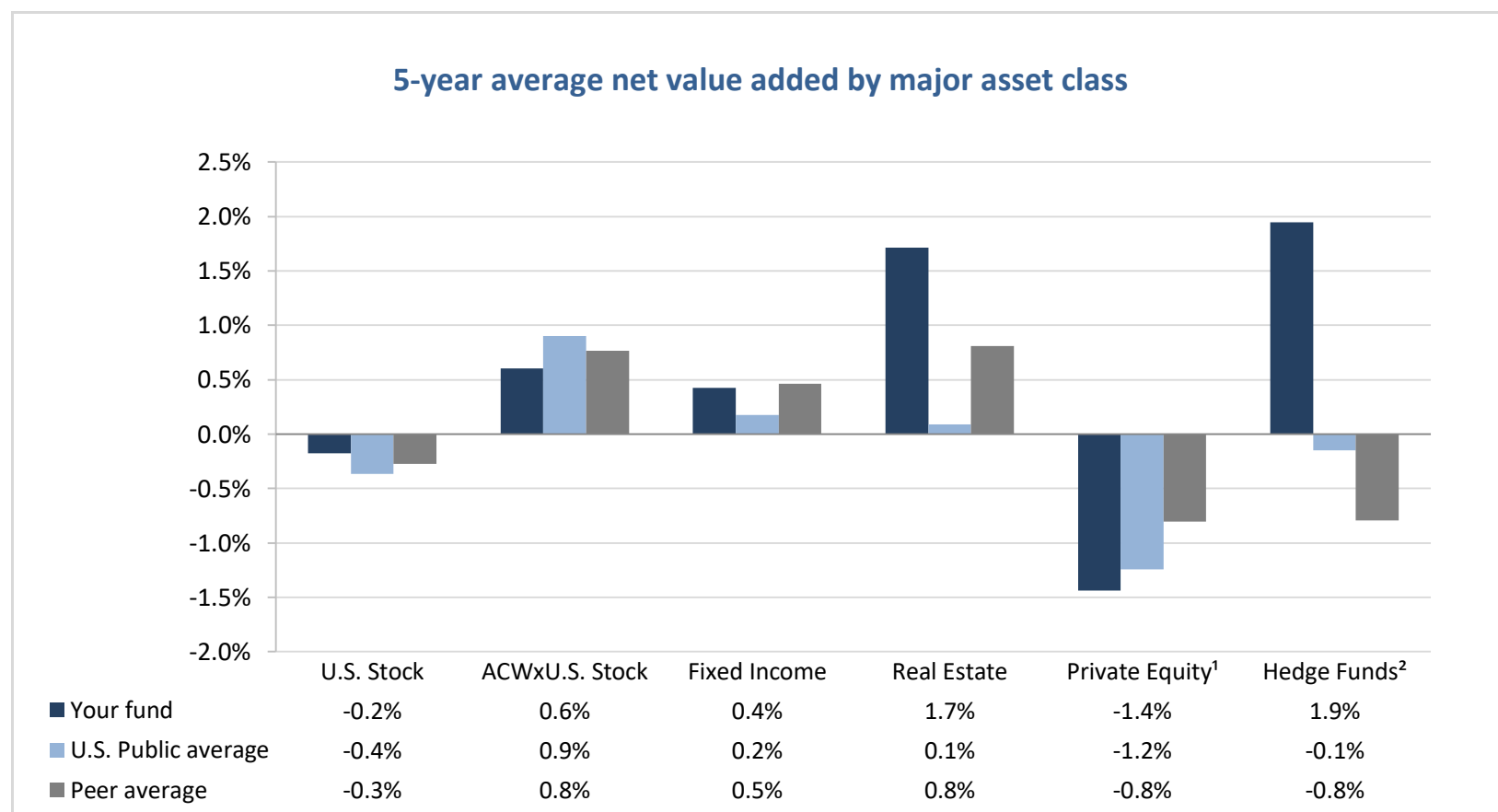
Year	Net Return	Policy Return	Net value Added
2016	6.3%	6.6%	(0.3%)
2015	0.3%	(0.4%)	0.7%
2014	6.2%	6.1%	0.1%
2013	12.3%	9.5%	2.8%
2012	11.8%	11.1%	0.8%
5-year	7.3%	6.5%	0.8%

Your 5-year net value added of 0.8% compares to a median of 0.3% for your peers and 0.2% for the U.S. Public universe.



Your value added was impacted by your choice of benchmarks for private equity. CEM suggests using lagged, investable benchmarks for private equity (see Research section, pages 6-7, for reasons why). If your fund used the private equity benchmark suggested by CEM, your 5-year total fund value added would have been 0.2% lower.

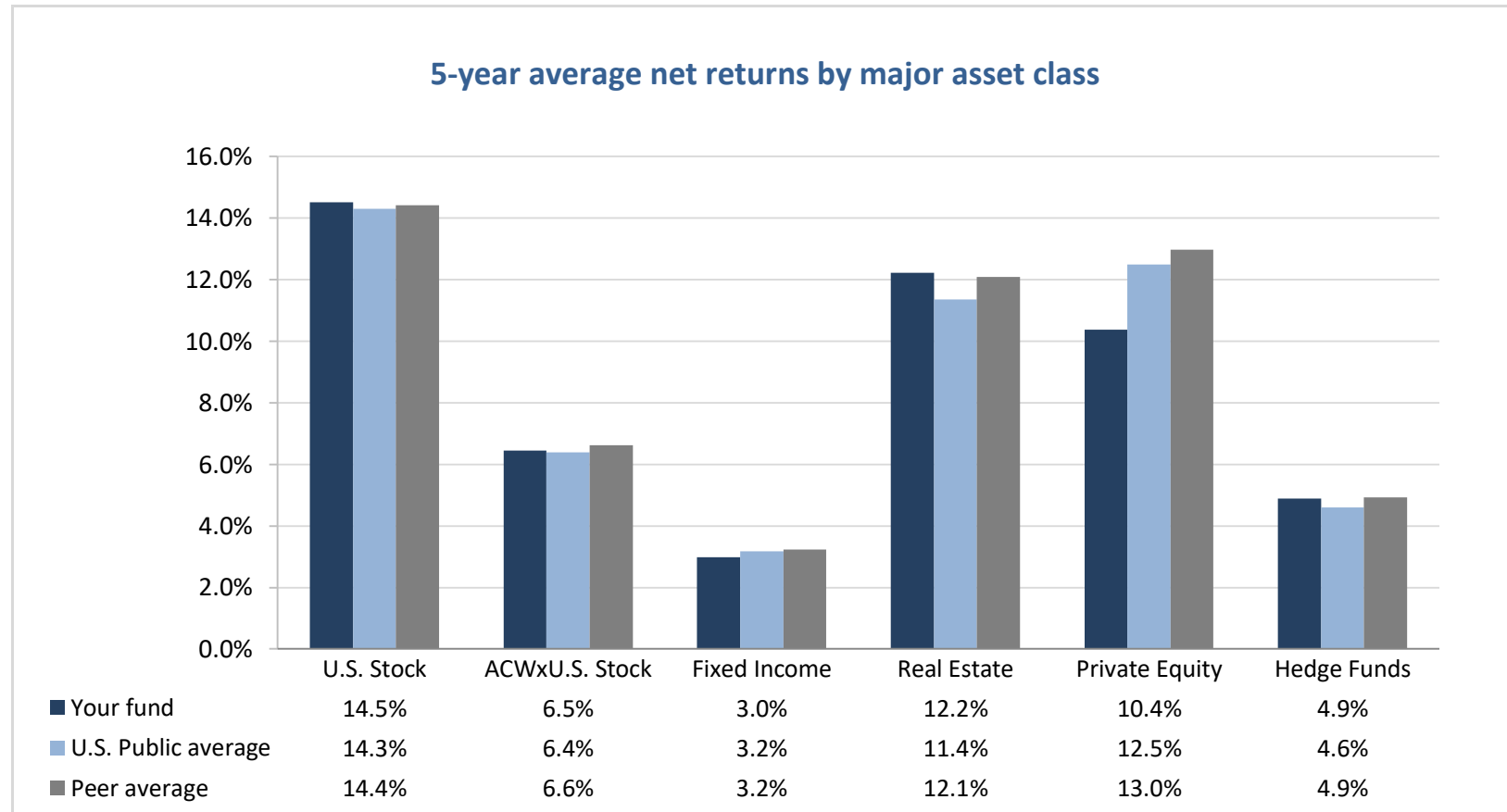
You had positive 5-year net value added in ACWxU.S. Stock, Fixed Income, Real Estate and Hedge Funds.



