Commission Meeting Agenda

Thursday, February 8, 2018 9:30 a.m.

RSIC Presentation Center

I. Call to Order and Consent Agenda
   A. Adoption of Proposed Agenda
   B. Approval of December Minutes

II. CEO's Report

III. CIO's Report
   A. 4th Quarter Investment Performance Summary
   B. Annual Investment Plan Update
   C. Risk Management

IV. Review of Asset Allocation

V. Executive Session to discuss investment matters pursuant to S.C. Code Sections 9-16-80 and 9-16-320; to receive advice from legal counsel pursuant to S.C. Code Section 30-4-70(a)(2) related to litigation filed by American Timberlands Fund II, LP and to receive advice from legal counsel pursuant to S.C. Code Section 30-4-70(a)(2)

VI. Potential Action Resulting from Executive Session

VII. Adjournment

NOTICE OF PUBLIC MEETING

This notice is given to meet the requirements of the S.C. Freedom of Information Act and the Americans with Disabilities Act. Furthermore, this facility is accessible to individuals with disabilities, and special accommodations will be provided if requested in advance.

South Carolina Retirement System Investment Commission
Meeting Minutes

December 7, 2017 9:30 a.m.
Capitol Center
1201 Main Street, 15th Floor
Columbia, South Carolina 29201
Meeting Location: Presentation Center

Commissioners Present:
Dr. Rebecca Gunnlaugsson, Chair
Dr. Ronald Wilder, Vice Chair
Ms. Peggy Boykin, PEBA Executive Director
Mr. Allen Gillespie
Mr. Edward Giobbe (Via Telephone)
Mr. Reynolds Williams
Mr. William H. Hancock
Bill Condon, Esq.

I. CALL TO ORDER AND CONSENT AGENDA

Chair Rebecca Gunnlaugsson called the meeting of the South Carolina Retirement System Investment Commission ("Commission") to order at 9:30 a.m. Mr. Allen Gillespie made a motion to approve the proposed agenda as presented. Dr. Ronald Wilder seconded the motion, which was approved unanimously.

The Chair referred to the draft minutes from the Commission's August and September meetings as presented and asked whether there was a motion to approve the minutes. Dr. Wilder made a motion to approve both sets of minutes as presented. Mr. Gillespie seconded the motion, which passed unanimously.

The Chair then introduced two new members of the Commission: Mr. William H. Hancock and Mr. Bill Condon. Mr. Hancock, who was appointed by the Governor of South Carolina, is a certified public accountant ("CPA") and a partner at the Brittingham Group, a tax and accounting firm. He also served as a Commissioner for the East Richland County Public Service District. Mr. Hancock graduated from the Citadel with business administration and accounting degrees. He then went on to the Darla Moore School of Business at the University of South Carolina and graduated with a masters of taxation.

The Chair also introduced Mr. Condon who was appointed by the South Carolina State Treasurer. Mr. Condon is a CPA and an attorney with over 33 years of financial experience and 11 years of legal experience. Mr. Condon serves as Managing Counsel for Litigation at South Carolina Department of Revenue. Mr. Condon received his bachelor of science in

accounting from Clemson University and a masters in arts and public policy and a juris doctorate from Regent University.

Mr. Edward Giobbe joined the meeting by telephone at 9:36 a.m.
Mr. Reynolds Williams arrived to the meeting at 9:53 a.m.

II. MEKETA ASSET ALLOCATION DISCUSSION

Mr. Frank Benham, Managing Principal and Director of Research for Meketa, began his presentation by introducing Meketa team members, Mr. Peter Woolley, Managing Principal and Co-Chief Executive Officer, and Mr. Aaron Lally, Vice President, who will be assisting in the presentation of educational information on TIPS, Long-Term Treasuries and Infrastructure. First Mr. Benham began by discussing Treasury Inflation Protected Securities ("TIPS"). Inflation-linked bonds are bonds, which are usually issued by the government, that offer a guaranteed return over inflation. Mr. Benham outlined the history of TIPS and explained that TIPS have more volatility risk than core bonds and have low correlation to equities due to the sensitivity to inflation. He explained that over time what matters more is not actual inflation, but the expectation of inflation.

Mr. Benham explained efficiency of using TIPS in a portfolio and stated that using TIPS is not an area where active managers can add a lot of value. Thus, he noted that most TIPS investors choose to take a passive option, low cost exposure to TIPS. Lastly Mr. Benham summarized that TIPS, which offer an inflation hedge against unexpected inflation, are different than the bond exposure in the Portfolio. TIPS produce different return patterns than stocks and bonds, which offers a diversification benefit and can improve the long-term risk/reward profile of the Plan.

Next, Mr. Woolley began the second educational topic of long-term treasuries, which he noted is a common type of investment used in RSIC's peers' portfolios. He outlined the four major benefits of investing in long-term treasuries: the value retention during equity declines, the value of long-term treasuries as a portfolio volatility dampener, the income produced by long-term treasuries, and the liquidity of these instruments.

Mr. Woolley described the history of long-term treasuries retaining value in equity declines, including the dot-com bubble bust in 2001 and 2002 and the global financial crisis in 2008. During both those time periods Treasuries not only retained value but provided strong returns. Thus, he explained that during the most severe bear markets long-term treasuries are generally the most reliable and strongest hedge. Mr. Woolley added that long-term treasuries in recent periods have experienced negative correlation to equities. From an asset allocation diversification perspective, long-term treasuries demonstrate a low to negative correlation better than other asset classes. Although the correlations change over time, Mr. Woolley stated that low correlations help build more efficient portfolios. He explained that long-term

treasuries offset equity risk and that adding an allocation to long-term treasuries would have the effect of reducing the Portfolio's standard deviation, which is one measure of portfolio risk.

A discussion ensued regarding thirty-year treasuries and trying to keep the long-term exposure. Mr. Bill Condon stated that long-term treasuries look like a great hedge from a volatility and a return perspective and asked about investment in long-term treasuries in the current, low rate environment. Mr. Woolley stated that in a financial crisis, long-term treasuries could be traded to pay out benefit payments, as long-term treasuries are very liquid and stable. Concerns about investing in long-term treasuries were discussed, including inflation risks. If inflation rises above 2 percent, it is more advantageous for the Plan to own TIPS rather than long-term treasury bonds. Other concerns noted included low yields and a continued low rate environment. Rates have a lot of room to rise implying potential downside for bond values. To summarize, if interest rates rise, long-term treasuries are more sensitive and can lose more value than an intermediate treasury position. Mr. Woolley then discussed historical events where rate rose.

Ms. Peggy Boykin asked if Meketa had taken into consideration the current rate environment going forward, including the rising national debt and the potential for tax policy change in preparing the presentations, to which Mr. Woolley replied that they did look at a number of different scenarios.

Next, Mr. Aaron Lally, of Meketa, presented educational information regarding infrastructure investments. Currently the Plan has a long term target to Infrastructure of 3 percent, and 2 percent of that exposure is with the Deutsche Bank Global listed infrastructure strategy. He defined infrastructure funds as purchased or leased physical assets or businesses that provide some sort of essential service to a community. He stated that there are four main components to infrastructure: utilities, transportation, communications and social. The benefits of having infrastructure within the Portfolio are that there are high barriers to entry, long-term contracts, stable revenue and income, limited economic cyclicality, and inflation linkage. Mr. Lally also reviewed some of the key risks of infrastructure investing.

Mr. Lally then explained the three types of infrastructure: public, core private and non-core private infrastructure, and further discussed the types of funds as open-ended versus closed-end. He stated that Meketa favors infrastructure investments in core private and non-core private. Next, he provided details regarding infrastructure funds' contract terms, and the asset class' limited competition and limited regulatory protections in place. Some key risks to infrastructure investments are their illiquid nature and the potential for changing regulations in the industry. He stated that Meketa would like to see paring down the Portfolio's exposure of liquid infrastructure and moving more into the private infrastructure side.

Break was taken from 11:00 a.m. to 11:10 a.m.

Mr. Benham was introduced to discuss Meketa's Asset Allocation Review. He explained that the Staff and Meketa had collaborated and shared extensive information to help Meketa develop recommendations regarding asset allocation. He reviewed the Plan's long term objectives, including: maintaining the stability of benefit payments and meeting obligations for growth; meeting or exceeding actuarial assumed rate of 7.25 percent; and improving the funded status and maintain purchasing power. He described some of the risks that the Plan will have to take on to try to achieve a 7.25 percent return, including: volatility and endpoint uncertainty; year-to-year fluctuations in asset values and contribution levels; risk of short term loss; and permanent capital impairment.

He then discussed Mean Variance Optimization ("MVO"), which he explained is a starting point for determining asset allocation. MVO mathematically determines an efficient frontier of policy portfolios with the highest risk-adjusted returns. Mr. Benham described how combining uncorrelated assets produces an efficient frontier and different combinations of assets will lie along this efficient frontier. He stated that by combining assets that are not highly correlated with each other, the Fund can produce a higher return for a given level of risk than it could by investing in perfectly correlated assets.

Next Mr. Benham discussed asset allocation policy options. Meketa provided a comparison of the Plan's current policy compared to a large variety of other policy options. Among the options were allocations including only public market exposure; increased allocations to conservative asset classes; allocations with and without the portable alpha program; and increased allocation to Treasuries and TIPS as well as emerging market equities. He stated that across the board, the policies included a lower allocation to cash.

Mr. Benham explained the differences between several policy options and the effect that selecting conservative or aggressive options would have on the chance of achieving a 7.25 percent expected return. Following the information about asset allocation methodology, Mr. Benham described some proposed changes to the Plan recommended by Meketa. The first recommendation was a reduction in the allocation to cash because it has the lowest expected return and will be the biggest drag on returns over the long term. He stated that Staff was very open to reducing the dedicated allocation to cash, while recognizing the need to have cash necessary to pay benefit payments and capital calls. The second recommendation Mr. Benham suggested was adding a dedicated allocation to Treasuries. He noted that historically Treasuries have been the most reliable hedge against periods of stress in the stock market. The third recommendation suggested was adding a dedicated allocation to TIPS, as a safe asset that can provide a modest hedge against inflation. Mr. Benham stated that the fourth recommendation would be to increase allocation to emerging market equities. He explained that emerging market equities have had a good year but prices remain low compared to US markets. The fifth recommendation that he introduced was reallocating within the real assets allocation. Mr. Benham suggested decreasing the allocation to 2 percent for infrastructure and shifting the focus from public infrastructure to private infrastructure investing. Additionally, he

noted that Meketa believes rebalancing the real estate portfolio to have at least half of the allocation invested in core real estate is favorable. Mr. Benham stated that proposed changes to the real assets allocation could be implemented gradually by Staff with the help of Albourne.

The final theme Mr. Benham discussed was the portable alpha portfolio, which he noted would continue in the February 2018 Commission meeting. He outlined the mechanics of the portable alpha portfolio. He stated that an example of the benefit of the portable alpha portfolio is that it allows the Plan additional equity exposure plus hedge fund returns, thereby potentially enhancing the return of the overall Portfolio. He noted risks inherent in the strategy and explained that Meketa would be working with Staff to understand the portable alpha portfolio and be in a better position to discuss the way the portfolio has been implemented.

Mr. Berg then added that he supports having Meketa perform a review of the quality of the implementation of the portable alpha portfolio. He stated that he would like Meketa to focus on three factors that are important and critical for the Commission to consider: (1) within the hedge fund portfolios, are they low market beta-type strategies or do we have work to do and should we reconsider this; (2) how we compose the beta portfolio so that we are asking less from a liquidity perspective, and thus mitigating liquidity risk, of the Plan; and (3) making an assessment of that liquidity risk. The Commission and Mr. Berg discussed some of the benefits and risks of the way in which the portable alpha portfolio is implemented and the rationale for including the strategy in the Portfolio.

Turning back to the recommendations provided by Meketa, Mr. Benham explained that the last suggestion in Meketa's presentation is to move risk parity strategies to the other opportunistic allocation and to set an upper limit for the allocation.

Mr. Benham provided extensive information about analyses performed by Meketa on the current asset allocation as well as several options presented as proposed asset allocation policy options ("Policy Options"). A lengthy discussion ensued regarding risk analysis of the current and proposed policy asset allocations. During the discussion, Commissioners asked questions and Meketa provided information about the impact to the current and proposed policy allocations under a substantial list of historical market events. The discussion included information about liquidity analyses, changes in inflation, increasing interest rates and the impact of benefit payments contemplated by the termination of the TERI program. The proposed policies were discussed under several stress tests and the projected impacts to the policies were compared and explained.

Mr. Benham summarized that Meketa is not recommending a specific policy allocation to be selected, but indicated that three of the proposed Policy Options, with expected returns between 7.5 percent and 7.75 percent, were the most advantageous of the options presented. In response to questions from Dr. Wilder, Mr. Benham explained that the inflation assumption Meketa set is 2.5 percent over a twenty-year period.

Break for lunch from 12:55 p.m. to 1:21 p.m.

The Chair confirmed that the goal is to approve an asset allocation by May and asked the Commissioners to think about information that would be helpful to aid in narrowing down the proposed policy allocations. Ms. Boykin asked that Meketa provide updates to the Policy Options, with the revised capital market's assumption from January at the next meeting. Ms. Boykin requested that Meketa provide more specificity to the Plan by incorporating information from the Plan's actuary. She also stated that the Commission should consider projected cash flow needs and be thoughtful regarding the implementation timeline for a changed asset allocation. It was decided that the Commissioners have one-on-one sessions over the telephone with Meketa to discuss the various asset allocation ideas prior to the next meeting. Dr. Wilder suggested additional thought be given to the use of leverage, and requested that Meketa dedicate some time analyzing the use of leverage and its effect on the Plan. The Chair thanked Meketa for their time and hard work.

III. CHAIR'S REPORT

The Chair stated that the Commission's proposed 2018 meeting schedule was before the Commissioners for their approval. Mr. Gillespie moved that the Commission approve the 2018 meeting schedule as presented. Dr. Wilder seconded the motion, which passed unanimously.

IV. AUDIT AND ENTERPRISE RISK MANAGEMENT COMMITTEE REPORT

Mr. Michael Hitchcock, CEO, introduced Mr. Brad Gainey, the new Director of Enterprise Risk Management and Compliance. Mr. Gainey was formerly the Vice President Senior Internal Audit Manager at South State Bank where he was responsible for the execution of all audit plan methodology. He also worked for Elliot Davis prior to State South Bank. He obtained both his Bachelor of Science and Master of Accounting from the Darla Moore School of Business at the University of South Carolina.

Mr. Gillespie began the Committee update by thanking Mr. Andrew Chernick and Mr. John Page for their hard work to help keep the audit plan on pace and moving forward. He stated that the Committee received a compliance report, noting no exceptions during the last quarter. The Committee also received a report on the Agreed Upon Procedures by the State Auditor's Office related to agency expenditures, which included no findings. CliftonLarsonAllen also provided a report on the Agreed Upon Procedures on valuation and due diligence, which had also resulted in no findings. Mr. Gillespie remarked that the Committee received a presentation on the Global Investment Performance Standards ("GIPS") application to public pension funds and approved an engagement, in cooperation with the State Auditor's Office, to retain a firm to complete the GIPS verification/certification for the RSIC.

Mr. Gillespie stated that the Committee discussed the upcoming Fiduciary Audit. Also, the Committee received a preliminary roadmap for the Audit and Enterprise Risk Management objectives from Mr. Gainey. Finally, the Committee approved the 2018 Committee meeting dates, which will be posted on the RSIC website.

V. CEO'S REPORT

The Chair recognized Mr. Hitchcock who noted he had nothing material to report at this time.

VI. CIO's REPORT

The Chair recognized Mr. Geoff Berg, Chief Investment Officer, for his report. Mr. Berg began by noting that he and Mr. Steve Marino, Director, had created a capital markets update. The update addressed a number of topics, including the following: (1) the U.S. economy's continuing strength, notwithstanding certain metrics suggesting that the economy appears to be in the later stage of the business cycle; (2) the remarkably broad-based economic growth being experienced globally; (3) low risks of recession in the U.S. over the next six to twelve months; (4) whether the extended period of low levels of inflation in the U.S. will continue, given the emergence of certain inflationary pressures; (5) the 'rich' valuation of virtually all risk assets; (6) the continuing high level of investor optimism; (7) the imminent changes in monetary policy, as the Federal Reserve Bank and European Central Bank look to unwind the stimulus packages of the last several years; and (8) a concluding, cautionary note that forward looking returns should be expected to be lower.

Mr. Berg informed the Commissioners that he had asked Mr. James Wingo, Senior Officer, to lead an internal team (Quantitative Solutions Group). He explained that Mr. Wingo's group will lead the development of a risk management framework and related tools, and will work with the private markets team to continue to advance the value creation analysis for investment underwriting. Additionally, he stated that he had created a risk management steering committee that will be evaluating the agency's needs as they relate to both risk reporting and risk management. The risk management steering committee will also asses the tools currently available to RSIC and whether different or additional tools may be needed. Mr. Berg concluded his portion of the presentation by stating that Staff will be focusing on liquidity risk as well as creating a benchmark for risk, and noted his intent to introduce these approaches to the Commission as they are developed.

Mr. Berg introduced Mr. David King, Reporting Officer, to present the Plan's third quarter investment performance update, as well as a brief update for October 2017. Mr. King stated that as of September 30, 2017, the Plan stood at $31 billion, with a return of 3.84 percent versus the policy benchmark of 3.29 percent. It was noted that the Plan paid out $203 million in net benefit payments, but that investment performance added $1.1 billion to the net asset base. Mr. King noted that in July, the Plan received a net cash inflow into the trust fund of approximately $20 million due to the increase in contributions that went into effect in July 2017, and stated that this inflow would normally be spread out through the year.

Mr. King pointed out that the Plan is currently at its highest market value since inception and that, since inception, $5.5 billion had been added to the Plan, while the Plan had paid out $11.5 billion in net benefit payments. He then reviewed peer rankings, noting that since the RSIC began tracking the Plan's rolling 12 month percentile ranking in June 2016, the ranking had made progress towards the median, while for the current fiscal year to date, the Plan's ranking was closer to the 25th percentile.

Mr. King reviewed asset class performance, pointing out that all classes through the fiscal year were positive, led by public equity, which returned 5.44 percent versus its benchmark of 5.32 percent.

