



Investment Performance Analysis

Ohio Retirement Study Council

Period Ended: December 31, 2018



2018 Year in Review

Executive Summary

<p>Preface: 2017</p>	<ul style="list-style-type: none"> • 2017 was a picturesque year for markets, characterized by low volatility and strong returns. • Many asset classes were bolstered by synchronized global growth, strong corporate profits, and prolonged accommodative monetary policy. 																														
<p>2018</p>	<ul style="list-style-type: none"> • A year later and there is a stark contrast. So what happened? <p style="text-align: center;">Year End Asset Class Performance</p> <table border="1"> <thead> <tr> <th>Asset Class</th> <th>2017 (%)</th> <th>2018 (%)</th> </tr> </thead> <tbody> <tr> <td>S&P 500</td> <td>21.8%</td> <td>-4.4%</td> </tr> <tr> <td>Russell 2000</td> <td>14.6%</td> <td>-11.0%</td> </tr> <tr> <td>MSCI EAFE</td> <td>25.0%</td> <td>-13.8%</td> </tr> <tr> <td>MSCI EAFE Small Cap</td> <td>33.0%</td> <td>-17.9%</td> </tr> <tr> <td>MSCI Emerging Markets</td> <td>37.3%</td> <td>-14.6%</td> </tr> <tr> <td>Bloomberg US Agg Bond</td> <td>3.5%</td> <td>0.0%</td> </tr> <tr> <td>BofA ML 3Mo US T-Bill</td> <td>0.9%</td> <td>1.9%</td> </tr> <tr> <td>Wilshire US REIT</td> <td>4.2%</td> <td>-4.6%</td> </tr> <tr> <td>Bloomberg Commodity Index</td> <td>1.7%</td> <td>-11.2%</td> </tr> </tbody> </table>	Asset Class	2017 (%)	2018 (%)	S&P 500	21.8%	-4.4%	Russell 2000	14.6%	-11.0%	MSCI EAFE	25.0%	-13.8%	MSCI EAFE Small Cap	33.0%	-17.9%	MSCI Emerging Markets	37.3%	-14.6%	Bloomberg US Agg Bond	3.5%	0.0%	BofA ML 3Mo US T-Bill	0.9%	1.9%	Wilshire US REIT	4.2%	-4.6%	Bloomberg Commodity Index	1.7%	-11.2%
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<p>Objective</p>	<ul style="list-style-type: none"> • The following presentation provides a holistic review of 2018, distilling major capital market themes that occurred throughout the year. • Specifically, we review broad economic conditions, market volatility, and take a deep-dive into the fourth quarter. We also highlight key themes for 2019. 																														

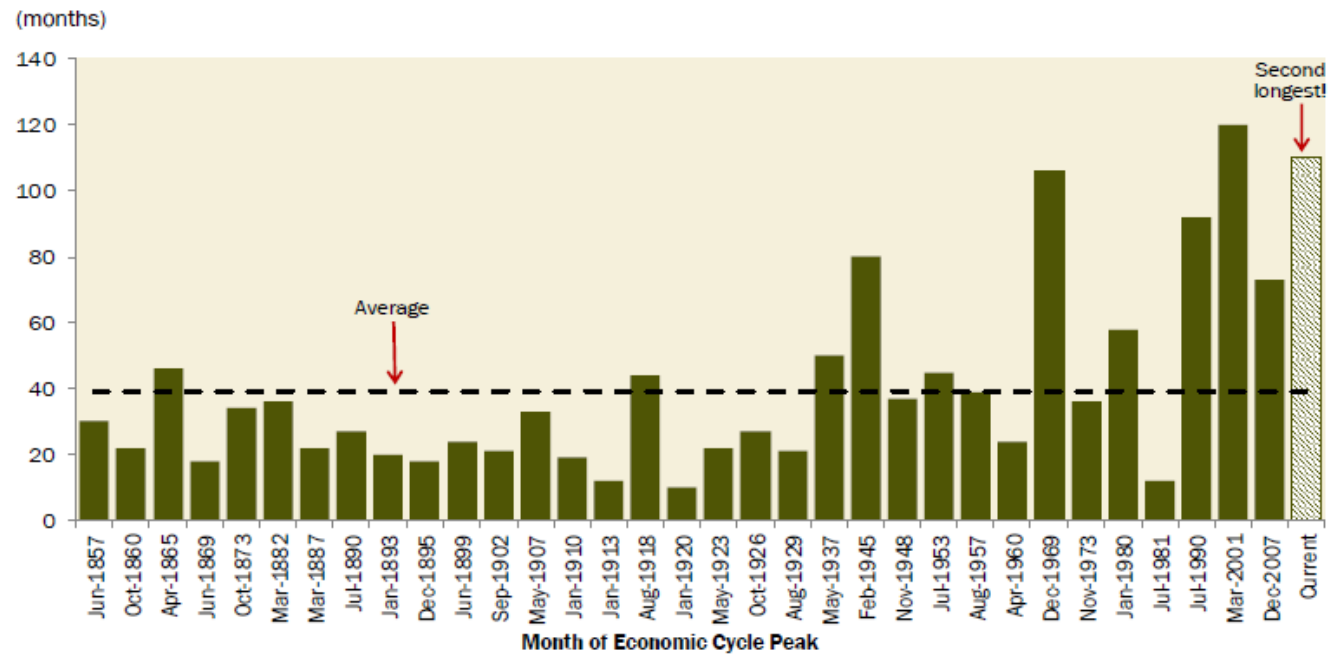
Macroeconomic Conditions

Economic Cycles

Current Cycle

- The general consensus is that the US economy (along with other developed nations) is finally decelerating, with growth expectations tapering off throughout the transition.

United States: Duration of Economic Expansions



Source: Gluskin Sheff + Associates Inc., based off of National Bureau of Economic Research data. As of November 30, 2018.

Key Takeaways

- A mature economy, combined with liquidity tightening as the Fed removes monetary stimulus, can lead to even slower growth and increase downside risk potential.
- Cyclical changes in the economy can create short-term friction for investors, but they should not take precedent over longer-term secular themes when focusing on portfolio construction.

2018 High Level Review

2018 – Overview

Notable Statistics: Year in Review

- Solid global GDP growth at 3.7%.
- Earning growth, propped up by the tax stimulus, was a key driver for US equity markets.
- First trillion dollar company (Apple).
- Federal Reserve: 4 rate hikes throughout the year.

Market Movements: Year in Review

- Aside from a hiccup in February, most markets were able to regain ground throughout the second and third quarters.
- US equity markets did well leading up to the fourth quarter. The rest of the world did not keep pace with the US, but international developed countries were able to post modest gains over the summer, while emerging countries felt more pressure from trade war tensions and unfavorable exchange rates.

Market Performance (%)

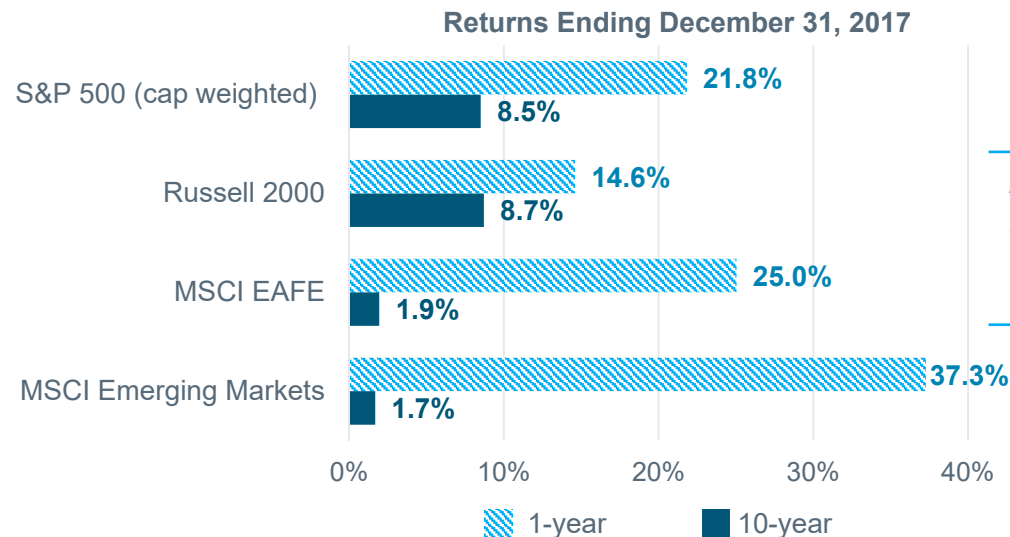
	Dec 31 2017 YTD	Monthly Returns					Dec 31 2018 YTD
		Feb 2018	Sep 30 2018 YTD	Oct 2018	Nov 2018	Dec 2018	
S&P 500 (cap weighted)	21.8	-3.7	10.6	-6.8	2.0	-9.0	-4.4
Russell 2000	14.6	-3.9	11.5	-10.9	1.6	-11.9	-11.0
MSCI EAFE	25.0	-4.5	-1.4	-8.0	-0.1	-4.9	-13.8
MSCI Emerging Markets	37.3	-4.6	-7.7	-8.7	4.1	-2.7	-14.6
Bloomberg US Agg Bond	3.5	-0.9	-1.6	-0.8	0.6	1.8	0.0
US 30 Yr Treasury	2.7	3.1	3.2	3.4	3.3	3.0	3.0
Bloomberg Commodity Index	1.7	-1.7	-2.0	-2.2	-0.6	-6.9	-11.2

2018 High Level Review

2018 – A Year of Mean Reversion

Equity Markets: Long-Term Perspective

- For equity markets in particular, 2018 could be viewed as a year of mean reversion.
- 2017 market returns were well above historical norms. Even without headline events, the sustainability of this growth was bound to come under pressure.



Against this backdrop, 2018 year-end market performance may not seem as severe.

Economic Data: Can Good get Better?

- A healthy economy, strong job market, high corporate earnings, and relatively low interest rates may appear inconsistent with the negative stock market performance, particularly during the fourth quarter.
- However, economic data tends to be backward looking while capital markets are forward-looking.

Economic Indicators:

- The unemployment rate is at its lowest since 1969
- 115 consecutive months of manufacturing expansion

Concern for Future Outlook:

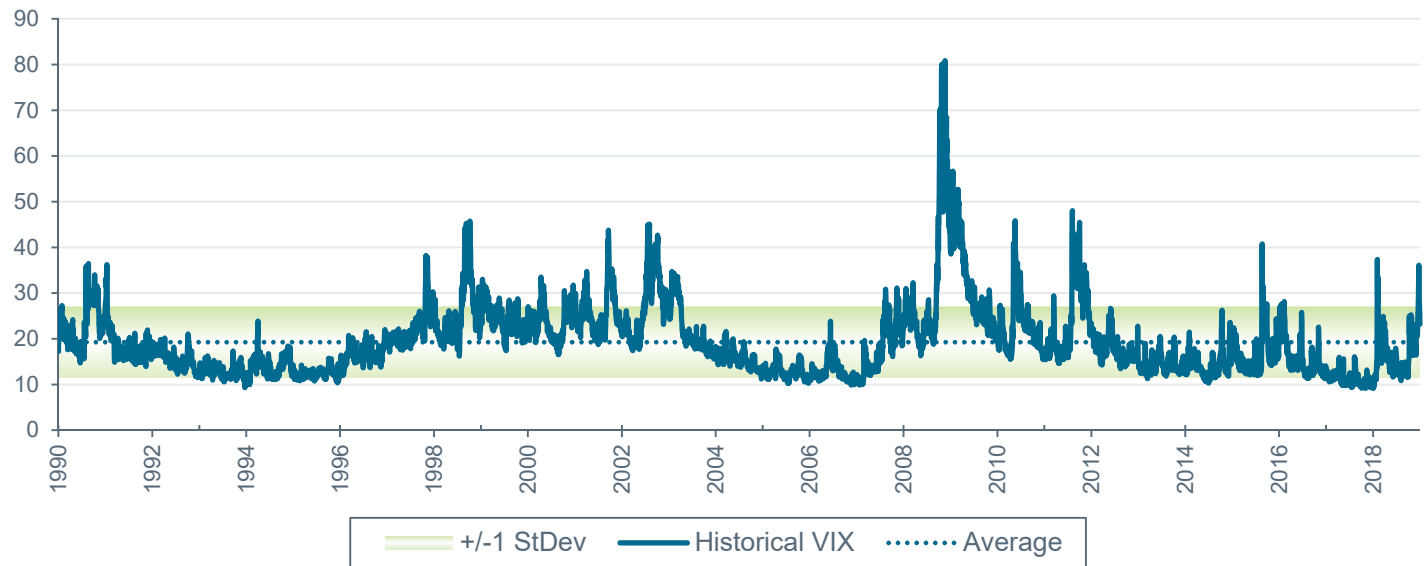
Is there still room for meaningful improvement?

Market Volatility

Historical Context

Long-Term Average of the VIX Index

- Volatility has been subdued since the Financial Crisis due to accommodative monetary policy.
- Prior to 2018, there were long periods of very low volatility compared to historical standards, with a handful of episodic occurrences largely influenced by macro events (e.g. China growth worries in 2015 and Brexit in 2016).



Volatility in Post-Crisis Bull Market

- While volatility was often lower than historical norms since 2009, price changes were not completely absent from the market.

	2013	2014	2015	2016	2017	2018
Number of S&P 500 Price Changes Greater than 1%	38	38	72	48	8	64

- From a historical volatility perspective, 2017 was more of an outlier than 2018.

Source: RVK calculations based on CBOE and Standard & Poor's data.

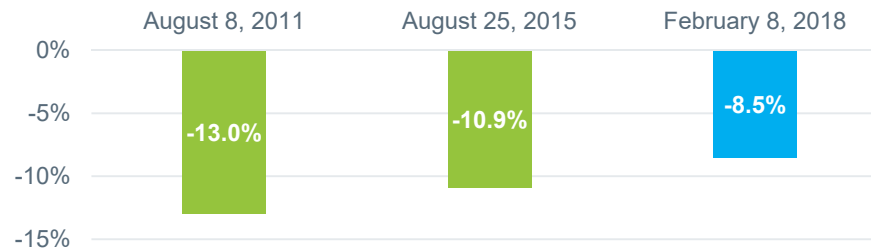
Market Volatility

February Deep Dive

February Market Volatility

- After a strong 2017, markets exhibited fragility in February 2018, with the S&P 500 Index dropping 10.2% by the close of February 8th.
- We noted in our memo that this was the largest 5-day market correction since 2015, coming after over 400 days without a 5% or greater correction.

Three Largest 5-day Corrections for the S&P 500 Index since market bottom in 2009



Note:

While the S&P 500 returned -3.7% for the month of February, it was up 2.7% year-to-date through June 30, 2018.

Source: RVK calculations based on Standard & Poor's data.

Drivers Behind Volatility

- At the beginning of the month, the Labor Department's job's report sparked concerns about wages and inflation, which was received poorly by the markets.
- The drawdown was further exacerbated by the trading mechanics of short volatility products.
[Short Volatility Refresh](#): Our February memo also discussed how short volatility strategies were another contributing factor to the correction. Short volatility products are inverse bets on market volatility, i.e. they profit when a volatility index, such as the VIX, goes down. In a low volatility environment, they can provide consistent positive returns.

However, they are very susceptible to volatility spikes and when the VIX increased 116% on February 5th, these strategies plummeted. Many of the available products were also concentrated in US equity volatility indices, further adding to the downward pressure during the month.
- With short volatility strategies, the market correction transitioned from an information-based trade surrounding economic data to a liquidity trade unrelated to asset or economic fundamentals.

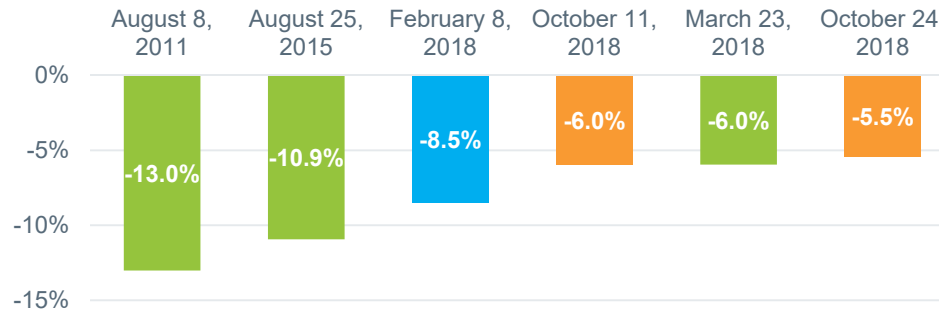
Market Volatility

October Deep Dive

October Market Volatility

- From a high on September 20th through October 26th, the S&P 500 index declined by more than 9%, and finished the month of October down -6.8% after enduring two large drawdowns about a week apart.

Largest 5-day Corrections for the S&P 500 Index since market bottom in 2009



Source: RVK calculations based on Standard & Poor's data.

Well Cited Drivers

- The US-China trade war is the most often cited source of negative pressure on the stock market.
 - As these are the two largest economies in the world, any disruption can have a ripple effect throughout the world.
- The yield curve has also been another source of dismay, with its continued flattening and anticipation of inversion.
 - Historically, recessions have been preceded by an inverted yield curve, although inversion does not guarantee a recession.

Key Takeaways

- China trade talks may have been the catalyst for the October market downturn.
- However, this then prompted the market to reprice future expectations of many factors that were already percolating:
 - Higher interest rates
 - Lower earning expectations for 2019
 - Maturing economic cycles around the globe

Market Volatility

Summary – 2018

February vs October

	Feb	Oct
Reason(s):	<ul style="list-style-type: none"> • Immediate inflation concerns 	<ul style="list-style-type: none"> • Trade War, Fed, lower growth expectations
Execution:	<ul style="list-style-type: none"> • More of a <i>liquidity event</i> than true price correction 	<ul style="list-style-type: none"> • Started with news but transitioned to <i>repricing event</i>
Outcome:	<ul style="list-style-type: none"> • Acute event 	<ul style="list-style-type: none"> • Adjusting to lower growth world

Key Takeaways

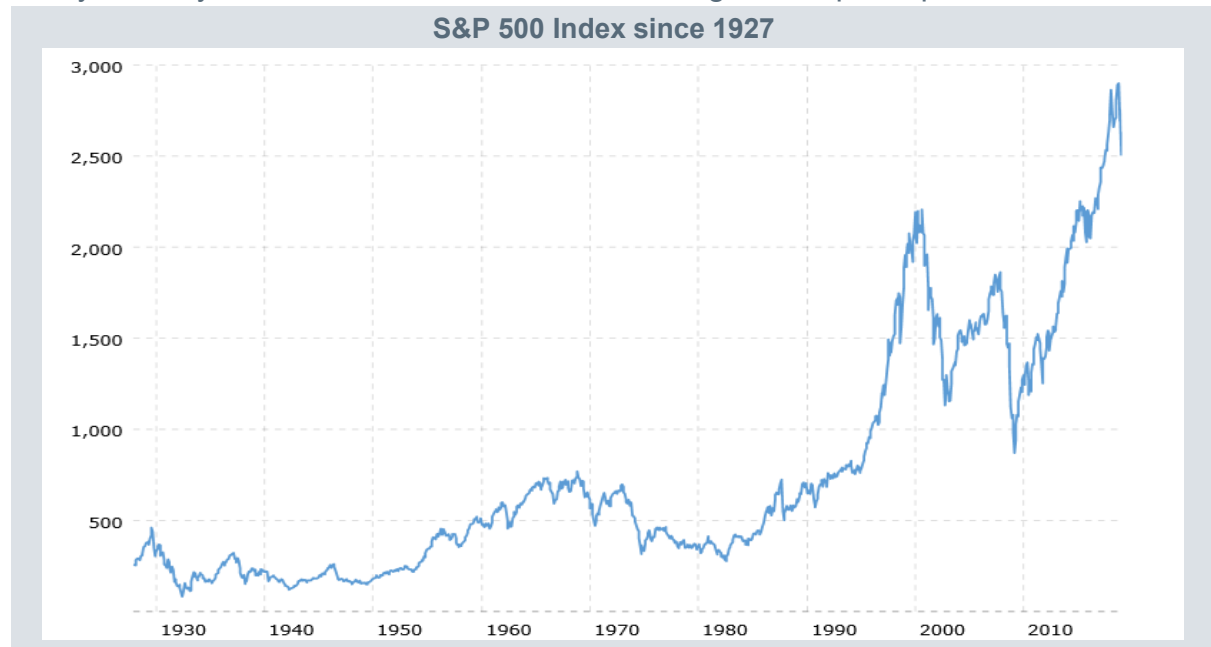
Historical Context:

- 2018 market volatility events were not abnormal.

Present:

- Decelerating growth can make the market more susceptible to adverse news.
 - For example, after the unexpected Brexit vote in June 2016, the market sell-off lasted only two days. At that time, however, there was greater upside potential for markets.

The equity market is susceptible to drawdowns but over the long-run has trended upward.



Source: Macrotrends LLC. Based off of monthly returns, adjusted for inflation using headline CPI. As of 12/31/2018.

Fourth Quarter Highlights

2018 Q4 – The Fed

Central Bank Influence: Mixed Messages

- Against a backdrop of tweets and trade wars, it was the Federal Reserve that seemed to have an inordinate influence on the markets during the fourth quarter of 2018.
- While rate hikes were anticipated, the inconsistent messaging seemed to amplify other concerns that were already on the periphery.

	Oct ¹	Nov	Dec
Tone	Hawkish	Dovish	???
FOMC Meeting Highlights	<p>“...we may go way past neutral. But we are a long way from neutral at this point”</p> <p>– Chairman Powell Oct 3rd</p>	<p>“Interest rates...remain just below the broad range of estimates of the level that would be neutral for the economy — that is, neither speeding up nor slowing down growth”</p> <p>– Chairman Powell Nov 28th</p>	<p>1. Fed lowered expected rate hikes in 2019 from 3 (announced in September 2018) down to 2</p> <p>2. Balance Sheet woes: “It will be substantially smaller than it is now”</p> <p>– Chairman Powell Dec 19th</p>
Federal Funds Rate (Target)	2.25% (↑ 0.25%)	2.25% (no change)	2.50% (↑ 0.25%)
Market Reaction	Negative	Favorable	Negative

- Growth concerns were a strong undercurrent throughout the fourth quarter, but the Fed also played a crucial role. Sequential FOMC meetings with somewhat contrasting messages spurred negative sentiment as the market struggled to interpret the Fed’s direction. Renewed interest in the balance sheet also gave the impression that the Fed was going to be less accommodative going forward.

Notes: “FOMC” stands for Federal Open Market Committee.

¹ Actual FOMC meeting was occurred between September 25-26.

2019 Market Outlook

Potential Themes

Global Growth Projections

- Global growth is expected to slow:



Notes from the International Monetary Fund's ("IMF") most recent Economic Outlook:

- Global growth forecasts were modestly reduced from the October Outlook due to "carry over from softer momentum in the second half of 2018."
- The report also indicated that "escalation of trade tensions beyond those already incorporated in the forecast remains a key source of risk."
- Other global risks on the horizon include: "no-deal" withdrawal of the United Kingdom from the European Union and a larger than expected slowdown in China's economy.

Source: IMF, World Economic Outlook Update, January 21, 2019.

Corporate Earnings (US)

- The corporate tax cut that helped lift stocks in 2018 will not be a significant contributor going forward. Corporate earnings will instead have to rely on profit margins and organic company growth, potentially making companies even more susceptible in an environment of uncertainty.

Recession Probability

- A recent Reuters poll of economists showed that the median predicted probability of a recession within the next year is 20%, while the probability of a recession within the next two years rose above 40%.

2019 Market Outlook

Potential Themes

The Fed: Major Factor for Markets in 2019

- The main concern is how the Fed will handle a two variable experiment involving short-term interest rates and balance sheet reduction.

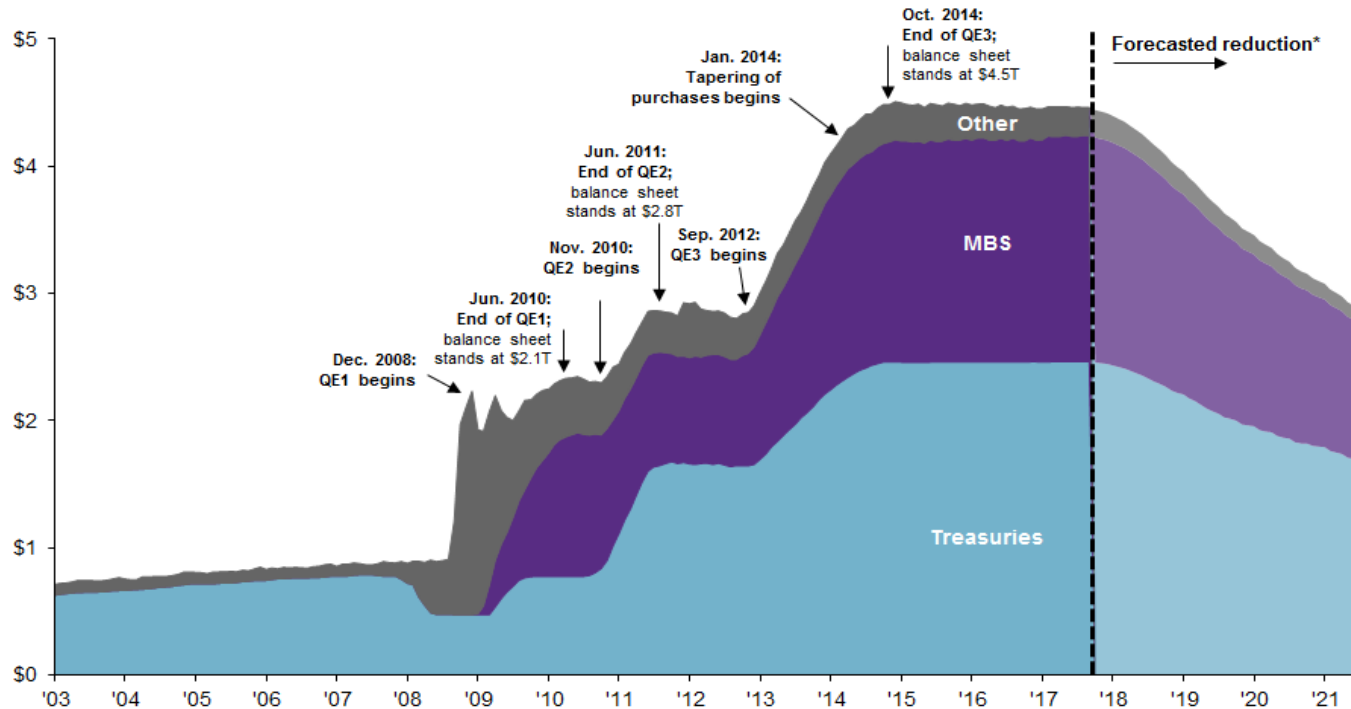
Quantitative Tightening Refresh:

Since the Financial Crisis, the Fed accumulated approximately \$4.5 trillion in assets, mainly composed of US Treasuries and mortgage-backed securities (“MBS”), from their large-scale asset purchasing program, Quantitative Easing.

In October 2017, the Fed began Quantitative Tightening to reduce the size of their balance sheet. Maturing securities were no longer being replaced to remain on the balance sheet, resulting in an “auto-pilot” roll-off of \$50 billion per month.

- Quantitative Easing was unprecedented monetary policy, and the unwinding of that policy, Quantitative Tightening, will be unprecedented as well.

Federal Reserve Balance Sheet



Source: JP Morgan *Guide to the Markets* 3Q 2017.

Federal Funds Rate Expectations ¹		
	2019	2020
FOMC Yr-End Est.	2.88%	3.13%
Market Expectations ¹	2.53%	2.39%
Federal Funds Rate (12/31/2018) 2.40%		
FOMC Long-Run Projection 2.75%		

¹Per JP Morgan, data as of 12/19/18.
Source: JP Morgan *Guide to the Markets* 1Q 2019.

INDEX GLOSSARY

S&P 500: The **S&P 500 Index (Cap Wtd)** is a commonly recognized, market-capitalization weighted index of 500 widely held equity securities designed to measure broad US equity performance.

R 3000: The **Russell 3000 Index** is a market-capitalization weighted index of 3,000 widely held equity securities designed to measure performance of the entire U.S. stock market.

Wilshire 5000: The **Wilshire 5000 Index** is a market-capitalization weighted index of more than 6,700 widely held equity securities designed to measure performance of the entire U.S. stock market.

MSCI ACW Ex US: The **MSCI ACW (All Country World) Ex US Index** is designed to measure equity market performance in global developed and emerging markets, excluding the US. The 22 underlying developed countries are: *Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, and the United Kingdom*. The 23 emerging market countries are: *Brazil, Chile, China, Colombia, Czech Republic, Egypt, Greece, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Peru, Philippines, Poland, Russia, Qatar, South Africa, Taiwan, Thailand, Turkey, and United Arab Emirates*.

MSCI ACW Ex US Investable Mkt: The **MSCI ACW Ex US Investable Mkt Index** is designed to measure equity performance across 22 of 23 Developed Markets (DM) countries (excluding the United States) and 24 Emerging Markets (EM) countries. With 6,174 constituents, the index covers approximately 99% of the global equity opportunity set outside the US.

MSCI EAFE: The **MSCI EAFE (Europe, Australasia, Far East) Index** is designed to measure equity market performance of 21 developed countries, excluding the US & Canada: *Australia, Austria, Belgium, Denmark, Finland, France, Germany, Hong Kong, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, and the United Kingdom*.

MSCI World Ex US: The **MSCI World Index Ex US Index** is designed to measure the equity market performance of developed markets. The MSCI World Index consists of the following 22 developed market country indexes: *Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Hong Kong, Ireland, Israel, Italy, Japan, Netherlands, New Zealand, Norway, Portugal, Singapore, Spain, Sweden, Switzerland, and the United Kingdom*.

MSCI Emerging Markets: The **MSCI Emerging Markets Index** is designed to measure equity market performance of emerging markets. The MSCI Emerging Markets Index consists of the following 24 emerging market country indexes: *Brazil, Chile, China, Colombia, Czech Republic, Egypt, Greece, Hungary, India, Indonesia, Korea, Malaysia, Mexico, Pakistan, Peru, Philippines, Poland, Qatar, Russia, South Africa, Taiwan, Thailand, Turkey* and United Arab Emirates*.

Bloomberg US Agg Bond: The **Bloomberg US Aggregate Bond Index** covers the US dollar-denominated, investment-grade, fixed-rate, taxable bond market of SEC-registered securities: US Treasury and agency bonds, domestic corporate debt, and mortgage-backed securities.

Bloomberg US Universal: The **Bloomberg US Universal Index** covers US dollar-denominated, taxable bonds that are rated either investment grade or high-yield.

Bloomberg US Trsy: **The Bloomberg US Treasury Index** measures US dollar-denominated, fixed-rate, nominal debt issued by the US Treasury.

Bloomberg US Trsy: US TIPS: The **Bloomberg US Treasury: US TIPS Index** is an unmanaged index that consists of inflation-protected securities issued by the U.S. Treasury.

Bloomberg Mortgage: The **Bloomberg US Mortgage Backed Securities (MBS) Index** tracks agency mortgage backed pass-through securities (both fixed-rate and hybrid ARM) guaranteed by Ginnie Mae (GNMA), Fannie Mae (FNMA), and Freddie Mac (FHLMC).

Bloomberg CMBS: The **U.S. Bloomberg CMBS Investment Grade Index** measures the market of conduit and fusion CMBS deals with a minimum current deal size of \$300mn.

Bloomberg US High Yield: The **Bloomberg US Corporate High Yield Bond Index** measures the USD-denominated, high yield, fixed-rate corporate bond market. Securities are classified as high yield if the middle rating of Moody's, Fitch and S&P is Ba1/BB+/BB+ or below.

Bloomberg Global High Yield: The **Bloomberg Global High-Yield Index** provides a broad-based measure of the global high-yield fixed income markets.

CS High Yield Dev Countries Only: The **Credit Suisse High Yield Dev Countries Only Index** tracks the performance of noninvestment-grade corporate bonds from developed countries.

CS Leveraged Loan: The **Credit Suisse Leveraged Loan Index** is an index designed to mirror the investable universe of the \$US-denominated leveraged loan market.

JPMorgan GBI-EM Gbl Dvf'd: The **JPMorgan GBI-EM Global Diversified Total Return Index (Unhedged)** is a global emerging markets index that consists of regularly traded, liquid fixed-rate, domestic currency government bonds.