1. To enable fairer comparisons, the private equity benchmarks of all participants, except your fund, were adjusted to reflect lagged, investable, public-market indices. If your fund used the private equity benchmark suggested by CEM, your fund's 5-year private equity net value added would have been -3.6%. Refer to the Research section, pages 6-7, for details as to why this adjustment makes for better comparisons. It is also useful to compare total returns. Your 5-year total return of 10.4% for private equity was below the U.S. average of 12.5%.

2. It is also useful to compare total returns for hedge funds. Your 5-year return of 4.9% for hedge funds was above the U.S. average of 4.6%.

You had higher 5-year net returns in U.S. Stock, ACWxU.S. Stock, Real Estate and Hedge Funds relative to the U.S. Public average.



Your investment costs were \$444.6 million or 50.5 basis points in 2016.

Asset management costs by asset class and style (\$000s)	Internal Mgmt		External Management			Total
	Active	Overseeing of external	Passive fees	Active base fees	Perform. fees ¹	
U.S. Stock - Broad/All		266		3,662		3,927
U.S. Stock - Large Cap		991	801	10,723		12,515
U.S. Stock - Mid Cap		280	22	6,418		6,720
U.S. Stock - Small Cap		339		8,420		8,759
Stock - EAFE		721	97	8,826		9,643
Stock - Emerging		447		11,696		12,143
Stock - ACWIxU.S.		1,235	1,440	17,420		20,095
Stock - Global		632		10,618		11,250
Stock - Other		21	0			21
Fixed Income - U.S.	3,470					3,470
Fixed Income - Inflation Indexed		254	87	694		1,035
Cash	563					563
Global TAA		704		1,940		2,644
Hedge Funds - Direct		1,193		38,312	22,199	61,704
Hedge Funds - Fund of Funds		423		18,770	8,034	27,227
Commodities		284		6,099	705	7,088
REITs		241	97	1,109		1,448
Real Estate		1,195		27,289	879 ¹	28,484
Real Estate - LPs		1,340		51,938	47,765 ¹	53,278
Real Estate - Fund of Funds		5		2,385	3,130 ¹	2,390
Real Estate - Co-investments		135		2,315		2,449
Infrastructure - LPs		194		6,549	161 ¹	6,743
Natural Resources - LPs		979		41,994	3,991 ¹	42,974
Natur. Resources - Co-investments		148		908		1,056
Diversified Priv.Eq. - Fund of Funds		575		22,265	6,505 ¹	22,839
LBO		1,027		35,320	36,107 ¹	36,346
Venture Capital		530		17,506	9,902 ¹	18,036
Venture Capital - Co-investments		7				7
Other Private Equity		1,038		32,096	22,078 ¹	33,134
Other Private Equity - Co-investments		16		1,630		1,646
Total excluding private asset performance fees						439,635 50.0bp
Oversight, custodial and other costs ²						
Oversight of the fund						3,224
Trustee & custodial						1,550
Consulting and performance measurement						
Audit						184
Total oversight, custodial & other costs						4,959 0.6bp
Total investment costs (excl. transaction costs & private asset performance fees)						444,594 50.5bp

Footnotes

¹ Total cost excludes carry/performance fees for real estate, infrastructure, natural resources and private equity. Performance fees are included for the public market asset classes and hedge funds.

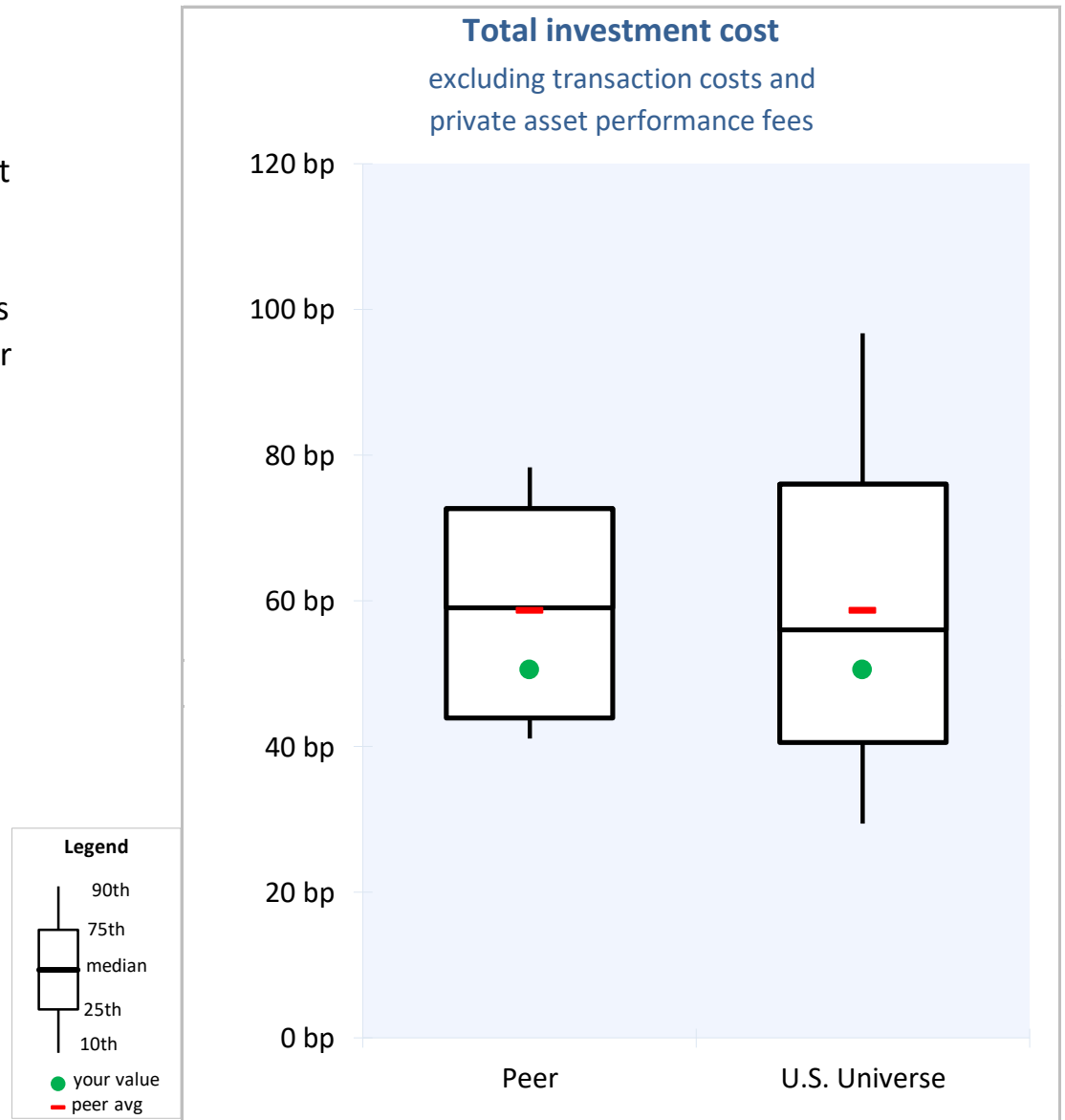
² Excludes non-investment costs, such as PBGC premiums and preparing checks for retirees.