He noted that through the end of October 2018, the Plan's fiscal year-to-date performance increased to 5.23 percent versus a policy benchmark of 4.36 percent. Mr. King indicated that during that four month period, the Plan added $1.5 billion in investment performance while paying out $341 million in net benefits. After a brief discussion, Mr. Berg and Mr. King concluded their performance report.

VII. EXECUTIVE SESSION

Mr. Gillespie made a motion that the Commission recede into Executive Session to discuss investment matters pursuant to S.C. Code Sections 9-16-80 and 9-16-320; to receive legal advice pursuant to Code 30-4-70(a)(2) related to litigation filed by American Timberlands Fund II, LP; and to receive legal advice pursuant to S.C. Code Section 30-4-70(a)(2). Dr. Wilder seconded the motion, which passed unanimously.

Executive Session from 2:13 p.m. until 4:36 p.m.

VIII. POTENTIAL ACTION RESULTING FROM EXECUTIVE SESSION

Upon return to open session at 4:36 p.m., Mr. Williams made a motion that the Commission (1) adopt the recommendation of the CIO and the Internal Investment Committee as set forth in the Summary Terms Chart on Page 1 of the Due Diligence Report dated November 13, 2017 relating to Owl Rock Capital and discussed in Executive Session; (2) authorize an investment up to $200 million; (3) approve a waiver of the three day review period; (4) authorize the CEO or his designee to negotiate and execute any necessary documents to implement the Investment as approved by the Commission upon documented approval for legal sufficiency by RSIC Legal; and (5) authorize the CEO and/or the CIO or their designees to thereafter authorize the custodian of funds to transfer such funds as are necessary to meet the Retirement System trust funds' obligations with respect to the Investment. Mr. Hancock seconded the motion, and the motion passed unanimously. Mr. Condon abstained from the vote.

IX. ADJOURNMENT

There being no further business, upon a motion made by Mr. Williams and seconded by Mr. Gillespie, the Commission voted unanimously to adjourn. The meeting adjourned at 4:41 p.m.

[Staff Note: In compliance with S.C. Code Ann. Section 30-4-80, public notice of and the agenda for this meeting were delivered to the press and to parties who requested notice and were posted at the entrance, in the lobbies and near the 15th Floor Presentation Center at 1201 Main Street, Columbia, S.C., at 5:07 p.m. on December 4, 2017.]

Performance Update

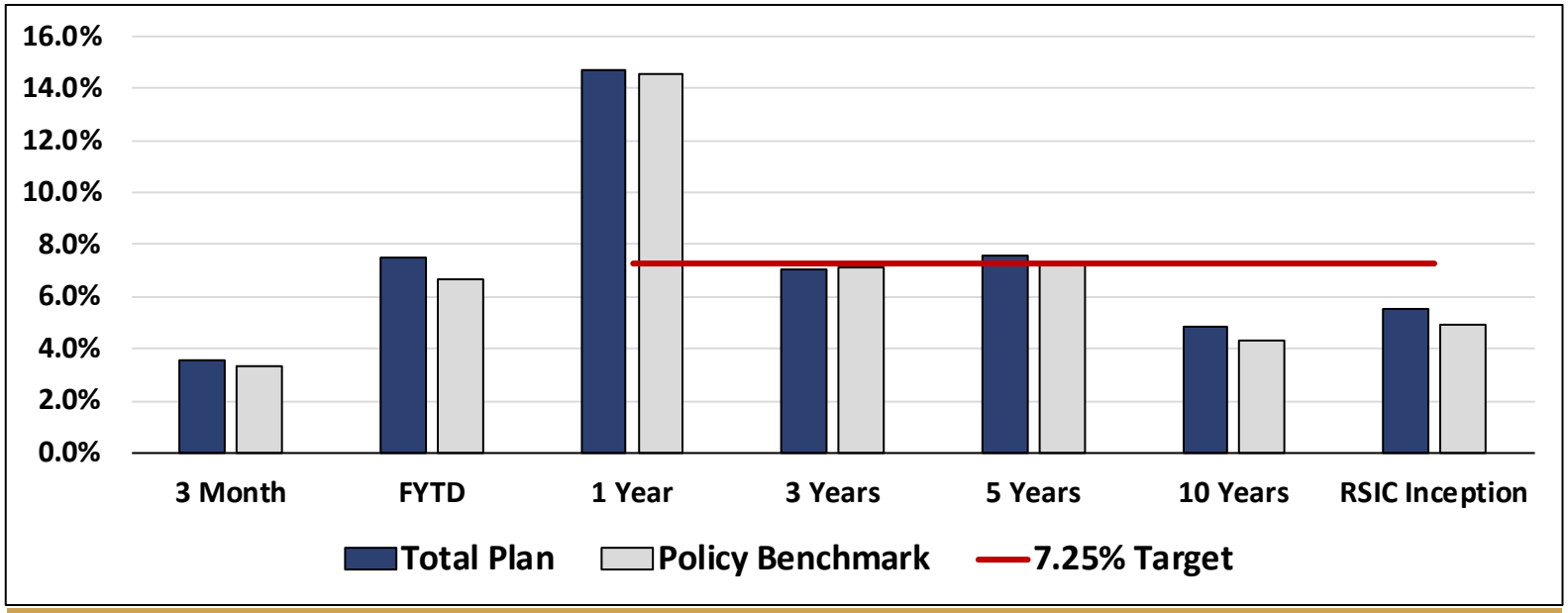
RSIC Commission Meeting

February 8, 2018

Data as of December 31, 2017

Performance– Plan & Policy Benchmark[1]

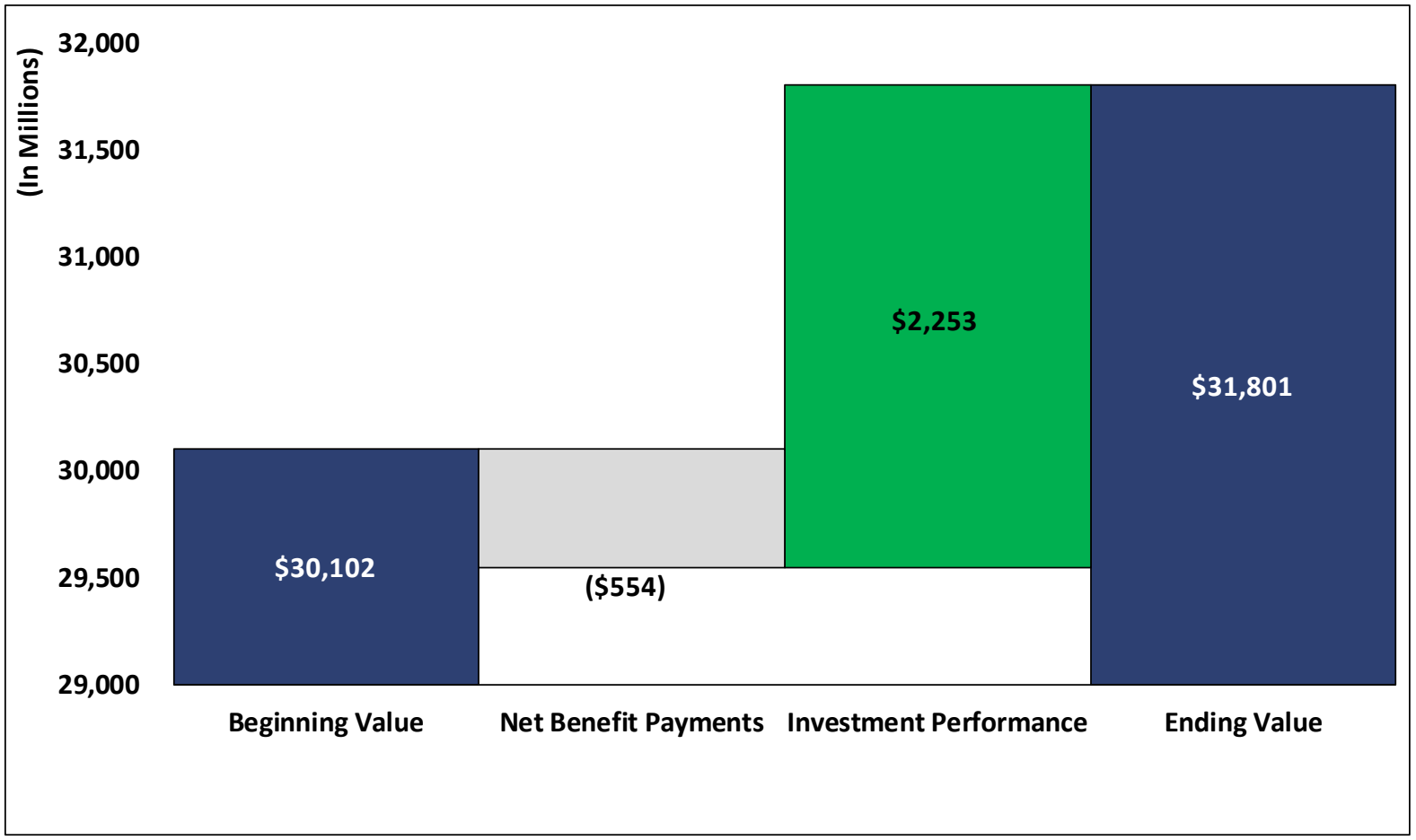
As of December 31, 2017



Historic Plan Performance As of 12/31/17	Market Value (In Millions)				Annualized			
		3 Month	FYTD	1 Year	3 Years	5 Years	10 Years	RSIC Inception
Total Plan	**$31,801**	**3.54%**	**7.51%**	**14.70%**	**7.07%**	**7.56%**	**4.86%**	**5.49%**
Policy Benchmark		3.29%	6.69%	14.55%	7.10%	7.24%	4.30%	4.95%
Excess Return		0.25%	0.83%	0.15%	-0.03%	0.32%	0.55%	0.54%
Net Benefit Payments (In Millions)		($351)	($554)	($1,130)	($3,303)	($5,347)	($9,891)	($11,803)

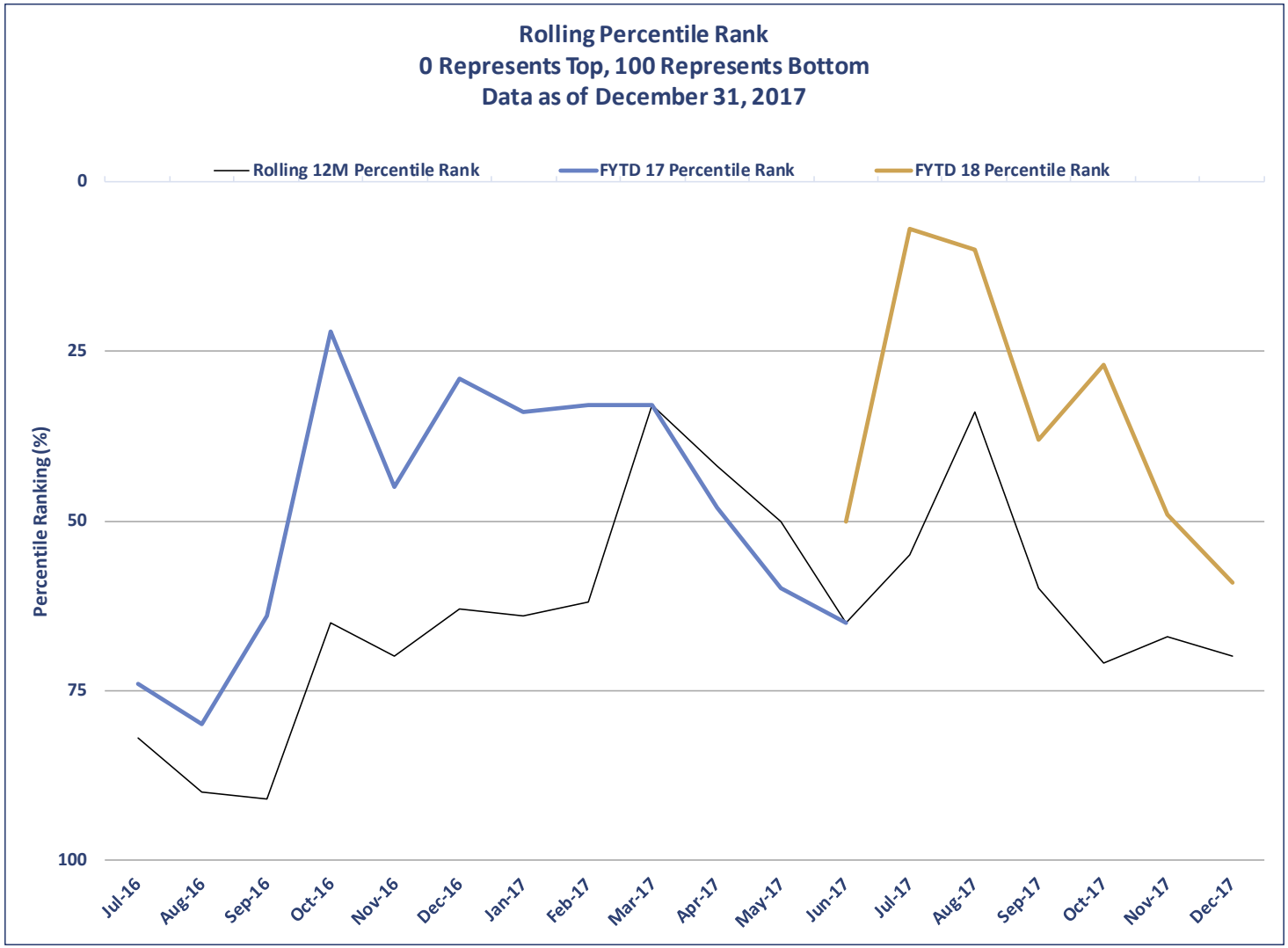
FYTD Benefits & Performance[1]

As of December 31, 2017



RSIC Universe Rankings[2]

As of December 31, 2017



Footnotes & Disclosures

Footnotes

1. Benefit payments are net of Plan contributions and disbursements.

2. RSIC Peer Universe is Bank of New York Public Plans Greater than 5 Billion dollars. The universe includes fund returns that are gross of invoiced fees. The RSIC percentile rank represents the RSIC return gross of invoiced fees.

Disclosures

- Returns are provided by BNY Mellon and are time-weighted, total return calculations. Net of fee performance is calculated and presented after the deduction of fees and expenses. Periods greater than one year are annualized. Past performance is no guarantee of future results. Policy benchmark is the blend of asset class policy benchmarks using policy weights. Asset class benchmarks and policy weights are reviewed annually by the Commission's consultant and adopted by the Commission and have changed over time. The policy benchmark return history represents a blend of these past policies.

- This report was compiled by the staff of the South Carolina Retirement System Investment Commission and has not been reviewed, approved or verified by the external investment managers. No information contained herein should be used to calculate returns or compare multiple funds, including private equity funds.

- Effective October 1, 2005, the State Retirement System Preservation and Investment Reform Act ("Act 153") established the Commission and devolved fiduciary responsibility for investment and management of the assets of the South Carolina Retirement Systems upon RSIC.

Footnotes & Disclosures

Benchmarks

- **Global Public Equity Blend**:
  7/2016 – Present: MSCI All-Country World Investable Markets Index (net of dividends)
  Prior to 7/2016: MSCI All-Country World Index (net of dividends)
- **Equity Options Strategies:** CBOE S&P Buy Write Index (BXM)
- **Private Equity Blend**: 80% Russell 3000 Index on a 3-month lag / 20% MSCI EAFE (net of dividends) on a 3-month lag Plus 300 basis points
- **Core Fixed Income**: Bloomberg Barclays US Aggregate Bond Index
- **Emerging Market Debt**: 50% JP Morgan EMBI Global Diversified (US Dollar) / 50% JP Morgan GBIEM Global Diversified (Local)
- **Private Debt** : S&P/LSTA Leveraged Loan Index + 150 basis points on a 3-month lag
- **Mixed Credit Blend**:
  7/2016 – Present: 1/2 Bloomberg Barclays US Corporate High Yield 2% Issuer Capped Bond Index
  1/2 S&P/LSTA Leveraged Loan Index
  Prior to 7/2016: 1/3 Bloomberg Barclays US Corporate High Yield 2% Issuer Capped Bond Index
  1/3 S&P/LSTA Leveraged Loan Index
  1/3 Bloomberg Barclays US Mortgage Backed Securities (MBS) Index
- **GTAA Blend**:
  7/2016 – Present: 50% MSCI World Index (net of dividends)
  50% Bloomberg Barclays US Aggregate Bond Index
  Prior to 7/2016: 50% MSCI World Index (net of dividends)
  50% Citi World Government Bond Index (WGBI)
- **Other Opportunistic**:
  7/2016 – Present: 50% MSCI World Index (net of dividends)
  50% Bloomberg Barclays US Aggregate Bond Index
- **Non PA Hedge Funds**
  7/2016 – Present: 50% MSCI World Index (net of dividends)
  50% Bloomberg Barclays US Aggregate Bond Index
- **Real Estate**: NCREIF Open-end Diversified Core (ODCE) Index + 75 basis points
- **Cash & Short Duration**: BofA Merrill Lynch 3-Month US Treasury Bill Index

FUND EVALUATION REPORT

South Carolina Retirement System

Performance Report
As of November 30, 2017

Confidentiality

The material contained in this report is confidential and may not be reproduced, disclosed, or distributed, in whole or in part, to any person or entity other than the intended recipient. The data are provided for informational purposes only, may not be complete, and cannot be relied upon for any purpose other than for discussion.

Meketa Investment Group has prepared this report on the basis of sources believed to be reliable. The data are based on matters as they are known as of the date of preparation of the report, and not as of any future date, and will not be updated or otherwise revised to reflect information that subsequently becomes available.