JPMorgan Emerging Markets Bond Global: The **JPMorgan Emerging Markets Bond Global Index** is a global emerging markets index that consists of regularly traded, liquid fixed-rate, US dollar-denominated government bonds.

NCREIF ODCE: The **NCREIF ODCE (Open End Diversified Core) Index** is an index of investment returns reporting on both a historical and current basis the results of 16 open-end commingled funds pursuing a core investment strategy, some of which have performance histories dating back to the 1970s. The NCREIF ODCE Index is capitalization-weighted and performance is time-weighted.

NCREIF Property: The **NCREIF Property Index** prepared by the National Council of Real Estate Investment Fiduciaries is a quarterly time series composite return measure for over 6,000 individual commercial real estate properties acquired in the private market for investment purposes. Total performance represents returns from appreciation and income, and includes multi-family, office, retail, and industrial properties.

HFRI FOF Composite: The **HFRI FOF (Fund of Funds) Composite Index** is an equal-weighted index that contains over 400 constituent hedge fund of funds, both domestic and offshore.

Burgiss All Private Equity: The **Burgiss All Private Equity Benchmark** is a composite of nearly 1400 private equity funds derived from the holdings of over 200 institutional investors.

Alerian MLP: The **Alerian MLP Index** is a market-capitalization weighted index of the 50 most prominent energy Master Limited Partnerships.

S&P Goldman Sachs Commodity: The **S&P Goldman Sachs Commodity Index** is a composite index of commodity sector returns representing an unleveraged, long-only investment in commodity futures that is broadly diversified across the spectrum of commodities. Components are weighted by their respective world production quantities.

Capital Markets Review

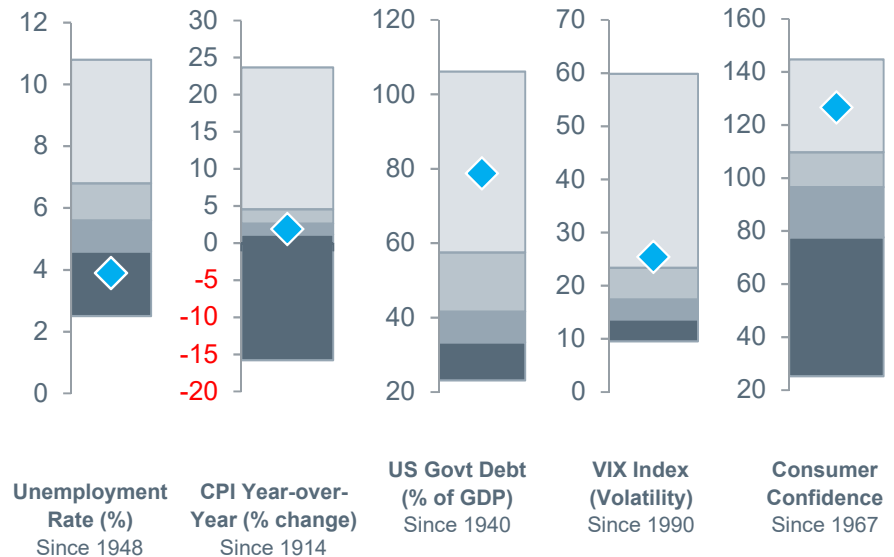


Fourth Quarter Economic Environment

Key Economic Indicators

The fourth quarter of 2018 was characterized by a heightened level of volatility and negative returns for the majority of risk assets. Though equity markets experienced an initial decline in October, the strongest risk-off environment emerged in December as global growth forecasts, inflation expectations, and corporate earnings expectations began to roll over in unison. During the quarter, the Federal Reserve, European Central Bank, and International Monetary Fund lowered 2019 GDP growth forecasts across regions, and the 5Y/5Y inflation expectation rate fell from nearly 2.3% at the start of the quarter to 1.9% at quarter-end. In a move that proved to be more controversial than many anticipated, the FOMC raised the target range for the federal funds rate by 0.25% for the fourth time in 2018 during its December meeting, resulting in a target range of 2.25% to 2.5%. US Economic data remained strong, with non-farm payrolls up 312,000 in December on a 3.9% unemployment rate. While the odds of a recession occurring in 2019 remain low, leading indicators such as falling oil prices, a flattening yield curve, declining consumer confidence and a subdued housing market contributed to negative investor sentiment at year-end.

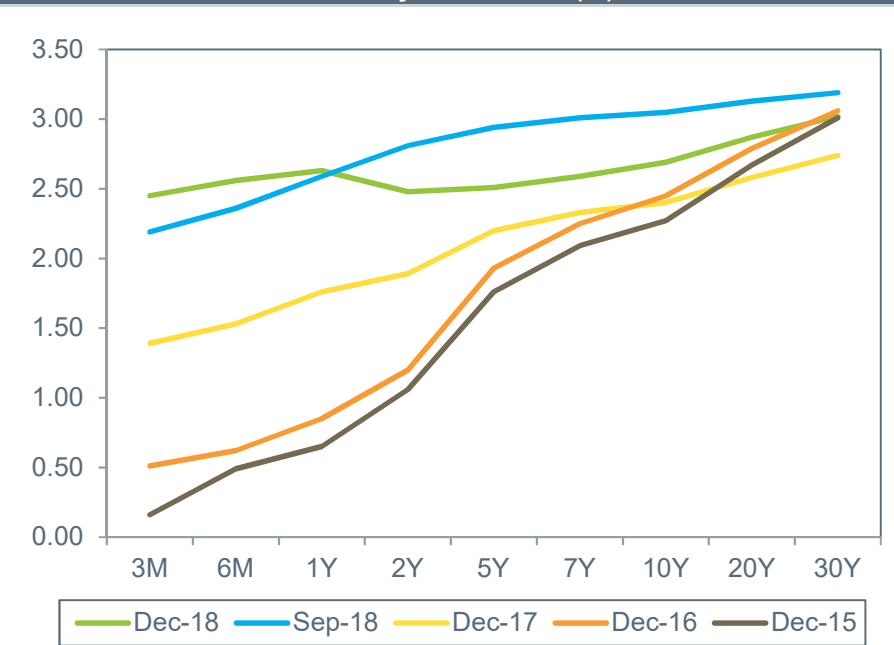
Key Economic Indicators



Economic Indicators

	Dec-18	Sep-18	Dec-17	Dec-15	20 Yr
Federal Funds Rate (%)	2.40 ▲	2.18	1.33	0.20	1.94
Breakeven Infl. - 1 Yr (%)	-2.84 ▼	1.18	0.85	0.85	N/A
Breakeven Infl. - 10 Yr (%)	1.71 ▼	2.14	1.98	1.58	N/A
CPI YoY (Headline) (%)	1.9 ▼	2.3	2.1	0.7	2.2
Unemployment Rate (%)	3.9 ▲	3.7	4.1	5.0	5.9
Real GDP YoY (%)	3.1 ▲	3.0	2.5	2.0	2.2
PMI - Manufacturing	54.3 ▼	59.5	59.4	48.4	52.8
USD Total Wtd Idx	91.79 ▲	90.11	87.47	94.25	86.32
WTI Crude Oil per Barrel (\$)	45.4 ▼	73.3	60.4	37.0	60.1
Gold Spot per Oz (\$)	1,282 ▲	1,193	1,303	1,061	879

Treasury Yield Curve (%)



Market Performance (%)

	QTD	CYTD	1 Yr	5 Yr	10 Yr
S&P 500 (Cap Wtd)	-13.52	-4.38	-4.38	8.49	13.12
Russell 2000	-20.20	-11.01	-11.01	4.41	11.97
MSCI EAFE (Net)	-12.54	-13.79	-13.79	0.53	6.32
MSCI EAFE SC (Net)	-16.05	-17.89	-17.89	3.06	10.51
MSCI Emg Mkts (Net)	-7.47	-14.58	-14.58	1.65	8.02
Bloomberg US Agg Bond	1.64	0.01	0.01	2.52	3.48
ICE BofAML 3 Mo US T-Bill	0.56	1.87	1.87	0.63	0.37
NCREIF ODCE (Gross)	1.76	8.35	8.35	10.41	7.00
FTSE NAREIT Eq REIT (TR)	-6.73	-4.62	-4.62	7.90	12.12
HFRI FOF Comp	-4.95	-4.03	-4.03	1.40	3.12
Bloomberg Cmdbt (TR)	-9.41	-11.25	-11.25	-8.80	-3.78

Treasury data courtesy of the US Department of the Treasury. Economic data courtesy of Bloomberg Professional Service. Breakeven Inflation does not have 20 years of history; therefore, its 20-year average is shown as N/A.

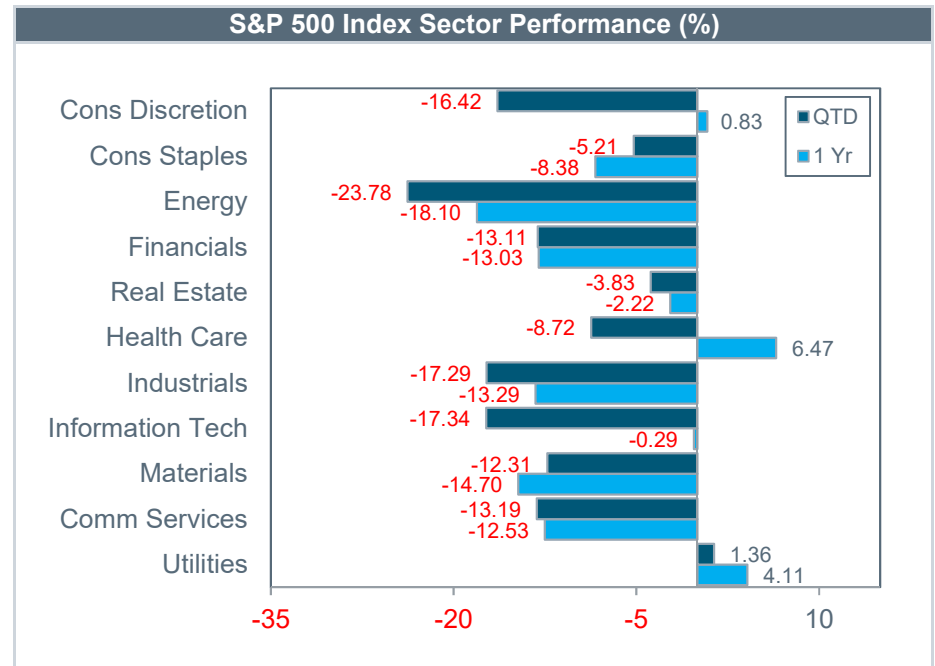
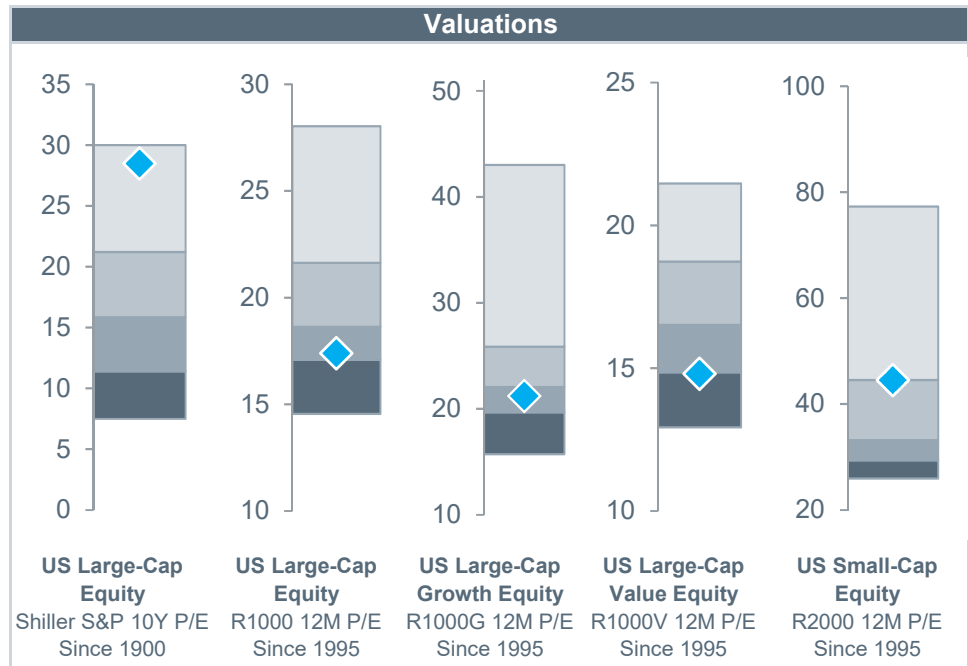
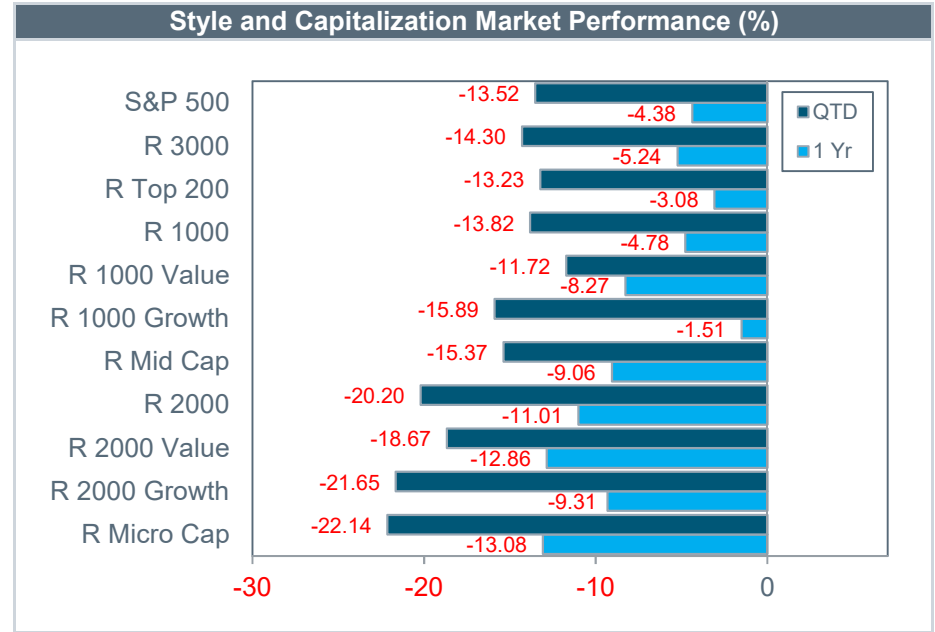


Fourth Quarter Review

Broad Market
 Amid broadening macroeconomic concerns, US equity markets faltered during the fourth quarter as the S&P 500 Index posted returns of -13.5%. Despite a year-to-date return of 10.6% through September, fourth quarter losses drove total S&P 500 Index returns to -4.4% for the year, marking the first negative calendar year result for the index since 2008.

Market Cap
 Generally, large cap managers weathered the volatility that characterized the fourth quarter better than small- and mid-cap managers.

Style and Sector
 Value indices outperformed growth indices during the fourth quarter. Active management results were mixed during the quarter, with growth managers performing relatively better across styles and market capitalizations as value generally struggled due to persistent underweights in defensive, income-oriented sectors.



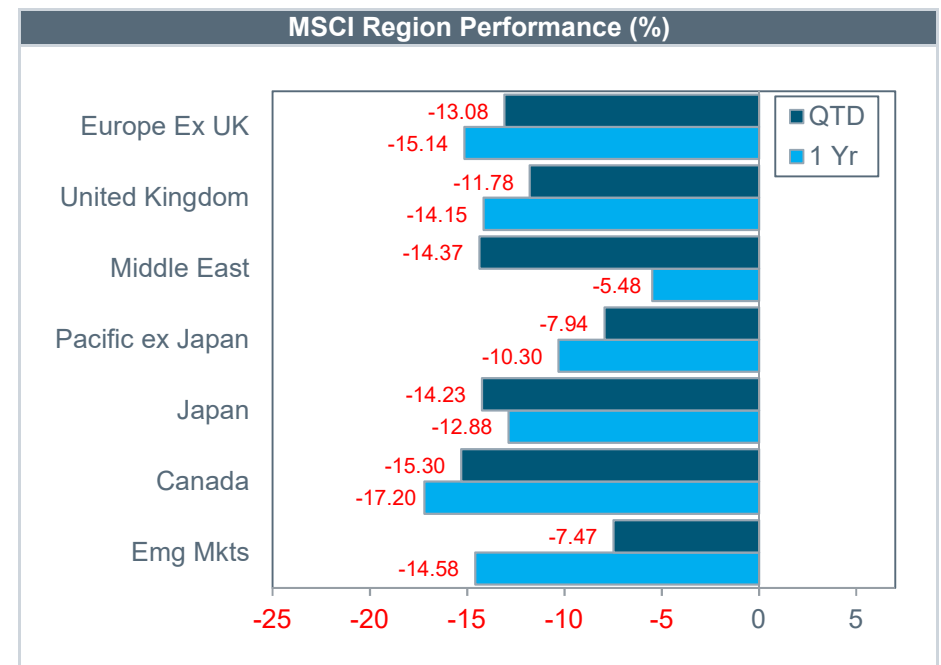
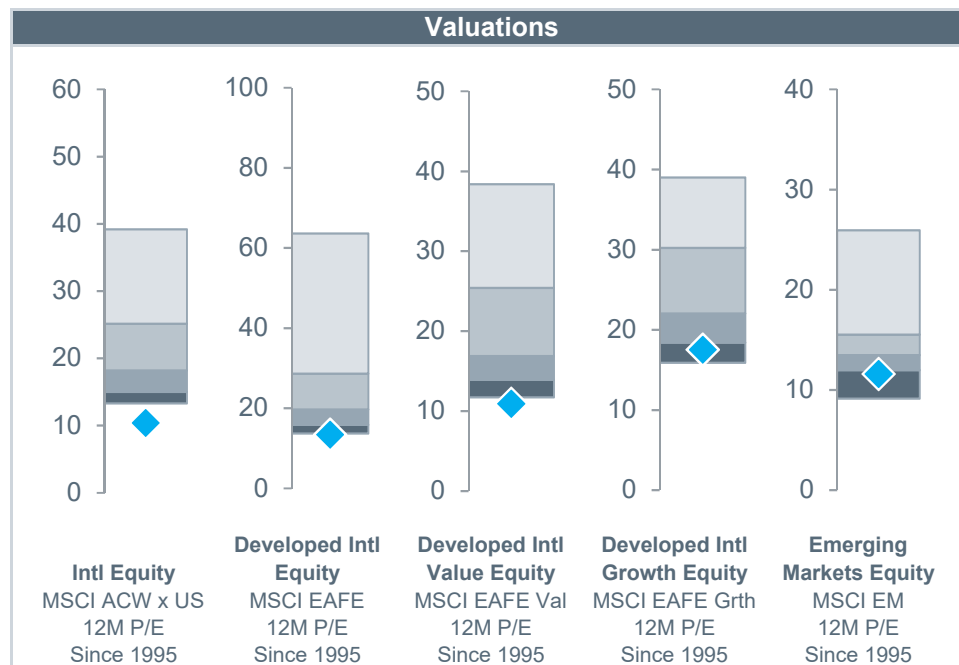
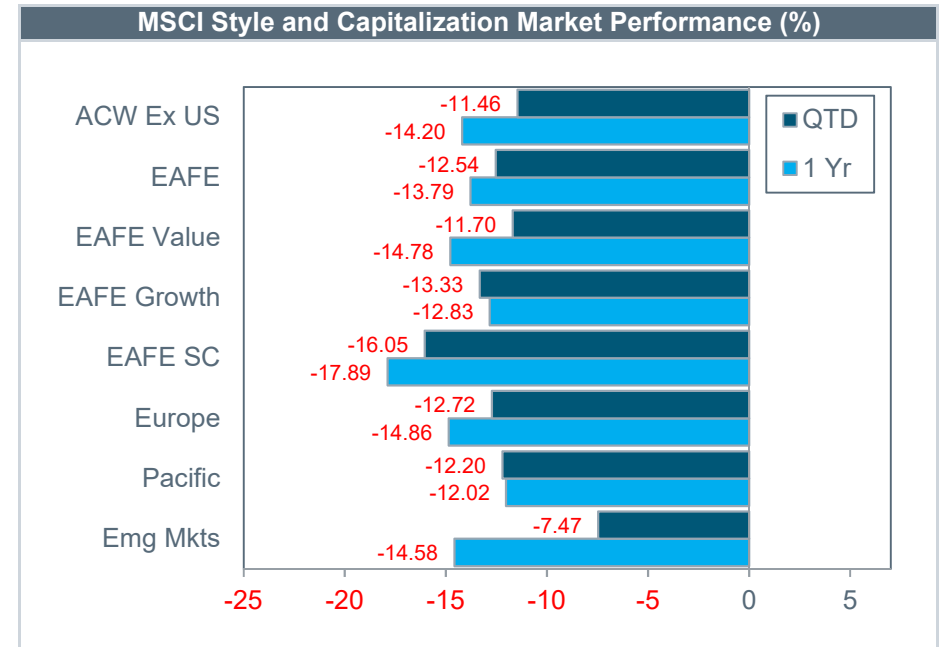
Valuation data courtesy of Bloomberg Professional Service and Robert J. Shiller, Irrational Exuberance, Second Edition. P/E metrics shown represent the 5th through 95th percentiles to minimize the effect of outliers.

Fourth Quarter Review

Developed Markets
 Developed international markets outperformed domestic markets, but also ended with negative double-digit returns in the fourth quarter. The sell-off was partially induced by volatility in the US market, but also driven by international economic tensions.

Emerging Markets
 The emerging markets were the best performing equity region in the fourth quarter, but still finished the quarter and year in negative territory. Additionally, overall investor sentiment weakened due to continued fears of growth moderation in China.

Market Cap & Style
 While international stocks were negative in the quarter, value broadly outperformed growth, bucking a long-term trend of growth stock leadership. Large cap outperformed small cap in developed international markets, but in a notable trend difference, emerging markets small cap stocks broadly outperformed the stocks of larger companies.



Valuation data courtesy of Bloomberg Professional Service.
 P/E metrics shown represent the 5th through 95th percentiles to minimize the effect of outliers.
 All returns are shown net of foreign taxes on dividends.

Fourth Quarter Review

Broad Market

The Federal Open Market Committee raised the target range for the federal funds rate by 0.25% for the fourth time in 2018 to 2.25% - 2.5%. The Bloomberg US Agg Bond returned 1.6% during the quarter to end the year roughly flat. The yield spread between 2-year and 10-year maturities, a popular range often cited as a recession indicator, narrowed to 0.21%, the lowest quarter-end value since the second quarter of 2007.

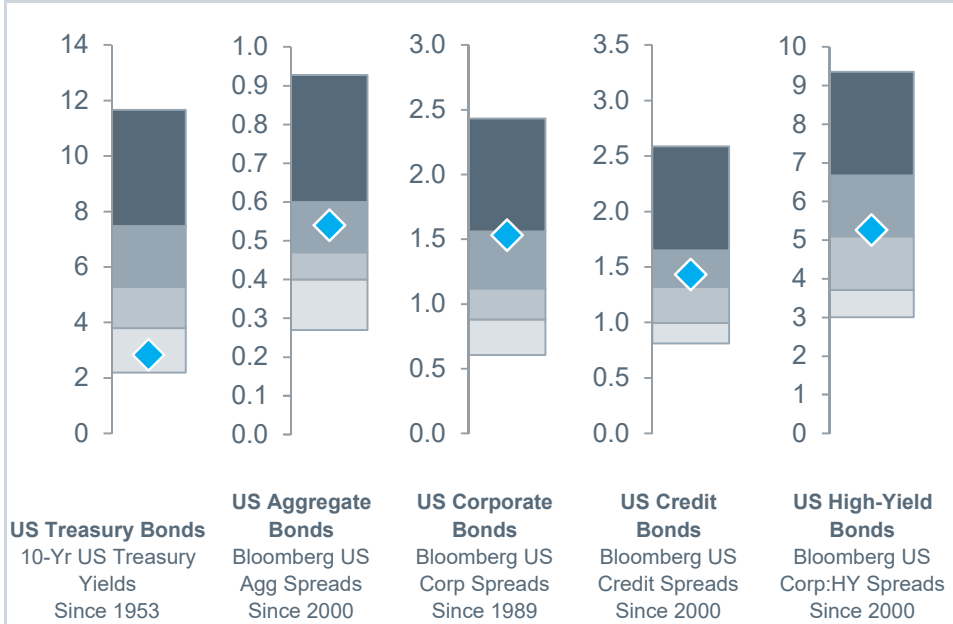
Credit Market

Credit spreads widened over the quarter, as investors sought the safety of Treasuries during the volatile market conditions. Securities rated below investment grade were hit hard during the quarter, with the Bloomberg US High Yield Index returning -4.5%.

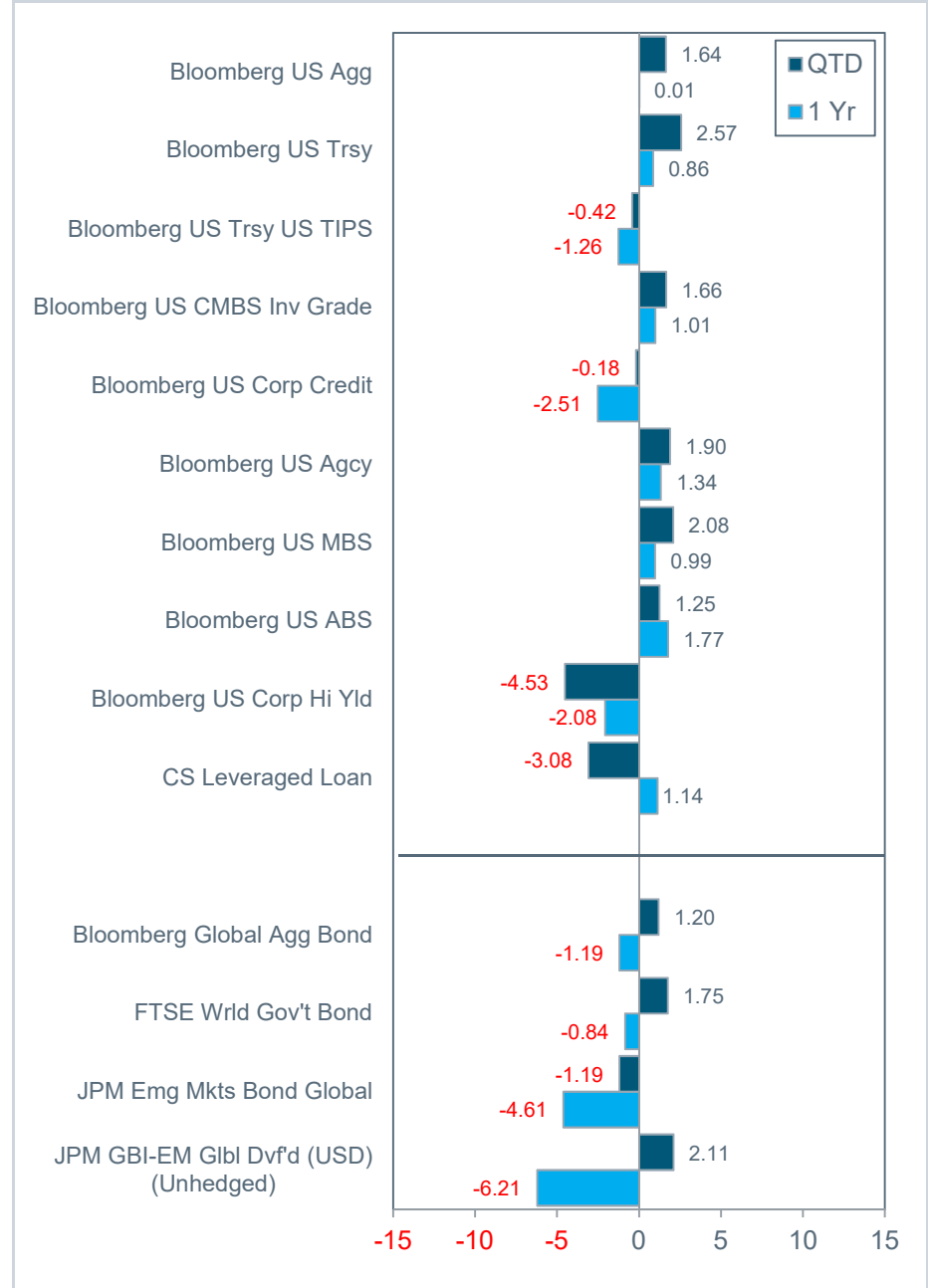
Emerging Market Debt

Non-dollar denominated emerging market debt posted positive returns during the quarter, with the JPM GBI-EM Global Diversified Index returning 2.1%.

Valuations



Fixed Income Performance (%)



Valuation data courtesy of Bloomberg Professional Service. Valuations shown represent the 5th through 95th percentiles to minimize the effect of outliers.



Fourth Quarter Review - Absolute Return

General Market - Hedge Funds

The hedge fund industry experienced its worst quarter since the third quarter of 2011 as measured by HFRI's Fund Weighted Composite Index, capping off a difficult year for the majority of hedge fund strategies with a return of -4.6%. Equity Long/Short funds in particular were a source of poor relative returns. Specifically, the HFRI Equity Hedge Index fell -8.4% for the quarter and finished the year with a return of -7.1%.

General Market - Global Tactical Asset Allocation (GTAA)

Most GTAA managers underperformed a less diversified blend of 60% US equity and 40% US fixed income in 2018, despite outperforming this benchmark in the fourth quarter. In general, the GTAA managers that achieved the strongest 2018 performance held significant short exposures and fixed income allocations compared to those of their less successful counterparts. The GTAA managers that lagged their peers by the largest margins in 2018 generally held heavier weights in global equities.

Fourth Quarter Review - Real Assets

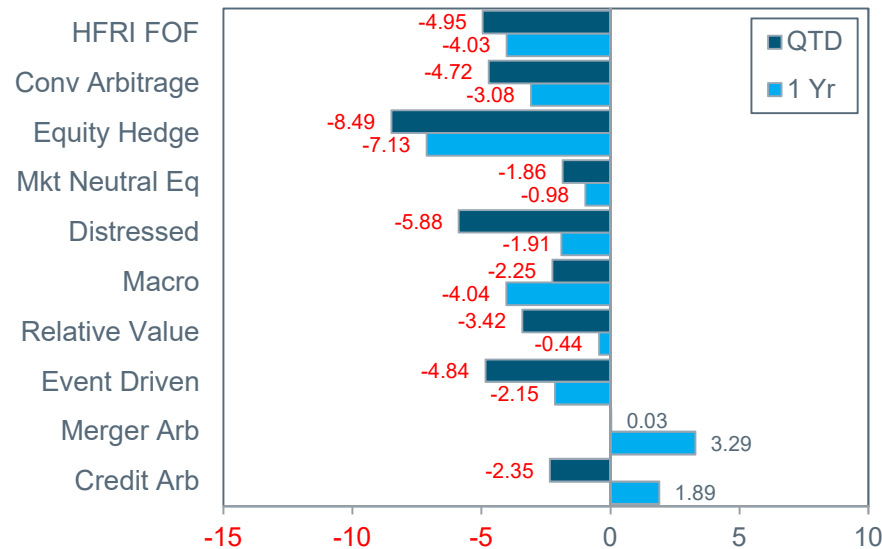
General Market - Diversified Inflation Strategies (DIS)

Performance of DIS managers ranged widely in the fourth quarter, though virtually all managers provided losses in 2018. Poor DIS manager performance during the fourth quarter coincided with both declines in measured inflation and market-based expectations of future inflation levels. Managers with larger allocations to TIPS experienced significantly less downside participation. Among managers with lower levels of TIPS exposure, those with larger natural resource equity and commodity exposure lagged peers by the largest margins.