Your total investment cost of 50.5 bps was below the peer median of 59.0 bps.

Differences in total investment cost are often caused by two factors that are often outside of management's control:

- Asset mix, particularly holdings of the highest cost asset classes: real estate (excl REITS), infrastructure, hedge funds and private equity. These high cost assets equaled 27% of your fund's assets at the end of 2016. This is equal to the peer average, but higher than the U.S. average of 17%.
- Fund size. Bigger funds have advantages of scale.

Therefore, to assess whether your costs are high or low given your unique asset mix and size, CEM calculates a benchmark cost for your fund. This analysis is shown on the following page.



Benchmark cost analysis suggests that, after adjusting for fund size and asset mix, your fund was low cost by 7.0 basis points in 2016.

Your benchmark cost is an estimate of what your cost would be given your actual asset mix and the median costs that your peers pay for similar services. It represents the cost your peers would incur if they had your actual asset mix.

Your total cost of 50.5 bp was below your benchmark cost of 57.5 bp. Thus, your cost savings was 7.0 bp.

Your cost versus benchmark

	\$000s	basis points
Your total investment cost	444,594	50.5 bp
Your benchmark cost	505,768	57.5 bp
Your excess cost	(61,175)	(7.0) bp

Your fund was low cost because you paid less than peers for similar services.

Reasons for your low cost status

	Excess Cost/ (Savings)	
	\$000s	bps
1. Higher cost implementation style		
• More fund of funds	6,640	0.8
• Use of external active management (vs. lower cost passive and internal)	5,549	0.6
• Less overlays	(1,198)	(0.1)
• Other style differences	(1,694)	(0.2)
	9,297	1.1
2. Paying less than peers for similar services		
• External investment management costs	(60,781)	(6.9)
• Internal investment management costs	(2,906)	(0.3)
• Oversight, custodial & other costs	(6,785)	(0.8)
	(70,472)	(8.0)
Total savings	(61,175)	(7.0)

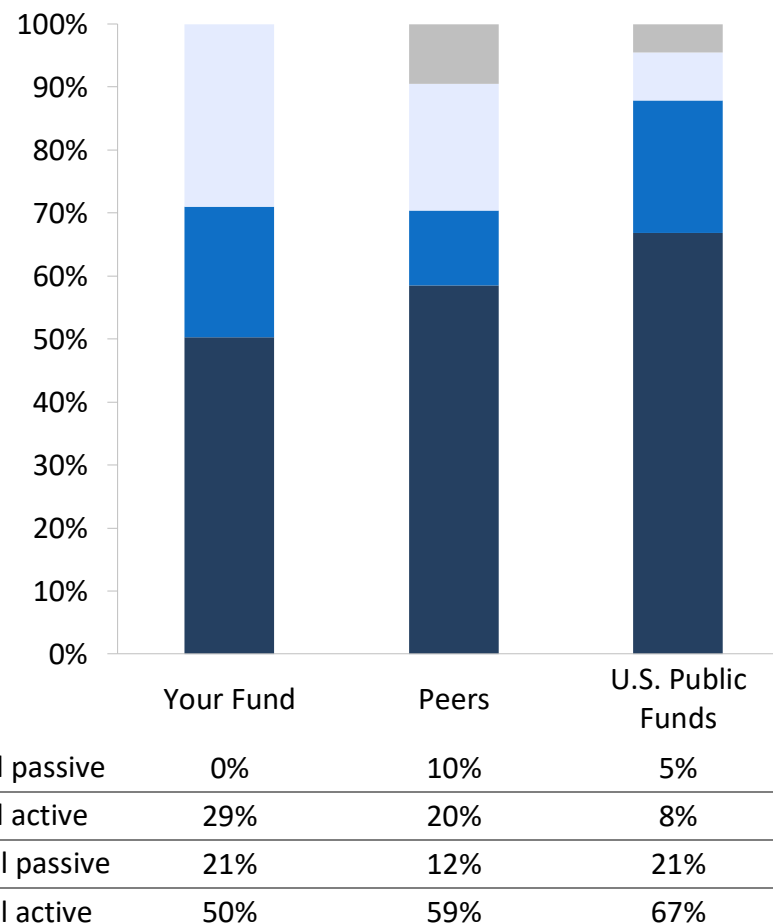
Differences in cost performance are often caused by differences in implementation style.

Implementation style is defined as the way in which your fund implements asset allocation. It includes internal, external, active, passive and fund of funds styles.

The greatest cost impact is usually caused by differences in the use of:

- External active management because it tends to be much more expensive than internal or passive management. You used less external active management than your peers (your 50% versus 59% for your peers).
- Within external active holdings, fund of funds usage because it is more expensive than direct fund investment. You had more in fund of funds. Your 10% of hedge funds, real estate and private equity in fund of funds compared to 6% for your peers.

Implementation style¹



1. The graph above does not take into consideration the impact of derivatives. The values in the graph are calculated using average holdings.

Using a more external and active style cost you 0.6 bp relative to your peers.