South Carolina Retirement System

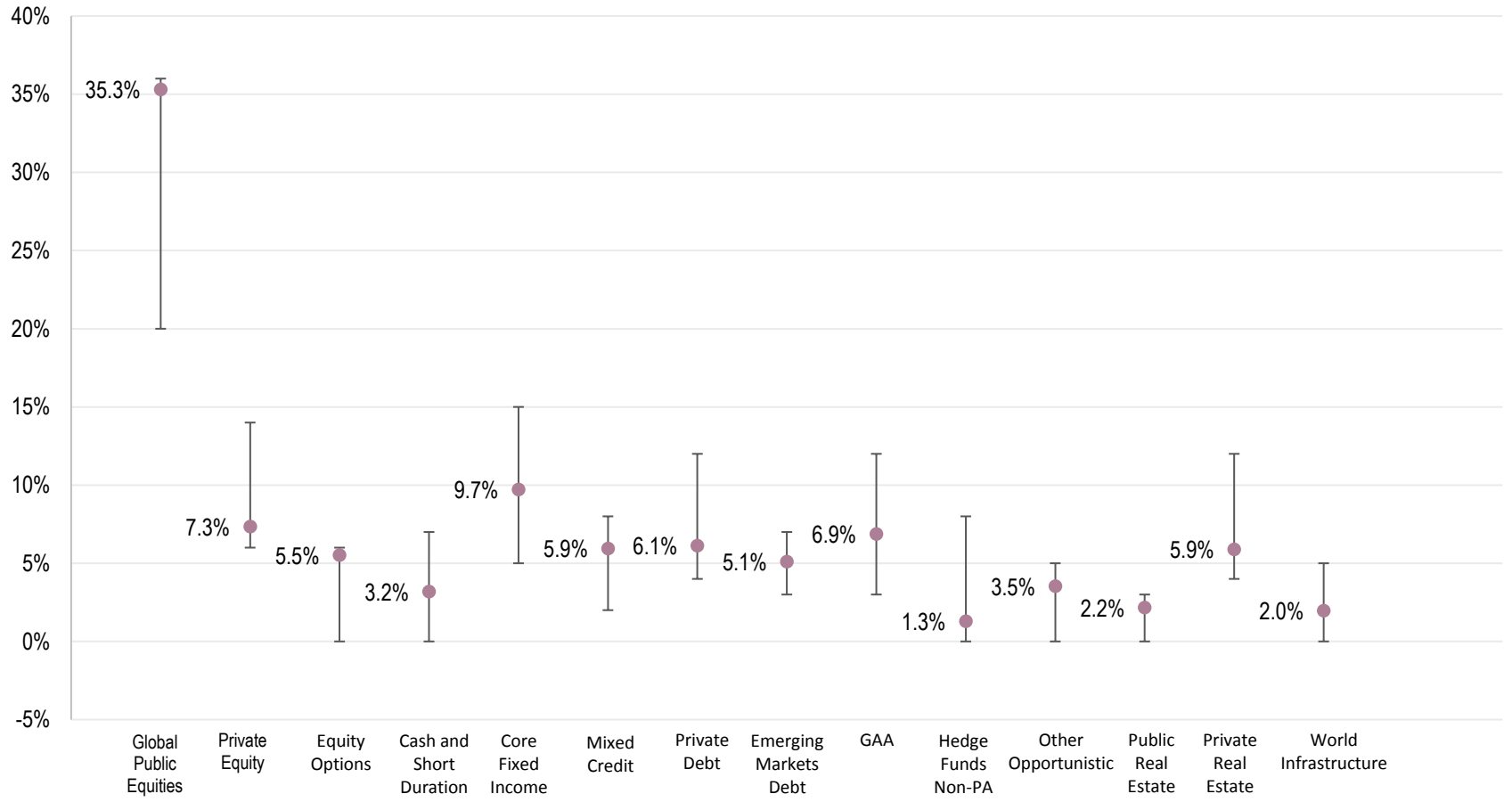
As of November 30, 2017

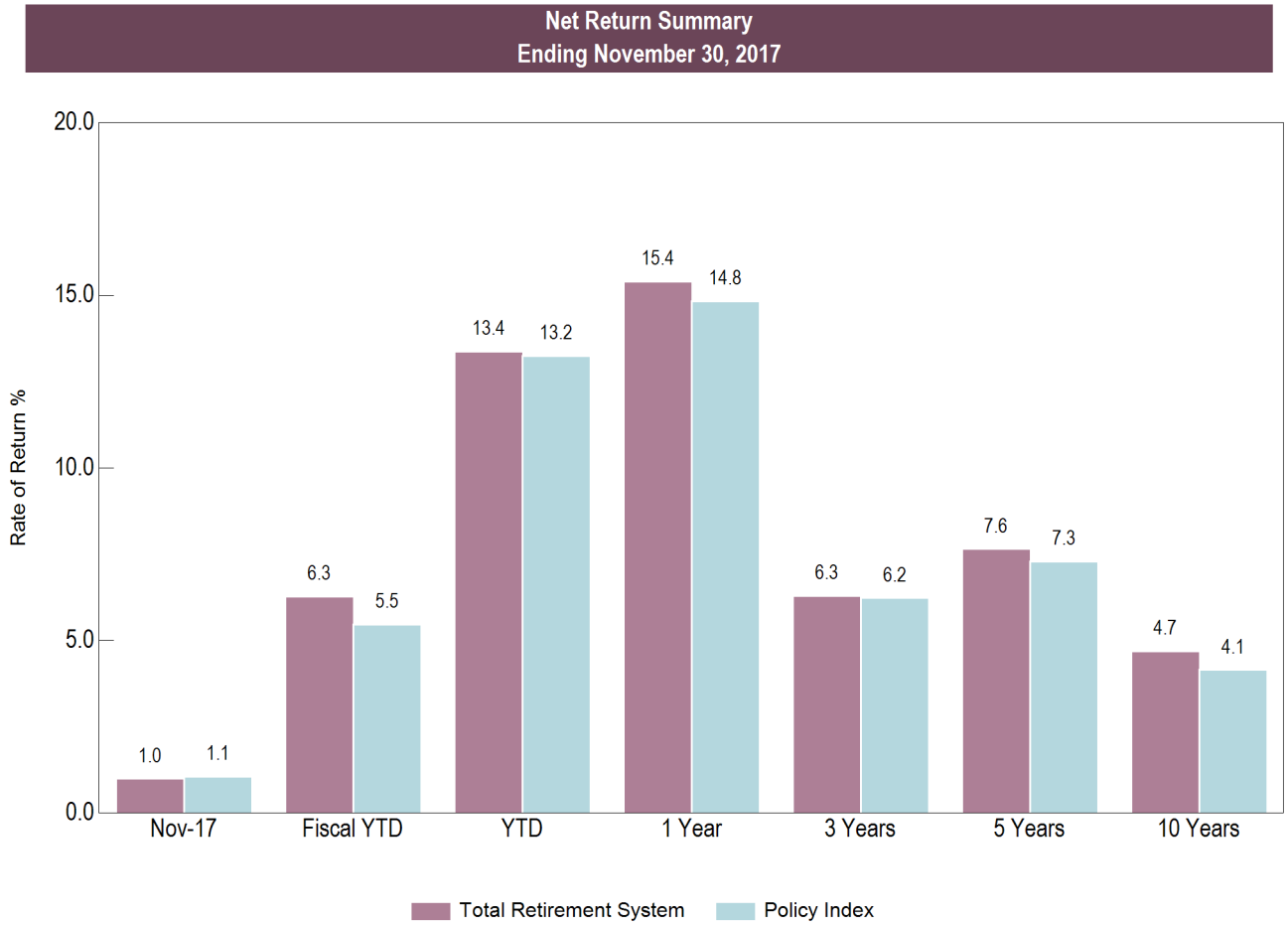
Allocation vs. Targets and Policy

	MV at 11/30/17	Overlay Exposures	Net Position	% of Total System	% of Total System (Net)	FY 17-18 (a) Policy Targets	Allowable Ranges	SIOP Compliance?
Total System	**31,572,918,696**	**-**	**31,572,918,696**	**100%**	**100%**	**100%**	**-**	**-**
Equity	**13,376,872,450**	**1,838,127,074**	**15,214,999,524**	**42%**	**48%**	**47%**	**42-52%**	**Yes**
Global Equity	9,310,220,580	1,838,127,074	11,148,347,654	29%	35%	35%	20-36%	Yes
Private Equity	2,318,862,147	-	2,318,862,147	7%	7%	7%	6-14%	Yes
Equity Options	1,747,789,723	-	1,747,789,723	6%	6%	5%	0-6%	Yes
Conservative Fixed Income	**4,289,817,808**	**(215,393,798)**	**4,074,424,009**	**14%**	**13%**	**12%**	**10-16%**	**Yes**
Cash and Short Duration	3,035,028,253	(2,027,830,151)	1,007,198,102	10%	3%	2%	0-7%	Yes
Core Fixed Income	1,254,789,554	1,812,436,353	3,067,225,907	4%	10%	10%	5-15%	Yes
Diversified Credit	**5,420,093,839**	**-**	**5,420,093,839**	**17%**	**17%**	**18%**	**15-21%**	**Yes**
Mixed Credit	1,876,713,740	-	1,876,713,740	6%	6%	7%	2-8%	Yes
Private Debt	1,933,294,371	-	1,933,294,371	6%	6%	6%	4-12%	Yes
Emerging Markets Debt	1,610,085,728	-	1,610,085,728	5%	5%	5%	3-7%	Yes
Opportunistic	**2,347,979,583**	**1,349,682,368**	**3,697,661,951**	**7%**	**12%**	**13%**	**9-19%**	**Yes**
GAA	825,811,827	1,343,543,214	2,169,355,040	3%	7%	8%	3-12%	Yes
Hedge Funds Non-PA	408,864,295	-	408,864,295	1%	1%	2%	0-8%	Yes
Other Opportunistic	1,113,303,461	6,139,154	1,119,442,615	4%	4%	3%	0-5%	Yes
Real Assets	**3,165,739,373**	**-**	**3,165,739,373**	**10%**	**10%**	**10%**	**8-14%**	**Yes**
Public Real Estate	683,072,897	-	683,072,897	2%	2%	2%	0-3%	Yes
Private Real Estate	1,857,787,827	-	1,857,787,827	6%	6%	6%	4-12%	Yes
World Infrastructure	624,878,649	-	624,878,649	2%	2%	2%	0-5%	Yes
Hedge Funds PA	2,972,415,643	(2,972,415,643)	-	9%	0%	NA	0-12%	**Yes**

Includes cash in the Russell Overlay separate account.
Percentages may not sum to 100% due to rounding.

Actual vs. Policy Ranges: (Including Overlay)





Returns for periods greater than one year are annualized.

Total Retirement System

As of November 30, 2017

Net Asset Class Performance Summary

	Market Value ($)	% of Portfolio	1 Mo (%)	Fiscal YTD (%)	YTD (%)	1 Yr (%)	3 Yrs (%)	5 Yrs (%)	10 Yrs (%)	Return (%)	Since
Total Retirement System	**31,572,918,696**	**100.0**	**1.0**	**6.3**	**13.4**	**15.4**	**6.3**	**7.6**	**4.7**	**6.4**	**Jul-94**
Policy Index			*1.1*	*5.5*	*13.2*	*14.8*	*6.2*	*7.3*	*4.1*	*5.8*	*Jul-94*
Global Public Equities	**9,310,220,580**	**29.5**	**1.7**	**9.9**	**23.5**	**25.9**	**8.5**	**12.1**	**6.0**	**5.2**	**Jun-99**
MSCI ACWI IMI Net USD			*2.0*	*9.6*	*22.0*	*24.6*	*8.3*	*11.2*	*4.7*	*5.7*	*Jun-99*
Private Equity	**2,318,862,147**	**7.3**	**1.7**	**6.5**	**13.8**	**17.3**	**10.3**	**13.9**	**8.7**	**7.4**	**Apr-07**
80% Russell 3000/20% MSCI EAFE + 300 basis points on a 3-month lag			*0.4*	*7.3*	*18.7*	*19.5*	*10.9*	*16.1*	*14.0*	*14.8*	*Apr-07*
Equity Options	**1,747,789,723**	**5.5**	**1.4**	**5.9**	**13.0**	**14.3**	**--**	**--**	**--**	**12.5**	**Jul-16**
CBOE S&P 500 BuyWrite USD			*1.5*	*4.7*	*12.3*	*12.4*	*8.6*	*8.7*	*5.0*	*12.0*	*Jul-16*
Short Duration	**1,273,823,990**	**4.0**	**-0.1**	**0.5**	**1.6**	**1.8**	**1.6**	**1.4**	**--**	**1.7**	**Mar-10**
BBgBarc US Govt/Credit 1-3 Yr. TR			*-0.2*	*0.1*	*0.8*	*0.9*	*0.8*	*0.8*	*1.9*	*1.1*	*Mar-10*
Cash and Overlay	**1,761,204,263**	**5.6**	**0.0**	**0.1**	**0.2**	**0.3**	**-0.3**	**-0.1**	**0.2**	**1.1**	**Oct-05**
BofA Merrill Lynch 91-Day T-Bill			*0.1*	*0.4*	*0.7*	*0.8*	*0.4*	*0.2*	*0.4*	*1.2*	*Oct-05*
Core Fixed Income	**1,254,789,554**	**4.0**	**-0.1**	**1.3**	**4.4**	**5.1**	**2.9**	**2.4**	**4.3**	**6.2**	**Jul-94**
BBgBarc US Aggregate TR			*-0.1*	*0.8*	*3.1*	*3.2*	*2.1*	*2.0*	*4.0*	*5.6*	*Jul-94*
Mixed Credit	**1,876,713,740**	**5.9**	**0.4**	**2.7**	**6.4**	**7.8**	**3.4**	**4.2**	**--**	**6.5**	**May-08**
50% S&P LSTA Leveraged Loan Index/50% Barclays High Yield Index			*-0.1*	*2.0*	*5.4*	*7.0*	*5.1*	*4.8*	*6.1*	*6.3*	*May-08*
Private Debt	**1,933,294,371**	**6.1**	**0.5**	**2.9**	**3.8**	**5.7**	**4.6**	**8.0**	**--**	**7.3**	**Jun-08**
S&P LSTA Leveraged Loan Index + 150 basis points on a 3-month lag			*0.1*	*2.1*	*6.3*	*7.3*	*5.0*	*5.7*	*5.0*	*5.2*	*Jun-08*
Emerging Market Debt	**1,610,085,728**	**5.1**	**0.0**	**2.4**	**11.8**	**14.1**	**4.4**	**2.0**	**--**	**6.0**	**Jul-09**
50% JP Morgan EMBI Global Diversified (USD)/50% JP Morgan EMBI Global Diversified			*0.9*	*2.7*	*11.2*	*13.0*	*2.9*	*1.5*	*5.4*	*6.0*	*Jul-09*
GAA	**825,811,827**	**2.6**	**0.0**	**5.0**	**10.0**	**11.6**	**3.6**	**4.6**	**4.8**	**5.4**	**Aug-07**
50% MSCI World Index/50% Barclays Aggregate Bond Index			*1.0*	*4.9*	*11.6*	*13.0*	*5.3*	*6.9*	*4.7*	*5.0*	*Aug-07*
Other Opportunistic	**1,113,303,461**	**3.5**	**0.4**	**3.8**	**--**	**--**	**--**	**--**	**--**	**3.8**	**Jul-17**
50% MSCI World Index/50% Barclays Aggregate Bond Index			*1.0*	*4.9*	*11.6*	*13.0*	*5.3*	*6.9*	*4.7*	*4.9*	*Jul-17*
Hedge Funds Non Portable Alpha	**408,864,295**	**1.3**	**0.3**	**2.0**	**4.2**	**5.1**	**1.1**	**3.5**	**2.3**	**2.5**	**Aug-07**
50% MSCI World Index/50% Barclays Aggregate Bond Index			*1.0*	*4.9*	*11.6*	*13.0*	*5.3*	*6.9*	*4.7*	*5.0*	*Aug-07*
Hedge Funds Portable Alpha	**2,972,415,643**	**9.4**	**-0.4**	**4.8**	**5.2**	**6.3**	**5.6**	**7.6**	**8.4**	**8.7**	**Jul-07**
3-Month Libor Total Return USD			*0.1*	*0.6*	*1.2*	*1.3*	*0.8*	*0.6*	*0.8*	*1.0*	*Jul-07*
Public Real Estate	**683,072,897**	**2.2**	**2.9**	**5.2**	**7.4**	**12.1**	**--**	**--**	**--**	**1.7**	**Jul-16**
FTSE NAREIT Equity REIT			*2.7*	*2.7*	*5.5*	*10.4*	*6.4*	*10.3*	*6.9*	*0.7*	*Jul-16*
Private Real Estate	**1,857,787,827**	**5.9**	**0.4**	**5.5**	**9.8**	**10.3**	**12.6**	**15.1**	**--**	**7.0**	**Jul-08**
NCREIF ODCE + 75 bps			*0.1*	*2.1*	*6.3*	*8.6*	*12.1*	*12.5*	*--*	*--*	*Jul-08*
World Infrastructure	**624,878,649**	**2.0**	**1.9**	**4.3**	**15.1**	**17.2**	**--**	**--**	**--**	**7.0**	**Jun-16**
DJ Brookfield Global Infrastructure			*1.9*	*5.1*	*17.2*	*19.9*	*3.9*	*9.2*	*6.7*	*12.5*	*Jun-16*

Returns are based on values obtained from BNYM.
Returns for periods greater than one year are annualized.