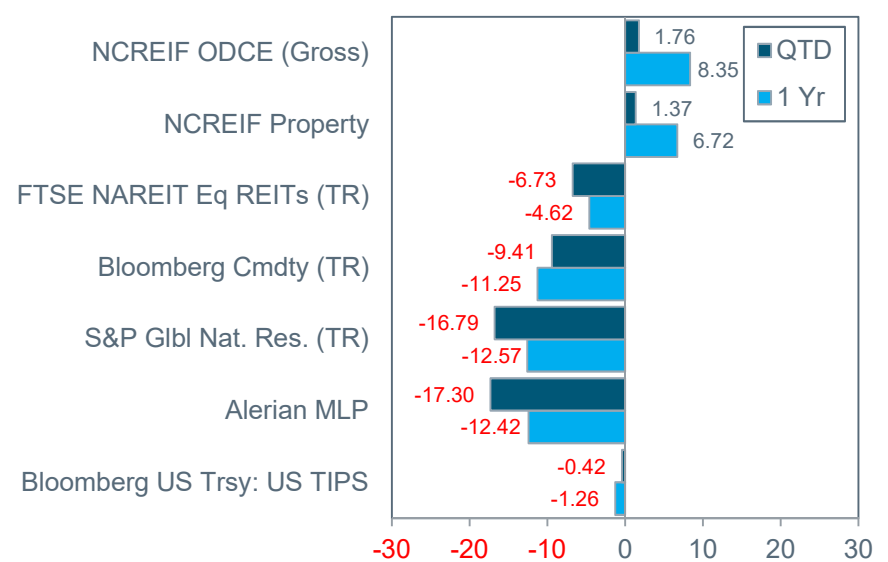
General Market - Real Estate

Core private real estate returned 1.8% during the fourth quarter, as tracked by the NCREIF-ODCE Index, with the total return comprised of 1.0% income and 0.7% price appreciation. Investors in publicly traded real estate significantly underperformed their private market counterparts during the fourth quarter. Publicly traded real estate experienced heightened price volatility over the quarter, ending the year with a negative return, measured by FTSE/NAREIT All REITs Index, of -6.1%.

HFRI Hedge Fund Performance (%)



Real Asset Performance (%)



Annual Asset Class Performance

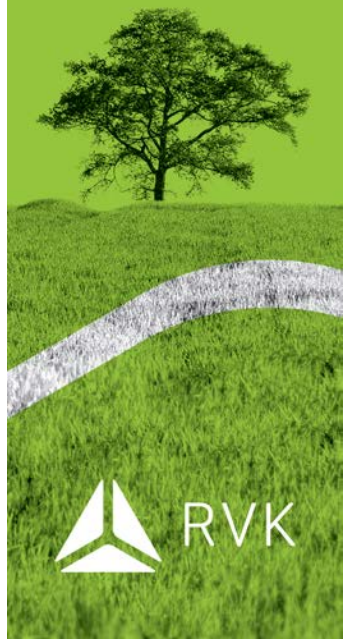
As of December 31, 2018

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Best	31.56	34.00	35.03	39.38	8.44	78.51	27.94	22.49	20.00	38.82	30.14	15.02	21.31	37.28	8.35
	31.45	26.19	32.18	16.23	5.24	58.21	26.85	15.99	18.23	32.39	19.31	9.59	17.13	33.01	1.87
	25.55	21.39	26.34	15.97	2.06	46.78	22.04	13.56	18.06	29.30	13.69	3.20	11.96	25.03	0.01
	20.25	21.36	19.31	11.63	-2.35	31.78	18.88	8.29	17.32	22.78	12.50	1.38	11.77	21.83	-1.26
	18.33	13.54	18.37	11.17	-10.01	28.01	16.83	7.84	16.35	13.94	5.97	0.55	11.19	14.65	-2.08
	13.06	12.17	16.32	10.25	-21.37	27.17	16.36	4.98	16.00	8.96	4.89	0.05	8.77	10.71	-4.03
	11.14	7.49	15.79	6.97	-26.16	26.46	15.12	2.11	15.81	7.44	3.64	-0.27	8.52	7.77	-4.38
	10.88	5.34	11.86	6.60	-33.79	18.91	15.06	0.10	10.94	2.47	3.37	-0.81	6.67	7.62	-4.62
	9.15	4.91	10.39	5.49	-35.65	11.47	10.16	-4.18	8.78	0.07	2.45	-1.44	4.68	7.50	-4.68
	8.56	4.55	4.85	5.00	-37.00	11.41	7.75	-5.72	6.98	-2.02	0.04	-3.30	2.65	5.23	-11.01
	8.46	3.07	4.34	1.87	-37.74	5.93	6.54	-12.14	4.79	-2.60	-2.19	-4.41	2.18	3.54	-11.25
	6.86	2.84	2.72	1.45	-43.38	1.92	6.31	-13.32	4.21	-8.61	-4.90	-4.47	1.00	3.01	-13.79
	4.34	2.74	2.07	-1.57	-47.01	0.21	5.70	-15.94	0.11	-8.83	-4.95	-14.92	0.51	1.70	-14.58
Worst	1.33	2.43	0.49	-15.70	-53.33	-29.76	0.13	-18.42	-1.06	-9.52	-17.01	-24.66	0.33	0.86	-17.89
	S&P 500 - US Large Cap	R 2000 - US Small Cap	MSCI EAFE (Net) - Int'l Dev.	MSCI EAFE SC (Net) - Int'l SC	MSCI EM (Net) - Int'l Emg Mkts	Bloombrg US Agg Bond - FI	Bloombrg US Corp Hi Yield - FI	Bloombrg US Trsy US TIPS - FI	Bloombrg US Gov Credit Lng - FI	NCREIF ODCE (Gross) - Real Estate	FTSE NAREIT Eq REITs Index (TR)	HFRI FOF Comp Index - ARS	Bloombrg Cmdty (TR) - Commod.	ICE BofAML 3 Mo T-Bill - Cash Equiv	

NCREIF ODCE (Gross) performance is reported quarterly; performance is shown N/A in interim-quarter months.



Performance Report - All Systems

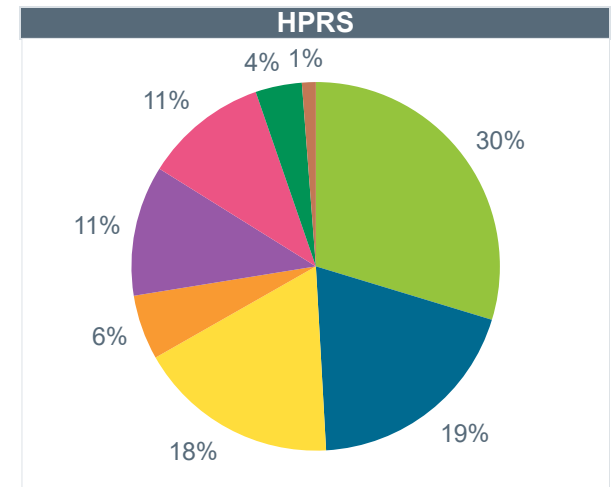
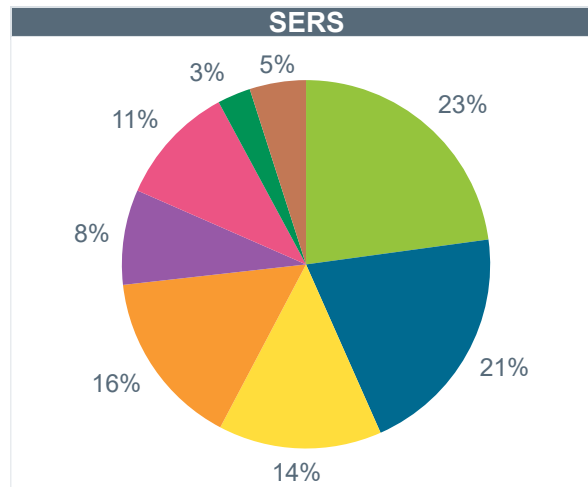
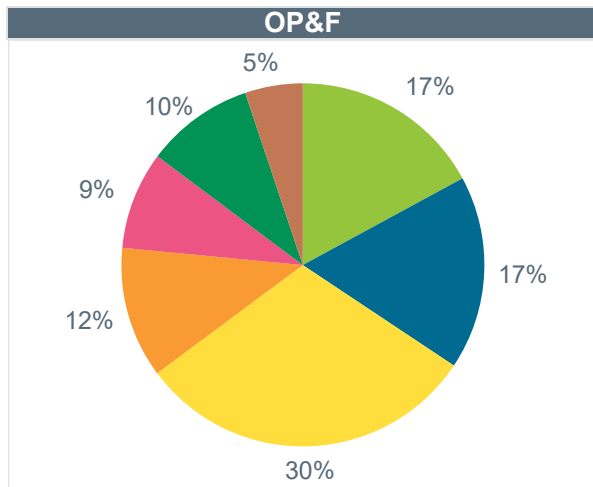
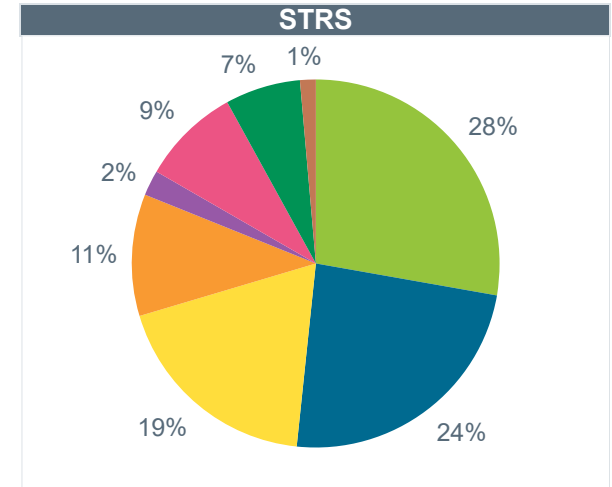
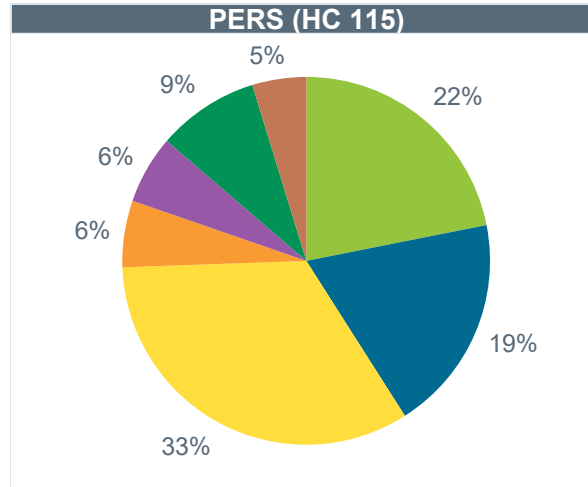
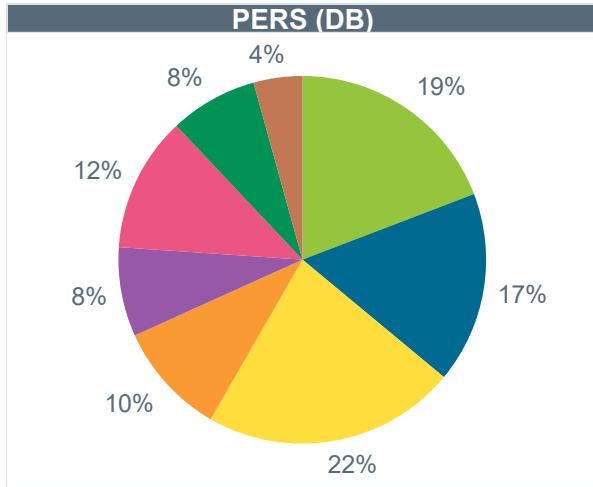


Asset Allocation & Performance - Gross of Fees											
	Market Value (\$000)	Trailing Performance (%)						Calendar Year Performance (%)			
		2 Quarters	1 Year	3 Years	5 Years	7 Years	10 Years	2017	2016	2015	2014
PERS (DB)	81,070,069	-3.33	-2.90	7.23	5.87	8.32	9.11	16.94	8.56	0.58	7.25
PERS (DB) Total Fund Benchmark		-3.71	-3.08	6.64	5.17	7.83	8.59	15.19	8.63	0.25	5.81
Difference		0.38	0.18	0.59	0.70	0.49	0.52	1.75	-0.07	0.33	1.44
Rank		34	48	18	22	28	29	23	23	47	26
PERS (HC 115)	11,341,375	-5.58	-5.76	5.35	3.84	6.29	8.08	15.25	7.67	-2.11	5.46
PERS (HC 115) Total Fund Benchmark		-5.58	-5.97	5.01	3.59	5.95	7.63	14.31	7.75	-1.93	5.01
Difference		0.00	0.21	0.34	0.25	0.34	0.45	0.94	-0.08	-0.18	0.45
Rank		77	93	87	92	90	81	64	60	97	72
STRS	72,888,693	-3.58	-1.75	7.20	6.38	8.91	9.59	15.90	8.18	2.46	7.95
STRS Total Fund Benchmark		-3.42	-2.04	6.86	6.09	8.83	9.55	15.35	8.00	1.70	8.26
Difference		-0.16	0.29	0.34	0.29	0.08	0.04	0.55	0.18	0.76	-0.31
Rank		39	31	21	6	8	12	53	38	5	15
OP&F	14,535,670	-3.98	-1.78	7.78	6.13	8.90	10.05	14.30	11.51	0.65	6.88
OP&F Total Fund Benchmark		-3.37	-2.65	6.84	4.98	7.69	8.89	12.41	11.46	-2.18	6.87
Difference		-0.59	0.87	0.94	1.15	1.21	1.16	1.89	0.05	2.83	0.01
Rank		52	32	8	13	9	2	77	1	43	33
SERS	13,536,746	-2.93	-1.28	7.78	6.62	9.12	9.18	17.36	8.08	2.93	6.92
SERS Total Fund Benchmark		-3.20	-2.03	6.24	5.35	7.87	8.32	14.37	7.02	1.48	6.66
Difference		0.27	0.75	1.54	1.27	1.25	0.86	2.99	1.06	1.45	0.26
Rank		25	22	6	3	3	26	11	41	1	30
HPRS	821,696	-6.44	-4.73	5.58	4.70	7.66	8.61	15.01	7.42	0.15	6.73
HPRS Total Fund Benchmark		-4.84	-3.51	5.89	4.95	7.70	8.85	14.55	7.40	0.19	7.03
Difference		-1.60	-1.22	-0.31	-0.25	-0.04	-0.24	0.46	0.02	-0.04	-0.30
Rank		93	78	86	77	56	60	66	67	64	42
<i>All Public Plans > \$1B-Total Fund Median</i>		<i>-3.95</i>	<i>-3.01</i>	<i>6.63</i>	<i>5.25</i>	<i>7.73</i>	<i>8.86</i>	<i>15.98</i>	<i>7.93</i>	<i>0.48</i>	<i>6.46</i>

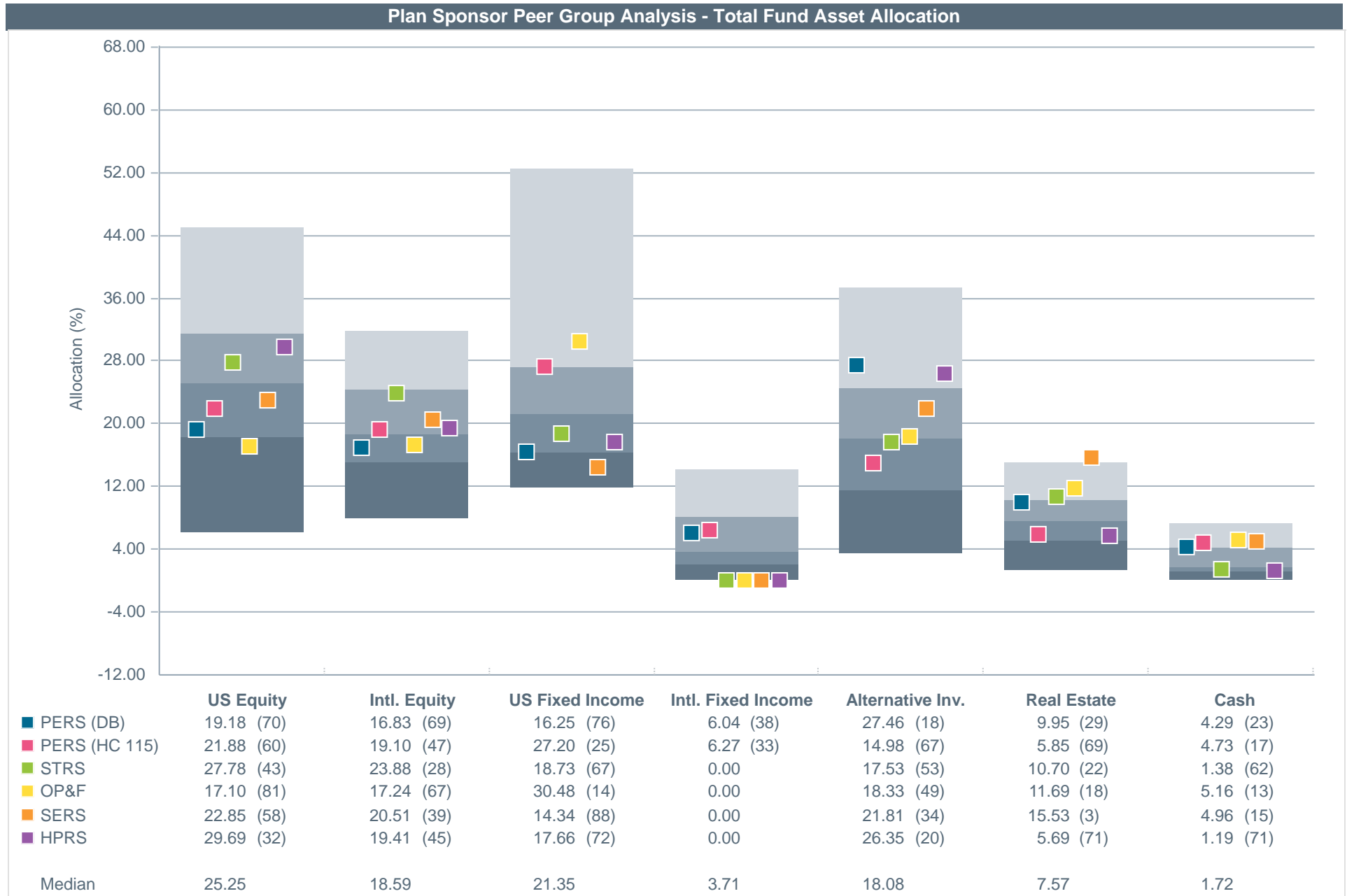
OPERS health care plan is not a pension plan and therefore has significantly different characteristics including a shorter focus asset allocation with more liquidity than the pension plans. For purposes of this study, the OPERS health care plan has been included in the results. The results for OPERS health care plan is reflected in the PERS 115 trust subsequent to October 2014 and in the PERS HC results prior to October 2014.

Asset Allocation & Performance - Net of Fees											
	Market Value (\$000)	Trailing Performance (%)						Calendar Year Performance (%)			
		2 Quarters	1 Year	3 Years	5 Years	7 Years	10 Years	2017	2016	2015	2014
PERS (DB)	81,070,069	-3.37	-2.99	7.07	5.67	8.11	8.92	16.81	8.31	0.33	6.96
PERS (DB) Total Fund Benchmark		-3.71	-3.08	6.64	5.17	7.83	8.59	15.19	8.63	0.25	5.81
Difference		0.34	0.09	0.43	0.50	0.28	0.33	1.62	-0.32	0.08	1.15
PERS (HC 115)	11,341,375	-5.58	-5.76	5.31	3.75	6.19	7.99	15.25	7.55	-2.23	5.28
PERS (HC 115) Total Fund Benchmark		-5.58	-5.97	5.01	3.59	5.95	7.63	14.31	7.75	-1.93	5.01
Difference		0.00	0.21	0.30	0.16	0.24	0.36	0.94	-0.20	-0.30	0.27
STRS	72,888,693	-3.65	-1.89	7.05	6.24	8.77	9.45	15.74	8.03	2.33	7.82
STRS Total Fund Benchmark		-3.42	-2.04	6.86	6.09	8.83	9.55	15.35	8.00	1.70	8.26
Difference		-0.23	0.15	0.19	0.15	-0.06	-0.10	0.39	0.03	0.63	-0.44
OP&F	14,535,670	-4.22	-2.40	7.16	5.53	8.33	9.54	13.68	10.90	0.07	6.27
OP&F Total Fund Benchmark		-3.37	-2.65	6.84	4.98	7.69	8.89	12.41	11.46	-2.18	6.87
Difference		-0.85	0.25	0.32	0.55	0.64	0.65	1.27	-0.56	2.25	-0.60
SERS	13,536,746	-3.25	-1.94	7.09	5.95	8.41	8.43	16.65	7.37	2.31	6.25
SERS Total Fund Benchmark		-3.20	-2.03	6.24	5.35	7.87	8.32	14.37	7.02	1.48	6.66
Difference		-0.05	0.09	0.85	0.60	0.54	0.11	2.28	0.35	0.83	-0.41
HPRS	821,696	-6.61	-5.13	5.09	4.20	7.22	8.20	14.29	7.03	-0.43	6.30
HPRS Total Fund Benchmark		-4.84	-3.51	5.89	4.95	7.70	8.85	14.55	7.40	0.19	7.03
Difference		-1.77	-1.62	-0.80	-0.75	-0.48	-0.65	-0.26	-0.37	-0.62	-0.73

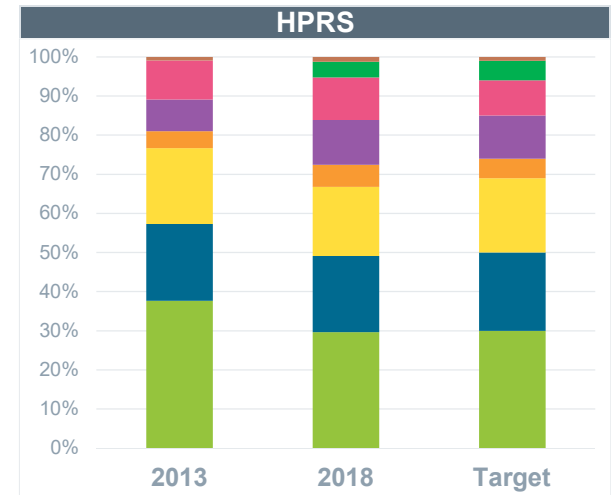
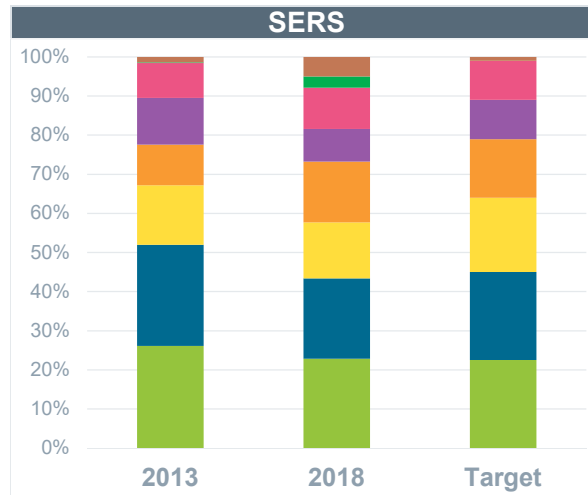
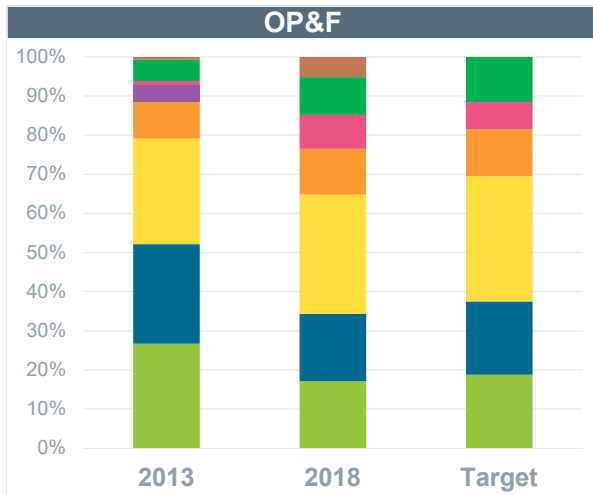
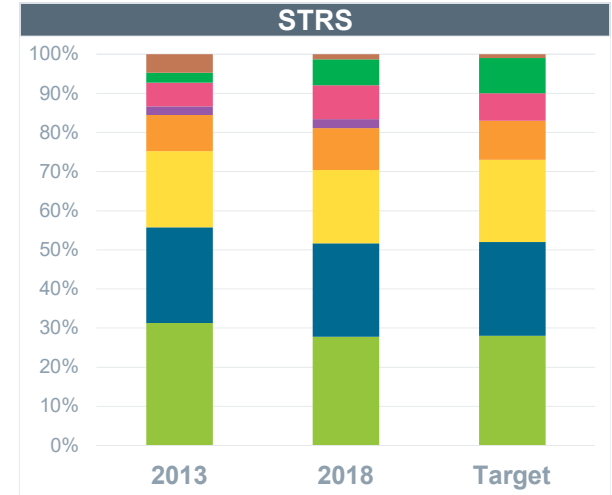
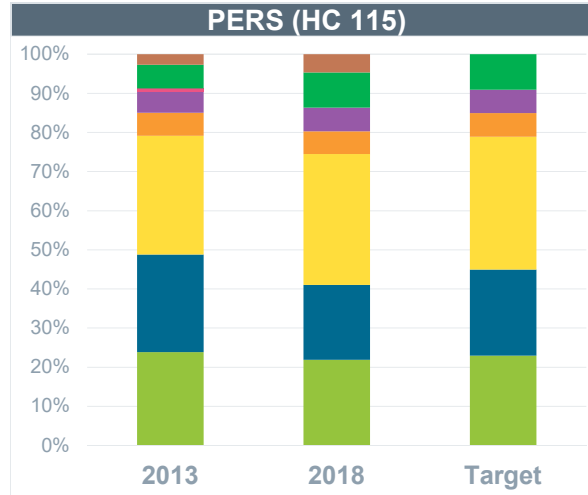
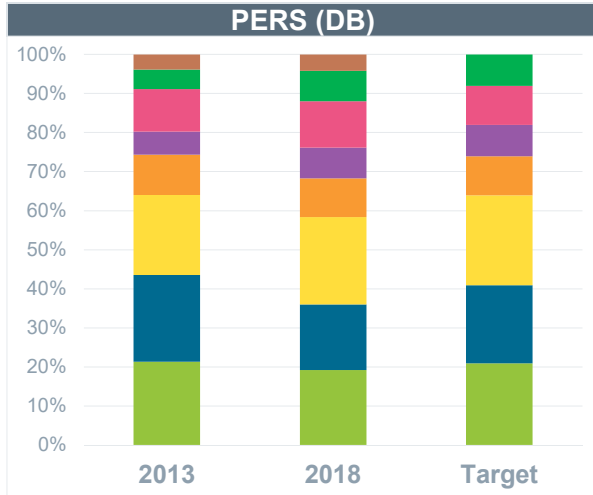
Performance shown is net of all investment management costs.



Allocations shown may not sum up to 100% exactly due to rounding. Cash Equivalents for PERS (DB) and PERS (HC 115) consists of cash, rebalancing, and additional annuity.



Allocations shown may not add up to 100% due to rounding. US Fixed Income may include allocations to Intl. Fixed Income not explicitly broken out by the plans. Parentheses contain percentile ranks. Cash Equivalents for PERS (DB) consists of cash, rebalancing, and additional annuity. Cash Equivalents for PERS (HC 115) consists of cash and rebalancing.

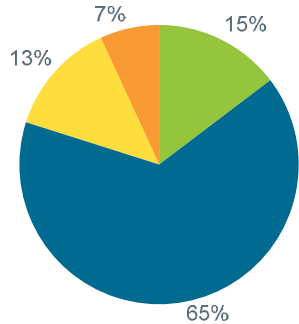


- US Equity
- International Equity
- Fixed Income
- Real Estate
- Hedge Funds
- Private Equity
- Other Alternatives
- Cash Equivalents

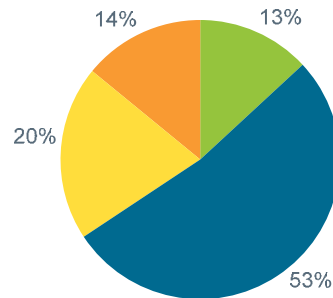
Summary

- **Alpha:** Aims to continually provide a return in excess of the portfolio benchmark return for a given level of risk and are intended to provide diversification (primarily with the Capital Appreciation and Capital Preservation components).
(Includes: Hedge Funds, Global Tactical Asset Allocation (GTAA), and Risk Parity)
- **Capital Appreciation:** Seeks high level of capital gains through increased risk-return trade-off.
(Includes: Public & Private Equities, High Yield, Emerging Markets Debt, MLPs, Timber, Non-Core Real Estate, Opportunistic Investments, and Securitized Debt)
- **Capital Preservation:** Conservative strategy designed to avoid risk of loss of principal.
(Includes: Core Fixed Income and Cash Equivalents)
- **Inflation:** Provide returns that will keep pace with normal inflationary movements in the long-term market. Designed not to lose value in an inflationary environment.
(Includes: TIPS, Commodities, Real Return, Floating Rate Debt, REITs, and Core Real Estate)

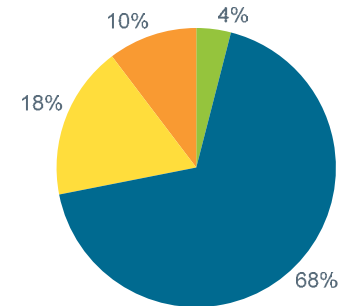
PERS (DB)



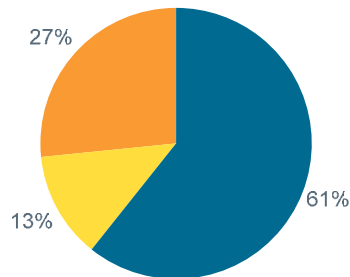
PERS (HC 115)



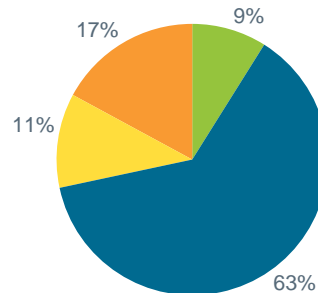
STRS



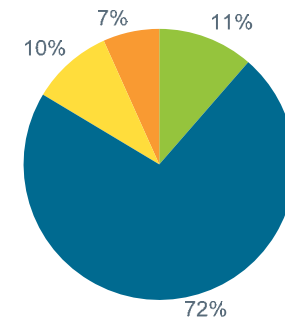
OP&F



SERS



HPRS



Asset Allocation by Thematic Category percentages are provided by the Plans. Allocations are based on dedicated composite allocations and not underlying investment manager exposures; as such, thematic allocations are approximations. OP&F does not have any dedicated exposure to Alpha strategies, but does have alpha exposure embedded within other asset class buckets. Allocations shown may not sum up to exactly 100% due to rounding. Please see the Glossary for additional information regarding thematic descriptions.

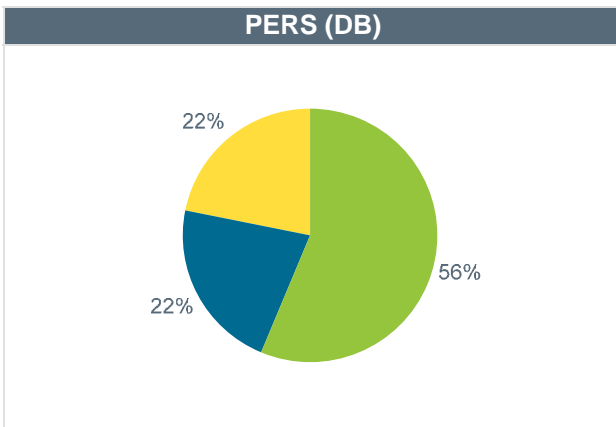
Summary

RVK Liquidity Rating - A qualitative method developed and calculated by RVK for determining the relative amount of liquidity in a portfolio.

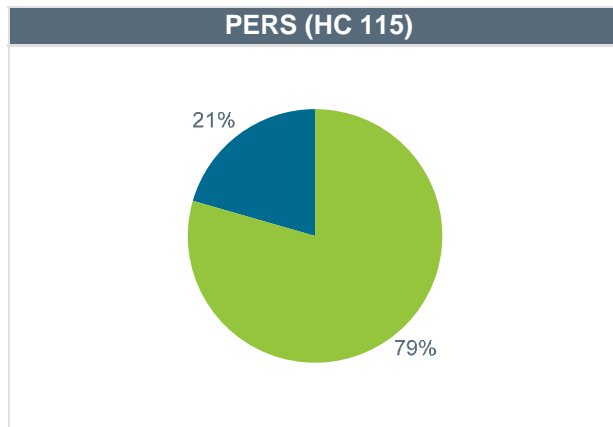
Liquid Investments: Publicly traded assets, largely exchanged traded with significant trading volume for the overall asset classes. Takes a relatively small discount or time required to raise cash, but generally expected to clear at quoted bid prices within several trading days.