Calculation of the cost impact of differences in implementation style

Asset class	Your avg holdings in \$mils ³ (A)	% External active			Premium vs passive & internal ¹ (C)	Cost/ (savings) \$000s (A X B X C)	bps
		You	Peer average	More/ (less) (B)			
U.S. Stock - Broad/All	1,046	100.0%	21.5%	78.5%	39.0 bp	3,199	
U.S. Stock - Large Cap	12,849	20.4%	14.6%	5.8%	23.0 bp	1,726	
U.S. Stock - Mid Cap	1,387	76.7%	35.7%	41.0%	49.4 bp	2,810	
U.S. Stock - Small Cap	1,336	100.0%	63.1%	36.9%	60.8 bp	3,004	
Stock - EAFE	3,420	80.6%	52.1%	28.5%	30.5 bp	2,972	
Stock - Emerging	1,761	100.0%	67.4%	32.6%	55.6 bp	3,188	
Stock - ACWIxU.S.	9,929	41.7%	67.5%	(25.8%)	41.5 bp	(10,637)	
Stock - Global	2,491	100.0%	74.4%	25.6%	31.8 bp	2,028	
Stock - Other	660	0.0%	0.0%	0.0%		0	
Fixed Income - U.S.	21,934	0.0%	36.7%	(36.7%)	11.5 bp	(9,215)	
Fixed Income - Inflation Indexe	724	59.8%	16.2%	43.6%	11.4 bp	359	
Global TAA	1,415	100.0%	93.5%	6.5%	N/A ²	0	
Commodities	808	100.0%	81.2%	18.8%	N/A ²	0	
REITs	682	50.7%	68.2%	(17.5%)	24.8 bp	(296)	
Infrastructure	570	100.0%	100.0%	(0.0%)		0	
Partnerships, as a proportion of external:	570	100.0%	87.5%	12.5%	N/A ²	0	
Real Estate ex-REITs	9,391	100.0%	90.7%	9.3%	N/A ²	0	
Partnerships, as a proportion of external:	9,391	63.7%	53.0%	10.7%	37.6 bp	3,783	
Natural Resources	5,225	100.0%	95.1%	4.9%	N/A ²	0	
Partnerships, as a proportion of external:	5,225	100.0%	69.0%	31.0%	16.2 bp	2,626	
Diversified Private Equity	1,057	100.0%	99.9%	0.1%	N/A ²	0	
LBO	2,688	100.0%	100.0%	0.0%		0	
Venture Capital	1,268	100.0%	100.0%	0.0%		0	
Other private equity	3,583	100.0%	98.4%	1.6%	N/A ²	0	
Impact of less/more external active vs. lower cost styles						5,549	0.6 bp

Footnotes

1. The cost premium is the additional cost of external active management relative to the average of other lower cost implementation styles - internal passive, internal active and external passive.
2. A cost premium listed as 'N/A' indicates that there was not enough peer data in one or both styles to calculate the premium.
3. If you provided us with the amount your fees are based on, this number is used instead of NAV.

The use of Fund of Funds versus Limited Partnerships cost you 0.8 bp relative to your peers.

Asset class	Your avg holdings in \$mils ⁴	Fund of funds % of LPs			Premium vs. direct LP ¹	Cost/ (savings)	
		You	Peer average	More/ (less)		\$000s	bps
	(A)			(B)	(C)	(A X B X C)	
Hedge Funds	6,076	19.2%	17.4%	1.8%	58.7 bp	626	
Performance Fee Impact:	6,076	19.2%	17.4%	1.8%	N/A ²	0	
Infrastructure - LPs	570	0.0%	6.8%	(6.8%)	N/A ²	0	
Real Estate ex-REITs - LPs	5,982	2.0%	1.7%	0.3%	79.1 bp	146	
Natural Resources - LPs	5,225	0.0%	0.0%	0.0%		0	
Private Equity - LPs	8,596	12.3%	2.8%	9.5%	71.8 bp	5,868	
Impact of less/more fund of funds vs. direct LPs						6,640	0.8 bp
<u>Overlays and other</u>							
Impact of lower use of portfolio level overlays						(1,198)	(0.1) bp
Impact of mix of internal passive, internal active, and external passive ³						(1,694)	(0.2) bp
Total impact of differences in implementation style						15,165	1.7 bp

1. The cost premium is the additional cost of external active management relative to the average of other lower cost implementation styles - internal passive, internal active and external passive.

2. A cost premium listed as 'N/A' indicates that there was not enough peer data in one or both styles to calculate the premium.

3. The 'Impact of mix of internal passive, internal active and external passive' quantifies the net cost impact of differences in cost between, and your relative use of, these 'low-cost' styles.

4. If you provided us with the amount your fees are based on, this number is used instead of NAV.

The net impact of paying more/less for external asset management costs saved 6.9 bps.

Cost impact of paying more/(less) for external asset management

	Your avg holdings in \$mils (A)	Cost in bps			Cost/ (savings) in \$000s (A X B)
		Your Fund	Peer median	More/ (less) (B)	
U.S. Stock - Broad/All - Active	1,046	37.5	40.6	(3.1)	(320)
U.S. Stock - Large Cap - Passive	10,223	1.1	1.0	0.1	125
U.S. Stock - Large Cap - Active	2,626	43.4	25.7	17.7	4,640
U.S. Stock - Mid Cap - Passive	323	1.0	4.6*	(3.6)	(116)
U.S. Stock - Mid Cap - Active	1,064	62.8	54.0*	8.8	939
U.S. Stock - Small Cap - Active	1,336	65.6	63.0	2.5	336
Stock - EAFE - Passive	663	1.8	1.8	(0.1)	(5)
Stock - EAFE - Active	2,756	34.6	34.5	0.0	11
Stock - Emerging - Active	1,761	69.0	62.1	6.8	1,201
Stock - ACWIxU.S. - Passive	5,786	2.8	2.8	0.0	21
Stock - ACWIxU.S. - Active	4,142	44.6	44.3	0.3	140
Stock - Global - Active	2,491	45.2	37.5	7.6	1,902
Stock - Other - Passive	660	0.3	11.4*	(11.1)	(732)
Fixed Income - Inflation Indexed - Passive	291	6.5	1.1	5.4	159
Fixed Income - Inflation Indexed - Active	433	19.5	12.4	7.1	308
Global TAA - Active	1,415	18.7	43.4	(24.7)	(3,500)
Hedge Funds - Active	4,911	80.4	142.5	(62.1)	(30,479)
Performance Fees:	4,911	45.2	56.3*	(11.1)	(5,432)
Hedge Funds - Fund of Fund	1,164	164.9	201.2	(36.4)	(4,234)
Performance Fees:	1,164	69.0	56.3*	12.8	1,484
Commodities - Active	808	87.7 ¹	65.4	22.3	1,803
Infrastructure - Limited Partnership	570	118.3	118.3	0.0	0
REITs - Passive	336	6.4	7.8*	(1.3)	(44)
REITs - Active	346	35.6	32.6	3.0	105
Real Estate ex-REITs - Active	3,410	83.5 ¹	59.2	24.3	8,299
Real Estate ex-REITs - Limited Partnership	5,863	95.0 ¹	95.5	(0.5)	(278)
Real Estate ex-REITs - Fund of Fund	118	201.8 ¹	174.6*	27.2	322
Natural Resources - Limited Partnership	5,225	84.3	115.0	(30.7)	(16,039)
Diversified Private Equity - Fund of Fund	1,057	216.0	233.2	(17.1)	(1,812)
LBO - Active	2,688	135.2 ¹	165.0	(29.8)	(8,003)
Venture Capital - Active	1,268	142.3 ¹	203.0	(60.6)	(7,689)
Other Private Equity - Active	3,583	97.1 ¹	107.9	(10.9)	(3,894)
Total impact of paying more/less for external management					(60,781)
Total in bps					(6.9) bp

Footnotes:

*Universe median used as peer data was insufficient.
¹ You paid performance fees in these asset classes.