Total Retirement System

As of November 30, 2017

Statistics Summary

5 Years Ending November 30, 2017

	Anlzd Return	Anlzd Standard Deviation	Information Ratio	Beta	Sharpe Ratio	Tracking Error
Total Retirement System	7.6%	4.7%	0.3	1.0	1.6	1.1%
Policy Index	7.3%	4.7%	--	1.0	1.5	0.0%
Global Public Equities	12.1%	9.8%	0.3	0.9	1.2	3.4%
MSCI ACWI IMI Net USD	11.2%	10.0%	--	1.0	1.1	0.0%
Private Equity	13.9%	4.2%	-0.2	0.0	3.2	10.1%
80% Russell 3000/20% MSCI EAFE + 300 basis points on a 3-month lag	16.1%	9.5%	--	1.0	1.7	0.0%
Short Duration	1.4%	0.6%	1.6	0.8	2.0	0.4%
BBgBarc US Govt/Credit 1-3 Yr. TR	0.8%	0.7%	--	1.0	0.9	0.0%
Cash and Overlay	-0.1%	0.8%	-0.4	0.1	-0.4	0.8%
BofA Merrill Lynch 91-Day T-Bill	0.2%	0.1%	--	1.0	0.0	0.0%
Core Fixed Income	2.4%	2.9%	0.7	1.0	0.8	0.6%
BBgBarc US Aggregate TR	2.0%	2.8%	--	1.0	0.6	0.0%
Mixed Credit	4.2%	3.4%	-0.4	1.1	1.2	1.6%
50% S&P LSTA Leveraged Loan Index/50% Barclays High Yield Index	4.8%	2.8%	--	1.0	1.6	0.0%
Private Debt	8.0%	3.3%	0.7	0.5	2.3	3.4%
S&P LSTA Leveraged Loan Index + 150 basis points on a 3-month lag	5.7%	2.4%	--	1.0	2.3	0.0%
Emerging Market Debt	2.0%	8.7%	0.3	1.0	0.2	1.5%
50% JP Morgan EMBI Global Diversified (USD)/50% JP Morgan EMBI Global Diversified	1.5%	8.3%	--	1.0	0.2	0.0%

Total Retirement System

As of November 30, 2017

	Anlzd Return	Anlzd Standard Deviation	Information Ratio	Beta	Sharpe Ratio	Tracking Error
GAA	4.6%	6.1%	-0.9	1.1	0.7	2.5%
50% MSCI World Index/50% Barclays Aggregate Bond Index	6.9%	5.2%	--	1.0	1.3	0.0%
Hedge Funds Non Portable Alpha	3.5%	3.4%	-0.8	0.4	0.9	4.4%
50% MSCI World Index/50% Barclays Aggregate Bond Index	6.9%	5.2%	--	1.0	1.3	0.0%
Hedge Funds Portable Alpha	7.6%	4.3%	1.6	-2.9	1.7	4.3%
3-Month Libor Total Return USD	0.6%	0.1%	--	1.0	2.7	0.0%
Private Real Estate	15.1%	3.4%	0.5	0.1	4.3	5.6%
NCREIF ODCE + 75 bps	12.5%	4.8%	--	1.0	2.6	0.0%

Disclosure Appendix	
Item 1.	Fiscal year begins July 1.
Item 2.	All returns are presented net of management fees.
Item 3.	Policy index performance is calculated by multiplying each asset class target weight by the performance of its respective benchmark.
Item 4.	As stipulated in the Statement of Investment Objectives and Policies, the target weights to Private Equity, Private Debt and Real Estate will be equal to their actual weights, reported by the custodial bank, as of the prior month end. In the case of Private Equity, the use of the actual weight will affect the target allocation to Global Equity. For example, in FY 17-18, the combined target weight of both of these asset classes shall equal 42% of the Plan. For Private Debt, the use of the actual weight will affect the target allocation to Mixed Credit, such that the combined target weight of both asset classes in FY 17-18 shall equal 13% of the Plan. For private market Real Estate, the use of the actual weight will affect the target allocation to public market Real Estate (REITs), such that the combined target weight of both asset classes in FY 17-18 shall equal 8% of the Plan
Item 5.	Overlay exposure is reported from Russell. Market values and performance reported by BNYM are reconciled to manager reported data for public markets strategies.
Item 6.	Total retirement system performance is calculated inclusive of the overlay investments. Individual asset class performance is reported by BNYM excluding synthetic exposure from the overlay program.
Item 7.	Asset classes with less than five years of historical returns are excluded from the risk statistics summary.

Annual Investment Plan (FY 18-19): Summary of Proposed Initiatives

Geoff Berg, CIO
Robert Feinstein, Managing Director

AIP for FY 2018-19 - Three priorities during the coming fiscal year

- **Building out the investment risk function**
  - Develop new risk tools for use by both the Investment team and the Commission.

- **Reducing fees and expenses** – We will continue to:
  - Examine the mix of structural and variable costs throughout the portfolio; and
  - Pursue other opportunities to improve the cost of the investment program (e.g., co-investments).

- **Currency hedging evaluation**
  - Assess the operational and portfolio impacts of hedging all or a portion of FX risk.

Strategic Risk Framework

The Challenge

- Employ a mosaic approach to Risk Management / Reporting
  - ***Total Portfolio Risk Benchmark***
  - Liquidity Risk
  - Asset Class Risk
  - Liability Risk

- Total Portfolio Risk framework goals:
  - Create a valid risk benchmark
  - Attack portfolio data latency issue
  - Develop ability to observe risk in real-time (daily)
  - Evaluate historical impact of potential portfolio actions

- Continue to iterate and test potential improvements

Challenge: Create Intuitive Framework For Benchmarking Risk

- Transition to top-down, allocation-based approach
  - Current allocation weights are assigned to representative indices for each asset class
- Compare current asset allocation to a simple, intuitive reference portfolio (the "Risk Benchmark")
  - Risk Benchmark uses only two assets, Global Equities and Core Fixed Income
  - ***70/30 stock-bond portfolio consistently explains majority of risk profile***
- Enables a straightforward conversation about Portfolio Risk
  - Avoids temptation to address risk in an overly-technical way

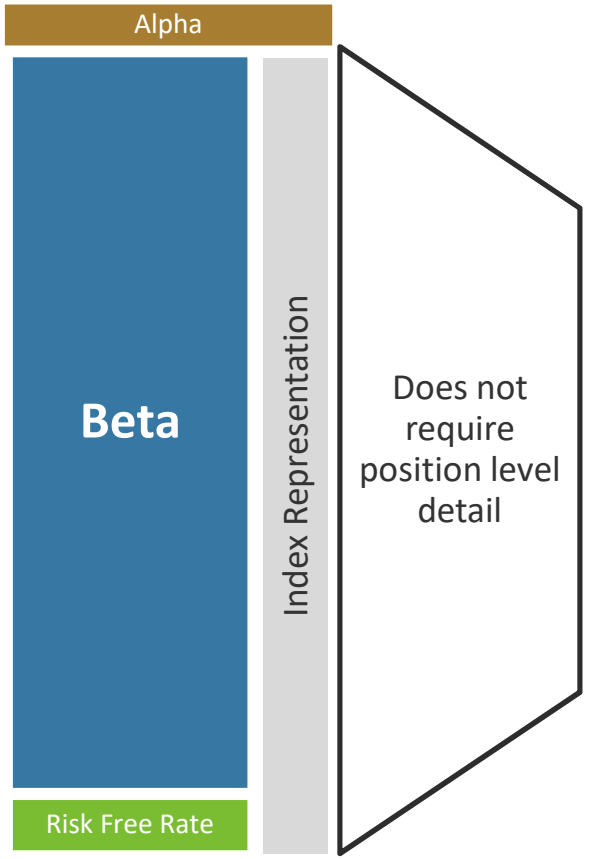
	Portfolio Risk Proxy		Current Allocation	
	Weights	Contribution to Volatility	Weights	Contribution to Volatility
Global Equity	70.00%	10.55%	48.80%	9.00%
Core Fixed Income	30.00%	0.04%	12.90%	-0.01%
Diversified Credit			17.20%	0.25%
Other Opportunistic			11.50%	0.86%
Real Assets			9.70%	1.25%
Totals	**100%**	**10.59%**	**100%**	**11.35%**

**Current contributions to volatility as of 02/05/2018*

Pros / Cons

- Advantages:
  - Captures > 90% of portfolio volatility
  - Operates in real-time
    - Does not require position level detail to function
  - Does not rely on normal return distributions
  - Identifies asset class contributions to risk
  - Flexible framework allows for customizable choice of rolling windows, periodicity, etc.

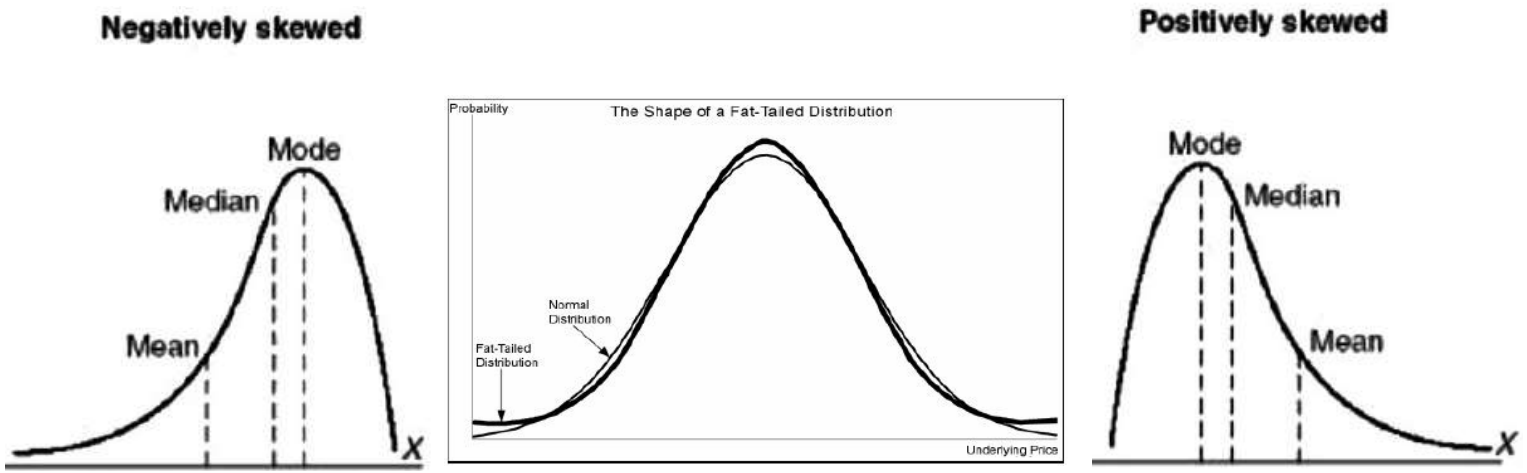
- Considerations:
  - Relies on the use of proxy indices
    - Will continue to iterate improvements
  - Does not identify risks associated with manager-specific active bets
    - Timeliness vs. Accuracy



$$r = \alpha + \beta(r_m - r_f) + r_f$$

Methodology

- Extend current allocation throughout history
- Capture non-normality of asset returns.
  - Most asset classes are not normal, and exhibit varying degrees of skew/kurtosis.
- Calculate risk metrics based on a rolling window
- Implement stress tests
- Compare output to risk benchmark

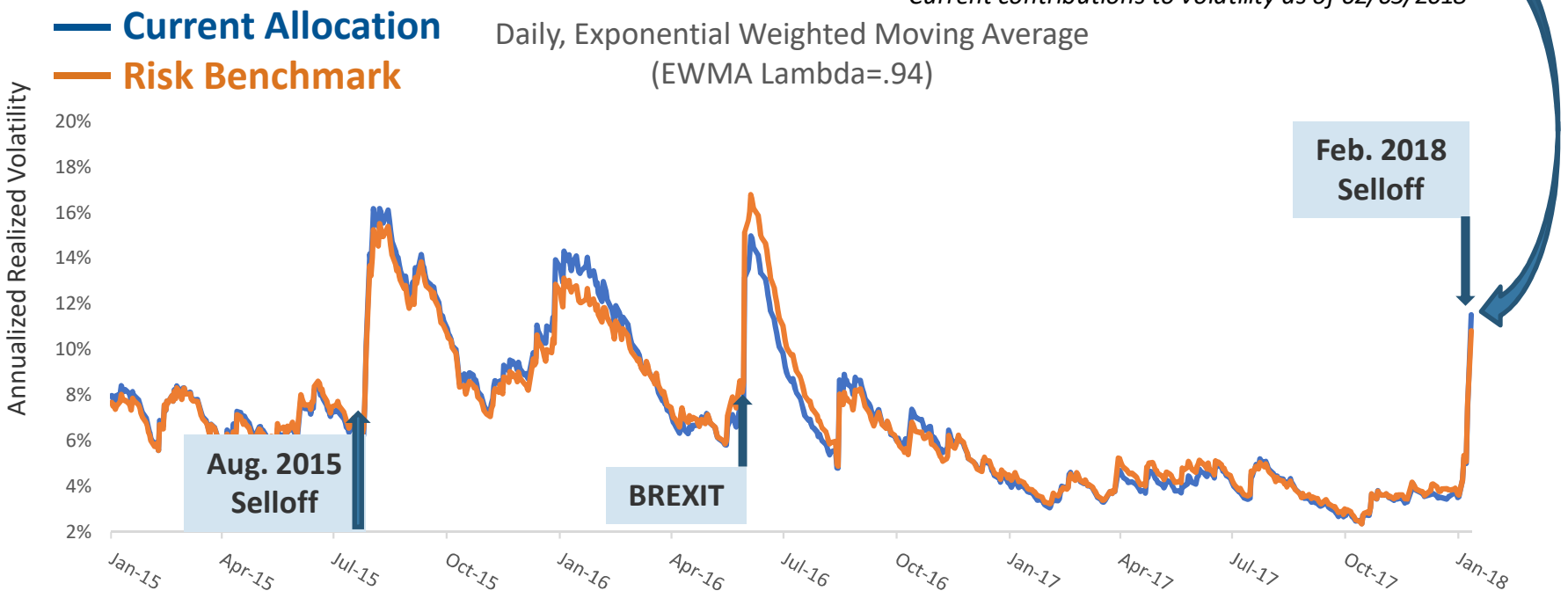


Sample Output

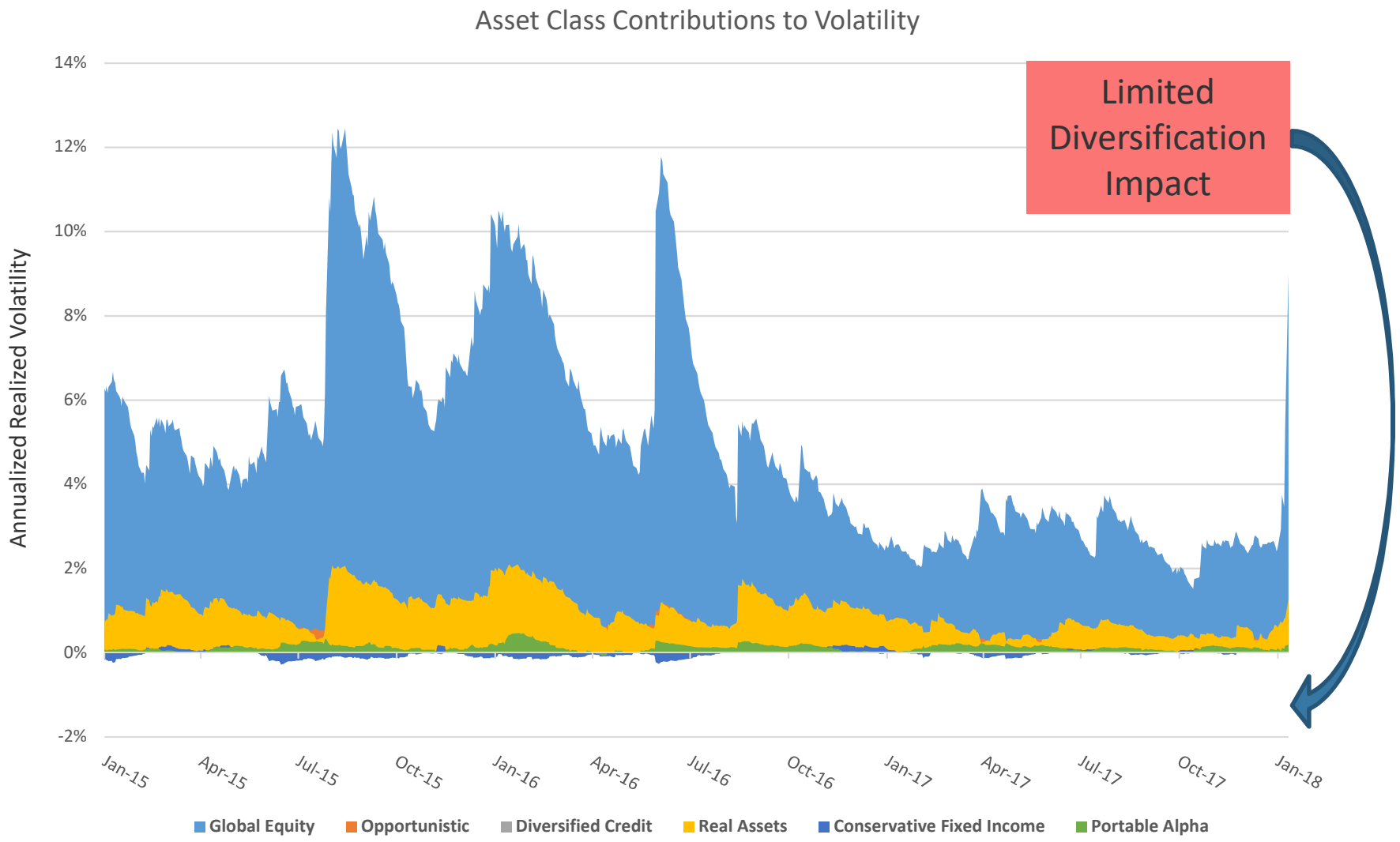
- Moving average with decaying volatility
- Shorter window focus can produce whipsawing, but captures extreme events well

	Portfolio Risk Proxy		Current Allocation	
	Weights	Contribution to Volatility	Weights	Contribution to Volatility
Global Equity	70.00%	10.55%	48.80%	9.00%
Core Fixed Income	30.00%	0.04%	12.90%	-0.01%
Diversified Credit			17.20%	0.25%
Other Opportunistic			11.50%	0.86%
Real Assets			9.70%	1.25%
Totals	**100%**	**10.59%**	**100%**	**11.35%**