Less Liquid Investments: Smaller trading volume, non-exchange traded, or vehicle-based liquidity constraints. Moderate to significant discount to raise cash, expected to see fewer purchase-oriented bids, or time required to receive cash is significantly greater than several trading days.

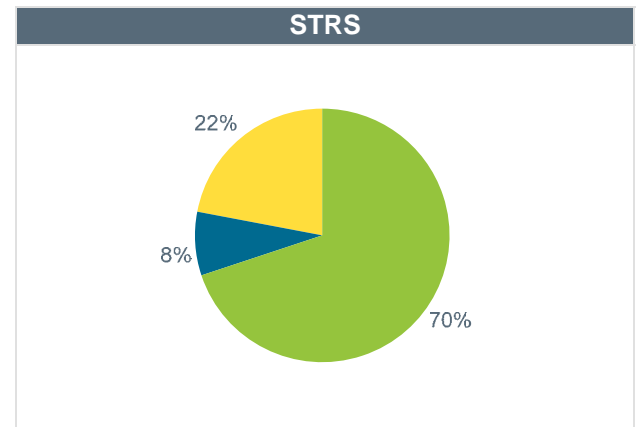
Not Liquid Investments: Private appraisal-based transactions, vehicle-based liquidity constraints, or privately held assets. Extreme discount to raise cash or 6-12+ months required to receive cash.



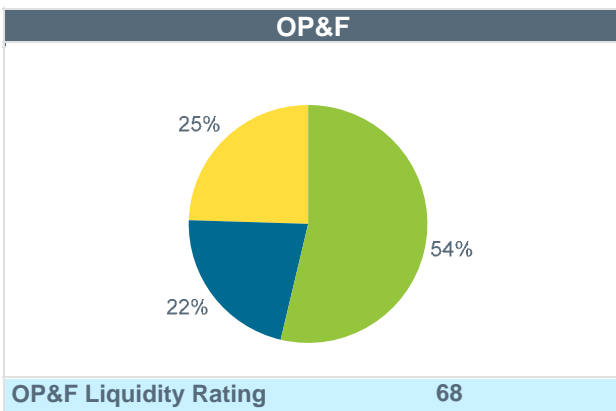
PERS (DB) Liquidity Rating 64



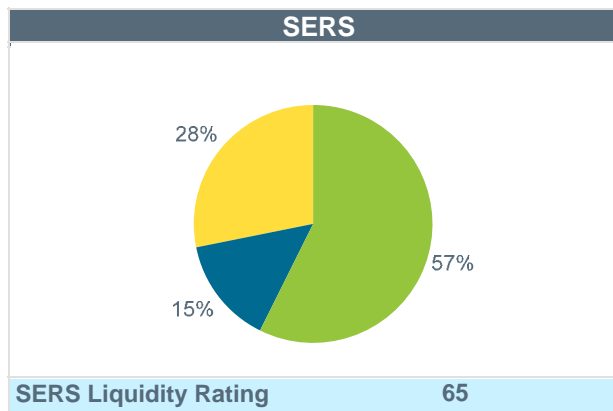
PERS (HC 115) Liquidity Rating 85



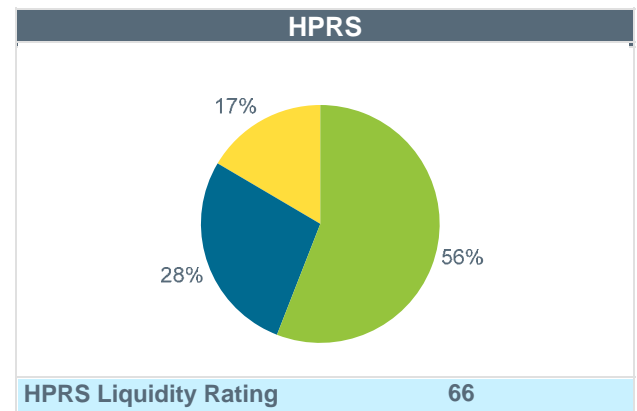
STRS Liquidity Rating 70



OP&F Liquidity Rating 68

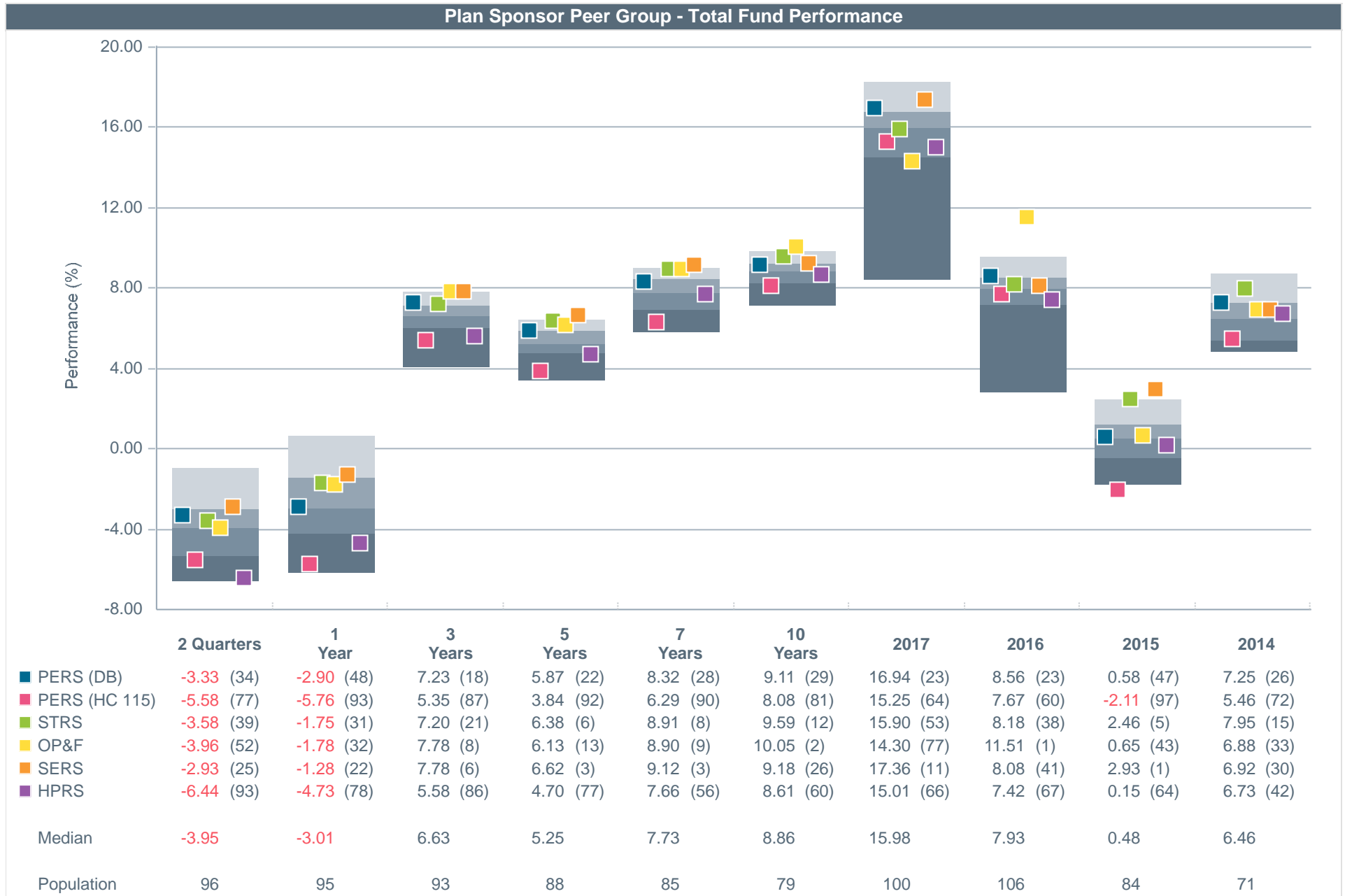


SERS Liquidity Rating 65



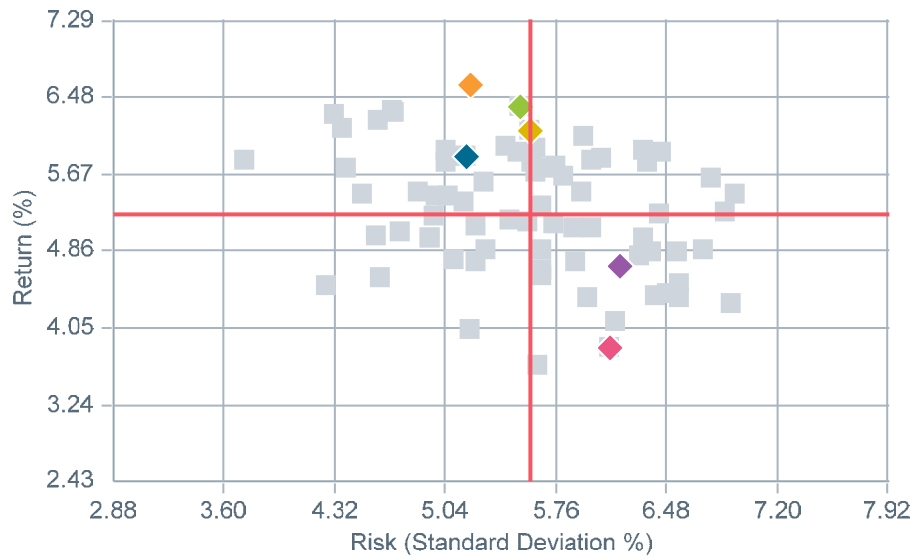
HPRS Liquidity Rating 66

Asset Allocation by Liquidity percentages are provided by the Plans. Allocations are based on dedicated composite allocations and not underlying investment manager exposures; as such, liquidity allocations are approximations. Allocations shown may not sum up to exactly 100% due to rounding. The RVK Liquidity Rating is calculated by RVK using beginning of quarter investment weights applied to each corresponding asset class liquidity rating. Please see the glossary for additional information regarding liquidity and custom index descriptions.



Performance shown is gross of fees. Parentheses contain percentile ranks.

Plan Sponsor Peer Group Scattergram - 5 Years

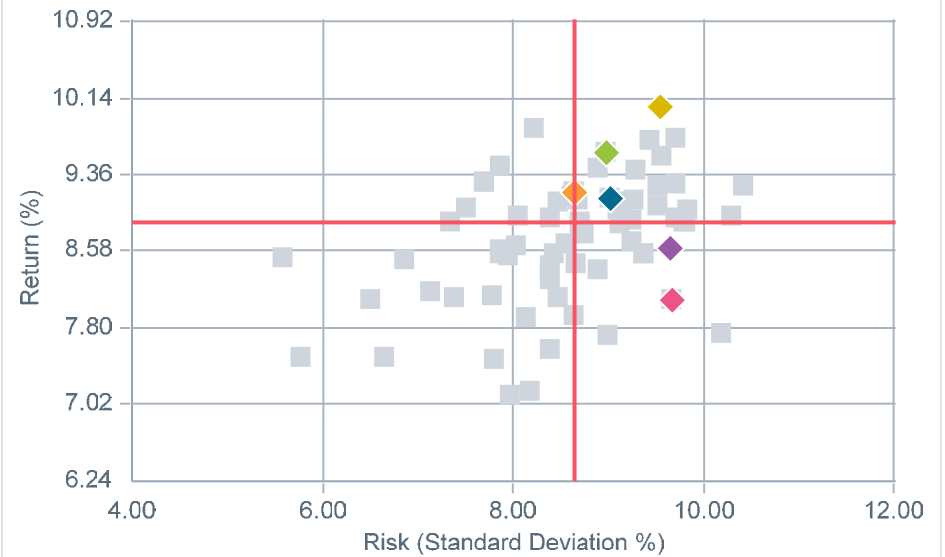


	Return	Standard Deviation
◆ PERS (DB)	5.87	5.18
◆ PERS (HC 115)	3.84	6.11
◆ STRS	6.38	5.53
◆ OP&F	6.13	5.60
◆ SERS	6.62	5.21
◆ HPRS	4.70	6.18
— Median	5.25	5.60

Sharpe Ratio - 5 Year

PERS (DB)	0.99
PERS (HC 115)	0.54
STRS	1.02
OP&F	0.97
SERS	1.13
HPRS	0.67
<i>All Public Plans > \$1B-Total Fund Median</i>	<i>0.85</i>

Plan Sponsor Peer Group Scattergram - 10 Years



	Return	Standard Deviation
◆ PERS (DB)	9.11	9.03
◆ PERS (HC 115)	8.08	9.68
◆ STRS	9.59	8.98
◆ OP&F	10.05	9.55
◆ SERS	9.18	8.64
◆ HPRS	8.61	9.65
— Median	8.86	8.65

Sharpe Ratio - 10 Year

PERS (DB)	0.97
PERS (HC 115)	0.81
STRS	1.03
OP&F	1.02
SERS	1.02
HPRS	0.87
<i>All Public Plans > \$1B-Total Fund Median</i>	<i>0.97</i>

Performance shown is gross of fees.

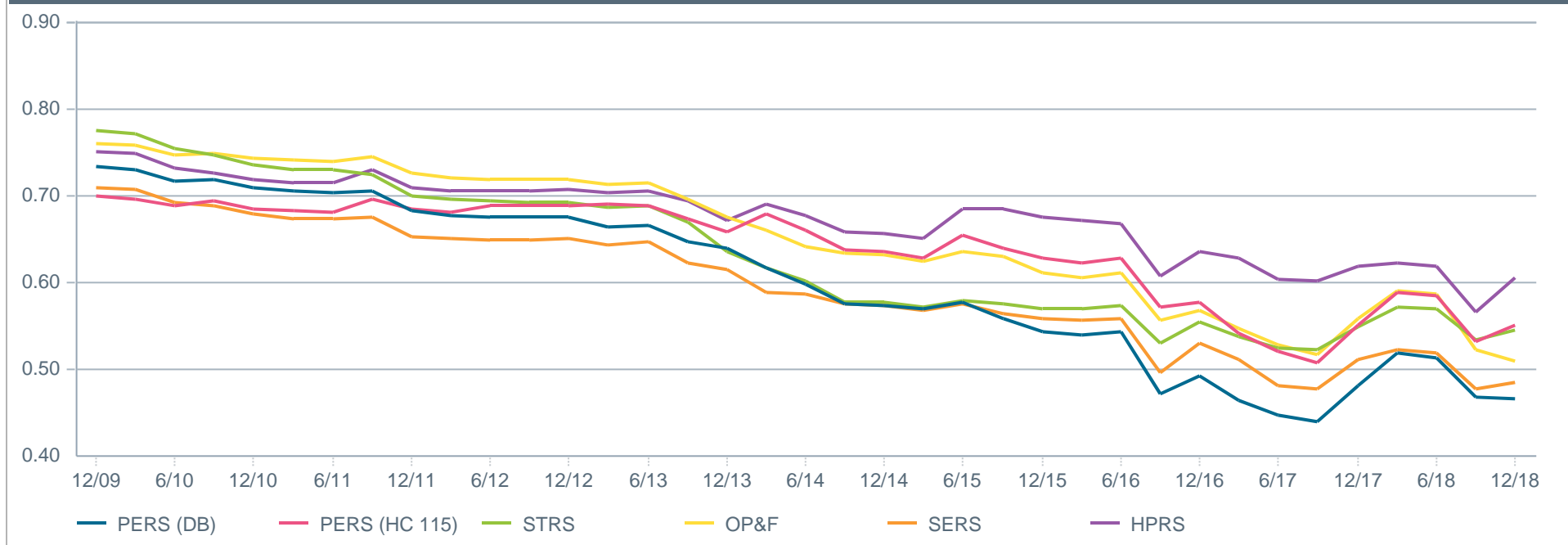
Summary

Beta is a measure of the sensitivity of a portfolio to the movements of the U.S. equity market as represented by the S&P 500 Index (Cap Wtd). Beta measures a portfolio's non-diversifiable or systematic risk. As an example, a Beta of 0.70 indicates that a portfolio captures roughly 70% of the S&P 500 Index return. If the S&P 500 Index returns 10%, the portfolio would be expected to return 7%.

Equity Beta

	3 Years	5 Years	7 Years	10 Years
PERS (DB)	0.45	0.47	0.47	0.60
PERS (HC 115)	0.52	0.55	0.55	0.64
STRS	0.53	0.55	0.54	0.62
OP&F	0.48	0.51	0.52	0.64
SERS	0.48	0.48	0.50	0.58
HPRS	0.60	0.61	0.62	0.66
S&P 500 Index (Cap Wtd)	1.00	1.00	1.00	1.00

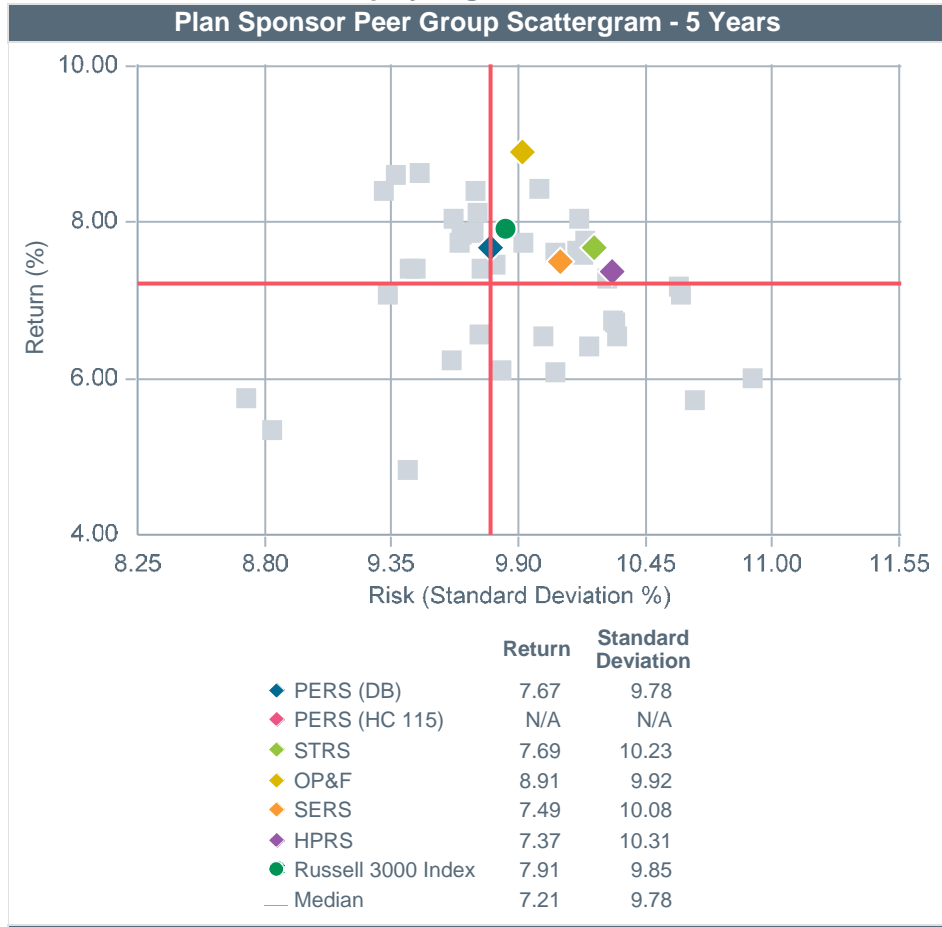
5 Year Rolling Equity Beta



Performance shown is gross of fees and is calculated using quarterly periodicity.

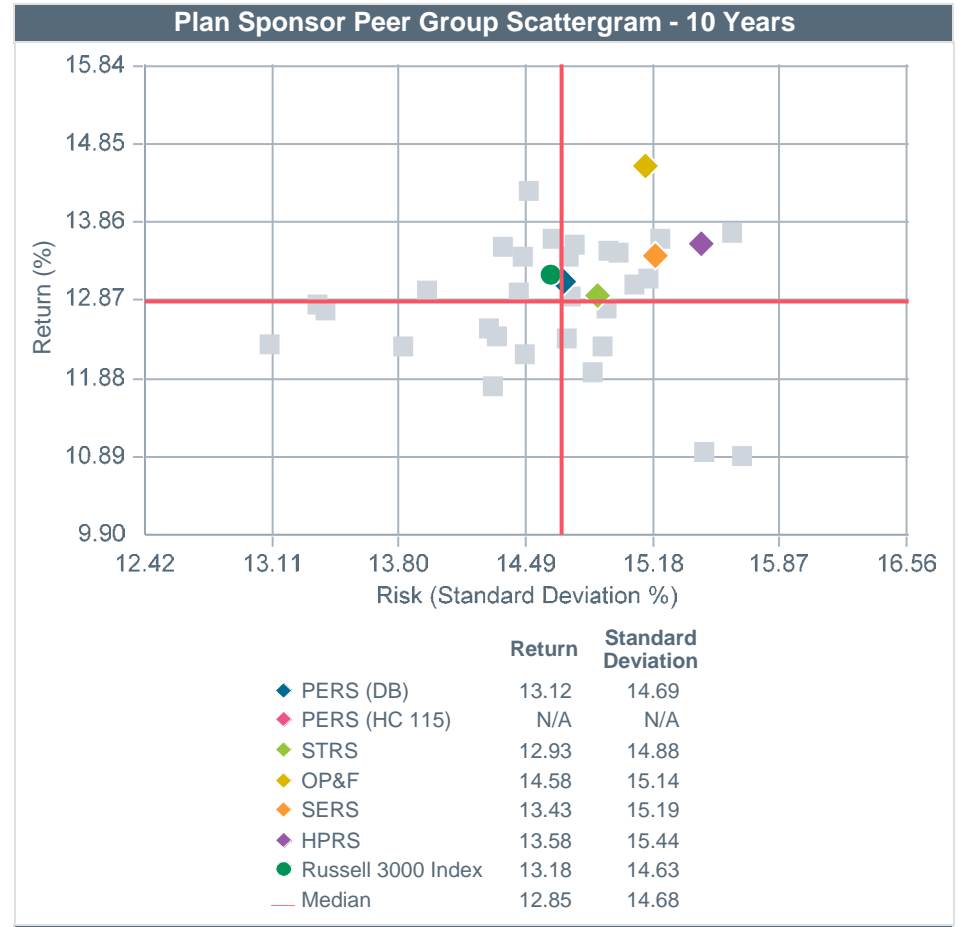
Performance										
	Trailing Performance (%)						Calendar Year Performance (%)			
	2 Quarters	1 Year	3 Years	5 Years	7 Years	10 Years	2017	2016	2015	2014
US Equity										
PERS (DB)	-8.11	-5.00	8.91	7.67	12.34	13.12	21.30	12.09	0.68	11.29
Russell 3000 Index	-8.20	-5.24	8.97	7.91	12.46	13.18	21.13	12.74	0.48	12.56
Difference	0.09	0.24	-0.06	-0.24	-0.12	-0.06	0.17	-0.65	0.20	-1.27
Rank	19	24	35	32	28	37	28	65	34	52
PERS (HC 115)	-8.11	-5.00	8.91	N/A	N/A	N/A	21.30	12.09	0.68	N/A
Russell 3000 Index	-8.20	-5.24	8.97	N/A	N/A	N/A	21.13	12.74	0.48	N/A
Difference	0.09	0.24	-0.06	N/A	N/A	N/A	0.17	-0.65	0.20	N/A
Rank	19	24	35	N/A	N/A	N/A	28	65	34	N/A
STRS	-9.29	-5.33	8.74	7.69	12.00	12.93	22.01	11.32	0.83	11.70
Russell 3000 Index	-8.20	-5.24	8.97	7.91	12.46	13.18	21.13	12.74	0.48	12.56
Difference	-1.09	-0.09	-0.23	-0.22	-0.46	-0.25	0.88	-1.42	0.35	-0.86
Rank	50	39	45	32	50	48	18	81	32	41
OP&F	-7.47	-3.30	11.00	8.91	13.14	14.58	22.40	15.56	0.66	11.27
Wilshire 5000 Index	-8.06	-5.27	9.12	8.07	12.47	13.19	20.99	13.37	0.67	12.71
Difference	0.59	1.97	1.88	0.84	0.67	1.39	1.41	2.19	-0.01	-1.44
Rank	13	6	2	5	3	6	13	7	34	53
SERS	-9.11	-6.15	8.49	7.49	12.50	13.43	22.27	11.27	1.24	10.99
Russell 3000 Index	-8.20	-5.24	8.97	7.91	12.46	13.18	21.13	12.74	0.48	12.56
Difference	-0.91	-0.91	-0.48	-0.42	0.04	0.25	1.14	-1.47	0.76	-1.57
Rank	47	63	51	40	21	30	15	81	23	56
HPRS	-10.87	-7.97	8.35	7.37	12.24	13.58	21.53	13.73	0.18	11.97
Russell 3000 Index	-8.20	-5.24	8.97	7.91	12.46	13.18	21.13	12.74	0.48	12.56
Difference	-2.67	-2.73	-0.62	-0.54	-0.22	0.40	0.40	0.99	-0.30	-0.59
Rank	89	87	57	48	36	18	22	25	49	29
<i>All Public Plans > \$1B-US Equity Segment Median</i>	<i>-9.30</i>	<i>-5.89</i>	<i>8.49</i>	<i>7.21</i>	<i>11.99</i>	<i>12.85</i>	<i>20.23</i>	<i>12.76</i>	<i>-0.05</i>	<i>11.41</i>

Performance shown is gross of fees. Ranks are shown against All Public Plans >\$1B-US Equity Segment.



Sharpe Ratio - 5 Years

PERS (DB)	0.74
PERS (HC 115)	N/A
STRS	0.72
OP&F	0.85
SERS	0.71
HPRS	0.68
Russell 3000 Index	0.76
<i>All Public Plans > \$1B-US Equity Segment Median</i>	0.71



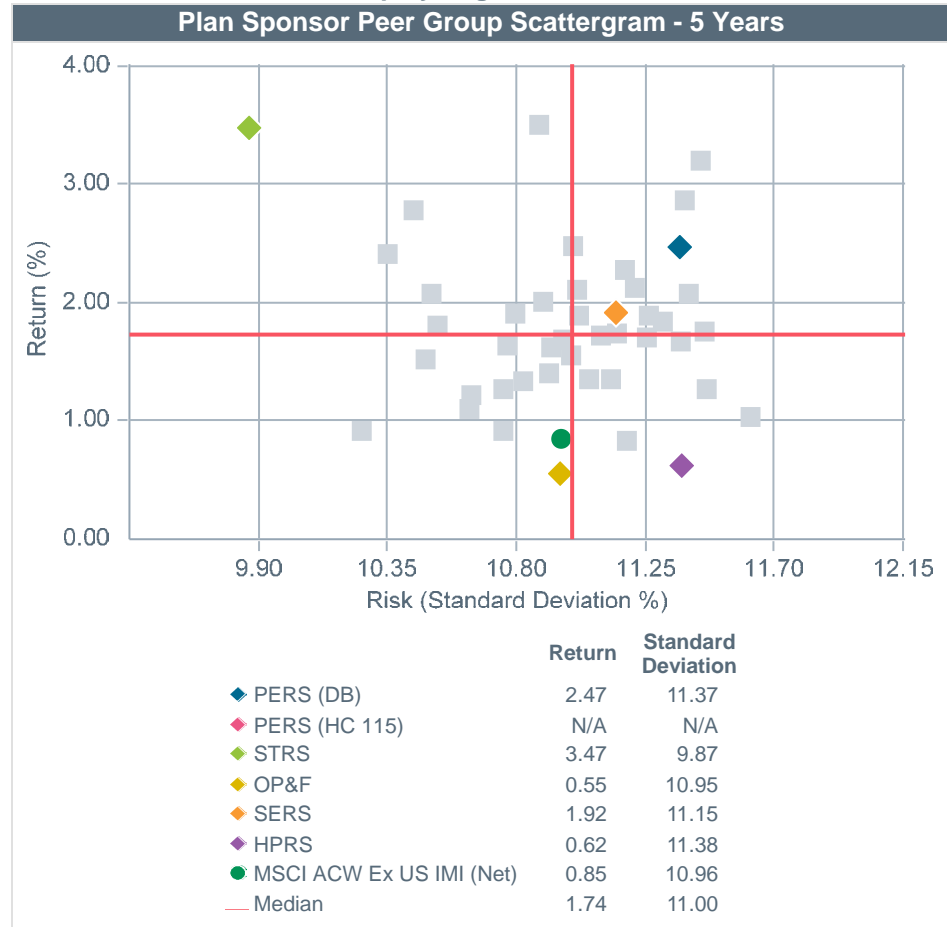
Sharpe Ratio - 10 Years

PERS (DB)	0.90
PERS (HC 115)	N/A
STRS	0.88
OP&F	0.96
SERS	0.89
HPRS	0.89
Russell 3000 Index	0.90
<i>All Public Plans > \$1B-US Equity Segment Median</i>	0.89

Performance shown is gross of fees.

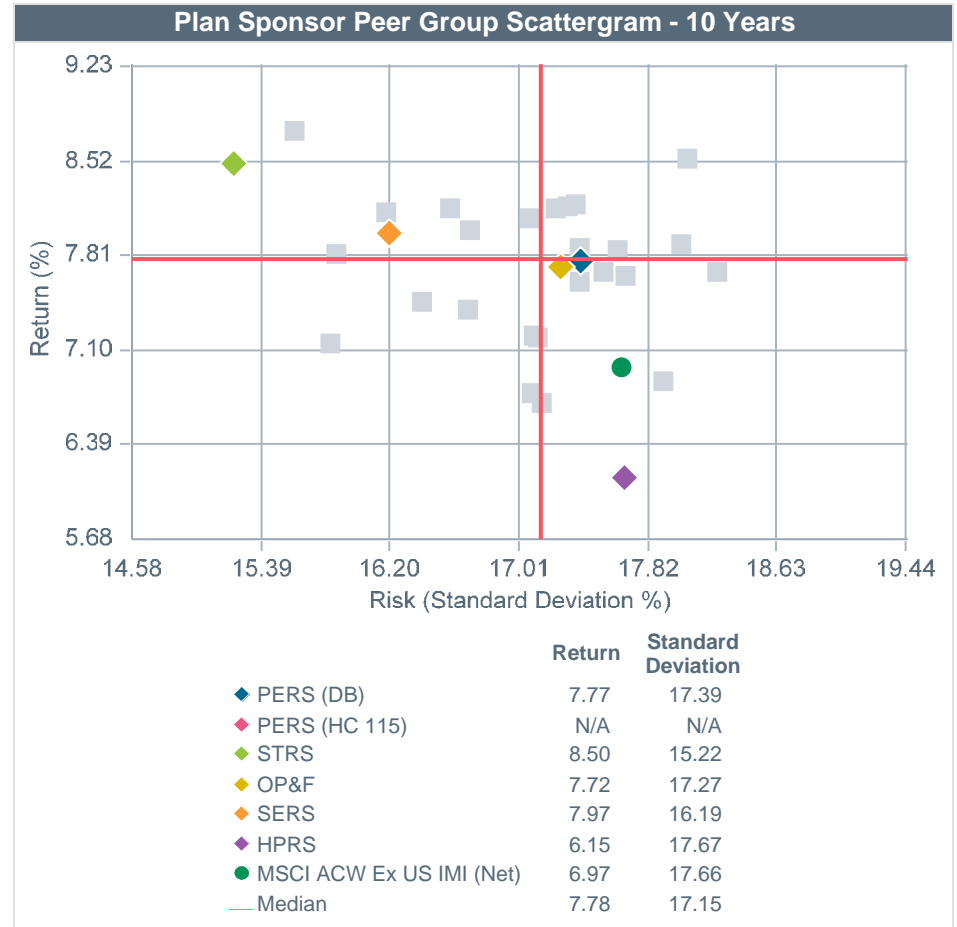
Performance										
	Trailing Performance (%)						Calendar Year Performance (%)			
	2 Quarters	1 Year	3 Years	5 Years	7 Years	10 Years	2017	2016	2015	2014
International Equity										
PERS (DB)	-11.18	-14.17	6.10	2.47	6.39	7.77	31.64	5.72	-4.01	-1.48
PERS (DB) International Equity Custom Benchmark	-11.15	-14.74	5.16	1.07	4.88	6.53	29.24	5.54	-6.09	-3.42
Difference	-0.03	0.57	0.94	1.40	1.51	1.24	2.40	0.18	2.08	1.94
Rank	51	66	17	20	42	51	11	23	72	31
PERS (HC 115)	-11.18	-14.17	6.10	N/A	N/A	N/A	31.64	5.72	-4.01	N/A
PERS (HC 115) International Equity Custom Benchmark	-11.15	-14.74	5.16	N/A	N/A	N/A	29.24	5.54	-6.09	N/A
Difference	-0.03	0.57	0.94	N/A	N/A	N/A	2.40	0.18	2.08	N/A
Rank	51	66	17	N/A	N/A	N/A	11	23	72	N/A
STRS	-9.33	-11.80	5.46	3.47	7.50	8.50	24.16	7.09	0.30	0.83
STRS International Equity Custom Benchmark	-9.99	-12.08	4.91	2.39	6.44	7.47	23.43	6.39	-2.78	0.24
Difference	0.66	0.28	0.55	1.08	1.06	1.03	0.73	0.70	3.08	0.59
Rank	11	11	35	7	6	11	97	13	9	4
OP&F	-13.95	-17.32	3.13	0.55	5.90	7.72	29.12	2.75	-0.77	-5.58
MSCI ACW Ex US IM Index (USD) (Net)	-11.53	-14.76	4.39	0.85	5.07	6.97	27.81	4.41	-4.60	-3.89
Difference	-2.42	-2.56	-1.26	-0.30	0.83	0.75	1.31	-1.66	3.83	-1.67
Rank	100	100	100	100	64	54	53	80	24	100
SERS	-10.84	-14.03	5.51	1.92	6.33	7.97	29.11	5.81	-2.37	-4.10
SERS International Equity Custom Benchmark	-10.84	-14.20	4.48	0.68	5.16	6.67	27.19	4.50	-5.66	-3.87
Difference	0.00	0.17	1.03	1.24	1.17	1.30	1.92	1.31	3.29	-0.23
Rank	39	62	33	39	43	36	54	23	51	91
HPRS	-13.34	-14.88	3.67	0.62	5.45	6.15	28.72	1.69	-2.91	-4.65
MSCI ACW Ex US IM Index (USD) (Net)	-11.53	-14.76	4.39	0.85	5.07	6.97	27.81	4.41	-4.60	-3.89
Difference	-1.81	-0.12	-0.72	-0.23	0.38	-0.82	0.91	-2.72	1.69	-0.76
Rank	99	83	94	100	85	100	60	88	58	98
<i>All Public Plans > \$1B-Intl. Equity Segment Median</i>	<i>-11.18</i>	<i>-13.53</i>	<i>4.90</i>	<i>1.74</i>	<i>6.09</i>	<i>7.78</i>	<i>29.22</i>	<i>4.05</i>	<i>-2.36</i>	<i>-2.68</i>

Performance shown is gross of fees. Ranks are shown against All Public Plans >\$1B-Intl. Equity Segment.