**The net impact of paying more/less for internal asset management saved 0.3 bps.
The differences in oversight, custodial & other costs saved an additional 0.8 bps.**

Cost impact of paying more/(less) for internal asset management

	Your avg holdings in \$mils	Cost in bps			Cost/ (savings) in \$000s
		Your Fund	Peer median	More/ (less)	
	(A)			(B)	(A X B)
Fixed Income - U.S. - Active	21,934	1.6	2.9	(1.3)	(2,906)
Total impact of paying more/less for internal management					(2,906)
Total in bps					(0.3) bp

Cost impact of differences in oversight, custodial & other costs

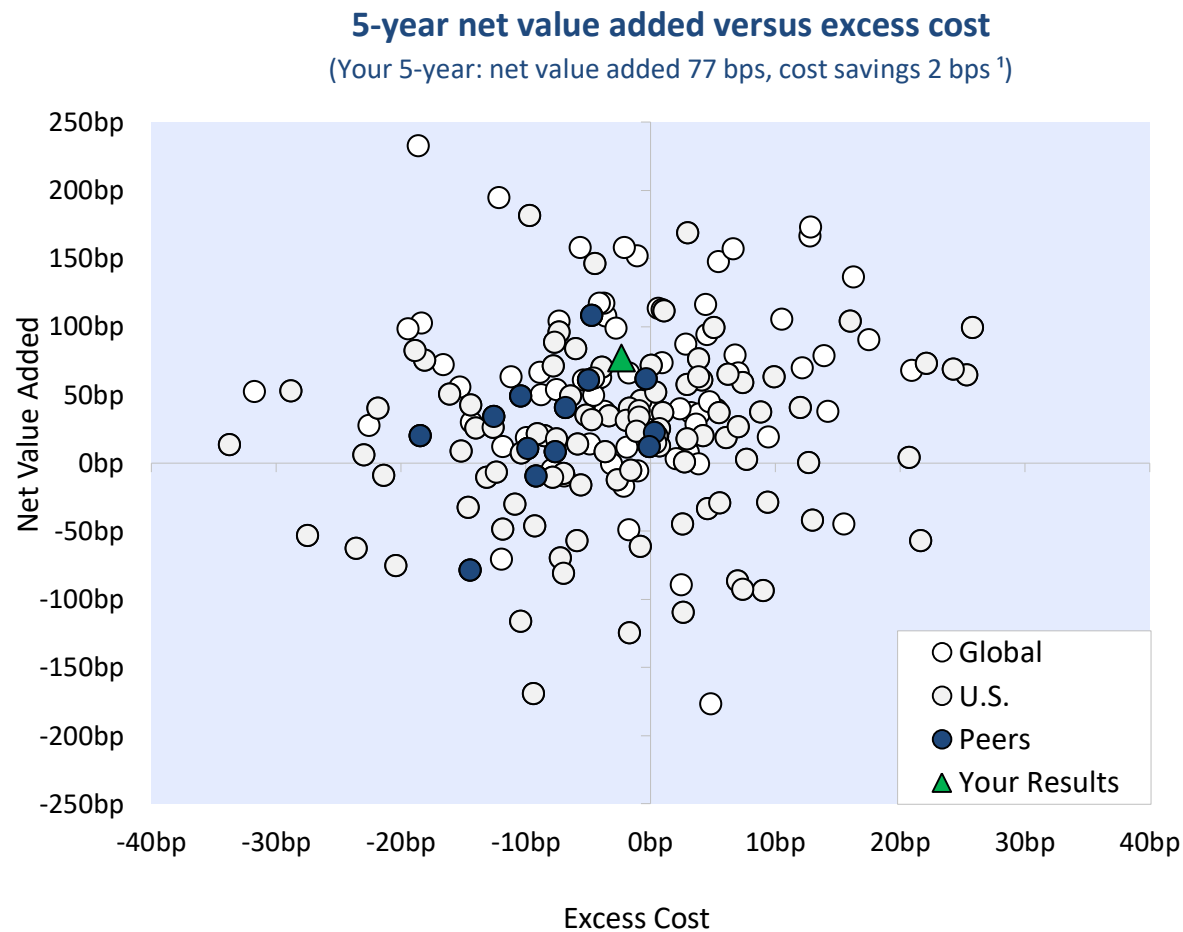
	Your avg holdings in \$mils	Cost in bps			Cost/ (savings) in \$000s
		Your fund	Peer median	More/ (less)	
	(A)			(B)	(A X B)
Oversight	87,960	0.4	0.5	(0.1)	(1,278)
Consulting	87,960	0.0	0.4	(0.4)	(3,919)
Custodial	87,960	0.2	0.3	(0.1)	(747)
Audit	87,960	0.0	0.0	(0.0)	(21)
Other	87,960	0.0	0.1	(0.1)	(821)
Total					(6,785)
Total in bps					(0.8) bp

In summary, your fund was low cost because you paid less than peers for similar services.

Reasons for your low cost status

	Excess Cost/ (Savings)	
	\$000s	bps
1. Higher cost implementation style		
• More fund of funds	6,640	0.8
• Use of external active management (vs. lower cost passive and internal)	5,549	0.6
• Less overlays	(1,198)	(0.1)
• Other style differences	(1,694)	(0.2)
	9,297	1.1
2. Paying less than peers for similar services		
• External investment management costs	(60,781)	(6.9)
• Internal investment management costs	(2,906)	(0.3)
• Oversight, custodial & other costs	(6,785)	(0.8)
	(70,472)	(8.0)
Total savings	(61,175)	(7.0)

Your 5-year performance placed in the positive value added, low cost quadrant of the cost effectiveness chart.