**Current contributions to volatility as of 02/05/2018*

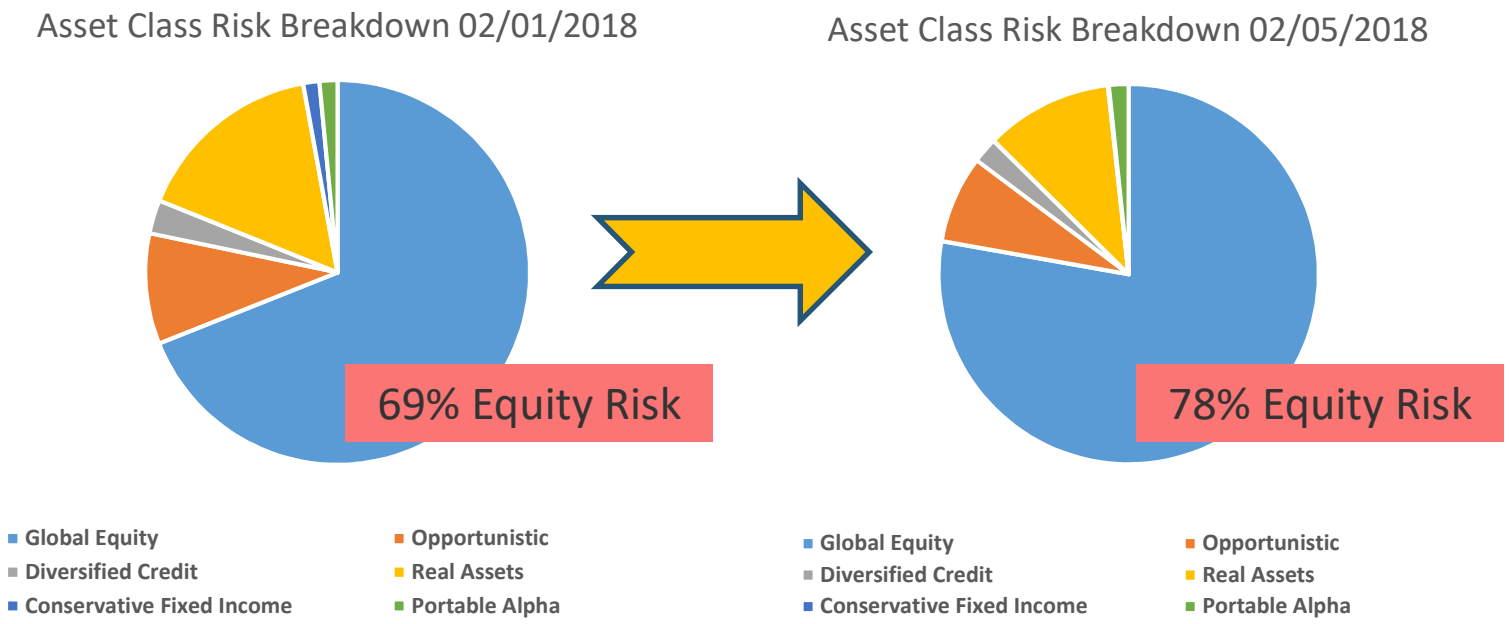


Sources of Risk in Current Allocation



Allocation Contributions to Volatility

- Contribution to volatility from individual asset classes
  - Dependent on both standard deviation and correlation with portfolio
- What changed during Monday's selloff?
  - Essentially no diversification effect from other assets



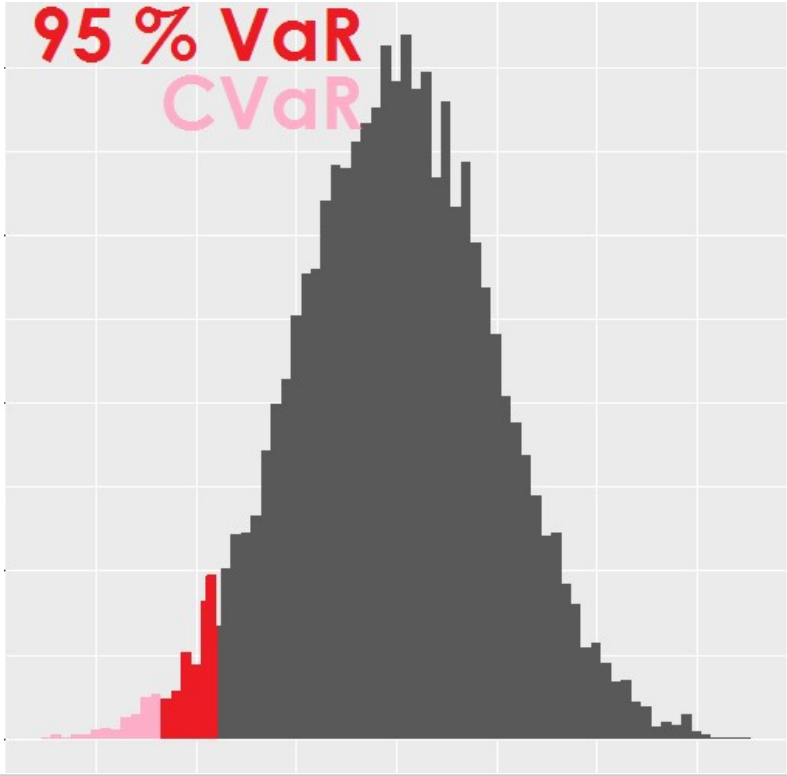
Beyond Portfolio Volatility

- Volatility is just one dimension of portfolio risk

- Other commonly employed metrics include Value-at-Risk (VaR) and Conditional Value-at-Risk (CVaR)

Value-at-Risk (VaR): What is the most I can expect to lose over a given time frame given a certain level of confidence?

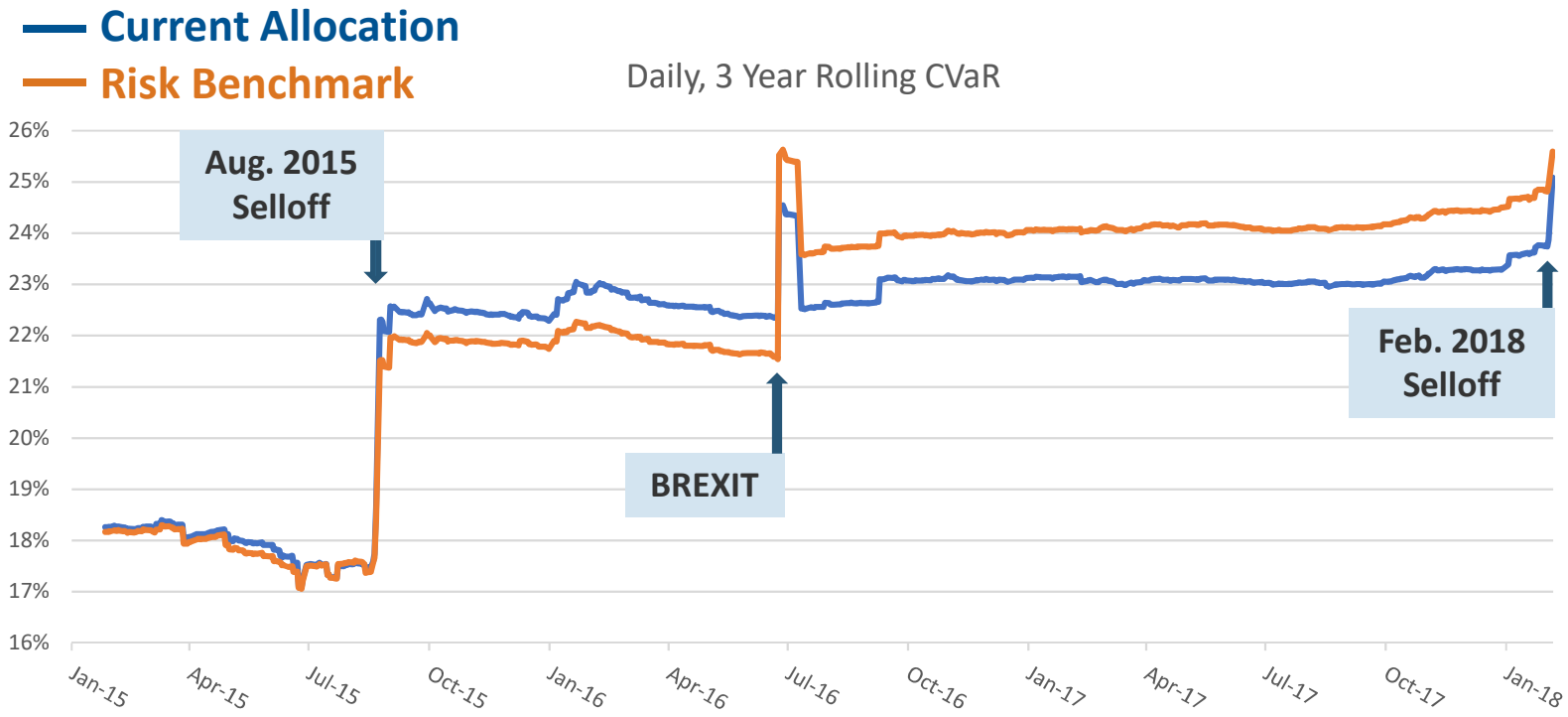
Conditional Value-at-Risk (CVaR): Given some large loss exceeding VaR, on average, how much can I expect to lose?



Conditional Value-at-Risk (CVaR)

- We have chosen to focus on CVaR
  - Better metric for capturing tail properties

- Current allocation CVaR shows an improvement post-BREXIT until the Monday selloff



Next Steps

- Monitoring of systemic (market) risk
  - Quantifying how much of portfolio's risk is attributable to market risk rather than just "equities"
- Measures of asset class drawdowns and/or evidence of mean reversion
  - Implications for rebalancing
- Quantify changing correlations between asset classes
  - Estimation of tail correlations
- Estimate plan and asset class level factor betas

South Carolina Retirement System Investment Commission

Asset Allocation Review and Risk Analysis

Presented
February 8, 2018

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Introduction

Introduction

- At the December 2017 Commission meeting, Meketa Investment Group reviewed a wide array of possible policy options.
- Several of the options were illustrative, showing, for example, portfolios with expected risk and return much lower and much higher than the current portfolio. It also showed the impact of investing only in public markets or only in U.S. Dollar assets.
- This document presents a more concise list of alternative asset allocation options for the Retirement System to consider adopting.

Asset Allocation Overview

Developing Investment Objectives

What is the Retirement System's long-term return objective?

- Benefits stability and /or growth
- Meet or exceed actuarial assumed rate of return of 7.25%
- Improve funded status
- Maintain purchasing power

What are the Retirement System's risk objectives?

- Volatility
  - Endpoint uncertainty
  - Year-to-year fluctuations in asset values and contribution levels
- Risk of short-term loss
- Permanent capital impairment
  - Failure to meet objectives
- Probability of meeting your assumed rate of return

Developing Investment Constraints

What is the overall time horizon for the Retirement System?

- On-going concern, with long-term time horizon for majority of assets.

What are the liquidity needs of the Retirement System?

- Net cash outflows of approximately $800 million per fiscal year for the next five years[1].

What are the legal and regulatory constraints under which the Retirement System operates?

- South Carolina Code Ann. Title 9, Chapter 16
  - This includes a 70% maximum limitation on equities.

Are there any other considerations that must be evaluated?

- Increasing contribution levels in the future.
- Changing ratio of active to retired participants in the Retirement System?
- State fiscal and budget status?

[1] The net outflow is expected to decline over each of the next five years, averaging $630 million from 2019 to 2022.

Proposed Policy Options

Review of Proposed Asset Allocation Policies

- Staff and Meketa Investment Group discussed numerous policy options and went through multiple iterations for several of the options.
- Meketa Investment Group recently completed its 2018 Asset Study, which resulted in marginal changes to the expectations of the asset mixes discussed during the December 2017 Commission meeting.
- The following page shows the current policy, the peer average, and three alternative policies for the Commission to consider adopting.
- The three alternative policies have return expectations of 7.4%, 7.5% and 7.6%.
- The subsequent pages describe the thematic changes consistent across all proposed policies.
- In addition we highlight the required implementation steps needed to adopt each proposed policy mix.
- The rest of this presentation looks at various measures of risk, such as stress tests, scenario analysis, liquidity analysis, liability analysis and drawdown analysis, in an attempt to provide a more complete assessment of the different risks within each proposed policy mix.

Recommended Asset Allocation Policy Options[1]

	Current Policy (%)	Policy X (%)	Policy Y (%)	Policy Z (%)	Peer Average (%)	Ranges (%)
Rate Sensitive:	**12**	**16**	**14**	**14**	**18**	**+/- 10**
Cash & Short-term Bonds	2	1	1	1	1	< 7
Core Bonds	10	15	13	13	17	+/- 7
Credit:	**18**	**15**	**15**	**14**	**7**	**+/- 5**
High Yield Bonds & Bank Loans	6	4	4	3	3	+/- 4
Private Debt	7	7	7	7	1	+/- 4
Emerging Market Debt	5	4	4	4	3	+/- 2
Equities:	**49**	**48**	**51**	**54**	**53**	**+8 / -20**
Global Public Equity	40	39	42	44	44	+8 / -20
Private Equity	9	9	9	10	9	+/- 4
Real Assets:	**11**	**12**	**12**	**11**	**12**	**+/- 5**
Real Estate	8	9	9	9	9	+/- 4
Infrastructure	3	3	3	2	2	+/- 2
Commodities & Natural Resources	0	0	0	0	1	n/a
Opportunistic	**20**	**19**	**18**	**17**	**10**	**+/- 6**
Hedge Funds[2] - Portable Alpha	10	10	10	10	8	< 12
Tactical Asset Allocation	8	7	7	6	2	+/- 4
Other Opportunistic & Risk Parity	2	2	1	1	0	< 3
Non-U.S. Dollar Exposure	*26*	*25*	*26*	*28*	*18*	
Expected Return	**7.4**	**7.4**	**7.5**	**7.6**	**7.2**	
Standard Deviation	**13.7**	**13.3**	**13.7**	**14.0**	**12.9**	
Probability of Achieving 7.25% over 20 Years	**51.4**	**51.2**	**52.1**	**53.6**	**48.0**	

[1] Expected return and standard deviation are based upon Meketa Investment Group's 2018 Annual Asset Study. Throughout this document, returns for periods longer than one year are annualized. Current Policy, Policies X, Y & Z sum to 110% exposure because of the Portable Alpha program.

[2] For the Current Policy (FY 18-19) and Policies X, Y & Z, the target allocation to hedge funds is via portable alpha. MIG modified its correlation assumptions for hedge funds to be more consistent with the expectations of the RSIC program. The Peer Average allocation to hedge funds represents traditional hedge fund exposure (not portable alpha).

Sub Asset Class Decomposition for Select Assets

	Current Policy (%)	Policy X (%)	Policy Y (%)	Policy Z (%)	Peer Average (%)
Core Bonds:	**10**	**15**	**13**	**13**	**17**
Nominal Investment Grade Bonds	6	7	6	5	9
Treasuries[1] (Intermediate/Long Duration)	4	5	5	6	5
TIPS	0	3	2	2	3
Global Public Equities:	**40**	**39**	**42**	**44**	**44**
U.S. Equity	18	17	18	18	31
Developed Market Equity (non-U.S.)	13	10	11	12	7
Emerging Market Equity	4	6	6	7	6
Option-Based Equity	5	6	7	7	0
Real Estate:	**8**	**9**	**9**	**9**	**8**
Public (REITs)	1	1	1	1	2
Private Core Real Estate	3	5	5	5	5
Private Non-Core Real Estate	4	3	3	3	1
Infrastructure:	**3**	**3**	**3**	**2**	**2**
Public	1	1	1	0	1
Private Core Infrastructure	2	1	1	1	1
Private Non-Core Infrastructure	0	1	1	1	0

[1] In Policy X, Y & Z, the Treasuries allocation was modeled with 80% intermediate duration and 20% long duration Treasuries.

Proposed Changes

- **Reduce cash.**
  - Cash is the asset class with the lowest expected return. As such, any allocation to it acts as a drag on portfolio returns.
  - The range for cash would be left broad, to accommodate liquidity needs as well as serve as a safe destination for assets during an extreme market event.
- **Increase exposure to Treasuries and TIPS within the core bonds allocation.**
  - Government bonds have historically been the most reliable hedge against bear markets in stocks.
  - TIPS would further diversify the bond portfolio, while providing a modest hedge against any unexpected increase in inflation.
- **Rotate some credit exposure into public equities.**
  - Credit spreads are extremely tight, providing less potential return for investors holding high yield bonds.
- **Rotate within public equites: decrease developed market (non-U.S.) and increase emerging market exposure.**
  - EM equities have the highest expected return among public market asset classes. Adding to EM equities would increase the return potential without sacrificing liquidity.
  - To mitigate currency risk, the allocation to EM debt (and developed non-US equity in several options) would be concurrently reduced.

Proposed Changes (continued)

- **Re-allocate within real estate.**
  - The allocation between core and non-core real estate would change. The mix would shift from its current blend of being predominantly non-core to being predominantly core (e.g., 50-70% core), consistent with the majority of peers.
- **Include risk parity in the Other Opportunistic category and set an upper bound.**
  - Meketa and Staff envision this allocation as being truly opportunistic. That is, assets would not necessarily be allocated to the category unless/until the right opportunities are identified and vetted. Risk parity can serve as a "place holder" for such assets.

Implementation – Exposure Change vs. Current Policy

- The following table shows the relative change for each policy mix versus the existing long term policy.

	Policy X (%)	Policy Y (%)	Policy Z (%)
Rate Sensitive:	**+4**	**+2**	**+2**
Cash & Short-term Bonds	-1	-1	-1
Core Bonds	+5	+3	+3
Credit:	**-3**	**-3**	**-4**
High Yield Bonds & Bank Loans	-2	-2	-3
Private Debt	0	0	0
Emerging Market Debt	-1	-1	-1
Equities:	**-1**	**+2**	**+5**
Global Public Equity	-1	+2	+4
Private Equity	0	0	+1
Real Assets:	**+1**	**+1**	**0**
Real Estate	+1	+1	+1
Infrastructure	0	0	-1
Opportunistic	**-1**	**-2**	**-3**
Hedge Funds - Portable Alpha	0	0	0
Tactical Asset Allocation	-1	-1	-2
Other Opportunistic & Risk Parity	0	-1	-1
Expected Return	**0.0**	**+0.1**	**+0.2**
Standard Deviation	**-0.4**	**0.0**	**+0.3**

Implementation Comments

- There are no significant liquidity concerns with moving the current exposure to any of the proposed policy mixes.
  - The slowest process would likely be the proposed transition to more in core real estate from non-core real estate, the latter of which are usually in closed-end vehicles offering no regular liquidity.
- The proposed reductions in credit strategies and proposed re-allocation within the public global equity portfolios could likely be completed without any changes to the current roster of managers (subject to the opinion of Staff).
- All of the proposed mixes would require new mandates to TIPS and dedicated Treasuries strategies.
  - These could be implemented relatively quickly, especially if they are implemented with passive strategies such as index funds or futures.
- The private equity allocation is currently below its long-term target. Bringing it up to its target allocation will take multiple years to complete. The use of the floating targets (as is current practice) for private market asset classes, will not meaningfully alter the current exposure, as the underweight to private market asset classes is "parked" in the public market substitute.