Sharpe Ratio - 5 Years

PERS (DB)	0.22
PERS (HC 115)	N/A
STRS	0.33
OP&F	0.05
SERS	0.17
HPRS	0.06
MSCI ACW Ex US IMI (Net)	0.08
<i>All Public Plans > \$1B-Intl. Equity Segment Median</i>	<i>0.15</i>



Sharpe Ratio - 10 Years

PERS (DB)	0.50
PERS (HC 115)	N/A
STRS	0.59
OP&F	0.50
SERS	0.53
HPRS	0.41
MSCI ACW Ex US IMI (Net)	0.45
<i>All Public Plans > \$1B-Intl. Equity Segment Median</i>	<i>0.50</i>

Performance shown is gross of fees.

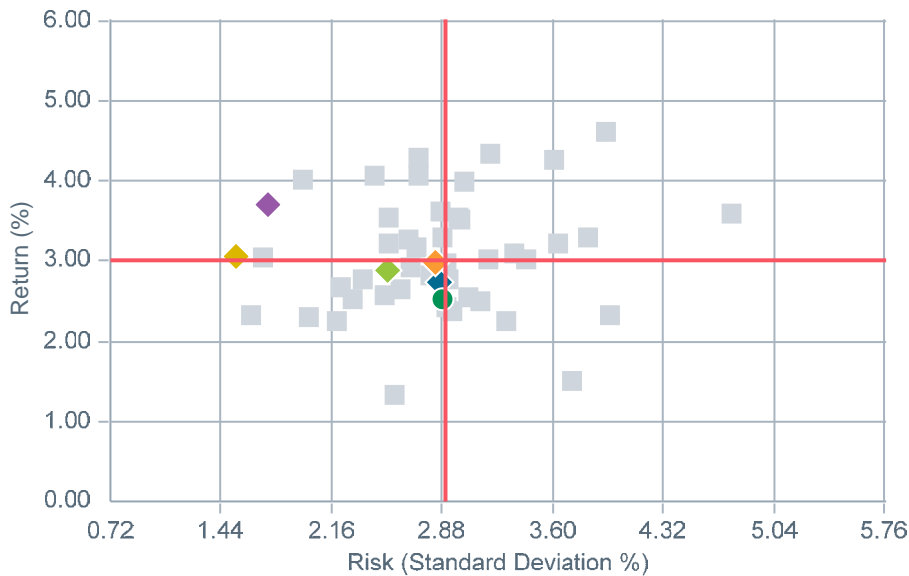
Performance										
	Trailing Performance (%)						Calendar Year Performance (%)			
	2 Quarters	1 Year	3 Years	5 Years	7 Years	10 Years	2017	2016	2015	2014
Fixed Income										
PERS (DB) Core Fixed Income	1.66	-0.06	2.10	2.73	2.50	4.15	3.75	2.66	0.96	6.47
PERS (DB) Core Fixed Income Custom Benchmark	1.66	0.01	2.06	2.52	2.10	3.48	3.54	2.65	0.55	5.97
Difference	0.00	-0.07	0.04	0.21	0.40	0.67	0.21	0.01	0.41	0.50
Rank	11	39	88	63	68	75	77	87	19	34
PERS (HC 115) Core Fixed Income	1.66	-0.06	2.10	N/A	N/A	N/A	3.75	2.66	0.96	N/A
PERS (HC 115) Core Fixed Income Benchmark	1.66	0.01	2.06	N/A	N/A	N/A	3.54	2.65	0.56	N/A
Difference	0.00	-0.07	0.04	N/A	N/A	N/A	0.21	0.01	0.40	N/A
Rank	11	39	88	N/A	N/A	N/A	77	87	19	N/A
STRS	1.48	0.16	2.95	2.88	2.77	5.08	3.98	4.77	0.60	5.02
STRS Fixed Income Blended Benchmark	1.59	0.09	2.60	2.75	2.54	4.07	3.86	3.91	0.43	5.56
Difference	-0.11	0.07	0.35	0.13	0.23	1.01	0.12	0.86	0.17	-0.54
Rank	18	27	52	56	57	45	72	54	31	76
OP&F Core Fixed Income	1.49	1.24	3.20	3.07	2.92	4.79	4.26	4.14	1.45	4.31
Bloomberg US Agg Bond Index	1.66	0.01	2.06	2.52	2.10	3.48	3.54	2.65	0.55	5.97
Difference	-0.17	1.23	1.14	0.55	0.82	1.31	0.72	1.49	0.90	-1.66
Rank	18	9	44	46	51	59	65	67	11	84
SERS	1.26	-0.38	3.10	2.98	3.36	5.90	5.09	4.67	-0.14	5.84
Bloomberg US Agg Bond Index	1.66	0.01	2.06	2.52	2.10	3.48	3.54	2.65	0.55	5.97
Difference	-0.40	-0.39	1.04	0.46	1.26	2.42	1.55	2.02	-0.69	-0.13
Rank	30	56	47	53	33	27	41	57	58	51
HPRS	1.27	2.45	4.69	3.71	3.45	5.22	5.29	6.36	0.54	4.00
Bloomberg US Agg Bond Index	1.66	0.01	2.06	2.52	2.10	3.48	3.54	2.65	0.55	5.97
Difference	-0.39	2.44	2.63	1.19	1.35	1.74	1.75	3.71	-0.01	-1.97
Rank	25	4	10	24	32	40	38	29	32	88
<i>All Public Plans > \$1B-US Fixed Income Segment Median</i>	<i>0.93</i>	<i>-0.29</i>	<i>2.97</i>	<i>3.01</i>	<i>2.93</i>	<i>4.90</i>	<i>4.81</i>	<i>4.83</i>	<i>0.00</i>	<i>5.87</i>

Performance shown is gross of fees. Ranks are shown against All Public Plans >\$1B-US Fixed Income Segment. PERS (DB), PERS (HC), and OP&F performance for Total Fixed Income is unavailable, so Core Fixed Income is shown for illustrative purposes. PERS (DB) and PERS (HC) changed mandates in 2010 and are therefore unable to report 7- and 10-year trailing returns.

Risk & Return - Fixed Income

All Public Plans > \$1B-US Fixed Income Segment

Plan Sponsor Peer Group Scattergram - 5 Years

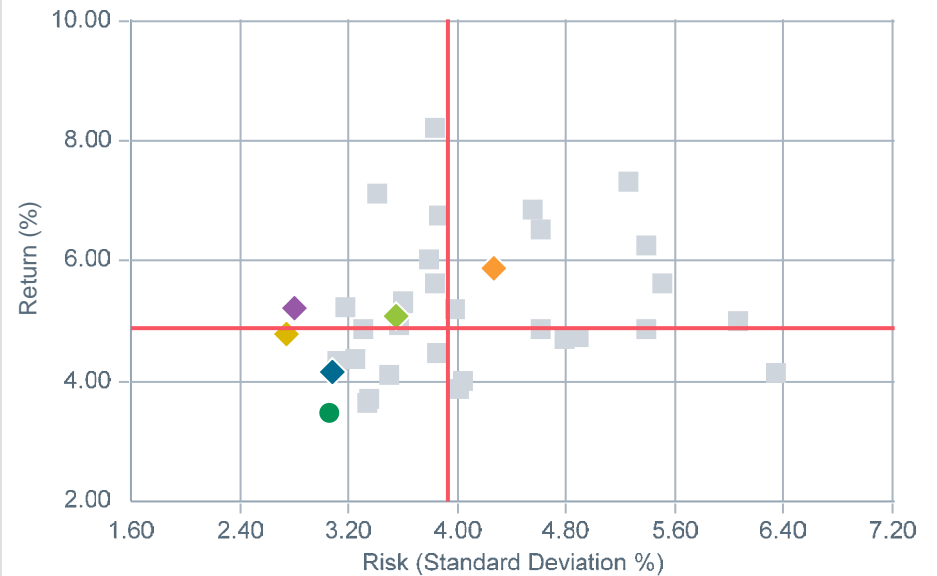


	Return	Standard Deviation
◆ PERS (DB) Core Fixed Income	2.73	2.86
◆ PERS (HC 115) Core Fixed Income	N/A	N/A
◆ STRS	2.88	2.53
◆ OP&F Core Fixed Income	3.07	1.54
◆ SERS	2.98	2.84
◆ HPRS	3.71	1.74
● Bloomberg US Agg Bond Index	2.52	2.89
— Median	3.01	2.91

Sharpe Ratio - 5 Years

PERS (DB) Core Fixed Income	0.72
PERS (HC 115) Core Fixed Income	N/A
STRS	0.86
OP&F Core Fixed Income	1.48
SERS	0.81
HPRS	1.69
Bloomberg US Agg Bond Index	0.65
All Public Plans > \$1B-US Fixed Income Segment Median	0.78

Plan Sponsor Peer Group Scattergram - 10 Years



	Return	Standard Deviation
◆ PERS (DB) Core Fixed Income	4.15	3.07
◆ PERS (HC 115) Core Fixed Income	N/A	N/A
◆ STRS	5.08	3.56
◆ OP&F Core Fixed Income	4.79	2.74
◆ SERS	5.90	4.27
◆ HPRS	5.22	2.80
● Bloomberg US Agg Bond Index	3.48	3.06
— Median	4.90	3.93

Sharpe Ratio - 10 Years

PERS (DB) Core Fixed Income	1.20
PERS (HC 115) Core Fixed Income	N/A
STRS	1.29
OP&F Core Fixed Income	1.56
SERS	1.27
HPRS	1.68
Bloomberg US Agg Bond Index	1.00
All Public Plans > \$1B-US Fixed Income Segment Median	1.13

Performance shown is gross of fees.

Performance										
	Trailing Performance (%)						Calendar Year Performance (%)			
	2 Quarters	1 Year	3 Years	5 Years	7 Years	10 Years	2017	2016	2015	2014
Additional Fixed Income										
PERS (DB) U.S. Treasury	1.94	0.84	1.39	N/A	N/A	N/A	2.33	0.99	N/A	N/A
Bloomberg US Trsy Index	1.96	0.86	1.40	N/A	N/A	N/A	2.31	1.04	N/A	N/A
Difference	-0.02	-0.02	-0.01	N/A	N/A	N/A	0.02	-0.05	N/A	N/A
PERS (DB) EMD	0.13	-5.63	5.92	1.72	2.79	N/A	13.52	10.94	-6.82	-1.64
PERS (DB) EMD Custom Benchmark	0.49	-5.33	5.40	1.65	2.38	N/A	12.26	10.18	-7.12	-0.20
Difference	-0.36	-0.30	0.52	0.07	0.41	N/A	1.26	0.76	0.30	-1.44
PERS (DB) High Yield	-1.95	-2.06	6.32	3.73	5.98	N/A	7.23	14.44	-2.74	2.73
Bloomberg U.S. High Yield Index	-2.24	-2.08	7.23	3.83	5.98	N/A	7.50	17.13	-4.47	2.45
Difference	0.29	0.02	-0.91	-0.10	0.00	N/A	-0.27	-2.69	1.73	0.28
PERS (DB) Floating Rate Debt	3.92	14.25	7.03	5.66	N/A	N/A	6.41	0.86	2.83	4.43
CS Lvg'd Loan Index	-1.21	1.14	5.03	3.33	N/A	N/A	4.25	9.88	-0.38	2.06
Difference	5.13	13.11	2.00	2.33	N/A	N/A	2.16	-9.02	3.21	2.37
PERS (DB) Securitized Debt	2.56	3.21	3.25	6.39	10.86	N/A	7.52	-0.80	4.93	17.98
Bloomberg CMBS Index + 2%	2.77	2.79	4.80	4.54	5.20	N/A	5.76	5.87	2.59	5.76
Difference	-0.21	0.42	-1.55	1.85	5.66	N/A	1.76	-6.67	2.34	12.22
PERS (DB) TIPS	-1.23	-1.26	2.07	1.68	N/A	N/A	2.88	4.69	-1.43	3.66
Bloomberg U.S. TIPS Index	-1.24	-1.26	2.11	1.69	N/A	N/A	3.01	4.68	-1.44	3.64
Difference	0.01	0.00	-0.04	-0.01	N/A	N/A	-0.13	0.01	0.01	0.02
PERS (HC 115) EMD	0.13	-5.63	5.92	N/A	N/A	N/A	13.52	10.94	-6.82	N/A
PERS (HC 115) EMD Custom Benchmark	0.49	-5.33	5.40	N/A	N/A	N/A	12.26	10.18	-7.12	N/A
Difference	-0.36	-0.30	0.52	N/A	N/A	N/A	1.26	0.76	0.30	N/A

Performance shown is gross of fees.

	Trailing Performance (%)						Calendar Year Performance (%)			
	2 Quarters	1 Year	3 Years	5 Years	7 Years	10 Years	2017	2016	2015	2014
Additional Fixed Income										
PERS (HC 115) High Yield	-1.95	-2.06	6.32	N/A	N/A	N/A	7.23	14.44	-2.74	N/A
Bloomberg Barclays U.S. High Yield Index	-2.24	-2.08	7.23	N/A	N/A	N/A	7.50	17.13	-4.47	N/A
Difference	0.29	0.02	-0.91	N/A	N/A	N/A	-0.27	-2.69	1.73	N/A
PERS (HC 115) Floating Rate Debt	3.92	14.25	N/A	N/A	N/A	N/A	6.41	N/A	N/A	N/A
CS Lvg'd Loan Index	-1.21	1.14	N/A	N/A	N/A	N/A	4.25	N/A	N/A	N/A
Difference	5.13	13.11	N/A	N/A	N/A	N/A	2.16	N/A	N/A	N/A
PERS (HC 115) Securitized Debt	2.56	3.21	N/A	N/A	N/A	N/A	7.52	N/A	N/A	N/A
Bloomberg Barclays CMBS Index + 2%	2.77	2.79	N/A	N/A	N/A	N/A	5.76	N/A	N/A	N/A
Difference	-0.21	0.42	N/A	N/A	N/A	N/A	1.76	N/A	N/A	N/A
PERS (HC 115) TIPS	-1.23	-1.26	2.07	N/A	N/A	N/A	2.88	4.69	-1.43	N/A
Bloomberg Barclays U.S. Tips Index	-1.24	-1.26	2.11	N/A	N/A	N/A	3.01	4.68	-1.44	N/A
Difference	0.01	0.00	-0.04	N/A	N/A	N/A	-0.13	0.01	0.01	N/A
OP&F Mortgages	3.27	5.29	4.59	5.09	5.35	5.77	2.87	5.63	3.21	8.56
Bloomberg Mortgage Index (1 Qtr Lag)	0.12	-0.92	0.98	2.02	1.79	3.34	0.30	3.63	3.43	3.78
Difference	3.15	6.21	3.61	3.07	3.56	2.43	2.57	2.00	-0.22	4.78
OP&F High Yield	-1.44	-0.48	6.32	4.13	5.99	10.42	7.05	12.80	-0.92	2.81
CS Developed Countries High Yield	-2.33	-2.26	7.40	3.73	5.78	10.67	7.48	17.95	-4.83	1.85
Difference	0.89	1.78	-1.08	0.40	0.21	-0.25	-0.43	-5.15	3.91	0.96
OP&F Private Credit Fixed Income	4.79	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
S&P LTSA Levered Loan Index + 2%	3.57	7.30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Difference	1.22	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
OP&F U.S. TIPS	-1.18	-0.28	6.82	7.85	5.96	9.91	2.89	18.76	0.26	19.43
Bridgewater Custom US TIPS Index	-3.97	-5.04	4.16	5.55	3.73	6.39	1.90	16.77	-2.36	18.76
Difference	2.79	4.78	2.66	2.30	2.23	3.52	0.99	1.99	2.62	0.67

Performance shown is gross of fees.

Performance										
	Trailing Performance (%)						Calendar Year Performance (%)			
	2 Quarters	1 Year	3 Years	5 Years	7 Years	10 Years	2017	2016	2015	2014
Real Estate										
PERS (DB)	4.05	4.37	8.64	12.33	12.84	8.35	9.61	12.08	17.28	18.92
PERS (DB) Real Estate Custom Benchmark	4.08	8.56	8.68	10.56	10.95	7.07	7.55	9.93	14.71	12.21
Difference	-0.03	-4.19	-0.04	1.77	1.89	1.28	2.06	2.15	2.57	6.71
PERS (HC 115) REITs	-5.83	-4.10	2.03	N/A	N/A	N/A	3.81	6.70	4.41	N/A
DJ US Select Real Estate Securities TR Index	-5.93	-4.22	1.96	N/A	N/A	N/A	3.76	6.65	4.46	N/A
Difference	0.10	0.12	0.07	N/A	N/A	N/A	0.05	0.05	-0.05	N/A
STRS	1.73	6.65	7.48	10.20	10.95	7.61	6.14	9.68	11.36	17.57
STRS Real Estate Custom Benchmark	1.77	5.09	6.62	9.21	9.63	8.56	6.70	8.10	11.89	14.54
Difference	-0.04	1.56	0.86	0.99	1.32	-0.95	-0.56	1.58	-0.53	3.03
OP&F	4.67	13.69	12.37	14.47	14.36	7.10	10.30	13.14	16.83	18.57
NCREIF ODCE Index (AWA) (Net) (1 Qtr Lag)	3.71	7.71	7.83	9.71	10.14	4.62	6.70	9.08	13.86	11.36
Difference	0.96	5.98	4.54	4.76	4.22	2.48	3.60	4.06	2.97	7.21
SERS	5.20	11.41	10.64	11.98	12.27	5.99	10.24	10.27	13.81	14.22
SERS Global Real Assets Benchmark	3.51	7.16	7.77	9.58	9.98	7.83	6.89	9.26	13.48	11.26
Difference	1.69	4.25	2.87	2.40	2.29	-1.84	3.35	1.01	0.33	2.96
HPRS	7.91	15.73	11.21	12.28	11.64	6.73	10.30	7.75	6.34	22.02
NCREIF Property Index (1 Qtr Lag)	3.51	7.16	7.75	9.57	9.98	6.42	6.89	9.22	13.48	11.26
Difference	4.40	8.57	3.46	2.71	1.66	0.31	3.41	-1.47	-7.14	10.76

Performance shown may be net or gross of fees depending on underlying investments. Prior to 2008, HPRS's real estate portfolio consisted of two buildings. Since then, HPRS has shifted its focus to externally managed funds.



Sharpe Ratio - 5 Years

PERS (DB)	2.99
PERS (HC 115) REITs	N/A
STRS	3.10
OP&F	6.24
SERS	6.92
HPRS	3.46
NCREIF ODCE Index (AWA) (Net)	5.28
S&P 500 Index (Cap Wtd)	0.84
Bloomberg US Agg Bond Index	0.65



Sharpe Ratio - 10 Years

PERS (DB)	1.20
PERS (HC 115) REITs	N/A
STRS	1.02
OP&F	0.75
SERS	0.66
HPRS	0.91
NCREIF ODCE Index (AWA) (Net)	0.78
S&P 500 Index (Cap Wtd)	0.93
Bloomberg US Agg Bond Index	1.00

Performance shown may be net or gross of fees depending on underlying investments.

Performance										
	Trailing Performance (%)						Calendar Year Performance (%)			
	2 Quarters	1 Year	3 Years	5 Years	7 Years	10 Years	2017	2016	2015	2014
Hedge Funds										
PERS (DB)	-3.11	-1.51	2.98	2.32	3.89	3.67	7.25	3.38	-1.20	3.93
PERS (DB) Hedge Funds Custom Benchmark	-3.96	-3.19	3.43	2.22	3.56	4.09	7.38	6.44	-1.70	2.59
Difference	0.85	1.68	-0.45	0.10	0.33	-0.42	-0.13	-3.06	0.50	1.34
PERS (HC 115)	-3.11	-1.51	2.98	N/A	N/A	N/A	7.25	3.38	-1.20	N/A
Hedge Funds Custom Benchmark	-3.96	-3.19	3.43	N/A	N/A	N/A	7.38	6.44	-1.70	N/A
Difference	0.85	1.68	-0.45	N/A	N/A	N/A	-0.13	-3.06	0.50	N/A
STRS	-1.69	0.64	3.18	2.44	4.38	4.82	5.59	3.38	-0.55	3.27
HFRI FOF Comp Index	-4.72	-4.02	1.31	1.40	2.93	3.12	7.77	0.51	-0.27	3.37
Difference	3.03	4.66	1.87	1.04	1.45	1.70	-2.18	2.87	-0.28	-0.10
SERS	-2.62	-1.61	2.56	2.34	4.17	5.48	7.27	2.20	-0.05	4.10
HFRI FOF Comp Index + 1%	-4.24	-3.06	2.32	2.41	3.96	4.15	8.85	1.52	0.73	4.40
Difference	1.62	1.45	0.24	-0.07	0.21	1.33	-1.58	0.68	-0.78	-0.30
HPRS	-6.28	-5.96	-0.29	0.73	2.82	4.23	5.70	-0.27	1.21	3.34
HFRI FOF Comp Index	-4.72	-4.02	1.31	1.40	2.93	3.12	7.77	0.51	-0.27	3.37
Difference	-1.56	-1.94	-1.60	-0.67	-0.11	1.11	-2.07	-0.78	1.48	-0.03

Performance shown is net of fees.



Performance shown is net of fees.

Performance										
	2 Quarters	1 Year	3 Years	5 Years	7 Years	10 Years	2017	2016	2015	2014
Private Equity										
PERS (DB)	8.71	15.48	13.81	13.02	14.26	12.49	19.60	6.72	6.09	17.94
PERS (DB) Private Equity Custom Benchmark	7.14	15.00	12.83	11.94	16.29	12.61	15.13	8.48	6.04	15.41
Difference	1.57	0.48	0.98	1.08	-2.03	-0.12	4.47	-1.76	0.05	2.53
STRS	9.29	19.85	15.16	14.81	15.75	12.56	19.35	6.76	9.89	18.90
STRS Private Equity Custom Benchmark	-7.73	-4.29	10.05	8.99	13.74	15.10	22.32	13.85	1.48	13.67
Difference	17.02	24.14	5.11	5.82	2.01	-2.54	-2.97	-7.09	8.41	5.23
OP&F	6.80	15.65	17.23	16.40	14.69	11.82	21.80	14.37	12.06	18.34
OP&F Private Equity Custom Benchmark	13.02	21.12	20.80	17.05	20.37	15.40	22.48	18.82	2.65	21.45
Difference	-6.22	-5.47	-3.57	-0.65	-5.68	-3.58	-0.68	-4.45	9.41	-3.11
SERS	9.35	18.27	17.34	17.68	16.97	12.84	21.56	12.37	13.81	22.77
Burgiss All Private Equity Benchmark	6.31	16.05	12.37	12.01	16.32	12.55	12.10	9.07	7.37	15.75
Difference	3.04	2.22	4.97	5.67	0.65	0.29	9.46	3.30	6.44	7.02
HPRS	1.06	7.27	9.69	8.39	8.61	6.57	8.46	13.44	0.85	12.41
HPRS Private Equity Custom Benchmark	1.06	7.27	11.00	12.68	17.25	13.14	12.37	13.44	9.64	21.15
Difference	0.00	0.00	-1.31	-4.29	-8.64	-6.57	-3.91	0.00	-8.79	-8.74

Performance shown is net of fees. HPRS's private equity portfolio did not begin in earnest until after 2008. Therefore longer period trailing returns relative to the benchmark may not be relevant.

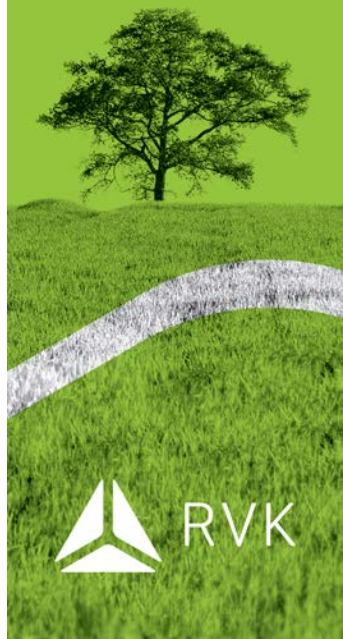
Performance										
	Trailing Performance (%)						Calendar Year Performance (%)			
	2 Quarters	1 Year	3 Years	5 Years	7 Years	10 Years	2017	2016	2015	2014
Other Alternatives										
PERS (DB) Opportunistic Investments	1.69	0.57	1.32	N/A	N/A	N/A	2.50	0.89	1.12	N/A
PERS (DB) Opportunistic Custom Benchmark	1.96	0.86	1.40	N/A	N/A	N/A	2.31	1.04	0.84	N/A
Difference	-0.27	-0.29	-0.08	N/A	N/A	N/A	0.19	-0.15	0.28	N/A
PERS (DB) Commodities	-21.71	-13.59	0.96	-13.95	N/A	N/A	6.40	11.92	-32.44	-32.12
S&P Goldman Sachs Commodity Index (TR)	-21.91	-13.82	0.50	-14.52	N/A	N/A	5.77	11.37	-32.86	-33.06
Difference	0.20	0.23	0.46	0.57	N/A	N/A	0.63	0.55	0.42	0.94
PERS (DB) Risk Parity	-8.52	-9.93	7.23	3.92	N/A	N/A	18.51	15.51	-10.42	9.73
PERS (DB) Risk Parity Custom Benchmark	-8.61	-10.07	2.37	3.59	N/A	N/A	11.50	7.00	3.30	7.64
Difference	0.09	0.14	4.86	0.33	N/A	N/A	7.01	8.51	-13.72	2.09
PERS (DB) GTAA	-7.94	-10.13	3.88	3.39	N/A	N/A	17.03	6.58	0.94	4.44
PERS (DB) GTAA Custom Benchmark	-4.84	-4.77	5.07	3.60	N/A	N/A	15.16	5.77	-0.69	3.61
Difference	-3.10	-5.36	-1.19	-0.21	N/A	N/A	1.87	0.81	1.63	0.83
PERS (HC 115) Opportunistic	1.69	0.57	1.32	N/A	N/A	N/A	2.50	0.89	1.12	N/A
PERS (HC 115) Opportunistic Custom Benchmark	1.96	0.86	1.40	N/A	N/A	N/A	2.31	1.04	0.84	N/A
Difference	-0.27	-0.29	-0.08	N/A	N/A	N/A	0.19	-0.15	0.28	N/A
PERS (HC 115) Commodities	-21.71	-13.59	0.96	N/A	N/A	N/A	6.40	11.92	-32.44	N/A
S&P Goldman Sachs Commodity Index (TR)	-21.91	-13.82	0.50	N/A	N/A	N/A	5.77	11.37	-32.86	N/A
Difference	0.20	0.23	0.46	N/A	N/A	N/A	0.63	0.55	0.42	N/A
PERS (HC 115) Risk Parity	-8.52	-9.93	7.23	N/A	N/A	N/A	18.51	15.51	-10.42	N/A
PERS (HC 115) Risk Parity Custom Benchmark	-8.61	-10.07	2.37	N/A	N/A	N/A	11.50	7.00	3.30	N/A
Difference	0.09	0.14	4.86	N/A	N/A	N/A	7.01	8.51	-13.72	N/A
PERS (HC 115) GTAA	-7.94	-10.13	3.88	N/A	N/A	N/A	17.03	6.58	0.94	N/A
PERS (HC 115) GTAA Custom Benchmark	-4.84	-4.77	5.07	N/A	N/A	N/A	15.16	5.77	-0.69	N/A
Difference	-3.10	-5.36	-1.19	N/A	N/A	N/A	1.87	0.81	1.63	N/A

Performance shown may be net or gross of fees depending on underlying investments. PERS (DB) funded a new opportunistic investments portfolio in the third quarter of 2014. Historical performance is represented by an opportunistic investments portfolio that was closed at the end of 2013.

	Trailing Performance (%)						Calendar Year Performance (%)			
	2 Quarters	1 Year	3 Years	5 Years	7 Years	10 Years	2017	2016	2015	2014
Other Alternatives										
STRS Opportunistic Investments ex HF	0.75	6.25	5.55	6.54	8.68	N/A	6.07	4.32	4.57	11.66
STRS Opportunistic Custom Benchmark	-8.66	-6.18	7.90	6.85	11.36	N/A	19.95	11.63	-0.52	11.45
Difference	9.41	12.43	-2.35	-0.31	-2.68	N/A	-13.88	-7.31	5.09	0.21
OP&F Real Assets	5.24	11.81	6.42	5.82	N/A	N/A	4.65	2.99	1.03	8.99
Consumer Price Index + 5% (1 Qtr Lag)	3.65	7.39	7.09	6.59	N/A	N/A	7.34	6.54	4.96	6.74
Difference	1.59	4.42	-0.67	-0.77	N/A	N/A	-2.69	-3.55	-3.93	2.25
OP&F MLPs	-14.66	-13.10	0.12	-3.67	N/A	N/A	-4.08	20.42	-23.31	16.91
Alerian MLP Index	-11.87	-12.42	-1.06	-7.31	N/A	N/A	-6.52	18.30	-32.59	4.80
Difference	-2.79	-0.68	1.18	3.64	N/A	N/A	2.44	2.12	3.28	12.11
SERS Opportunistic & Tactical Portfolio	0.53	5.33	10.29	6.44	N/A	N/A	14.55	11.17	-5.64	7.96
SERS Opportunistic Custom Benchmark	-3.20	-2.03	6.24	5.35	N/A	N/A	14.37	7.02	1.48	6.66
Difference	3.73	7.36	4.05	1.09	N/A	N/A	0.18	4.15	-7.12	1.30
HPRS Real Assets	-7.78	-6.64	-2.32	N/A	N/A	N/A	-4.27	4.28	N/A	N/A
HPRS Real Assets Custom Benchmark	-3.44	-0.44	2.67	N/A	N/A	N/A	-0.43	9.17	N/A	N/A
Difference	-4.34	-6.20	-4.99	N/A	N/A	N/A	-3.84	-4.89	N/A	N/A

Performance shown may be net or gross of fees depending on underlying investments.