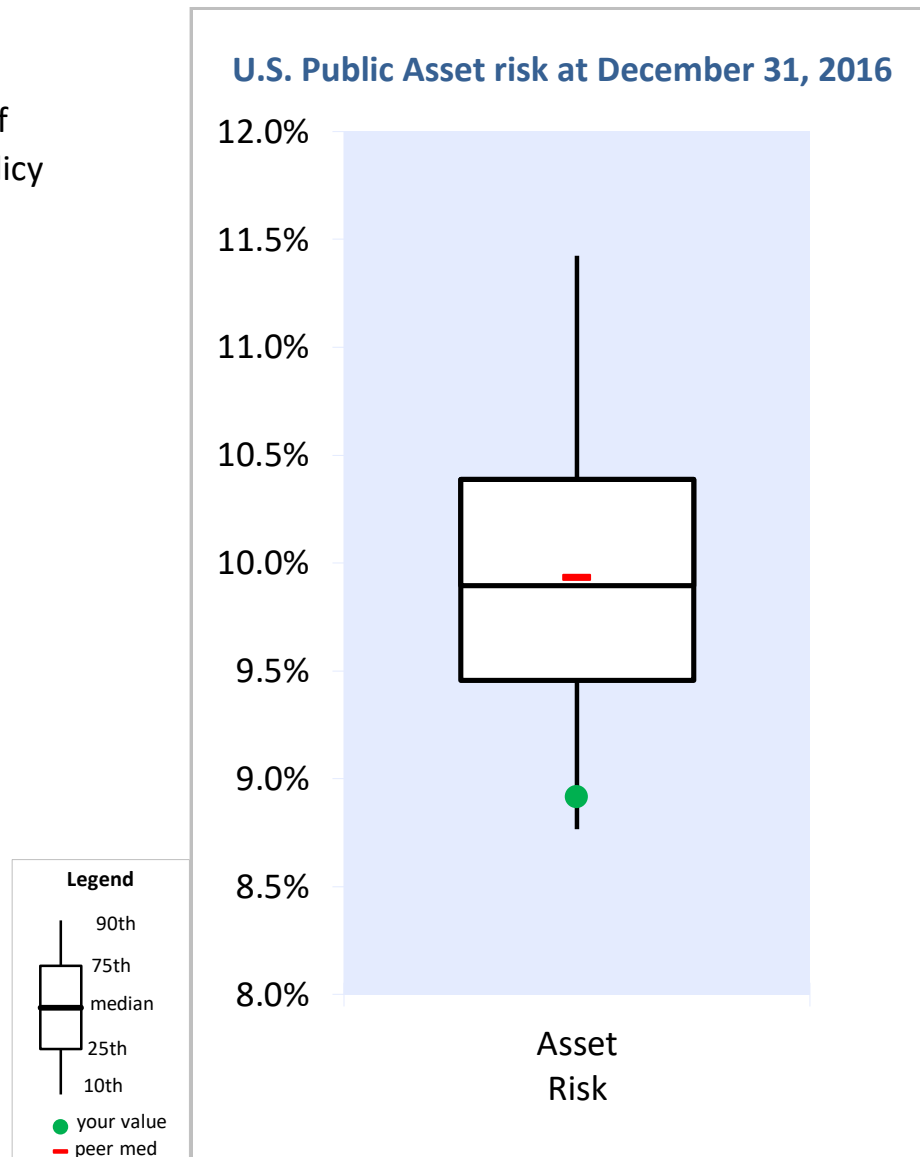


1. Your 5-year cost savings of 2 basis points is the average of your cost savings for the past 5 years.

	2016	2015	2014	2013	2012	5-year
Net value added	-34 bp	67 bp	9 bp	275 bp	75 bp	77 bp
Excess Cost	-7 bp	-10 bp	-2 bp	3 bp	4 bp	-2 bp

Your asset risk was among the lowest in the U.S. Public Universe

Your asset risk of 8.9% was among the lowest in the universe. It was well below the U.S. Public median of 9.9%. Asset risk is the standard deviation of your policy return. It is based on the historical variance of, and covariance between, the asset classes in your policy mix.



Key takeaways

Returns

- Your 5-year net total return was 7.3%. This was below both the U.S. Public median of 8.7% and the peer median of 8.8%.
- Your 5-year policy return was 6.5%. This was below both the U.S. Public median and the peer median (both 8.4%).
- The primary reason for your lower returns is your higher allocation towards fixed income. The policy return is lower because you used lower benchmarks for most of your private asset classes.

Value added

- Your 5-year net value added was 0.8%. This was above the U.S. Public median of 0.2% and above the peer median of 0.3%.

Cost

- Your investment cost of 50.5 bps was below your benchmark cost of 57.5 bps. This suggests that your fund was low cost compared to your peers.
- Your fund was low cost because you paid less than peers for similar services.

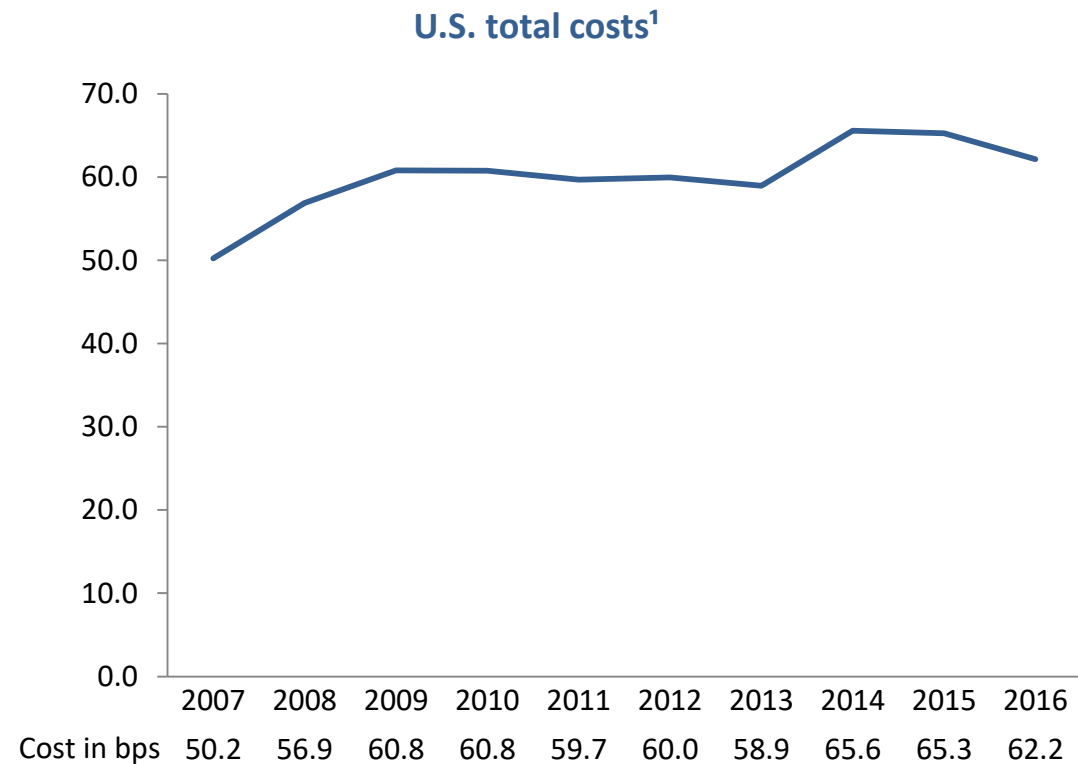
Risk

- Your asset risk of 8.9% was among the lowest in the universe. It was well below the U.S. Public median of 9.9% and the peer median of 9.9%

U.S. fund costs have grown by 12 basis points on average over the last 10 years.

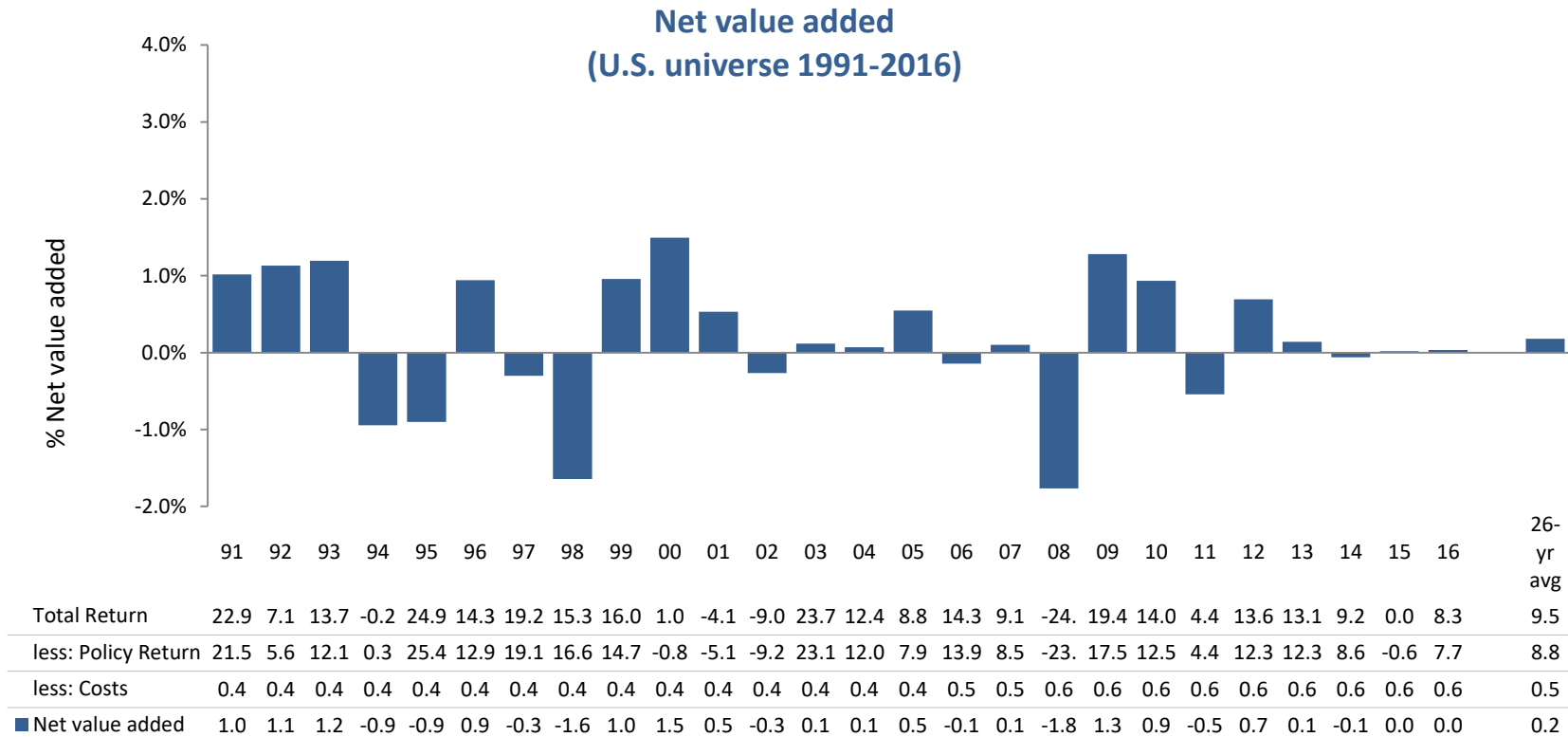
Reasons for the increase in costs include:

- Allocation to the more expensive asset classes - hedge funds, real assets and private equity- increased from 14% to 23% on average.
- Changes in implementation style have had a minor impact.



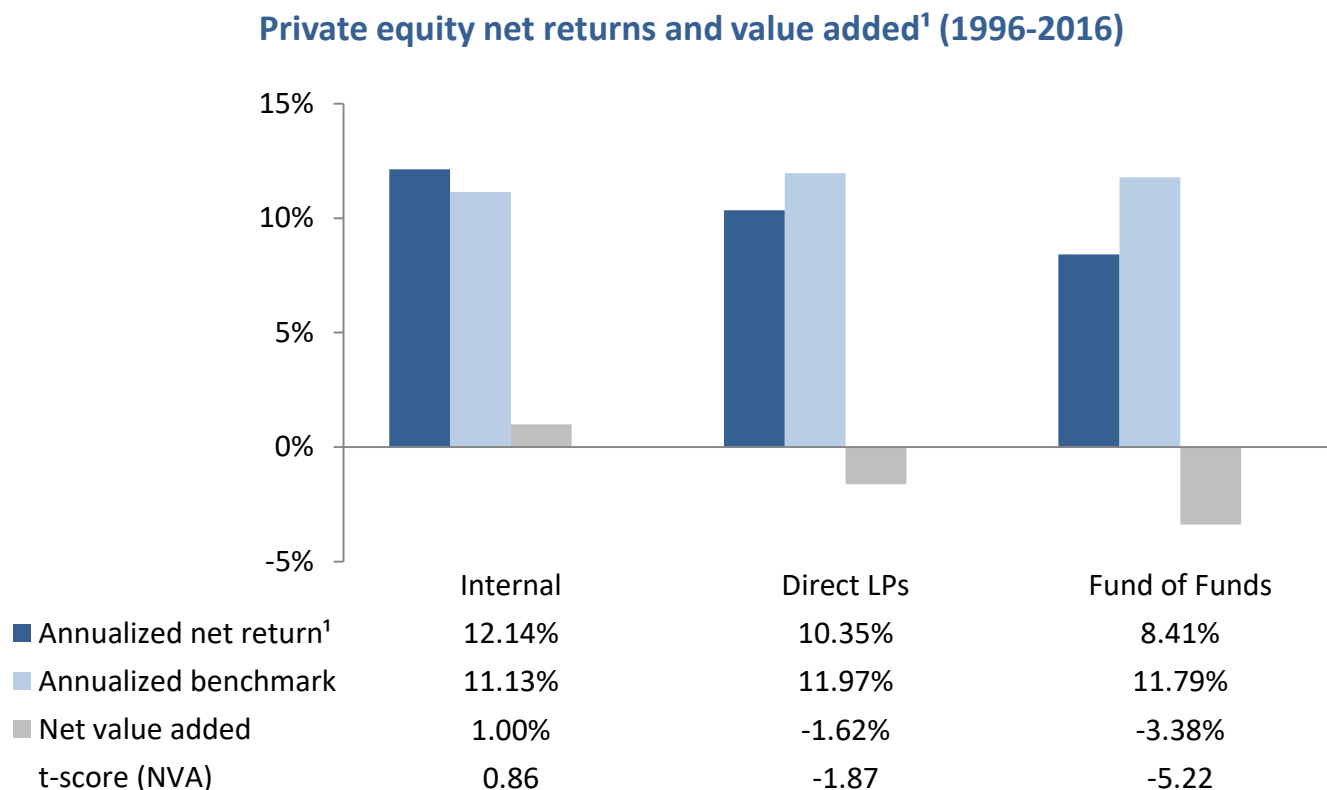
1. This analysis is based on 79 U.S. funds with 10 consecutive years of data.

In the U.S., net value added averaged 0.2% over the past 26 years ending 2016.



Value added analysis is based on 4,419 annual fund total performance observations from the CEM U.S. universe for the 26-year period ending 2016. The 26-year average is an arithmetic average of the annual averages.

Costs matter - Lower cost internal investment in private equity outperformed direct LPs. Direct LPs outperformed fund of funds.