Comparison to Peers - Tracking Error

- The Retirement System's current target and proposed asset allocation policies are different than that of its peers.
- Each fund in the peer group is unique and differs in some way from the average of the peer group.
- Based on the peer average, the Retirement System can expect long-term tracking error (i.e., over a 20-year period) for each policy as follows:

Policy	Tracking Error per Annum (%)
Current Policy	1.5
Policy X	1.3
Policy Y	1.4
Policy Z	1.6

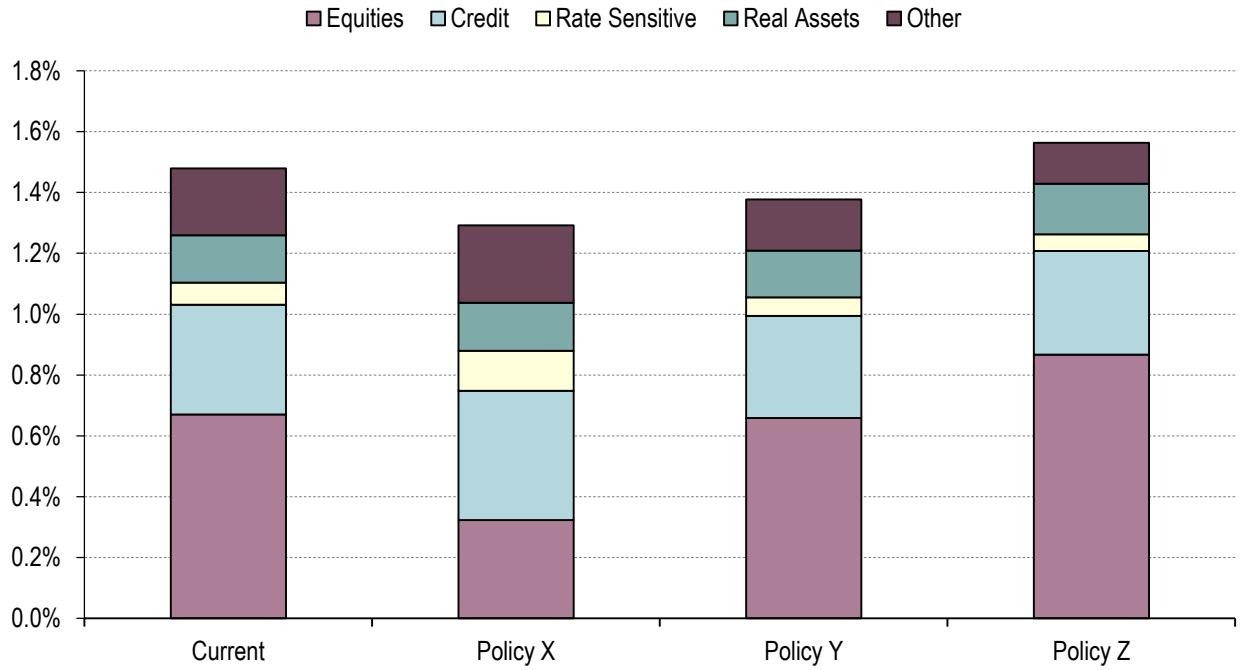
- The tracking error of all three policy mixes is much lower than the "book-end" mixes that were discussed in December 2017[1].
- For reference, a positive 2% tracking error would have moved a median plan up to the 16th percentile over the trailing ten years[2]; and a negative 2% tracking error would have moved the median plan down to the 77th percentile.

[1] Assuming a one standard deviation event. The tracking error for the mixes reviewed in December ranged from 1.6% to 2.7%.
[2] Based on Investor Force Public DB >$1B Universe as of September 30, 2017.

Decomposition of Tracking Error

- Tracking error relative to the peer group can come from many different sources.
- The chart below examines the sources of tracking error due to differences in asset allocation.
  - Note that additional tracking error can be expected due to variances resulting from active management.

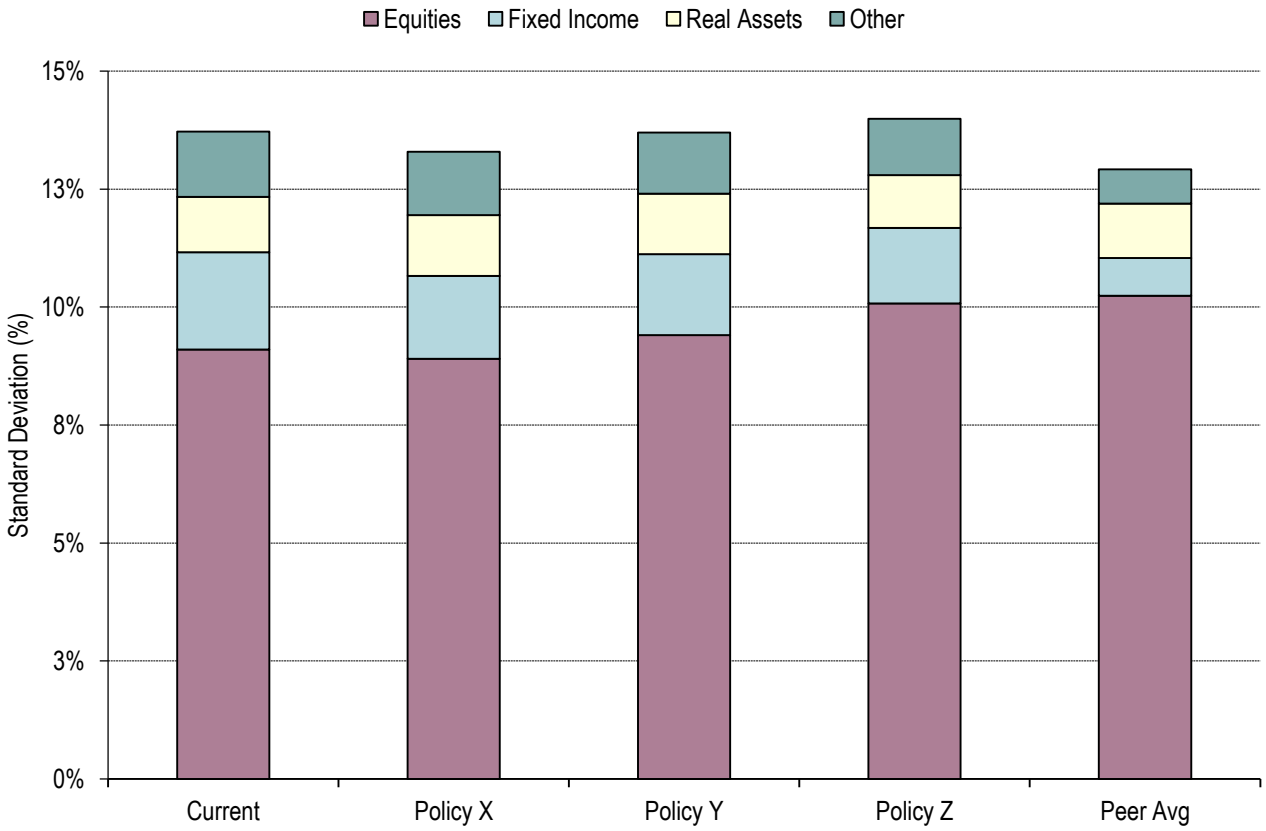
Source of Tracking Error by Asset Group[1]



- Policy X is most similar to the peer average because it has the lowest allocation to international equities and the highest exposure to core bonds of the four mixes.

[1] Other includes Hedge Funds, Tactical Asset Allocation and Risk Parity.

Risk Budgeting Analysis[1]
(Absolute Contribution to Risk)



- No matter which policy is selected, equities will represent the largest source of risk.

[1] Other includes Hedge Funds, TAA and risk parity.

MVO-Based Risk Analysis

Scenario:	Current Policy (%)	Policy X (%)	Policy Y (%)	Policy Z (%)	Peer Average (%)
"Worst Case" Returns[1]:					
One Year	-22.4	-21.7	-22.4	-22.8	-21.2
Three Years *(annualized)*	-11.0	-10.5	-10.9	-11.2	-10.3
Five Years *(annualized)*	-7.2	-6.8	-7.1	-7.3	-6.6
Ten Years *(annualized)*	-3.1	-2.9	-3.1	-3.2	-2.8
Probability of Experiencing Negative Returns					
One Year	28.7	28.2	28.5	28.6	28.2
Three Years	16.5	15.8	16.3	16.4	15.9
Five Years	10.4	9.8	10.2	10.3	9.9
Ten Years	3.8	3.4	3.6	3.7	3.4

- Policy Z is structured to have the highest likelihood of reaching the target return over the long term. It also has the highest "worst case" returns, though the difference between it and the worst case for the current policy is 40 basis points.
- Each of the policy options considered would be expected to produce a negative return roughly two out of every seven years.

[1] "Worst Case" Return Projections encompass 99th percentile of possible outcomes.

Value at Risk[1]

Scenario	Current Policy	Policy X	Policy Y	Policy Z	Peer Average
VaR (%):					
One Month	-8.6	-8.3	-8.5	-8.7	-8.1
Three Months	-14.0	-13.5	-14.0	-14.3	-13.1
VaR ($ mm):					
One Month	-2,704	-2,616	-2,699	-2,758	-2,543
Three Months	-4,415	-4,265	-4,404	-4,502	-4,147

Conditional Value at Risk[1]

Scenario	Current Policy	Policy X	Policy Y	Policy Z	Peer Average
CVaR (%):					
One Month	-9.9	-9.5	-9.8	-10.1	-9.3
Three Months	-16.2	-15.7	-16.2	-16.5	-15.2
CVaR ($ mm):					
One Month	-3,115	-3,014	-3,109	-3,177	-2,930
Three Months	-5,121	-4,949	-5,110	-5,222	-4,813

- According to the CVaR model, the Retirement System could lose up to $3.1 billion in a single month given its current exposure and market value.
- The Peer Average has the lowest VaR and CVaR. It also has the lowest probability of producing a 7.25% return over the long term.

[1] Calculated with a 99% confidence level and based upon Meketa Investment Group's Annual Asset Study. CVaR represents the average loss past the 99th percentile. Based on market value as of November 30, 2017.

Historical Negative Scenario Analysis[1] (*Cumulative* Return)

Scenario:	Current Policy (%)	Policy X (%)	Policy Y (%)	Policy Z (%)	Peer Average (%)
Taper Tantrum (May-Aug 2013)	-0.9	-1.1	-0.9	-0.9	-0.6
Global Financial Crisis (4Q07 thru 1Q09)	-27.1	-25.0	-26.3	-26.4	-25.6
Popping of the TMT bubble (Apr 2000 – Sep 2002)	-9.2	-8.0	-9.9	-10.5	-11.7
LTCM (Jul – Aug 1998)	-10.0	-9.7	-10.0	-10.2	-9.5
Interest Rate Spike (1994)	1.9	0.9	1.2	1.4	1.5
Crash of 1987 (September thru November 1987)	-11.9	-11.5	-12.1	-12.2	-12.7
Strong U.S. Dollar (1Q81 through 3Q82)	1.5	2.6	1.6	1.3	3.6
Stagflation (January thru March 1980)	-4.4	-4.3	-4.1	-4.2	-4.2
Stagflation (1Q73 thru 3Q74)	-23.8	-22.4	-23.4	-24.1	-20.4

- Policy X would have performed the *best* in environments of declining equity markets, due to its more conservative positioning.
- Policy X would have fared *worst* during periods of rising rates; however, the losses in these environments are dwarfed by the losses during an equity downturn.

[1] See the Appendix for our scenario inputs. In periods where the ideal benchmark was not yet available we used the next closest benchmark(s) as a proxy.

Historical Positive Scenario Analysis[1]
(Cumulative Return)

Scenario	Current Policy (%)	Policy X (%)	Policy Y (%)	Policy Z (%)	Peer Average (%)
Global Financial Crisis Recovery (Mar 2009 - Nov 2009)	35.8	34.3	35.4	35.7	34.5
Best of Great Moderation (Apr 2003 -Feb 2004)	31.6	30.9	31.8	32.5	29.4
Peak of the TMT Bubble (Oct 1998 - Mar 2000)	44.0	43.8	44.9	47.0	42.8
Plummeting Dollar (Jan 1986 - Aug 1987)	54.1	51.4	53.0	54.5	50.3
Volcker Recovery (Aug 1982 - Apr 1983)	31.4	30.7	30.8	31.1	34.0
Bretton Wood Recovery (Oct 1974 - Jun 1975)	28.1	27.1	27.8	28.3	29.9

- The Current Policy and Policy Z would have been the best options for capturing most of the upside historically in strongly positive markets.

[1] See the Appendix for our scenario inputs. In periods where the ideal benchmark was not yet available we used the next closest benchmark(s) as a proxy.

Stress Testing: Impact of Market Movements
(Expected Return under Stressed Conditions)[1]

What happens if (over a 12-month period):	Current Policy (%)	Policy X (%)	Policy Y (%)	Policy Z (%)	Peer Average (%)
10-Year T-Bond rates rise 100 bp	6.2	5.9	6.2	6.2	5.7
10-Year T-Bond rates rise 200 bp	4.2	3.9	4.3	4.3	3.4
10-Year T-Bond rates rise 300 bp	2.4	1.9	2.5	2.3	1.6
BBB Spreads widen by 50 bp, HY by 200 bp	-0.8	-0.6	-0.8	-0.8	-0.6
BBB Spreads widen by 300 bp, HY by 1000 bp	-22.2	-21.1	-21.9	-22.0	-20.2
Trade-weighted U.S.$ gains 10%	-0.6	-0.3	-0.4	-0.5	0.4
Trade-weighted U.S.$ gains 20%	-2.3	-2.1	-2.1	-2.1	-1.7
Equities decline 10%	-5.7	-5.3	-5.6	-5.7	-5.4
Equities decline 25%	-15.3	-14.6	-15.1	-15.3	-14.9
Equities decline 40%	-27.5	-26.6	-27.5	-27.6	-26.3

- Each policy portfolio has a different sensitivity to four major risk factors: interest rates, credit spreads, currency fluctuations, and equity values.
- The System's largest risk factors would continue to be an equity market decline and a widening of credit spreads, no matter the policy.

[1] Assumes that assets not directly exposed to the factor are affected nonetheless. See the Appendix for further details.

Stress Testing: Impact of Positive Market Movements

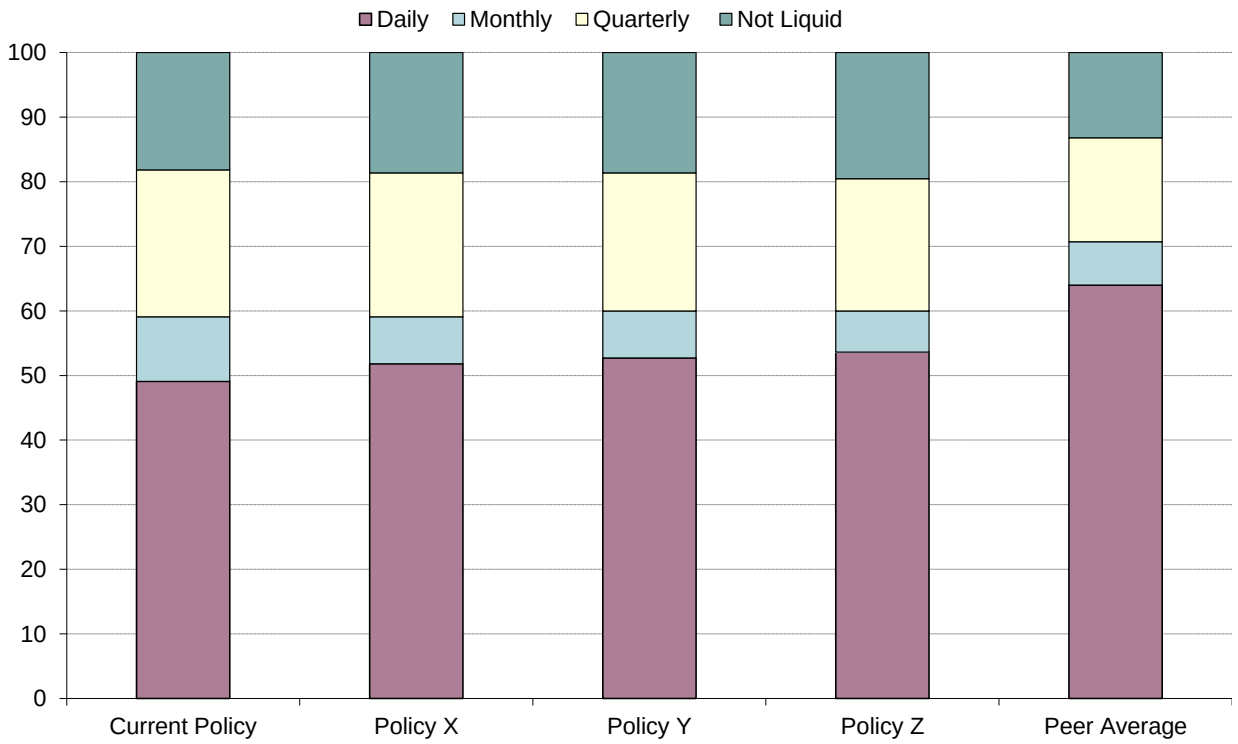
(Expected Return under Stressed Conditions)[1]

What happens if (over a 12-month period):	Current Policy (%)	Policy X (%)	Policy Y (%)	Policy Z (%)	Peer Average (%)
10-Year T-Bond rates decline 100 bp	7.9	7.9	7.8	7.9	7.6
10-Year T-Bond rates decline 200 bp	16.6	16.4	16.5	16.9	16.8
BBB Spreads narrow by 30 bp, HY by 100 bp	9.3	9.0	9.2	9.3	8.6
BBB Spreads narrow by 100 bp, HY by 300 bp	16.7	16.1	16.3	16.4	15.1
Trade-weighted U.S.$ declines 10%	7.5	7.2	7.3	7.5	6.6
Trade-weighted U.S.$ declines 20%	17.5	17.1	17.5	18.0	16.7
Equities appreciate 10%	7.6	7.4	7.6	7.7	7.3
Equities appreciate 30%	17.9	17.4	17.8	18.1	18.4

- The portfolios with the least downside risk are likewise the portfolios that participate least in upside scenarios.
- Each of the policy options has more credit and non-USD exposure than the peer average.

[1] Assumes that assets not directly exposed to the factor are affected nonetheless. See the Appendix for further details.