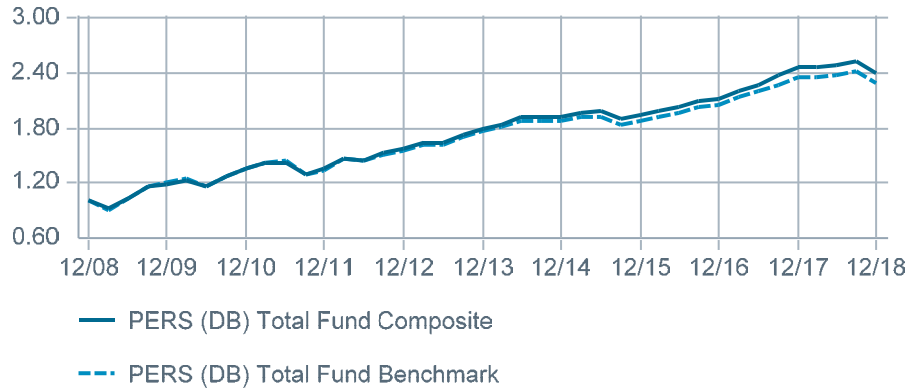
Plan Specific Pages



Summary

- PERS (DB) has generated an annualized 0.62% of alpha over the trailing 5-year period and 0.70% over the trailing 10-year period.
- Relative to a 60 Equity/40 Bond portfolio, the plan has exhibited larger up-market capture and smaller down-market capture characteristics over the past 10 years.

Growth of \$1 - 10 Years



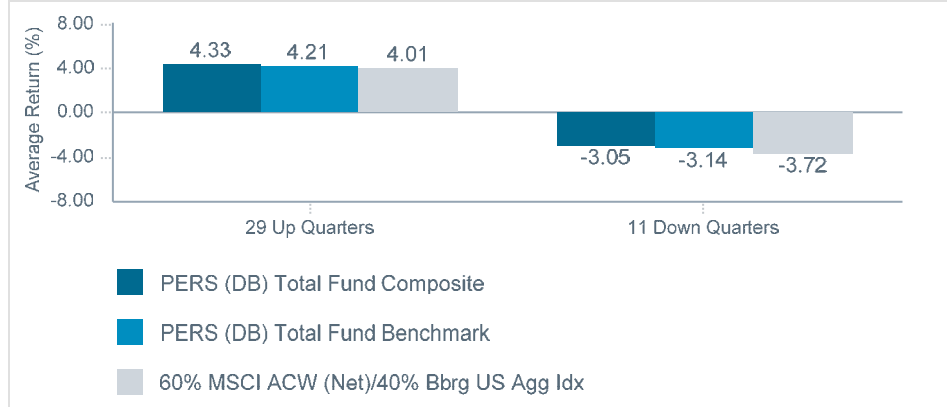
MPT Stats

	5 Years	10 Years
Maximum Return	4.40	12.34
Minimum Return	-5.60	-9.24
Standard Deviation	5.18	9.03
vs. PERS (DB) Total Fund Benchmark		
Info Ratio	1.05	0.52
Tracking Error	0.64	0.89
Alpha	0.62	0.70
vs. S&P 500 Index (Cap Wtd)		
Beta	0.47	0.60
vs. ICE BofAML 3 Mo US T-Bill Index		
Sharpe Ratio	0.99	0.97

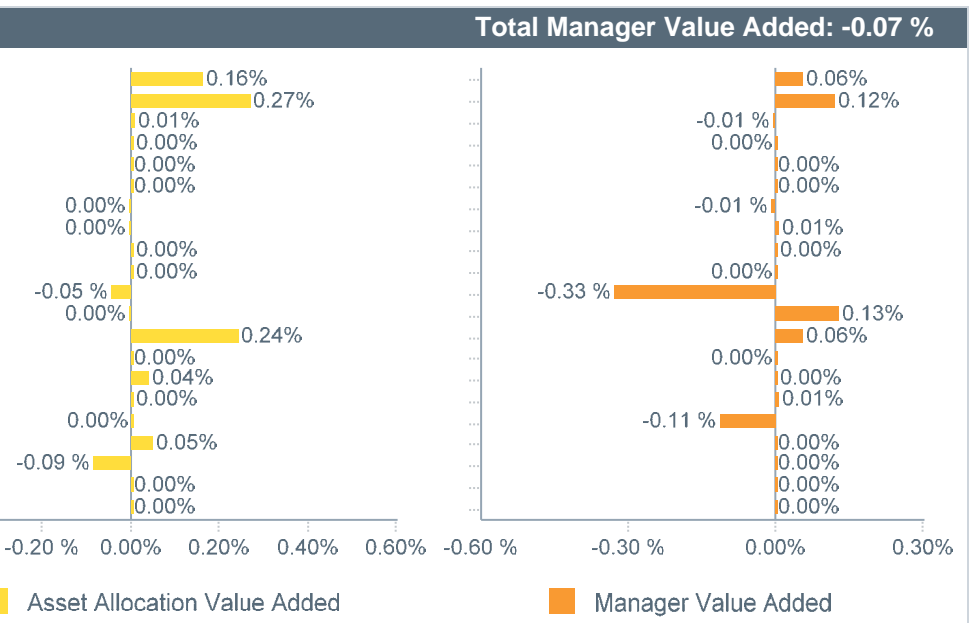
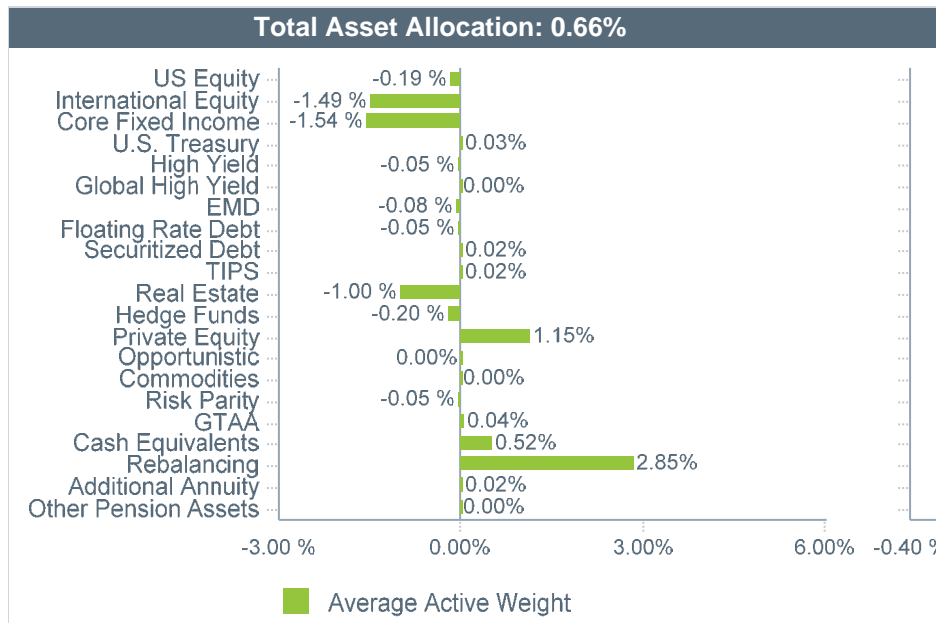
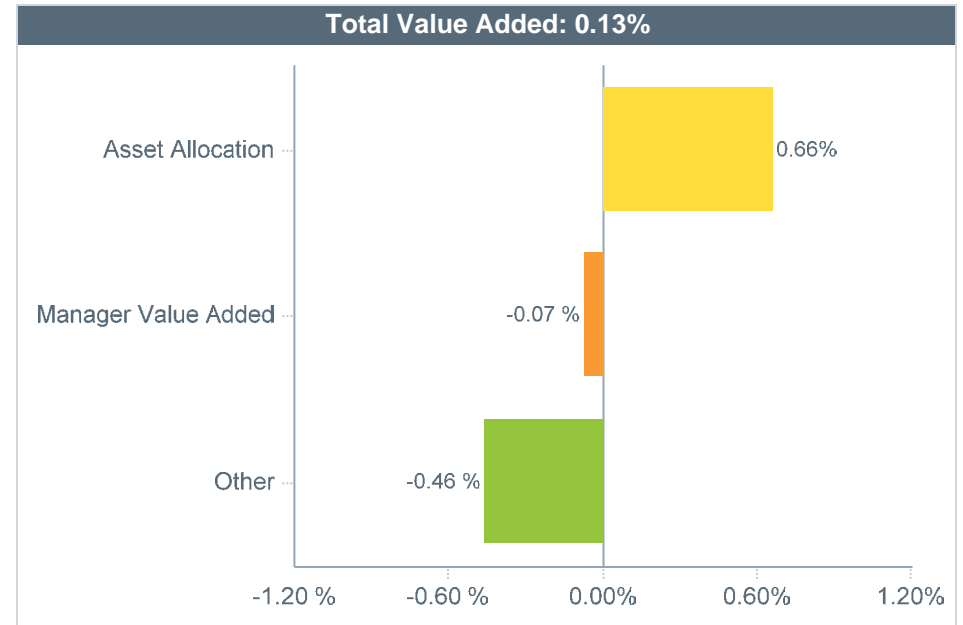
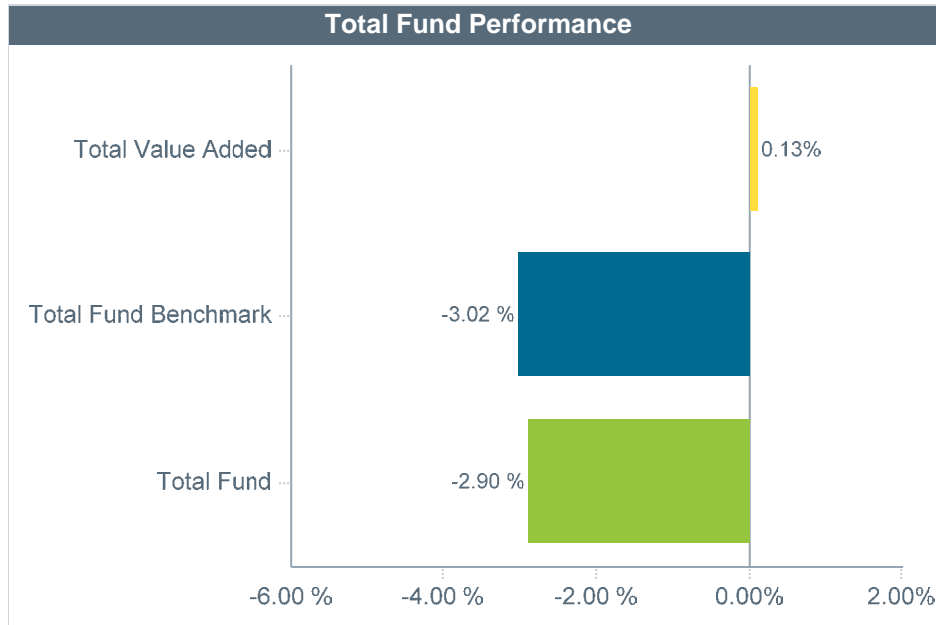
Asset Allocation vs. Targets

	Market Value (\$)	Allocation (%)	Target (%)
US Equity	15,548,707,450	19.18	20.90
International Equity	13,643,433,538	16.83	20.00
Core Fixed Income	8,160,256,867	10.07	10.90
U.S. Treasury	864,359,153	1.07	1.00
High Yield	1,574,842,687	1.94	2.00
Global High Yield	7,167	0.00	0.00
EMD	4,898,635,706	6.04	6.00
Floating Rate Debt	26,387,400	0.03	0.10
Securitized Debt	862,714,400	1.06	1.00
TIPS	1,683,741,828	2.08	2.00
Real Estate	8,062,977,953	9.95	10.00
Hedge Funds	6,358,638,296	7.84	8.00
Private Equity	9,643,470,655	11.90	10.00
Opportunistic	85,325,574	0.11	0.10
Commodities	640,763,230	0.79	1.00
Risk Parity	3,926,557,357	4.84	5.00
GTAA	1,610,360,758	1.99	2.00
Cash Equivalents	716,782,260	0.88	0.00
Rebalancing	2,745,131,517	3.39	0.00
Additional Annuity	16,974,169	0.02	0.00
Other Pension Assets	825	0.00	0.00
Total Fund	81,070,068,789	100.00	100.00

Up/Down Markets - 10 Years



Performance shown is gross of fees. Calculations are based on quarterly periodicity. Allocations shown may not sum up to 100% exactly due to rounding.

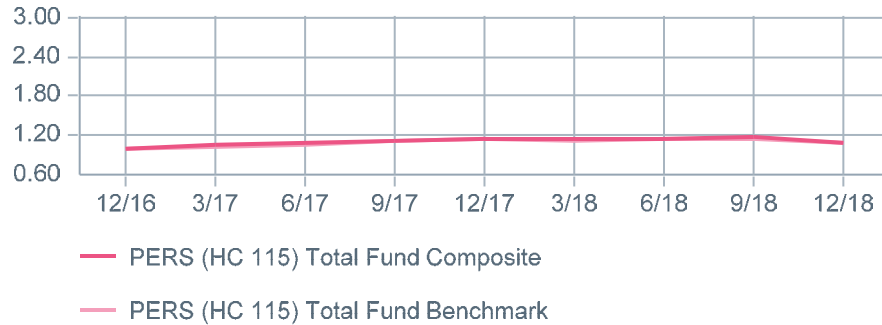


Performance shown is gross of fees. Calculation is based on monthly periodicity. See Glossary for additional information regarding the Total Fund Attribution calculation. Total Fund Benchmark return is calculated by RVK and may differ from Plan provided return due to rounding.

Summary

- PERS HC was formed in 2005, segregating HC from the DB assets. PERS HC 115 was formed October 2014 to hold all HC assets of PERS, and has a performance inception date of January 2015.
- OPERS health care plan is not a pension plan and therefore has significantly different characteristics including a shorter focus asset allocation with more liquidity than the pension plans. For purposes of this study, the OPERS health care plan has been included in the results. The results for OPERS HC plan were reflected in the PERS HC since 2005 through October 2014, and then transferred to and renamed PERS HC 115 at that time.

Growth of \$1 - 2 Years



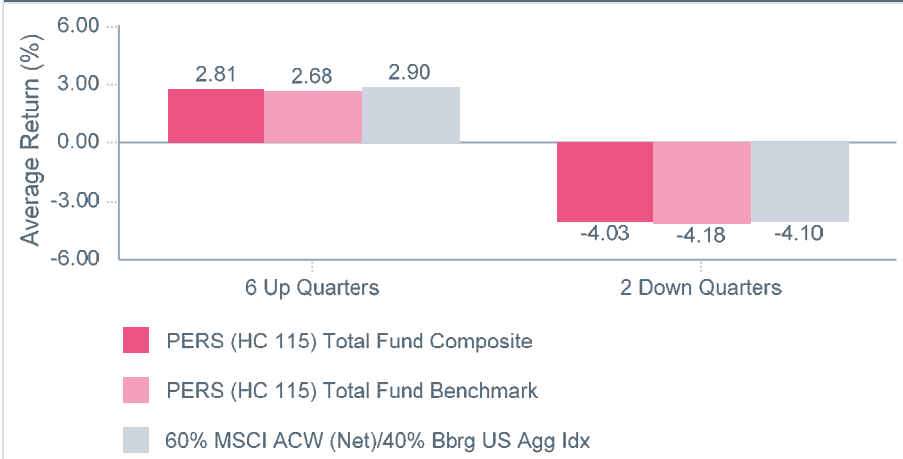
Asset Allocation vs. Targets

	Market Value (\$)	Allocation (%)	Target (%)
US Equity	2,481,800,008	21.88	22.90
International Equity	2,166,361,021	19.10	22.00
Core Fixed Income	1,883,200,564	16.60	17.90
EMD	710,578,855	6.27	6.00
High Yield	219,647,775	1.94	2.00
Floating Rate Debt	2,640,342	0.02	0.10
Securitized Debt	124,048,884	1.09	1.00
TIPS	728,146,195	6.42	6.00
Global High Yield	59,262	0.00	0.00
REITs	663,224,326	5.85	6.00
Hedge Funds	683,085,820	6.02	6.00
Opportunistic	11,769,497	0.10	0.10
Commodities	199,332,922	1.76	2.00
Risk Parity	576,084,832	5.08	5.00
GTAA	228,608,580	2.02	2.00
Cash Equivalents	12,234,411	0.11	0.00
PERS (HC 115) U.S. Treasury	126,631,764	1.12	1.00
Rebalancing	523,920,005	4.62	0.00
Total Fund	11,341,375,062	100.00	100.00

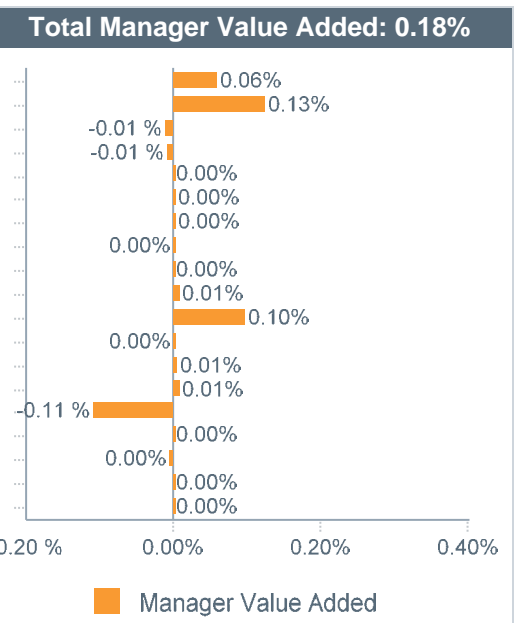
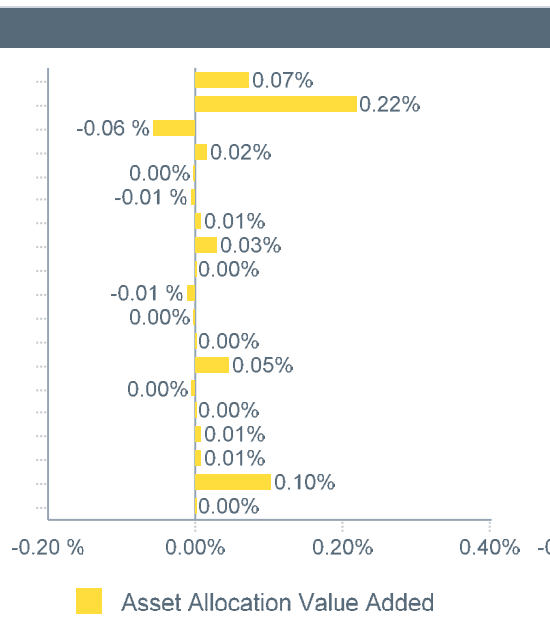
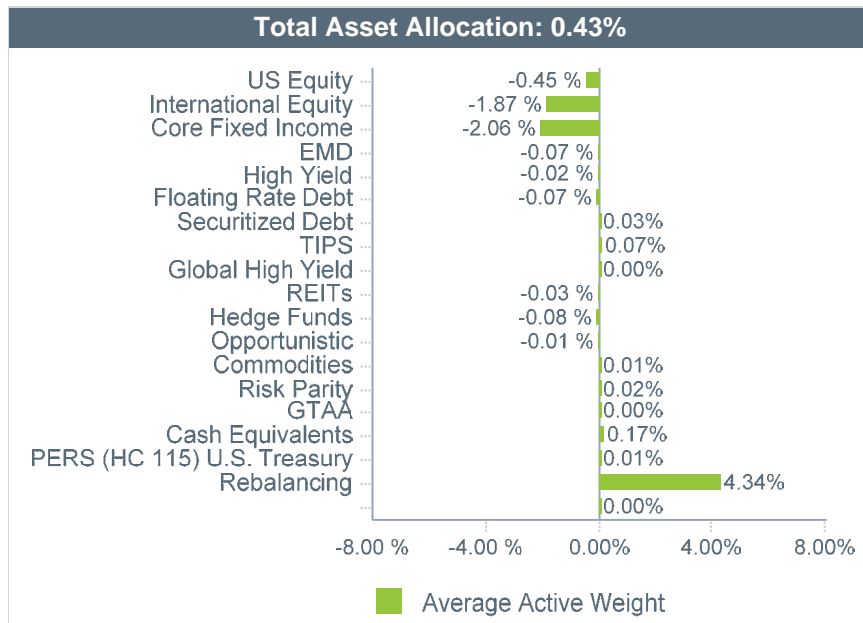
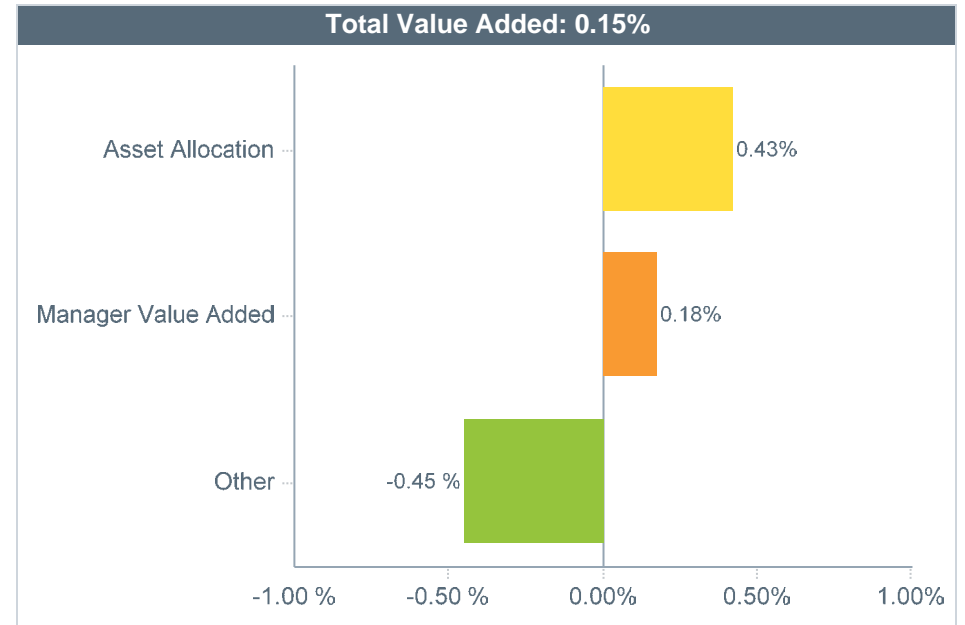
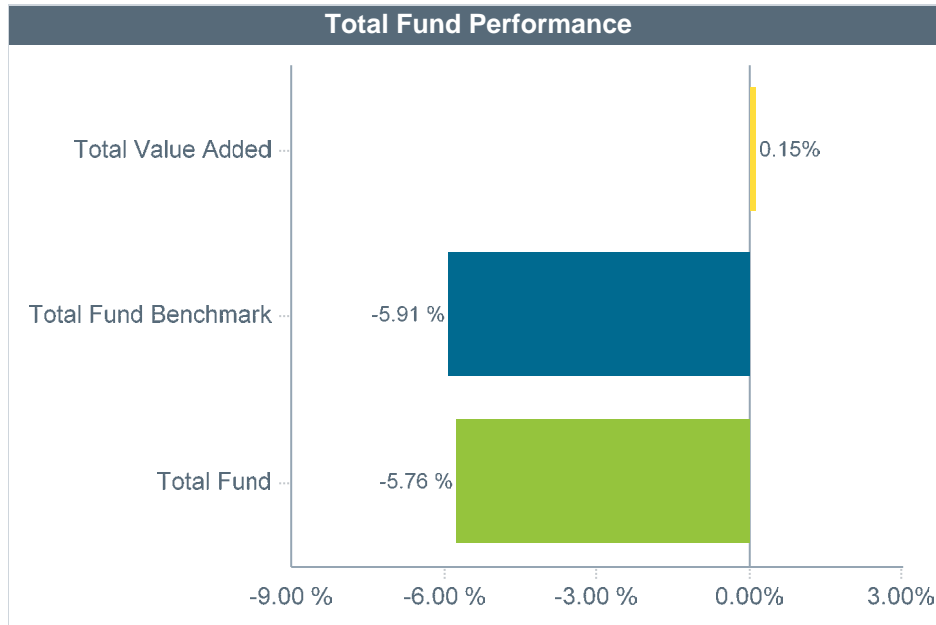
MPT Stats

	1 Year
Maximum Return	1.83
Standard Deviation	7.02
Minimum Return	-7.28
vs. PERS (HC 115) Total Fund Benchmark	
Info Ratio	0.77
Tracking Error	0.28
Alpha	0.21
vs. S&P 500 Index (Cap Wtd)	
Beta	0.44
vs. ICE BofAML 3 Mo US T-Bill Index	
Sharpe Ratio	-1.05

Up/Down Markets - 2 Years



Performance shown is gross of fees. Calculations are based on quarterly periodicity. Allocations shown may not sum up to 100% exactly due to rounding.

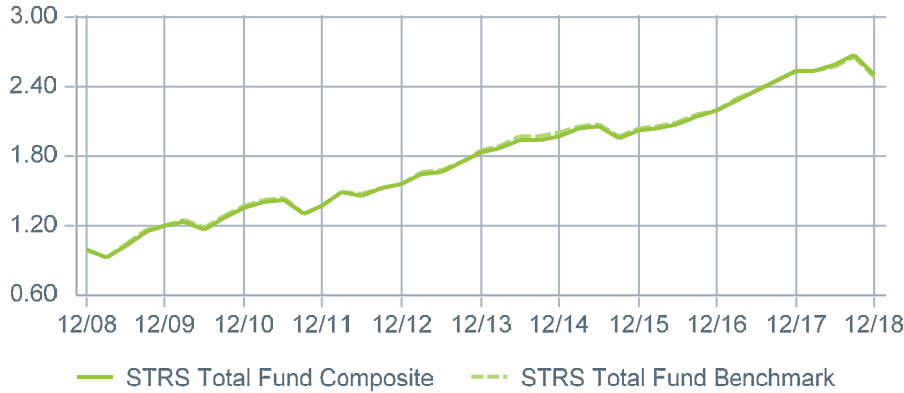


Performance shown is gross of fees. Calculation is based on monthly periodicity. See Glossary for additional information regarding the Total Fund Attribution calculation. Total Fund Benchmark return is calculated by RVK and may differ from Plan provided return due to rounding.

Summary

- STRS has generated 0.19% of alpha over the trailing 5-year period and 0.25% of alpha over the trailing 10-year period.
- Relative to a 60 Equity/40 Bond portfolio, the plan has exhibited larger up-market capture and smaller down-market capture characteristics over the past 10 years.

Growth of \$1 - 10 Years



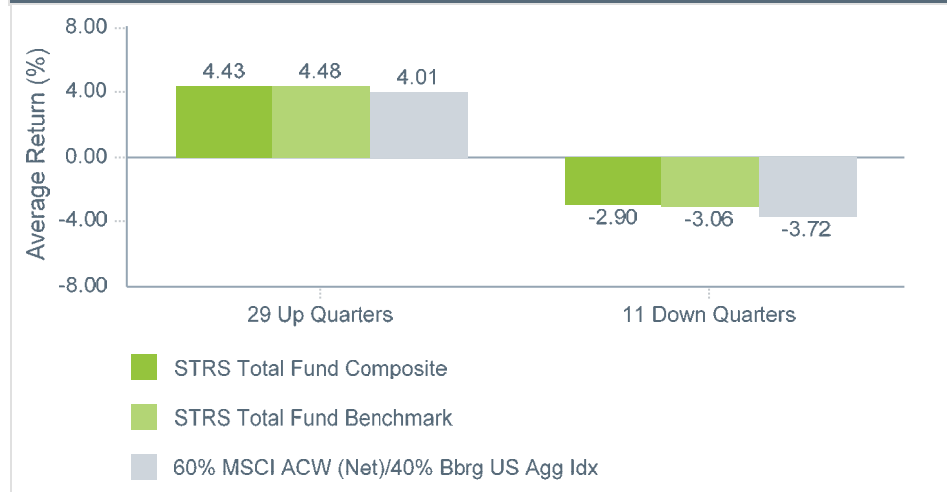
Asset Allocation vs. Targets

	Market Value (\$)	Allocation (%)	Target (%)
US Equity	20,249,196,766	27.78	28.00
International Equity	17,403,735,960	23.88	24.00
Fixed Income	13,649,838,258	18.73	21.00
Real Estate	7,802,182,249	10.70	10.00
Opportunistic (Incl. Hedge Funds)	6,456,328,158	8.86	9.00
Private Equity	6,324,660,520	8.68	7.00
Cash Equivalents	1,002,750,860	1.38	1.00
Total Fund	72,888,692,771	100.00	100.00

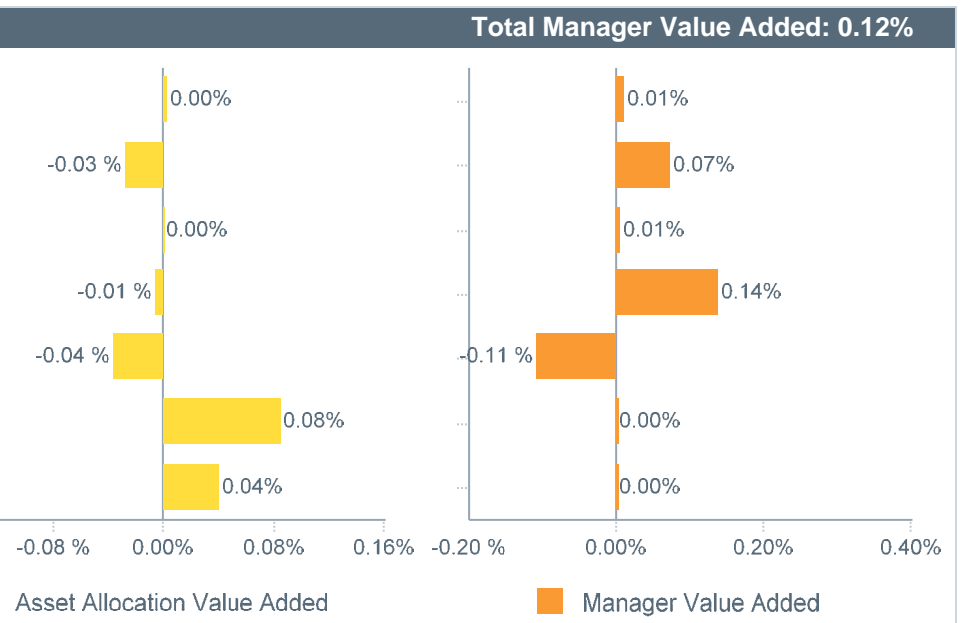
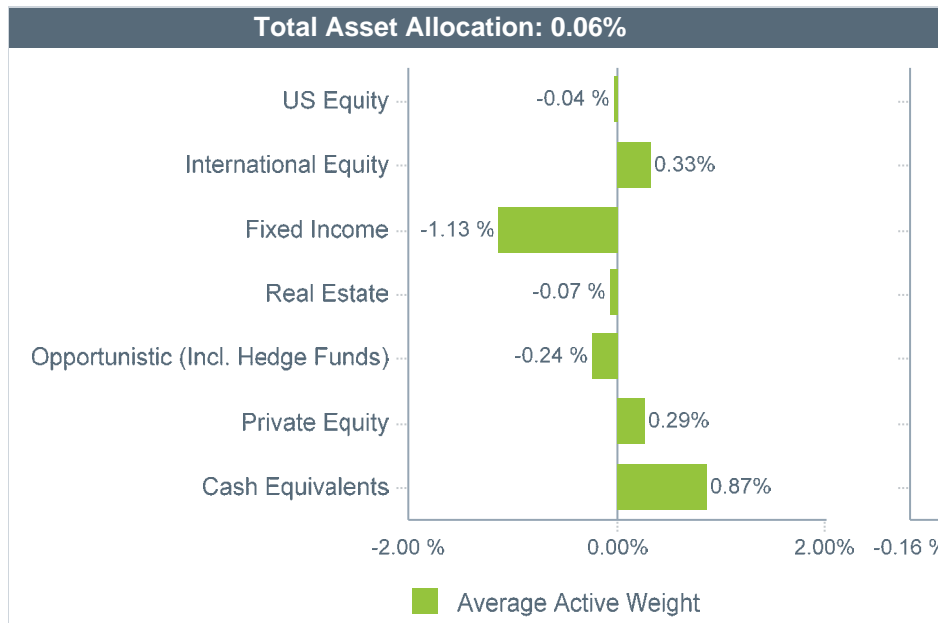
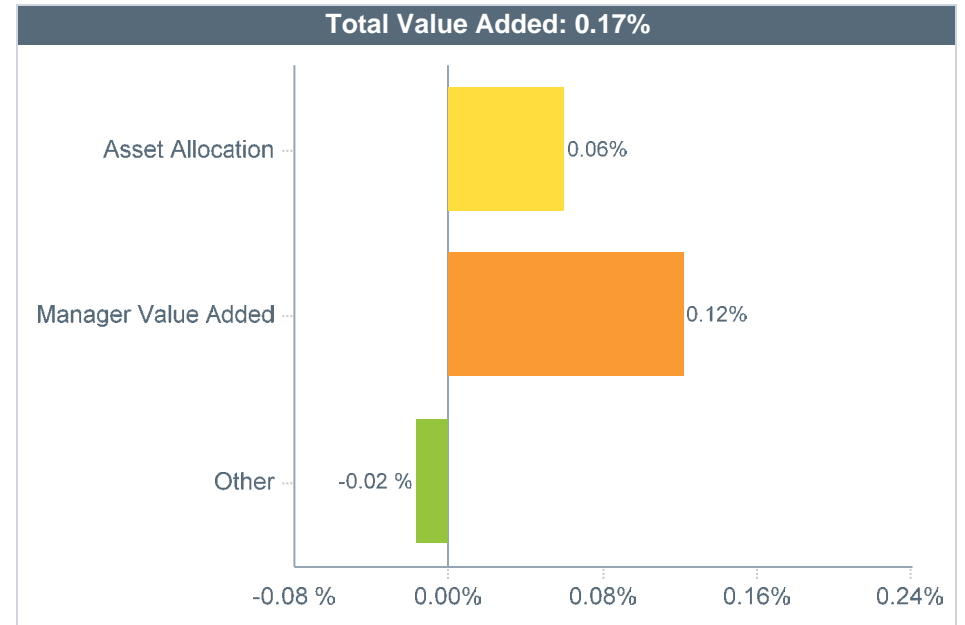
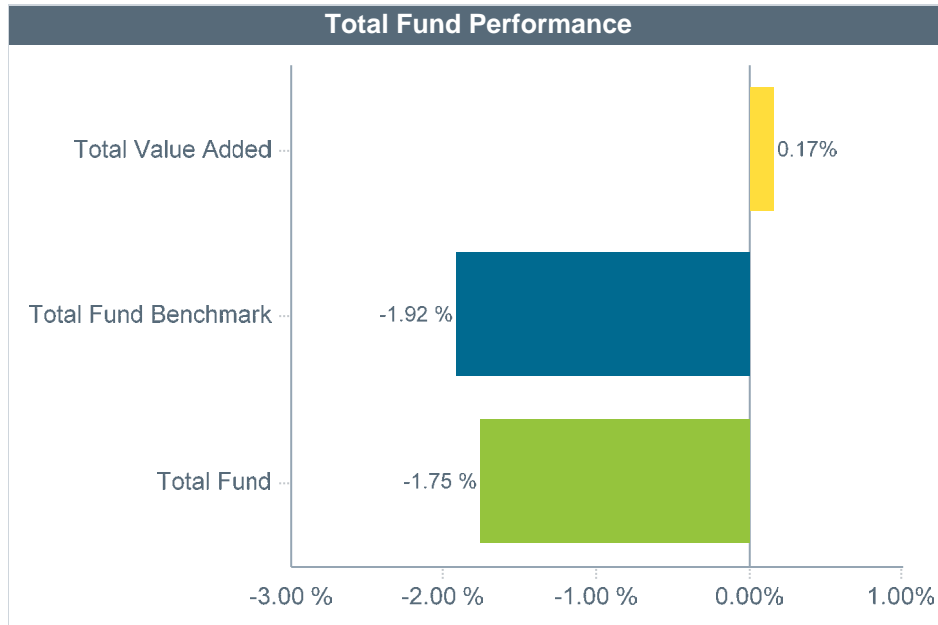
MPT Stats

	5 Years	10 Years
Maximum Return	4.14	12.25
Minimum Return	-6.73	-8.92
Standard Deviation	5.53	8.98
vs. STRS Total Fund Benchmark		
Info Ratio	0.81	0.03
Tracking Error	0.36	0.60
Alpha	0.19	0.25
vs. S&P 500 Index (Cap Wtd)		
Beta	0.55	0.62
vs. ICE BofAML 3 Mo US T-Bill Index		
Sharpe Ratio	1.02	1.03

Up/Down Markets - 10 Years



Performance shown is gross of fees. Calculations are based on quarterly periodicity. Allocations shown may not sum up to 100% exactly due to rounding.