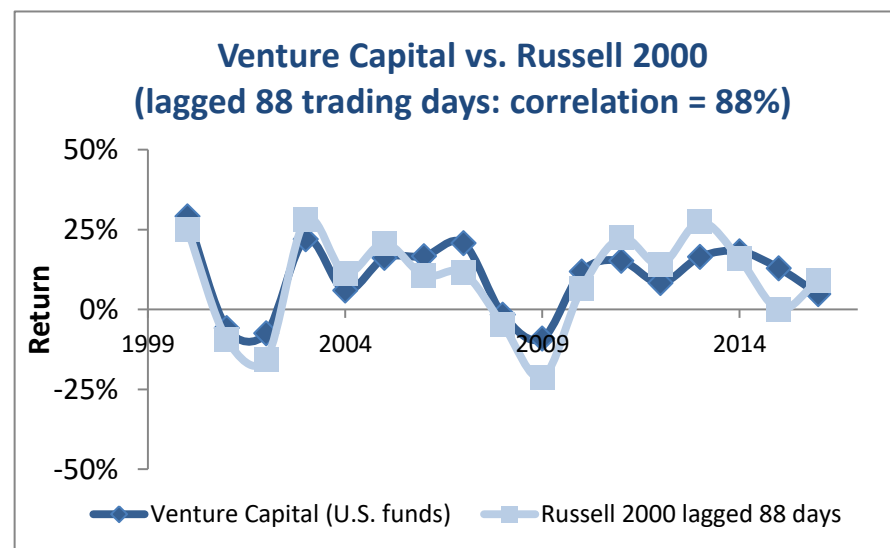
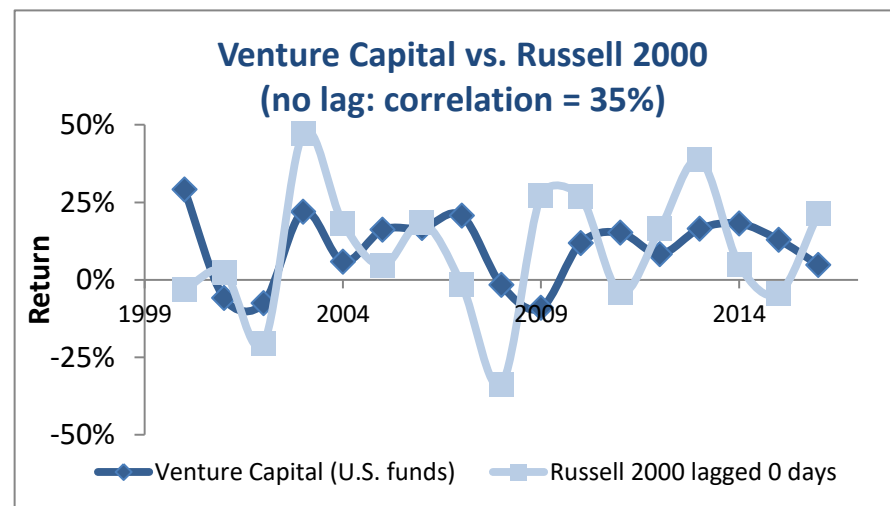
1. Private equity performance by investment style research was updated on June 27 2017. Net value added has dropped by a significant margin since the original research spanning 1996-2012. The reason for the drop was the 2013 bull market in small cap equities which is the basis of the benchmark.

2. To compare the performance of private equity implementation styles over long periods, Monte Carlo simulations were used to capture differences in risk between styles. For details, see "How Implementation Style and Costs Affect Private Equity Performance", Alex Beath, Chris Flynn, and Jody MacIntosh, International Journal of Pension Management pp. 50, vol. 7, issue 1, Spring 2014.

Private equity benchmarks used by most funds are flawed.

A high proportion of the benchmarks used for illiquid assets by participants in the CEM universe are flawed. Flaws include:

- Timing mismatches due to lagged reporting. For example, as the graphs on the right demonstrate, reported venture capital returns clearly lag the returns of stock indices. Yet most funds that use stock indices to benchmark their private equity do not use lagged benchmarks. The result is substantial noise when interpreting performance. For example, for 2008 the Russell 2000 index return was 27.2% versus -21.3% if lagged 88 trading days. Thus if a fund earned the average reported venture capital return for 2008 of -9.1%, they would have mistakenly believed that their value added from venture capital was -36.2% using the un-lagged benchmarks versus 12.2% using the same benchmark lagged to match the average 88 day reporting lag of venture capital funds.
- Un-investable peer-based benchmarks. Peer based benchmarks reflect the reporting lags in peer portfolios so they have much better correlations than un-lagged investable benchmarks. But their relationship statistics are not as good as for lagged investable benchmarks.
- Aspirational premiums (i.e., benchmark + 2%). Premiums cannot be achieved passively, and evidence suggests that a fund has to be substantially better than average to attain them. More importantly, when comparing performance to other funds, they need to be excluded to ensure a level playing field.



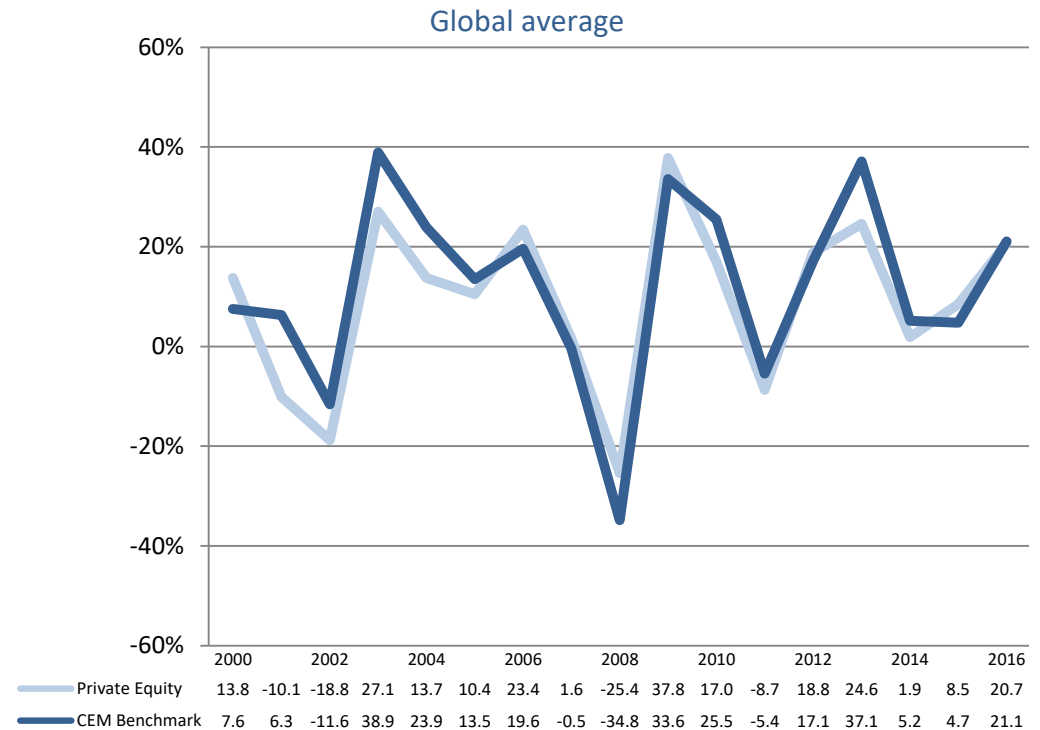
To enable fairer comparisons, CEM uses default private equity benchmarks.

Benchmarks used for private equity by most participants in the CEM universe are flawed (see previous page). So to enable fairer comparisons, CEM replaced the reported private equity benchmarks of all funds except yours with defaults. The defaults are:

- Investable. They are comprised of lagged small cap benchmarks.
- Custom lagged for each participant. Your default benchmark had a lag of 88 trading days. Different portfolios had different lags. CEM estimated the lag on private equity portfolios with multi-year histories by comparing annual private equity returns to public market proxies with 1 day of lag, 2 days of lag, 3 days of lag, etc. At some number of days lag, correlation between the two series is maximized. The median lag was 101 trading days (i.e., approximately 142 calendar days or 4.7 calendar months)
- Regional mix adjusted based on the average estimated mix of regions in private equity portfolios for a given country.

The result is the default benchmarks are superior to most self-reported benchmarks. Correlations improve to a median of 84% for the default benchmarks versus 48% for self-reported benchmarks. Other statistics such as volatility were also much better.

Private equity returns versus default benchmark returns¹



1. To enable better comparison between lagged returns and lagged benchmarks, lags have been removed from both. See "Asset allocation and fund performance of defined benefit pension funds in the United States, 1998-2014" by Alexander D. Beath and Chris Flynn for details.