Liquidity Profile[1]



- Each policy portfolio has approximately 60% allocated to daily or monthly liquid assets
- The Peer Average is the most liquid. It has similar sized exposure to private equity and private real estate as RSIC, but much less private debt.

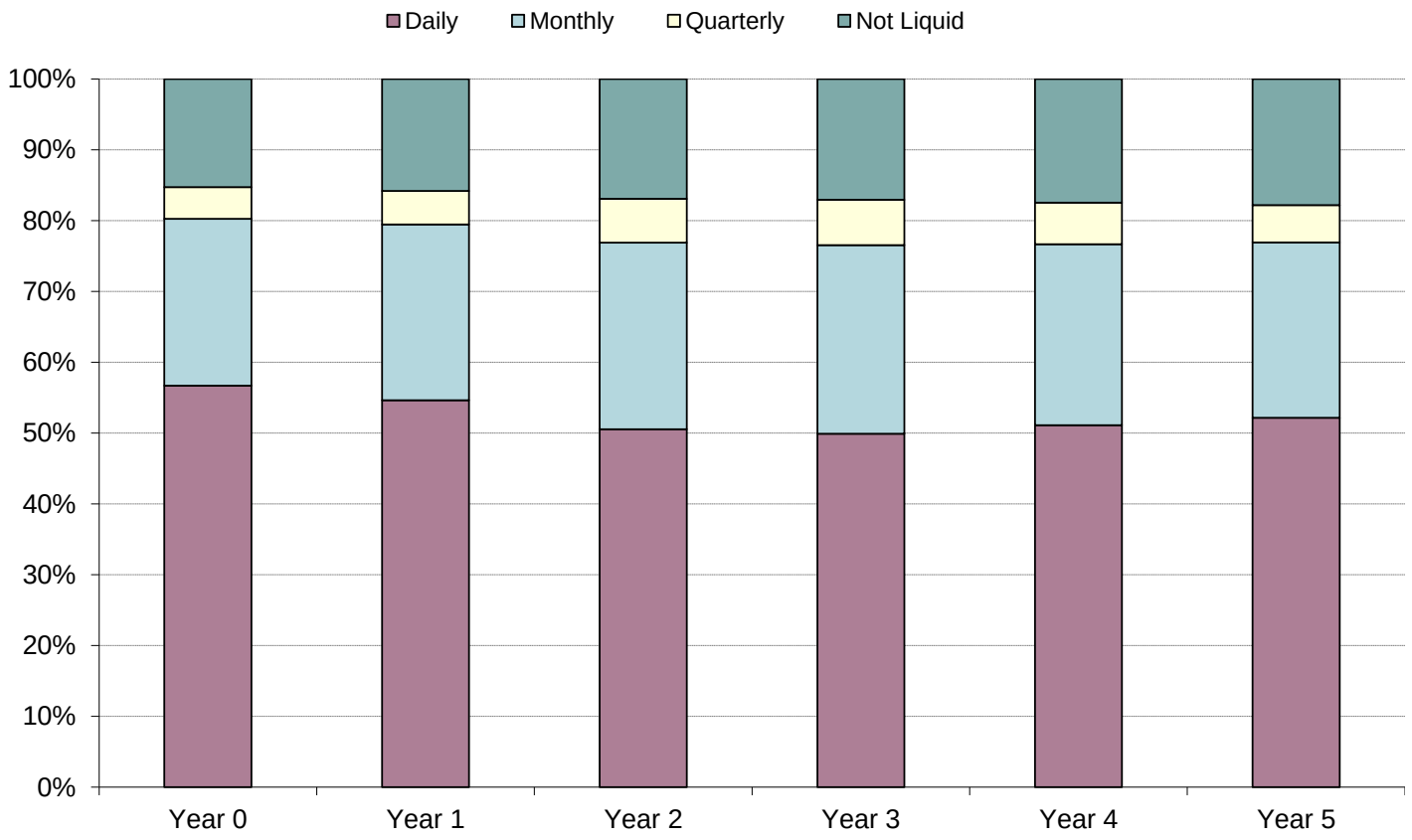
[1] For this analysis, we assume that most liquid credit provides monthly liquidity; core real estate, core infrastructure and hedge funds provide quarterly liquidity; and private equity, private debt, non-core real estate and non-core infrastructure are illiquid.

Liquidity Stress Test Introduction

- We conducted an extreme stress test to analyze the Retirement System's liquidity. Specifically, we evaluated whether the Retirement System could:
  - Continue to meet its benefit obligations and expenses,
  - While staying within its target allocation ranges,
  - And at what cost (i.e., to what extent would it be forced to sell stressed or distressed assets?)
- The scenario is designed to be extreme.
  - In Years 1 – 3, we use the returns produced by each asset class in 4q07, 2008, and 1q09, respectively. In Years 4 – 5, we assume flat (0%) returns for each asset class (i.e., no rebound).
  - We assume net outflows based on data received from the Retirement System's actuary. Specifically we modeled net outflows of $1.433 bb in Year 1, $732 mm in Year 2, $656 mm in Year 3, $564 in Year 4 and $468 mm in Year 5.
  - We assume closed-end funds offer no liquidity.
  - We assume open-end and hedge funds offer no liquidity in years 1 – 3, and limited liquidity in years 4 - 5.
  - We assume the Retirement System would rebalance toward its policy targets each year.
- We show the results based on the current exposure[1] starting on the following pages.

[1] As of September 30, 2017.

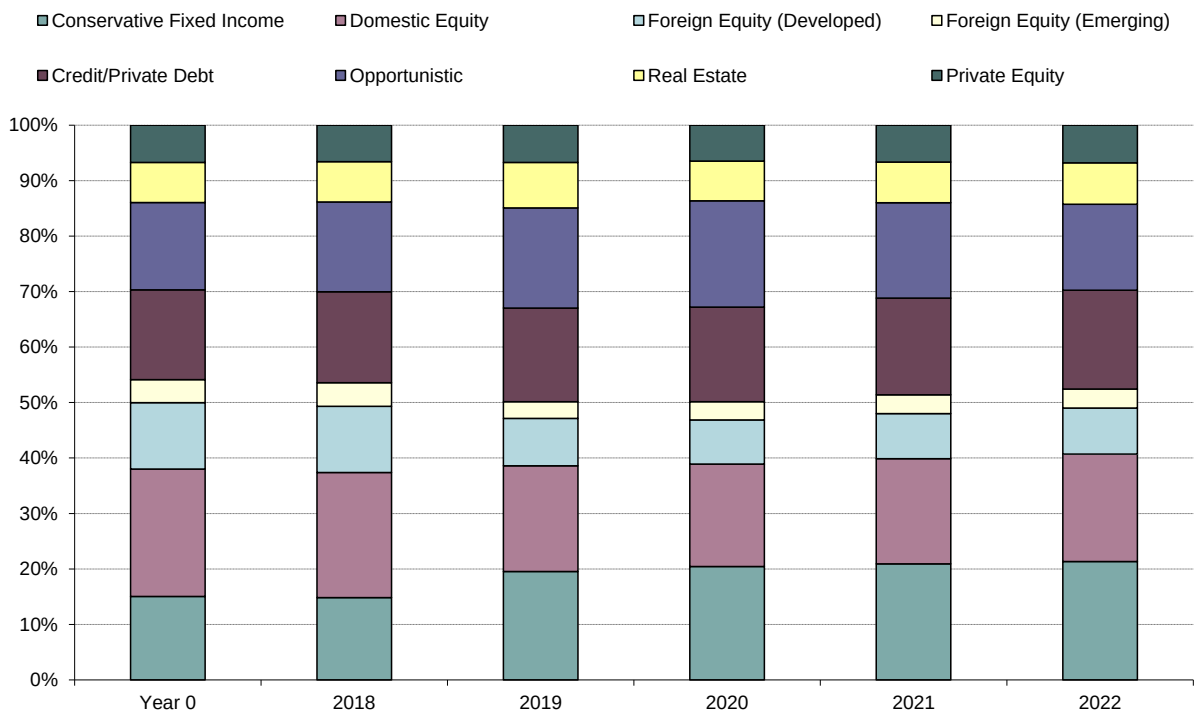
Liquidity Stress Test: Liquidity Profile
(for Current Exposure[1])



- At the trough, the Retirement System would still have 50% of its assets in daily liquid vehicles.

[1] As of September 30, 2017

Liquidity Stress Test: Impact on Asset Allocation
(for Current Exposure[1])



- A stressful market environment would alter the asset allocation. However, rebalancing of the liquid assets would bring most asset classes back to their targets.

[1] As of September 30, 2017

Liquidity Stress Test: Summary
(for Current Exposure[1])

	Year 1	Year 2	Year 3	Year 4	Year 5
Ending Market Value ($ mm)	29,471	22,077	20,352	19,788	19,320
Net Outflows[2] ($ mm)	1,433	732	656	564	468
Outflows as % of Market Value	4.6%	2.5%	3.0%	2.8%	2.4%
% of Assets sold in duress[3]	0%	0%	2.3%	2.8%	2.4%
Remaining Liquid Market Value ($ mm)[4]	23,412	16,976	15,611	15,206	14,895
Estimated Funded Status	53%	39%	35%	33%	32%

- Even under this extreme scenario, the Retirement System would maintain sufficient liquidity to pay benefits and other expenses.
- The Retirement System has sufficient cash and high quality bonds to cover the first two years of expected net outflows[5].
- In this analysis, in years three through five, the System would need to sell some of its assets that have decreased in value by more than 10% in order to meet its obligations (assuming it rebalanced to its target allocations).

1 As of September 30, 2017.
2 Based on forecasted net outflows provided by the Retirement System's actuary.
3 Includes assets sold at more than a 10% loss.
4 Includes all System assets that could be readily liquidated within 30 days.
5 Modeled under the assumption that no margin calls would be needed for the synthetic exposure.

Asset-Liabilities Analysis

Historical Negative Scenario Analysis[1] (Resulting Funded Status[2])

Scenario:	Current Policy (%)	Policy X (%)	Policy Y (%)	Policy Z (%)	Peer Average (%)
Taper Tantrum (May-Aug 2013)	59.0	58.8	59.0	59.0	59.1
Global Financial Crisis (4Q07 thru 1Q09)	43.4	44.6	43.9	43.8	44.2
Popping of the TMT bubble (Apr 2000 – Sep 2002)	54.0	54.7	53.6	53.3	52.5
LTCM (Jul – Aug 1998)	53.6	53.7	53.5	53.4	53.8
Interest Rate Spike (1994)	60.6	60.1	60.2	60.3	60.4
Crash of 1987 (September thru November 1987)	52.4	52.7	52.3	52.2	51.9
Strong U.S. Dollar (1Q81 through 3Q82)	60.4	61.1	60.4	60.3	61.7
Stagflation (January thru March 1980)	56.9	56.9	57.0	57.0	57.0
Stagflation (1Q73 thru 3Q74)	45.3	46.2	45.6	45.2	47.3

- There is no material difference among the proposed policies (or current policy or peer average) in terms of maintaining funded status during a severe market event.
- The most significant factor is the magnitude of the market correction.

[1] See the Appendix for our scenario inputs. In periods where the ideal benchmark was not yet available we used the next closest benchmark(s) as a proxy.
[2] Assumes no change in interest rates when calculating present value of liabilities. Based off total System market value of assets as of November 30, 2017 with starting funded status of 59.5%.

Stress Testing: Impact of Market Movements
(Funded Status[1] under Stressed Conditions)[2]

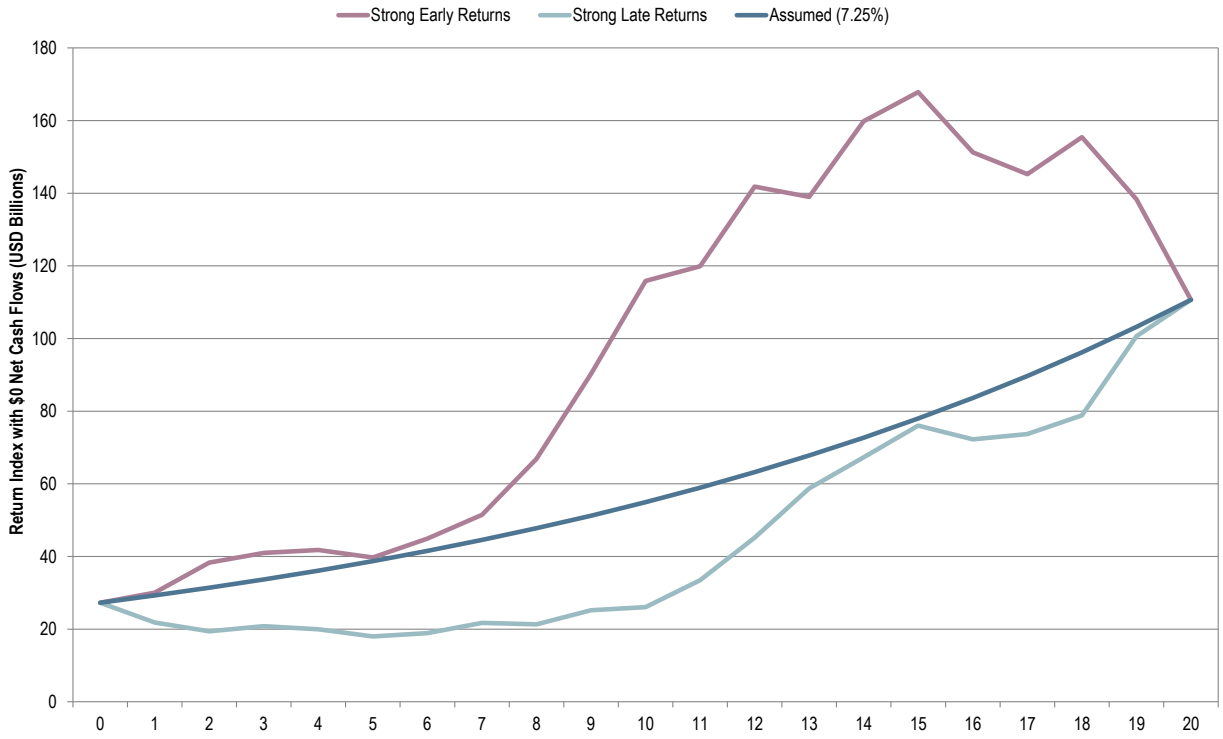
What happens if (over a 12-month period):	Current Policy (%)	Policy X (%)	Policy Y (%)	Policy Z (%)	Peer Average (%)
10-Year T-Bond rates rise 100 bp	63.2	63.0	63.2	63.2	62.9
10-Year T-Bond rates rise 200 bp	62.0	61.8	62.1	62.1	61.5
10-Year T-Bond rates rise 300 bp	60.9	60.6	61.0	60.9	60.5
BBB Spreads widen by 50 bp, HY by 200 bp	59.0	59.1	59.1	59.0	59.2
BBB Spreads widen by 300 bp, HY by 1000 bp	46.3	46.9	46.5	46.4	47.5
Trade-weighted U.S.$ gains 10%	59.1	59.3	59.2	59.2	59.7
Trade-weighted U.S.$ gains 20%	58.2	58.3	58.3	58.3	58.5
Equities decline 10%	56.1	56.3	56.2	56.1	56.3
Equities decline 25%	50.4	50.8	50.5	50.4	50.6
Equities decline 40%	43.1	43.7	43.1	43.1	43.9

- An equity market decline will have the biggest impact on funded status across all the policy mixes.

[1] Assumes no change in interest rates when calculating present value of liabilities. Based off total System market value of assets as of November 30, 2017 with starting funded status of 59.5%.
[2] Assumes that assets not directly exposed to the factor are affected nonetheless. See the Appendix for further details.

Sequence of Returns – Does Not Matter with No Cash Flows

- This analysis reviews three scenarios that achieve the same twenty-year annualized return of 7.25% but that take very different paths to arrive at this destination.
- The "Strong Early Returns" and "Strong Late Returns" scenarios produce the same returns but the order in which the returns are generated is reversed. The third scenario assumes 7.25% is earned every year.
- If net cash flow ("CF") is $0, the ending value is the same for all three scenarios.



Note: Assumes $0 cash flow over the 20-year period. Modeled for SCRS only.

Corresponding Data – Sequence of Returns with No Cash Flows

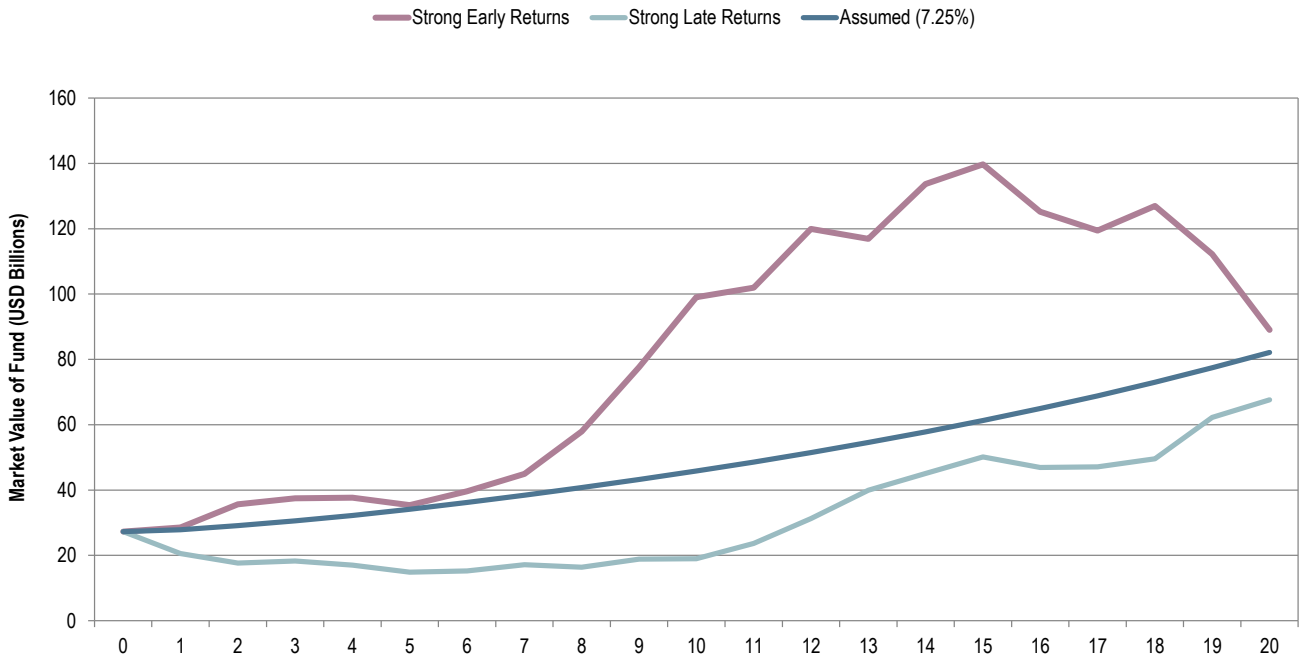
Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Market Values[1] ($ bb)																					
Strong Early Returns (%)	27	30	38	41	42	40	45	51	67	90	116	120	142	139	160	168	151	145	155	138	111
Strong Late Returns (%)	27	22	19	21	20	18	19	22	21	25	26	33	45	59	67	76	72	74	79	101	111
Assumed (7.25%)	27	29	31	34	36	39	42	45	48	51	55	59	63	68	73	78	84	90	96	103	111
Cash Flows ($ bb)																					
Net Cash Flow	-	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Returns (%)																					
Strong Early Returns (%)	-	10	28	7	2	-5	13	15	30	35	28	4	18	-2	15	5	-10	-4	7	-11	-20
Strong Late Returns (%)	-	-20	-11	7	-4	-10	5	15	-2	18	4	28	35	30	15	13	-5	2	7	28	10

- The market values all end up at the exact value at the end of twenty years if there are no cash flows into or out of the System.