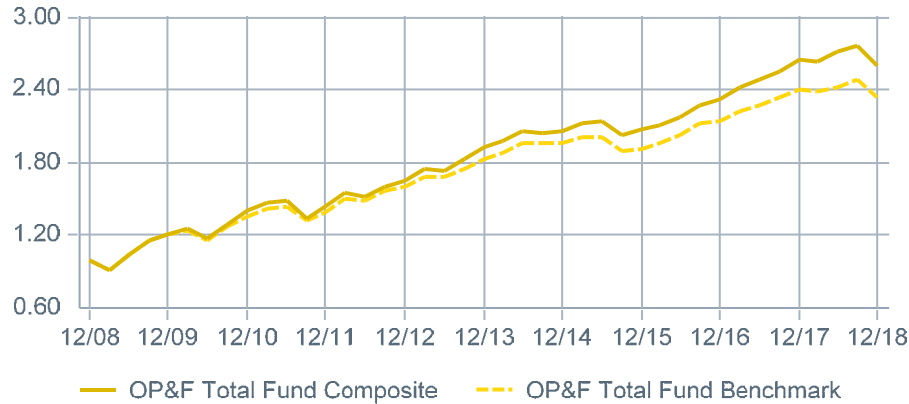


Performance shown is gross of fees. Calculation is based on monthly periodicity. See Glossary for additional information regarding the Total Fund Attribution calculation. Total Fund Benchmark return is calculated by RVK and may differ from Plan provided return due to rounding.

Summary

- OP&F has generated 1.21% of alpha over the trailing 5-year period and 0.96% of alpha over the trailing 10-year period.
- Relative to a 60 Equity/40 Bond portfolio, the plan has exhibited larger up-market and smaller down-market capture characteristics over the past 10 years.

Growth of \$1 - 10 Years



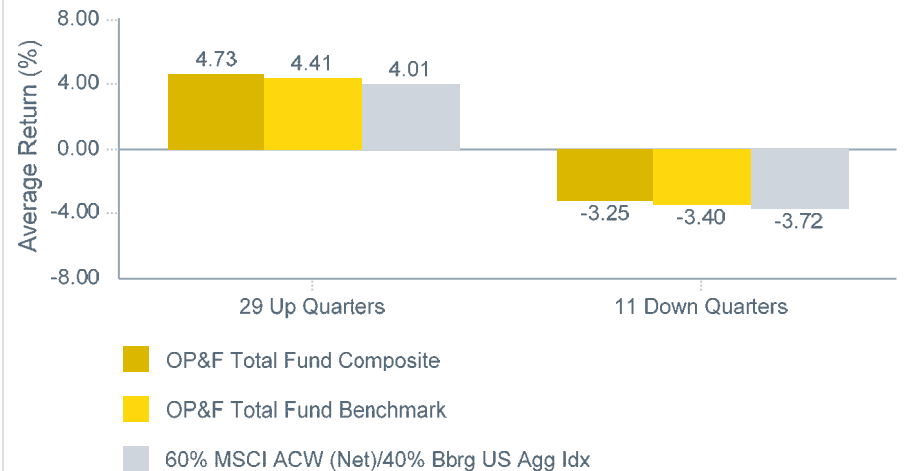
MPT Stats

	5 Years	10 Years
Maximum Return	4.54	13.00
Minimum Return	-5.99	-9.75
Standard Deviation	5.60	9.55
vs. OP&F Total Fund Benchmark		
Info Ratio	0.99	1.04
Tracking Error	1.12	1.06
Alpha	1.21	0.96
vs. S&P 500 Index (Cap Wtd)		
Beta	0.51	0.64
vs. ICE BofAML 3 Mo US T-Bill Index		
Sharpe Ratio	0.97	1.02

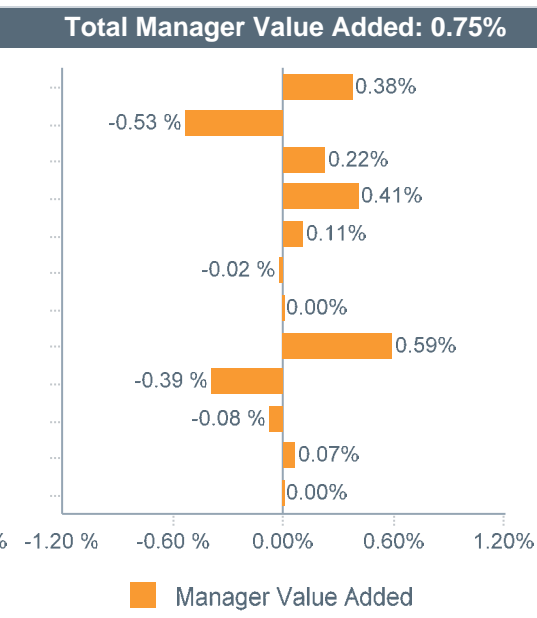
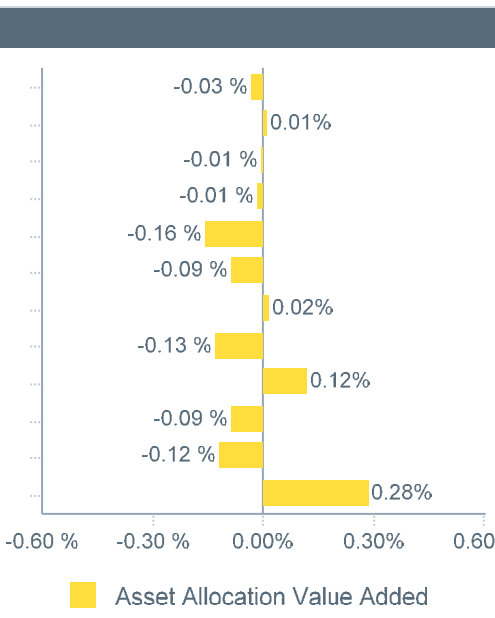
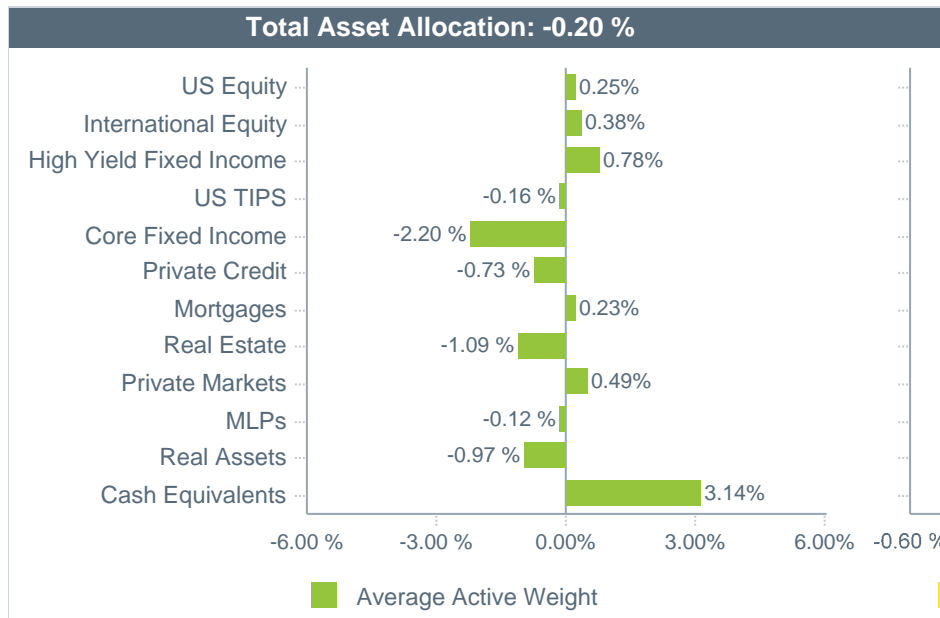
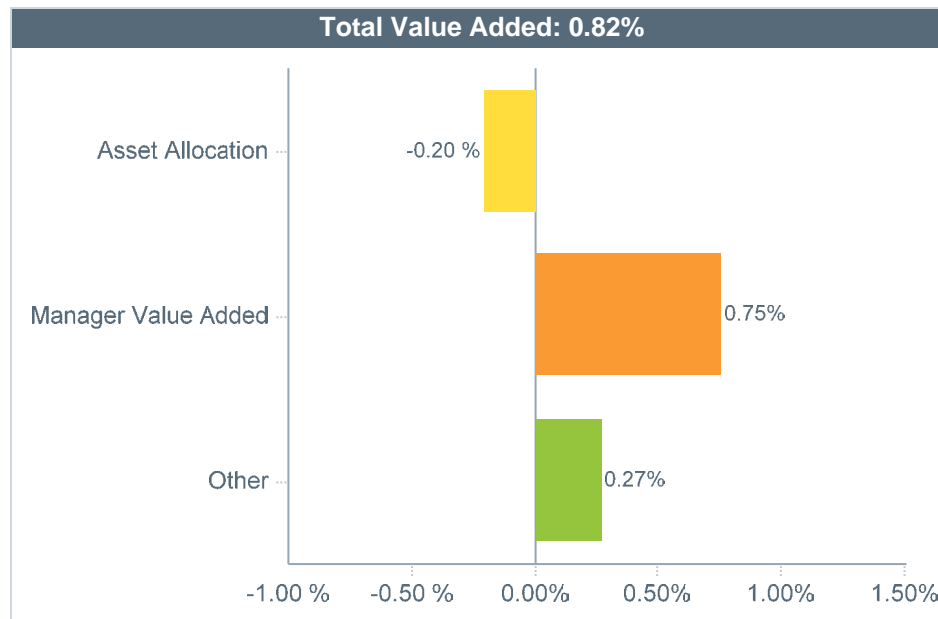
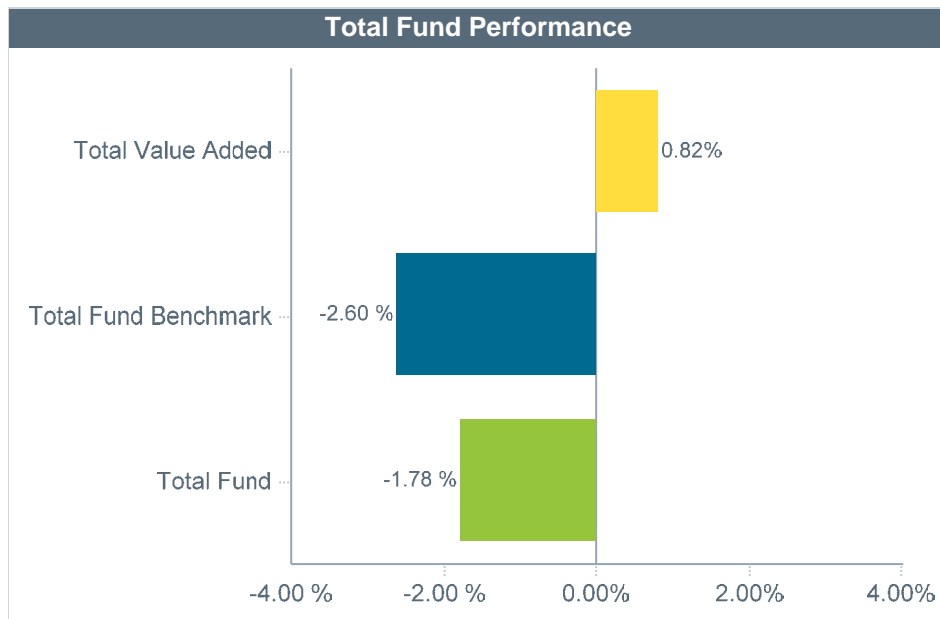
Asset Allocation vs. Targets

	Market Value (\$)	Allocation (%)	Target (%)
US Equity	2,485,775,750	17.10	18.75
International Equity	2,505,433,467	17.24	18.75
High Yield Fixed Income	1,722,797,040	11.85	11.00
US TIPS	1,321,238,394	9.09	8.50
Core Fixed Income	1,058,315,061	7.28	10.00
Private Credit	291,550,227	2.01	2.50
Mortgages	36,586,741	0.25	0.00
Real Estate	1,698,861,658	11.69	12.00
Private Markets	1,267,161,874	8.72	7.00
MLPs	1,099,666,881	7.57	8.00
Real Assets	298,258,454	2.05	3.50
Cash Equivalents	750,024,267	5.16	0.00
Total Fund	14,535,669,815	100.00	100.00

Up/Down Markets - 10 Years



Performance shown is gross of fees. Calculations are based on quarterly periodicity. Allocations shown may not sum up to 100% exactly due to rounding.

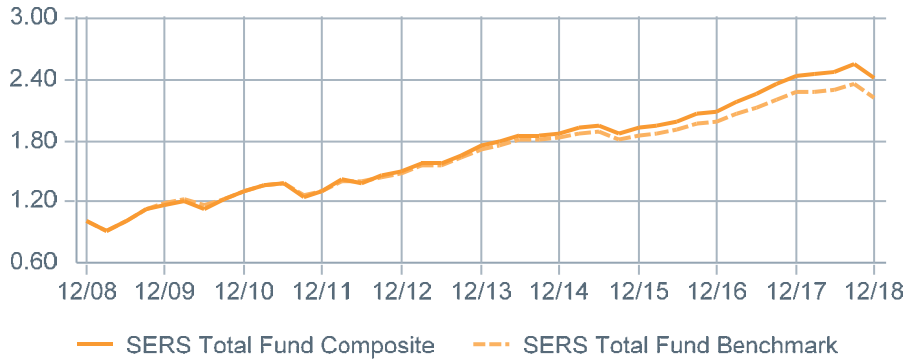


Performance shown is gross of fees. Calculation is based on monthly periodicity. See Glossary for additional information regarding the Total Fund Attribution calculation. Total Fund Benchmark return is calculated by RVK and may differ from Plan provided return due to rounding.

Summary

- SERS has generated 0.64% of alpha over the trailing 5-year period and 0.31% of alpha over the trailing 10-year period.
- Relative to a 60 Equity/40 Bond portfolio, SERS has exhibited larger up-market capture and smaller down-market capture characteristics over the past 10 years.

Growth of \$1 - 10 Years



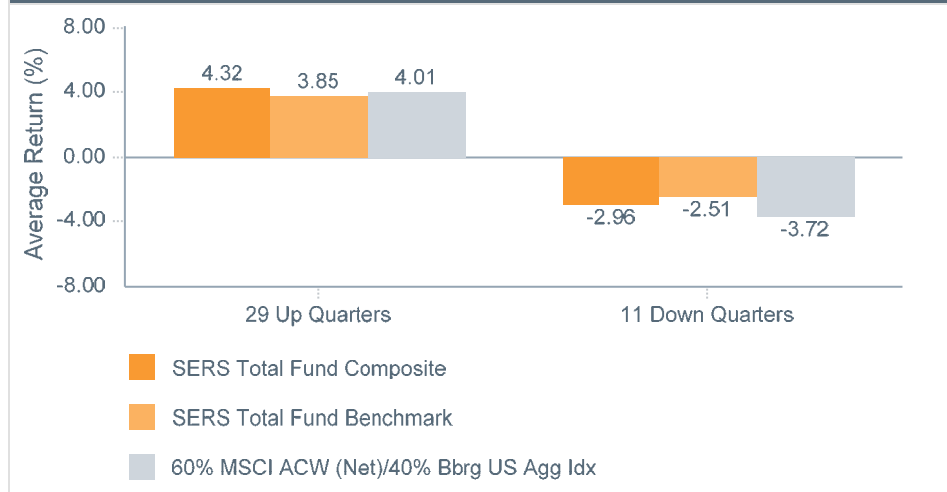
MPT Stats

	5 Years	10 Years
Maximum Return	4.65	11.01
Minimum Return	-5.89	-9.12
Standard Deviation	5.21	8.64
vs. SERS Total Fund Benchmark		
Info Ratio	1.64	0.54
Tracking Error	0.76	1.61
Alpha	0.64	0.31
vs. S&P 500 Index (Cap Wtd)		
Beta	0.48	0.58
vs. ICE BofAML 3 Mo US T-Bill Index		
Sharpe Ratio	1.13	1.02

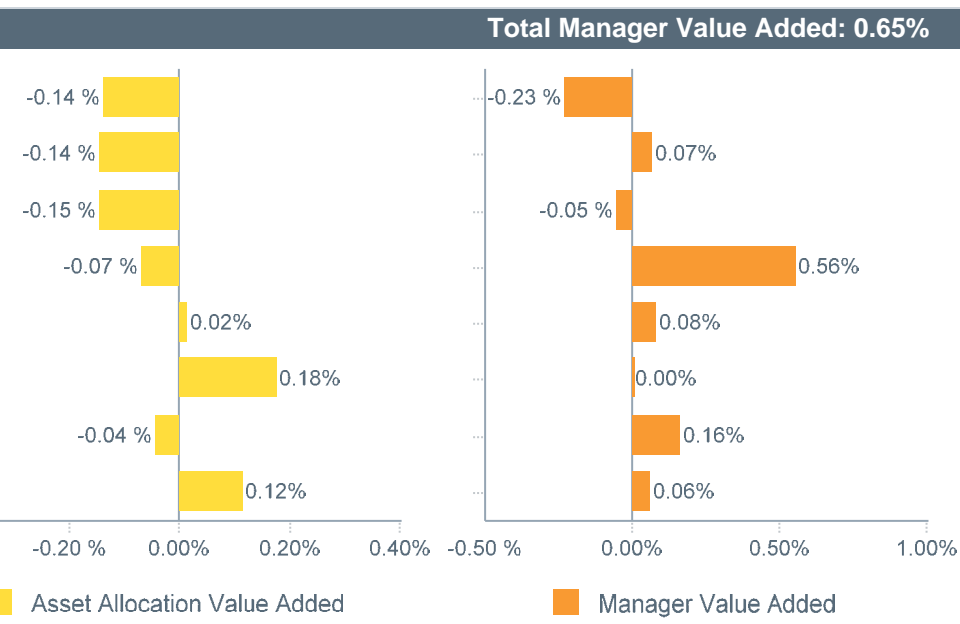
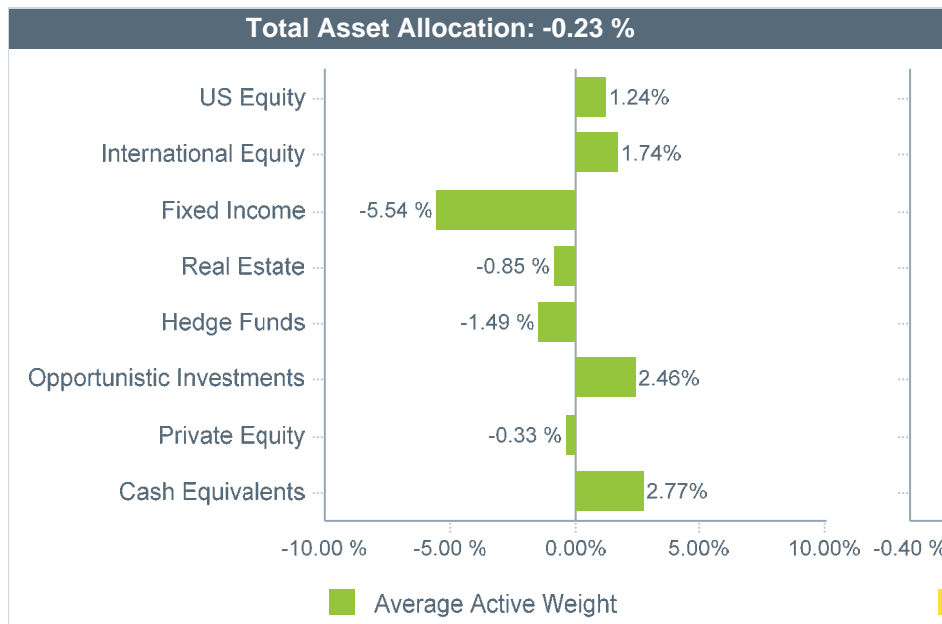
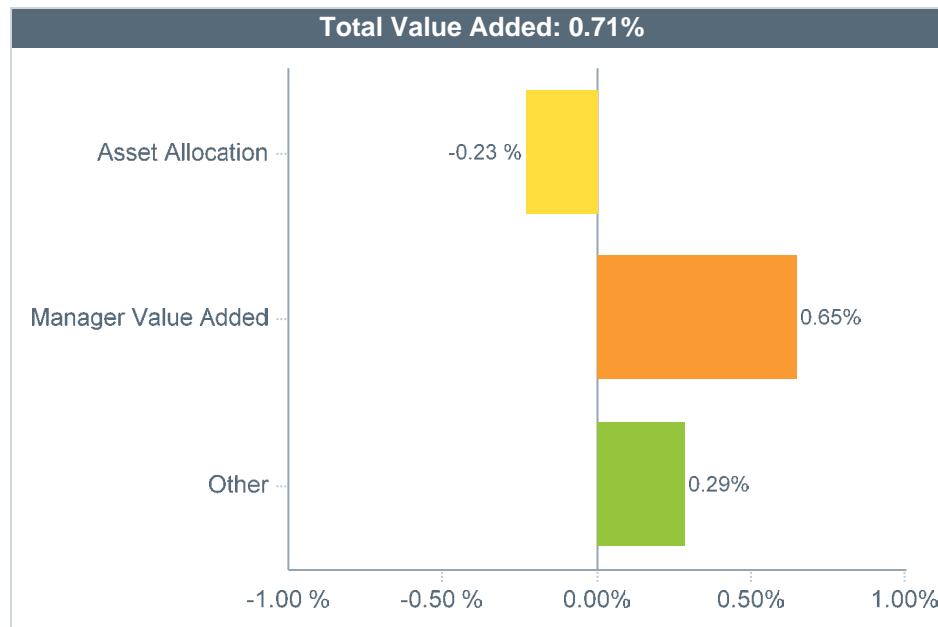
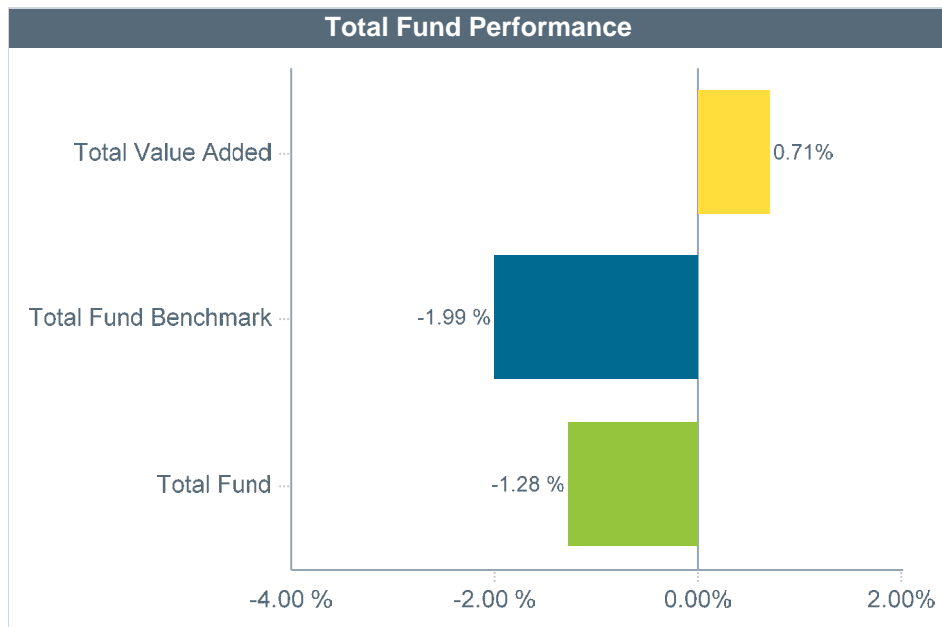
Asset Allocation vs. Targets

	Market Value (\$)	Allocation (%)	Target (%)
US Equity	3,093,420,387	22.85	22.50
International Equity	2,776,499,549	20.51	22.50
Fixed Income	1,941,054,878	14.34	19.00
Real Estate	2,102,534,136	15.53	15.00
Hedge Funds	1,130,151,495	8.35	10.00
Opportunistic Investments	392,257,003	2.90	0.00
Private Equity	1,429,915,471	10.56	10.00
Cash Equivalents	670,913,028	4.96	1.00
Total Fund	13,536,745,947	100.00	100.00

Up/Down Markets - 10 Years



Performance shown is gross of fees. Calculations are based on quarterly periodicity. Allocations shown may not sum up to 100% exactly due to rounding.

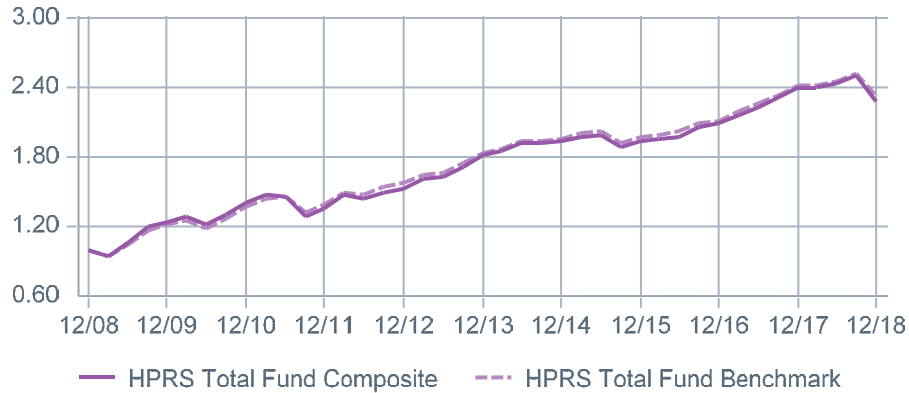


Performance shown is gross of fees. Calculation is based on monthly periodicity. See Glossary for additional information regarding the Total Fund Attribution calculation. Total Fund Benchmark return is calculated by RVK and may differ from Plan provided return due to rounding.

Summary

- HPRS has lost 0.56% of alpha over the trailing 5-year period and lost 0.73% of alpha over the trailing 10-year period.
- Relative to a 60 Equity/40 Bond portfolio, the total portfolio has exhibited larger up-market and smaller down-market capture characteristics over the past 10 years.

Growth of \$1 - 10 Years



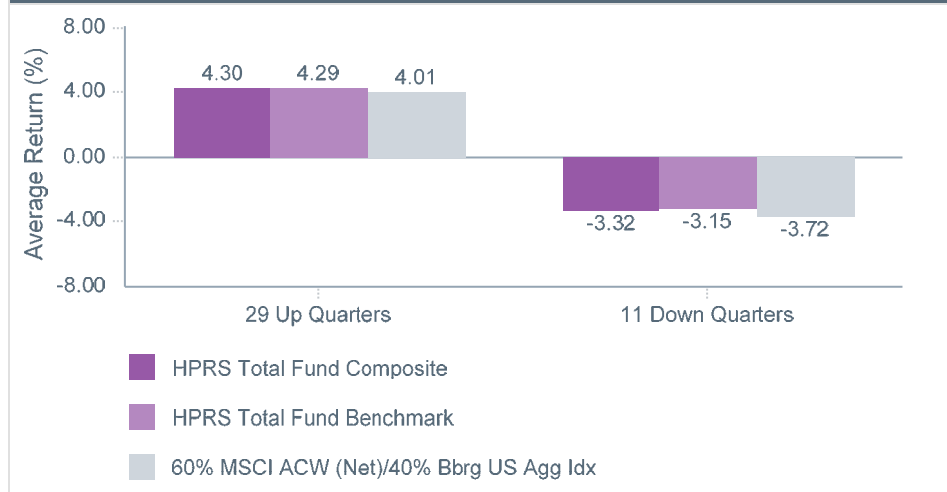
Asset Allocation vs. Targets

	Market Value (\$)	Allocation (%)	Target (%)
US Equity	243,978,761	29.69	30.00
International Equity	159,498,488	19.41	20.00
Fixed Income	145,112,592	17.66	19.00
Real Estate	46,788,824	5.69	5.00
Hedge Funds	94,030,040	11.44	11.00
Private Equity	88,975,763	10.83	9.00
Real Assets	33,505,560	4.08	5.00
Cash Equivalents	9,805,793	1.19	1.00
Total Fund	821,695,821	100.00	100.00

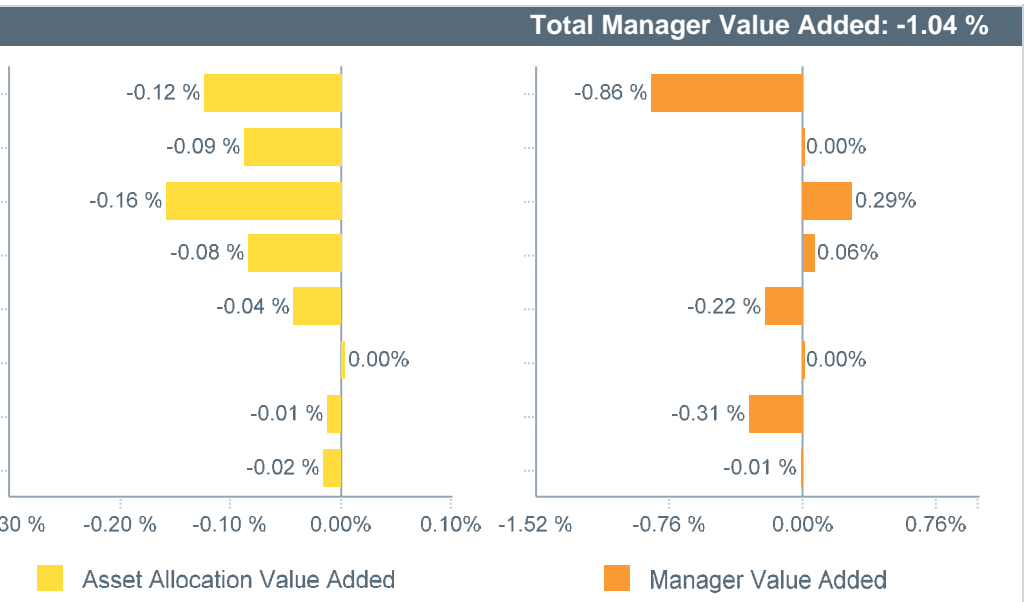
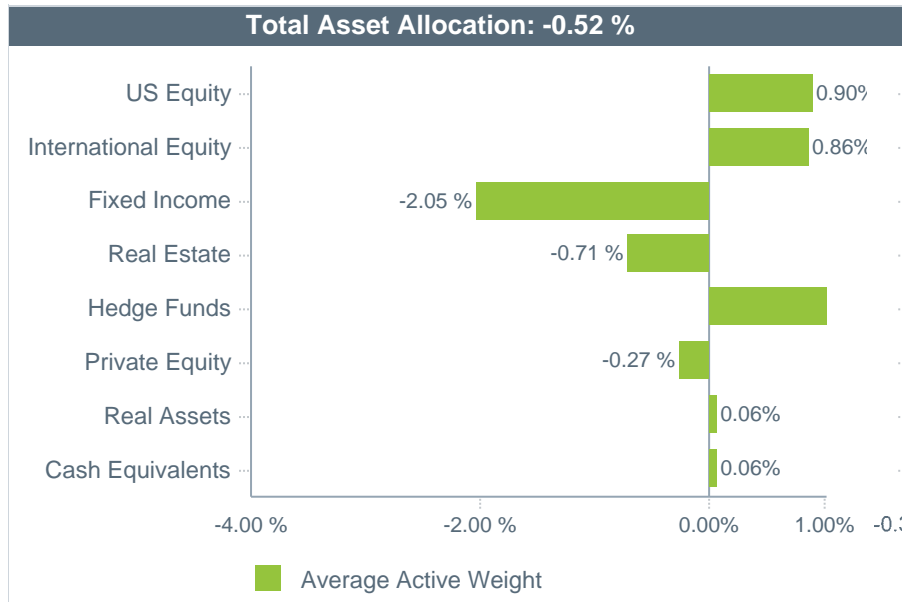
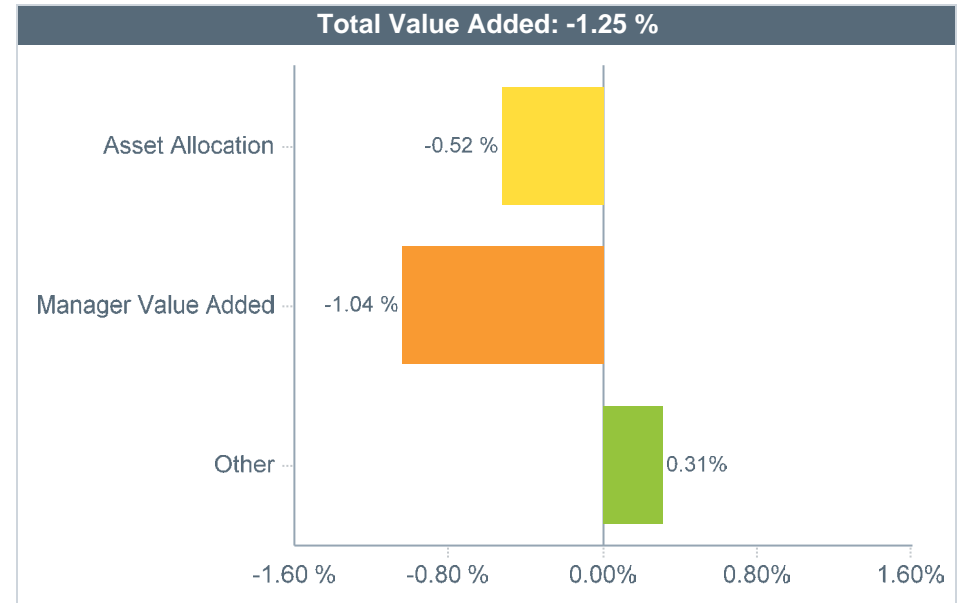
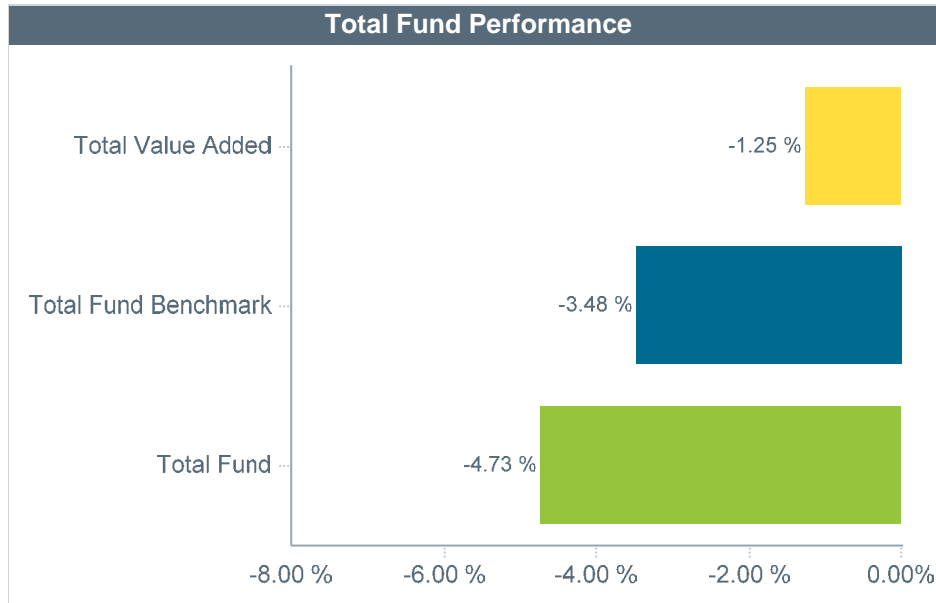
MPT Stats

	5 Years	10 Years
Maximum Return	3.93	12.56
Minimum Return	-8.81	-11.24
Standard Deviation	6.18	9.65
vs. HPRS Total Fund Benchmark		
Info Ratio	-0.24	-0.10
Tracking Error	0.88	1.49
Alpha	-0.56	-0.73
vs. S&P 500 Index (Cap Wtd)		
Beta	0.61	0.66
vs. ICE BofAML 3 Mo US T-Bill Index		
Sharpe Ratio	0.67	0.87

Up/Down Markets - 10 Years



Performance shown is gross of fees. Calculations are based on quarterly periodicity. Allocations shown may not sum up to 100% exactly due to rounding.



Performance shown is gross of fees. Calculation is based on monthly periodicity. See Glossary for additional information regarding the Total Fund Attribution calculation. Total Fund Benchmark return is calculated by RVK and may differ from Plan provided return due to rounding.

Ohio Retirement Study Council
HPRS Total Fund Performance vs. Peers

As of December 31, 2018

	Market Value (\$000)	Trailing Performance (%)						Calendar Year Performance (%)			
		2 Quarters	1 Year	3 Years	5 Years	7 Years	10 Years	2017	2016	2015	2014
HPRS	821,696	-6.44	-4.73	5.58	4.70	7.66	8.61	15.01	7.42	0.15	6.73
HPRS Total Fund Benchmark		-4.84	-3.51	5.89	4.95	7.70	8.85	14.55	7.40	0.19	7.03
Difference		-1.60	-1.22	-0.31	-0.25	-0.04	-0.24	0.46	0.02	-0.04	-0.30
<i>All Public Plans > \$1B-TF Median</i>		-3.95	-3.01	6.63	5.25	7.73	8.86	15.98	7.93	0.48	6.46
Rank		93	78	86	77	56	60	66	67	64	42
Population		96	95	93	88	85	79	100	106	84	71
<i>All Public Plans \$250M to \$1B-TF Median</i>		-5.74	-4.83	6.22	5.02	7.71	8.69	15.86	8.19	0.12	6.52
Rank		78	45	67	64	55	55	60	63	48	46
Population		37	37	34	34	34	34	26	25	24	23

Performance shown is gross of fees but is net of embedded fees on externally managed real estate and alternative investments.

Appendix

Performance Related Comments

- Performance shown is gross of fees unless otherwise noted and is annualized for periods greater than one year.
- Peer group ranks are measured in percentiles.
- Total Fund performance shown is net of embedded fees on externally managed real estate and alternative investments.
- All quarterly market value and performance data, including custom benchmark performance, is provided by the individual Plans.
- In 2005, the 401(h) Health Care Trust portfolio assets were segregated from the pension portfolio and invested with a more conservative asset-allocation. In 2014, the 115 Health Care Trust portfolio was created as another funding vehicle for post-employment health care for members in the Traditional Pension Plan and Combined Plan. Assets were segregated into the 115 Health Care Trust beginning September 2014, with the initial health care disbursements from the trust commencing late 2015 for January 2016 premium reimbursements. Favorable rulings from the Internal Revenue Service received March 2016 allowed OPERS to consolidate health care assets from the VEBA Trust and the 401(h) Health Care Trust into the 115 Health Care Trust.

Asset Class Fee Comparison – as of 12/31/2018

(annualized fees shown in basis points)							
	Domestic Equity	International Equity	Fixed Income	Real Estate	Private Equity	Hedge Funds	Other Alternatives
■ PERS (DB)	6	26	10	73	57	126	48
■ PERS (HC 115)	1	4	2	-	-	13	7
■ STRS	11	21	8	44	67	149	68
■ OP&F	45	35	47	98	180	-	86
■ SERS	21	44	21	83	58	138	77
■ HPRS	35	77	49	143	104	102	79

- Fees for Private Equity are based on committed capital, with the exception of OP&F, which is based on AUM.
- PERS (DB) and PERS (HC 115) Other Alternatives include Risk Parity, GTAA, Commodities and Opportunistic.
- STRS Other Alternatives include Opportunistic/Diversified Investments excluding Hedge Fund exposure.
- OP&F Other Alternatives include Real Assets and MLPs.
- SERS Other Alternatives include Opportunistic & Tactical Portfolio.
- HPRS Other Alternatives fees include Real Assets.

Percentage of Assets Managed by External Managers – as of 12/31/2018

Percentage of Assets Managed by External Managers - As of 12/31/2018								
	Total Fund	Domestic Equity	International Equity	Fixed Income	Real Estate	Private Equity	Hedge Funds	Other Alternatives
■ PERS (DB)	60%	16%	78%	33%	100%	100%	100%	88%
■ PERS (HC 115)	39%	16%	78%	23%	0%	-	100%	79%
■ STRS	31%	10%	42%	11%	11%	96%	100%	73%
■ OP&F	100%	100%	100%	100%	100%	100%	-	100%
■ SERS	95%	100%	100%	100%	100%	100%	100%	95%
■ HPRS	100%	100%	100%	100%	100%	100%	100%	100%

- PERS (DB) and PERS (HC 115) Other Alternatives include Risk Parity, GTAA, Commodities and Opportunistic.
- STRS Other Alternatives include Opportunistic/Diversified Investments excluding Hedge Fund exposure.
- OP&F Other Alternatives include Real Assets and MLPs.
- SERS Other Alternatives include Opportunistic Investments.
- SERS has one internally-managed Cash mandate.
- HPRS Other Alternatives fees include Real Assets.

Percentage of Actively Managed Assets – as of 12/31/2018

Percentage of Assets Actively Managed - As of 12/31/2018								
	Total Fund	Domestic Equity	International Equity	Fixed Income	Real Estate	Private Equity	Hedge Funds	Other Alternatives
■ PERS (DB)	80%	37%	78%	83%	100%	100%	100%	90%
■ PERS (HC 115)	66%	37%	78%	76%	0%	-	100%	80%
■ STRS	86%	63%	100%	100%	85%	100%	100%	100%
■ OP&F	94%	55%	100%	100%	100%	100%	-	100%
■ SERS	84%	58%	71%	100%	98%	100%	100%	95%
■ HPRS	86%	52%	100%	100%	100%	100%	100%	100%

- PERS (DB) and PERS (HC 115) Other Alternatives include Risk Parity, GTAA, Commodities and Opportunistic.
- STRS Other Alternatives include Opportunistic/Diversified Investments excluding Hedge Fund exposure.
- OP&F Other Alternatives include Real Assets and MLPs.
- SERS Other Alternatives include Opportunistic Investments.
- SERS has one internally-managed Cash mandate.
- HPRS Other Alternatives fees include Real Assets.

Custom Benchmark Glossary

PERS (DB) Total Fund Custom Benchmark:

- 20.9% Russell 3000 Index
- 20.0% PERS (DB) International Equity Custom Benchmark
- 10.9% PERS (DB) Core Fixed Income Custom Benchmark
- 1.0% Bloomberg Barclays U.S. Treasury Index
- 2.0% Bloomberg Barclays U.S. High Yield Index
- 6.0% PERS (DB) EMD Custom Benchmark
- 0.1% CS Leveraged Loan Index
- 1.0% PERS (DB) Securitized Debt Custom Benchmark
- 2.0% Bloomberg Barclays U.S. TIPS Index
- 10.0% PERS (DB) Real Estate Custom Benchmark
- 8.0% PERS (DB) Hedge Funds Custom Benchmark
- 10.0% PERS (DB) Private Equity Custom Benchmark
- 0.1% PERS (DB) Opportunistic Custom Benchmark
- 1.0% S&P Goldman Sachs Commodity Index (TR)
- 5.0% PERS (DB) Risk Parity Custom Benchmark
- 2.0% PERS (DB) GTAA Custom Benchmark

PERS (HC 115) Total Fund Custom Benchmark:

- 22.9% Russell 3000 Index
- 22.0% PERS (HC 115) International Equity Custom Benchmark
- 17.9% PERS (HC 115) Core Fixed Income Custom Benchmark
- 6.0% PERS (HC 115) EMD Custom Benchmark
- 2.0% Bloomberg Barclays U.S. High Yield Index
- 0.1% CS Leveraged Loan Index
- 1.0% PERS (HC 115) Securitized Debt Custom Benchmark
- 6.0% Bloomberg Barclays U.S. TIPS Index
- 6.0% Dow Jones U.S. Select Real Estate Securities TR Index
- 6.0% PERS (HC 115) Hedge Funds Custom Benchmark
- 0.1% PERS (HC 115) Opportunistic Custom Benchmark
- 2.0% S&P Goldman Sachs Commodity Index (TR)
- 5.0% PERS (HC 115) Risk Parity Custom Benchmark
- 2.0% PERS (HC 115) GTAA Custom Benchmark
- 1.0% Bloomberg Barclays U.S. Treasury Index

STRS Total Fund Custom Benchmark:

- 28.0% Russell 3000 Index
- 24.0% MSCI World Ex US Index (50% Hedged)/ MSCI Emg Mkts Index
- 21.0% STRS Fixed Income Blended Benchmark
- 10.0% STRS Real Estate Custom Benchmark
- 9.0% Opportunistic Composite Performance
- 7.0% Private Equity Composite Performance
- 1.0% BofA ML 3 Mo US T-Bill Index

OP&F Total Fund Custom Benchmark:

- 18.75% Wilshire 5000 Index
- 18.75% MSCI ACW Ex US IMI Index (Net)
- 10.0% Bloomberg US Aggregate Bond Index
- 11.0% CS High Yield Dev. Countries Only Index
- 8.5% Bridgewater Custom US TIPS Index
- 2.5% S&P LTSA Levered Loan Index + 2%
- 12.0% NCREIF ODCE (Net) (1 Quarter Lag)
- 3.5% CPI + 5% (1 Quarter Lag)
- 8.0% Alerian MLP Index
- 7.0% OP&F Private Equity Custom Benchmark

SERS Total Fund Custom Benchmark:

- 22.5% Russell 3000 Index
- 22.5% SERS International Equity Custom Benchmark
- 19.0% Bloomberg US Aggregate Bond Index
- 15.0% NCREIF Property Index (1 Quarter Lag)
- 10.0% HFRI FOF Composite Index + 1%
- 10.0% Burgiss All Private Equity (1 Quarter Lag)
- 1.0% Citigroup 30 Day T-Bill Index

HPRS Total Fund Custom Benchmark:

- 30.0% Russell 3000 Index
- 20.0% MSCI ACW Ex US IM Index (USD) (Net)
- 19.0% HPRS Fixed Income Custom Benchmark
- 5.0% HPRS Total Real Estate Composite
- 11.0% HFRI FOF Composite Index
- 9.0% HPRS Total Private Equity Custom Composite
- 5.0% HPRS Real Assets Custom Index
- 1.0% BofA Merrill Lynch 91-Day T-Bill

Custom Benchmark Glossary

PERS (DB) International Equity Custom Benchmark:

- 55% MSCI World Ex US Standard Index
- 10% MSCI World Ex US Small Cap Index
- 31% MSCI Emerging Markets Standard Index
- 4% MSCI Emerging Markets Small Cap Index

PERS (DB) Core Fixed Income Custom Benchmark:

- Bloomberg Barclays US Aggregate Bond Index

PERS (DB) EMD Custom Benchmark:

- 50% JP Morgan Emerging Markets Bond Index Global
- 50% JP Morgan Government Bond Index-Emerging Markets Global Diversified

PERS (DB) Securitized Debt Custom Benchmark:

- 50% Bloomberg Barclays Non-Agency Investment Grade CMBS: BBB Total Return Index (Unhedged) (USD)
- 50% Bloomberg Barclays Non-Agency CMBS Agg Eligible Total Return Index Value (Unhedged) (USD)

PERS (DB) Real Estate Custom Benchmark:

- NFI-ODCE Index (Net) + 0.85% (1 Quarter Lag)
- Prior to 2013: NCREIF Property Index (1 Quarter Lag)

PERS (DB) Private Equity Custom Benchmark:

- State Street Private Equity Index (1 Quarter Lag)
- Prior to 2015: 60% Russell 3000 Index, 40% MSCI ACWI Ex US IMI plus 300 basis points (1 Quarter Lag)
- Prior to 2013: Russell 3000 Index + 300 bps (1 Quarter Lag)

PERS (DB) Hedge Funds Custom Benchmark:

- 20% HFRI Equity Hedge (Total) Index
- 30% HFRI Event Driven (Total) Index
- 25% HFRI Relative Value (Total) Index
- 25% HFRI Macro (Total) Index
- Prior to 2014Q2: The minimum of 700 basis points or 3-month LIBOR plus 400 basis points

PERS (DB) Opportunistic Custom Benchmark:

- The market weight of underlying portfolio benchmarks

PERS (DB) Risk Parity Custom Benchmark:

- HFR Risk Parity Vol 15 Institutional Index

PERS (HC 115) International Equity Custom Benchmark:

- 55% MSCI World Ex US Standard Index
- 10% MSCI World Ex US Small Cap Index
- 31% MSCI Emerging Markets Standard Index
- 4% MSCI Emerging Markets Small Cap Index

PERS (HC 115) Core Fixed Income Custom Benchmark:

- Bloomberg Barclays US Aggregate Bond Index

PERS (HC 115) EMD Custom Benchmark:

- 50% JP Morgan Emerging Markets Bond Global Index
- 50% JP Morgan Government Bond Index-Emerging Markets Global Diversified

PERS (HC 115) Securitized Debt Custom Benchmark:

- 50% Bloomberg Barclays Non-Agency Investment Grade CMBS: BBB Total Return Index (Unhedged) (USD)
- 50% Bloomberg Barclays Non-Agency CMBS Agg Eligible Total Return Index Value (Unhedged) (USD)

PERS (HC 115) Hedge Funds Custom Benchmark:

- 20% HFRI Equity Hedge (Total) Index
- 30% HFRI Event Driven (Total) Index
- 25% HFRI Relative Value (Total) Index
- 25% HFRI Macro (Total) Index

PERS (HC 115) Opportunistic Custom Benchmark:

- The market weight of underlying portfolio benchmarks

PERS (HC 115) Risk Parity Custom Benchmark:

- HFR Risk Parity Vol 15 Institutional Index

PERS (HC 115) GTAA Custom Benchmark:

- The market weight of underlying portfolio benchmarks

STRS International Equity Custom Benchmark:

- 80% MSCI EAFE Index
- 20% MSCI Emerging Markets Index

Custom Benchmark Glossary

STRS Fixed Income Blended Benchmark:

- Effective July 1, 2017, the Fixed Income Blended Benchmark is calculated using the actual daily beginning weight of Core Fixed Income multiplied by the Bloomberg Barclays U.S. Universal Index return combined with the actual daily beginning weight of the Liquid Treasury Portfolio multiplied by the Bloomberg Barclays US Intermediate Treasury Index return. Prior to July 1, 2017, the Fixed Income Blended Benchmark consisted of the Bloomberg Barclays U.S. Universal Index.

STRS Real Estate Custom Benchmark:

- 85% NCREIF Property Index
- 15% FTSE NAREIT Equity REITs Index

STRS Private Equity Custom Benchmark:

- Russell 3000 + 100 basis points

STRS Opportunistic Custom Benchmark:

- Russell 3000 - 100 basis points

OP&F Private Equity Custom Benchmark:

- Wilshire 5000 + 3% (1 Quarter Lag)
- Prior to 2007Q1: Wilshire 5000 (1 Quarter Lag)
- Prior to 2006Q4: Wilshire 5000 + 5%

SERS International Equity Custom Benchmark:

- MSCI ACW Ex US Index (USD) (Net)
- Prior to 2014Q1: MSCI ACWI ex-US (Net) Index (dev. markets 50% hedged)
- Prior to 2013Q3: MSCI ACWI ex-US (Gross) Index (dev. markets 50% hedged)

SERS Opportunistic Custom Benchmark:

- SERS Total Fund Custom Benchmark

HPRS Fixed Income Custom Benchmark:

- 53% Bloomberg Aggregate Bond Index
- 15.7% Citi WGBI
- 15.7% Credit Suisse Leveraged Loans
- 15.6% BofA Merrill Lynch 91-Day T-Bill

HPRS Total Private Equity Custom Benchmark:

- Private Equity Composite Performance
- Wilshire 5000 + 3% (1 Quarter Lag)
- Prior to 2010Q3: CPI + 5%

HPRS Real Assets Custom Benchmark:

- 60% NCREIF Timberland
- 40% Alerian MLP

Glossary

Alpha - A measure of the difference between a portfolio's actual returns and its expected performance, given its level of risk as measured by beta. It is a measure of the portfolio's historical performance not explained by movements of the market.

Benchmark - A standard against which the performance of a fund or investment manager can be measured.

Beta - A measure of the sensitivity of a portfolio to the movements in the market. A beta of 1.0 indicates the same level of stock market risk as the S&P 500 Index (Cap Wtd), unless otherwise noted. Lower betas indicate lower stock market risk. Beta is a measure of a portfolio's non-diversifiable or systematic risk.

Capital Markets Review -

Breakeven Inflation - Measures the expected inflation rate at each stated maturity by taking the difference between the real yield of the inflation-linked maturity curve and the yield of the closest nominal Treasury maturity.

Consumer Confidence - Measures domestic consumer confidence as defined by the degree of optimism on the state of the economy that consumers express through saving and spending.

Consumer Price Index (CPI) - Measures the change in the price level of consumer goods and services.

Option-Adjusted Spread - Measures the flat spread of an index or bond to the Treasury yield curve after removing the effect of any embedded options.

Purchasing Managers Index (PMI) - Measures economic activity by surveying purchasing managers on a monthly basis as to whether business conditions have improved, worsened, or stayed the same.

US Dollar Total Weighted Index - Measures the value of the US Dollar relative to a basket of other world currencies. It is calculated as the weighted geometric mean of the dollar's value versus the EUR, GBP, CAD, SEK, CHF, and JPY.

VIX - Measures the implied volatility of S&P 500 Index options by looking at the market's expectation of the S&P 500 Index volatility over the next 30 day period. Commonly referred to as the "fear index" or the "fear gauge."

Downside Risk - A measure similar to standard deviation, but focuses only on the negative returns of the fund or investment. The higher the factor, the riskier the fund or investment.

Correlation - A statistical measure of the relationship between asset class returns. A value of 1.00 is a perfect correlation; that is, the asset classes always move in the same direction. A value of -1.00 indicates a perfect negative correlation, in which the asset classes always move in opposite directions of each other. A value of 0 indicates there is no relationship between the direction of returns of the two asset classes. Correlation calculations only consider the direction of changes relative to two variables and not the magnitude of those changes.

Down Market Capture - Down market by definition is negative benchmark return and down market capture represents the ratio in % terms of the average portfolios return over the benchmark during the down market period. The lower the value of the down market capture the better the product's performance.

Excess Return - Arithmetic difference between the fund or investment return and the risk-free return (or other specified market index) over a specified time period, shown on an annualized basis.

Indices - All indices and related information are considered intellectual property and are licensed by each index provider. The indices may not be copied, used or distributed without the index provider's prior written approval. Index providers make no warranties and bear no liability with respect to the indices, any related data, their quality, accuracy, suitability and/or completeness.

Information Ratio - Measured by dividing the active rate of return by the tracking error. The higher the information ratio, the more value-added contribution relative to the market benchmark.

Maximum Return - The maximum quarterly return earned over the specified time period.

Minimum Return - The minimum quarterly return earned over the specified time period.

Glossary

Peer Groups -

Plan Sponsor Peer Groups - RVK utilizes the Mellon Analytical Solutions Trust Universe along with the Investment Metrics Plan Sponsor Universe. The combined Mellon Analytical Solutions Trust Universe and Investment Metrics Plan Sponsor Universe is used for comparison of total fund composite results and utilizes actual client returns compiled from consultant and custodial data. The Plan Sponsor Peer Group database includes performance and other quantitative data for over 2,100 plans which include corporate, endowment, foundation, public, and Taft Hartley plans. Plan Sponsor Peer Groups are gross of fees.

Percentile Rankings - Percentile rank compares an individual fund's performance with those of other funds within a defined peer group of managers possessing a similar investment style. Percentile rank identifies the percentage of a fund's peer group that has a higher return (or other comparative measurement) than the fund being ranked. Conversely, 100 minus the individual fund's ranking will identify the percentage of funds within the peer group that have a lower return than the fund being ranked.

1 - Highest Statistical Value 100 - Lowest Statistical Value

Example: American Funds AMCP;R-4 (RAFEX) is ranked in the 4th percentile within the IM US Equity Large-Cap Growth Funds (MF) Peer Group for the Sharpe Ratio. Within the IM US Equity Large-Cap Growth Funds peer group, 4% of the other funds performed better than American Funds AMCP;R-4 (RAFEX), while 96% of the funds performed worse.

Performance Methodology - RVK calculates performance beginning with the first full month following inception. Since inception performance may vary from manager reported performance due to RVK using the first full month of returns as the inception date. Performance for both managers and composites is annualized for periods greater than one year.

Return - Compounded rate of return for the period.

%Return - The time-weighted rate of return of a portfolio for a given period.

RVK Liquidity Rating - A qualitative method for determining the relative amount of liquidity in a portfolio. The characteristics considered when determining relative liquidity include trading volume, gates for redemption, leverage, nature of transactions, and pricing mechanisms. The RVK Liquidity Rating is calculated using beginning of month investment weights applied to each corresponding asset class liquidity rating.

<u>Asset Class</u>	<u>RVK Liquidity Rating</u>	<u>Asset Class</u>	<u>RVK Liquidity Rating</u>
<u>Liquid Investments</u>		<u>Less Liquid Investments</u>	
T-Bills and Treasuries	100	Fixed Income Plus Sector	50
Cash Equivalents	98	Bank Loans	50
TIPS	95	Emerging Markets Debt	50
US Large Cap Equity	95	Hedge Funds	35
Diversified Real Return	93	Hedge Funds of Funds	35
Non-US Large Cap Equity	90	<u>Not Liquid Investments</u>	
Global Tactical Asset Allocation	88	Core Real Estate	25
US Small Cap Equity	85	Core Plus Real Estate	15
REITs	85	Plus Only Real Estate	5
Non-US Small Cap Equity	85	Private Equity	5
Emerging Markets Equity	85		
Core Fixed Income	85		
Core Plus Fixed Income	80		

Sharpe Ratio - Represents the excess rate of return over the risk-free return (i.e., BofA ML 3 Mo US T-Bill Index unless specified otherwise), divided by the standard deviation of the excess return. The result is the absolute rate of return per unit of risk. The higher the value, the better the portfolio's historical risk-adjusted performance.

Standard Deviation - A statistical measure of the range of a portfolio's performance and is a commonly used proxy for overall investment risk. The variability of a return around its average return over a specified time period.

Tracking Error - A measure of the standard deviation of a portfolio's performance relative to the performance of the market index.



Glossary

Thematic Classification - Represents dedicated manager allocations; as such, thematic allocations are approximations. RVK categorizes the following asset classes as Alpha, Capital Appreciation, Capital Preservation, and Inflation:

<u>Alpha</u>	<u>Capital Appreciation</u>	<u>Capital Preservation</u>	<u>Inflation</u>
Absolute Return Strategies	Public Equity	Core Fixed Income	TIPS
Currency Overlay	Private Equity	CMBS Fixed Income	Bank Loans
GTAA (Global Tactical Asset Allocation)	Preferred Securities	Asset Backed Fixed Income	Core Real Estate
	High Yield	Domestic Core Plus Fixed Income	Real Return
	Convertible Fixed Income	Mortgage Backed Fixed Income	Inflation Hedges
	TALF Funds	International Developed Fixed Income	REITs
	Distressed Debt	Cash Equivalents	Commodities
	Emerging Market Fixed Income	Stable Value	
	MLPs		
	Value Added Real Estate		
	Opportunistic Real Estate		

Total Fund Attribution - A method for identifying the sources of a total fund's over- or underperformance relative to its benchmark. The calculation identifies the contributions of positive or negative total fund excess return caused by allocation differences relative to the total fund's custom benchmark, and performance differences of the investment managers relative to the benchmark components that represent them.

Total Fund Performance -

Total Fund - The percentage return of the total fund for the specified time period.

Total Fund Benchmark - The percentage return of the total fund benchmark for the specified time period; calculated using the target asset allocation and the corresponding benchmark returns.

Total Value Added - The percentage of over- or underperformance of the total fund as compared to the total fund benchmark.

Total Value Added -

Asset Allocation - Shows how the variance of the total fund's actual allocation from its target allocation added to or subtracted from fund performance.

Manager Value Added - The portion of the total value added attributable to the outperformance or underperformance of the fund's investment managers, relative to the individual benchmarks that represent them in the total fund benchmark.

Market Timing/Other - The contribution of other residual factors, including estimation error and transaction timing.

Tracking Error - A measure of the standard deviation of a portfolio's performance relative to the performance of an appropriate market benchmark.

Unit Value - The dollar value of a portfolio, assuming an initial nominal investment of \$1.00, growing at the compounded rate of %Return for a given period.

Up Market Capture - Up market by definition is positive benchmark return and up market capture represents the ratio in % terms of the average portfolios return over the benchmark during the up market period. The higher the value of the up market capture the better the product's performance.

PORTLAND

BOISE

CHICAGO

NEW YORK

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