[1] Starting market value based on actuarial asset value for SCRS only from 2017 CAFR.

Sequence of Returns - Significant Impact with Negative Cash Flows

- For many plans, high negative cash flow can severely impact the funded status such that it never recovers after a market downturn. Fortunately, for RSIC, negative CF is projected to be relatively small (versus the Market Value) over the next ten years[1].
- Inserting SCRS' projected cash flows, the ending market value (year 20) would be $21 billion higher if strong returns are experienced in the first ten years as opposed to years eleven through twenty.



[1] Note: Contributions, Benefit payments, and actuarial liability figures were provided by the actuary, GRS.

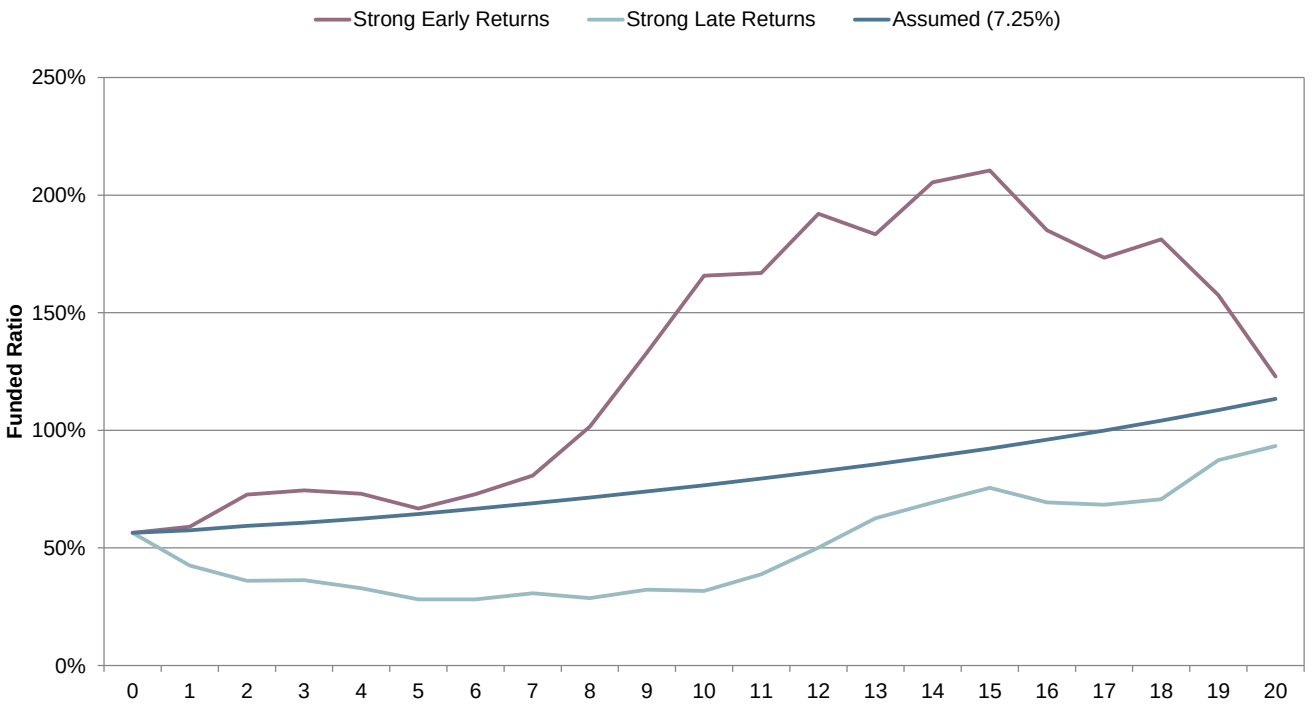
Corresponding Data – Sequence of Returns with Estimated Cash Flows[1]

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Market Values[2] ($ bb)																					
Strong Early Returns (%)	27	29	36	37	38	35	40	45	58	78	99	102	120	117	134	140	125	119	127	112	89
Strong Late Returns (%)	27	21	18	18	17	15	15	17	16	19	19	24	31	40	45	50	47	47	50	62	68
Assumed (7.25%)	27	28	29	31	32	34	36	38	41	43	46	49	51	55	58	61	65	69	73	77	82
Cash Flows ($ bb)																					
Net Cash Flow	-	-1.4	-0.7	-0.6	-0.5	-0.4	-0.4	-0.4	-0.4	-0.5	-0.5	-0.5	-0.6	-0.6	-0.7	-0.7	-0.7	-0.8	-0.8	-0.8	-0.8
Returns (%)																					
Strong Early Returns (%)	-	10	28	7	2	-5	13	15	30	35	28	4	18	-2	15	5	-10	-4	7	-11	-20
Strong Late Returns (%)	-	-20	-11	7	-4	-10	5	15	-2	18	4	28	35	30	15	13	-5	2	7	28	10

- "Strong Early Returns" (inclusive of estimated negative cash flows) results in an estimated ending market value of $89 billion.
- "Strong Late Returns" (inclusive of estimated negative cash flows) results in an estimated ending market value of $68 billion.

[1] Contributions, Benefit payments, and actuarial liability figures were provided by the Actuary, GRS.
[2] Starting market value based on actuarial asset value for SCRS only from 2017 CAFR.

Impact on Funded Status



- The ending (year 20) funded status[1] could range from 93% to 123% for this same hypothetical scenario.

[1] Funded status figures use estimated market values (not smoothed asset values).

Impact on Funded Status (continued)

Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Funded Status[1]																					
Strong Early Returns (%)	56	59	73	74	73	67	73	81	102	133	166	167	192	183	205	211	185	173	181	157	123
Strong Late Returns (%)	56	43	36	36	33	28	28	31	29	32	32	39	50	63	69	76	69	68	71	87	93
Assumed (7.25%)	56	58	59	61	62	64	67	69	71	74	77	80	82	86	89	92	96	100	104	109	113
Cash Flows ($ bb)																					
Net Cash Flow	0.0	-1.4	-0.7	-0.6	-0.5	-0.4	-0.4	-0.4	-0.4	-0.5	-0.5	-0.5	-0.6	-0.6	-0.7	-0.7	-0.7	-0.8	-0.8	-0.8	-0.8
Returns (%)																					
Strong Early Returns (%)	0	10	28	7	2	-5	13	15	30	35	28	4	18	-2	15	5	-10	-4	7	-11	-20
Strong Late Returns (%)	0	-20	-11	7	-4	-10	5	15	-2	18	4	28	35	30	15	13	-5	2	7	28	10

[1] Starting market value based on actuarial asset value for SCRS only from 2017 CAFR. Contributions, Benefit payments, and actuarial liability figures were provided by the Actuary, GRS.

Stress Test - Impact on Funded Status[1]

(Equities Down 25%)

- This analysis assumes the expected return is earned each year except for a -25% equity shock in the year shown below[2].
- The impact of such an event on the System's funded status is time dependent on the starting point.

Year Negative Event Occurs	Funded Status: Pre Event (%)	Funded Status: Post Event (%)	Recovery back to 56% (Years)	Recovery up to 66% (Years)	Recovery up to 80% (Years)	Recovery up to 98% (Years)[3]
Year 0	56	45	9	13	18	22
Year 5	66	54	2	7	12	17
Year 10	80	65	n/a	2	7	11
Year 15	98	81	n/a	n/a	n/a	5

- The table looks at the number years to recover to the current funded status.
- The duration of the recovery period is much quicker if a negative event happens in the future if/when the System is anticipated to be better funded
- To recover beyond 98%, Employer and Member Contributions will need to continue at current rates past year 20.

[1] Based on Fiscal Year 18-19 Asset Policy and the assumption assets grow at expected rate of return (7.4%) in all other years. Funded status and liabilities reflect those for SCRS.

[2] Assumes that a -25% equity shock would result in approximately -15.3% return for the Retirement System.

[3] Based on the assumption that Employer and Member contributions continue beyond year 20 at the same current rate, as opposed to the GRS projections for much larger net outflows after year 20. The GRS projections assume the System is fully funded after 20 years, which would allow for a significant decrease in Employer and Member contributions.

Recommendations

Recommendations

- Meketa Investment Group recommends the Commission select one of the three proposed policy mixes.
- Policy X is the most conservative of the three options. Relative to the other policy mixes it will likely perform the best in a crisis but will likely lag in a strong equity market.
- Policy Z is the most aggressive of the three options. It is expected to produce the highest expected return in the long run but will likely suffer the largest drawdown in a crisis.
- Policy Y falls between Policy X and policy Z on the risk/return spectrum. It is estimated to produce a slightly better expected return (7.5% vs. 7.4%) than the current policy with similar risk.

Appendix

Overview of Annual Asset Study Methodology

- In order to construct an optimal portfolio from a risk-return standpoint, conventional financial wisdom dictates that one develop return, volatility, and correlation expectations over the relevant investing horizon.
- Given the uncertainty surrounding financial and economic forecasts, expectations development is challenging, and any of several methodological approaches may meaningfully contribute to this complex task.
- Meketa Investment Group's process relies on both quantitative and qualitative methodologies.
- First, we employ a large set of quantitative models to arrive at a set of baseline expected ten-year annualized returns for major asset classes.
- These models attempt to forecast a gross "beta" return for each *public market* asset class; that is, we specifically do not model "alpha," nor do we apply an estimate for management fees or other operational expenses[1].
- Our models are fundamentally based (based on some theoretically defined return relationship with current observable factors).
- Some of these models are more predictive than others. For this reason, we next overlay a qualitative analysis, which takes the form of a data-driven deliberation among the research team and our Investment Policy Committee.
- Return assumptions for hard-to-predict asset classes as well as those with limited data will be influenced more heavily by our qualitative analysis.
- As a result of this process, we form our ten-year annualized return expectations, which serve as the primary foundation of our longer-term, twenty-year expectations.

[1] Our expectations are net of fees where passive management is not available (e.g., private markets and hedge funds).

Overview of Annual Asset Study Methodology (continued)

- We form our twenty-year annualized return expectations by systematically considering historical returns on an asset class by asset class level. Specifically, we construct a weighted average of our ten-year expectations and average historical returns in each asset class.
- The weights are determined by a qualitative assessment of the value of the historical data. Generally, if we have little confidence that the historical average return is representative of what an investor can expect[1], we will weight our ten-year forecast more heavily. Therefore, the weight on our ten-year forecasts ranges from 0.5 to 0.9.
- We develop our twenty-year volatility and correlation expectations differently. We rely primarily on historical averages, with an emphasis given to the experience of the trailing ten years.
- Qualitative adjustments, when applied, usually serve to increase the correlations and volatility over and above the historical estimates (e.g., using the higher correlations usually observed during a volatile market).
- We also make adjustments to the volatility based on the historical skewness of each asset class (e.g., increasing the volatility for an asset class that has been negatively skewed).
- In the case of private markets and other illiquid asset classes where historical volatility and correlations have been artificially dampened, we seek public market equivalents on which to base our estimates before applying any qualitative adjustments.
- These volatility and correlation expectations are then combined with our twenty-year return expectations to assist us in subsequent asset allocation work, including mean-variance optimization and scenario analyses.

[1] For example, we have less confidence in historical data that do not capture many possible market scenarios or that are overly polluted by survivorship bias.

Each year, we revise our capital market expectations via our Asset Study

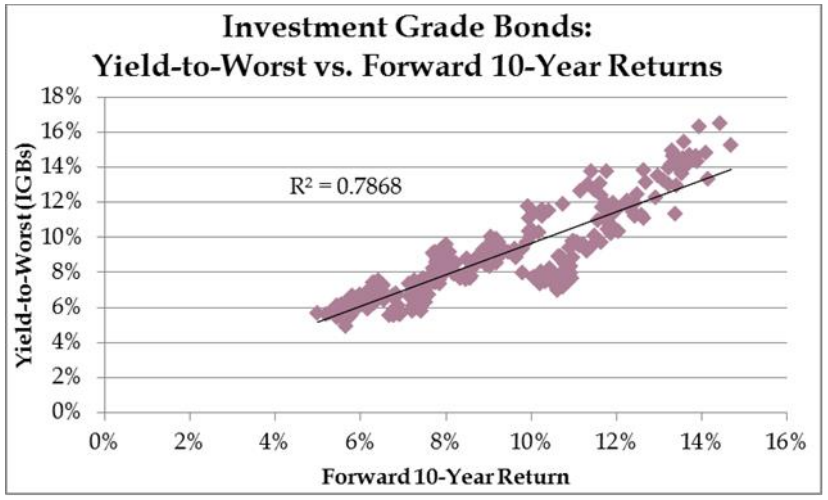
- This involves setting long-term expectations for a variety of asset classes for:
  - Returns
  - Standard Deviation
  - Correlations
- Our process relies on both quantitative and qualitative methodologies.

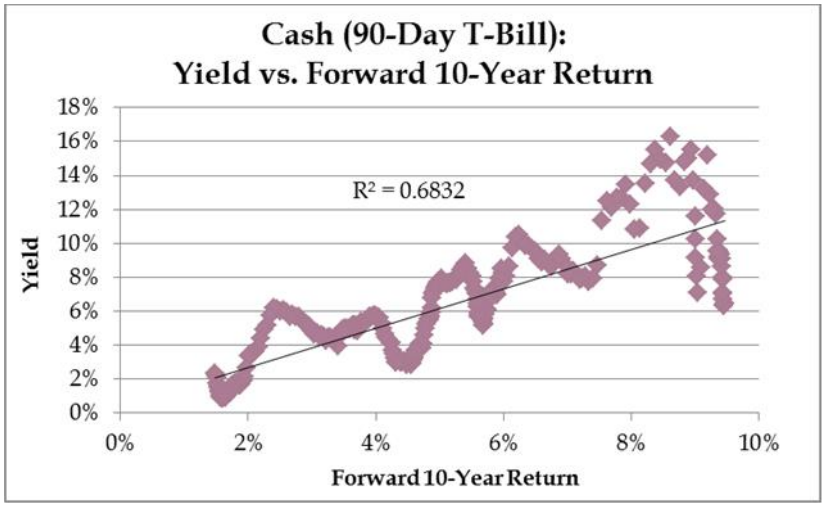
Our Process

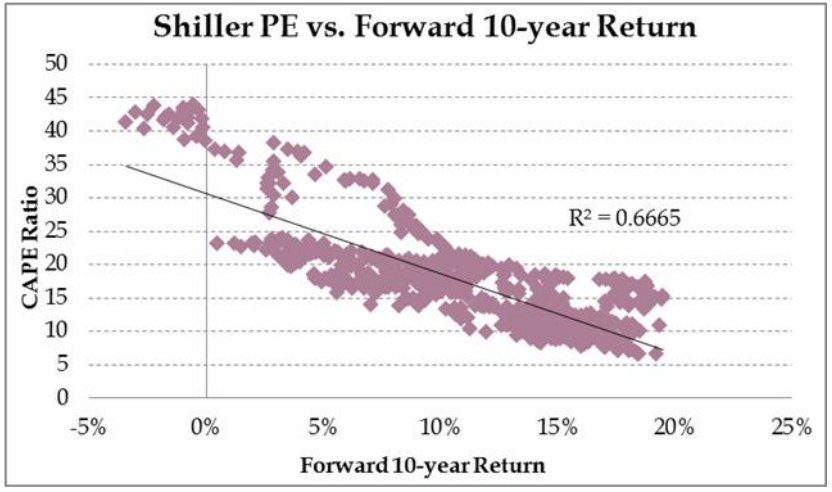
- The first step is to build our 10-year forecasts.
  - Our fundamental models are primarily valuation based.
- Each model falls in one of eight groups, based on the most important factors that drive their returns:

Asset Class Category	Major Factors
Equities	Dividend Yield, GDP Growth, Valuation
Bonds	Yield to Worst, Default Rate, Recovery Rate
Commodities	Collateral Yield, Roll Yield, Inflation
Infrastructure	Public IS Valuation, Income, Growth
Natural Resources	Price per Acre, Income, Public Market Valuation
Real Estate	Cap Rate, Yield, Growth
Private Equity	EBITDA Multiple, Debt Multiple, Public VC Valuation
Hedge Funds and Other	Leverage, Alternative Betas

Some models are naturally more predictive than others







The next step is to move from 10-year to our 20-year forecasts

- We do this by combining our 10-year forecasts with the historical returns for each asset class.
  - How much we apply to each depends on our confidence in them (both the model & the data).
- The 10-year model weighting varies between 50% and 100%.
- It only hits 100% when there is a lack of good historical data.
- We then infer a forecast of 10-year returns in ten years (i.e., years 11-20).
  - This allows us to test our assumptions with finance theory.
  - Essentially, we assume mean-reversion over the first ten years, then consistency with CAPM thereafter.

The final step is to make any qualitative adjustments

- The Investment Committee reviews the output and may make adjustments due to:
  - Quality of the underlying data.
  - Confidence in the model.
  - External inputs (e.g., perceived risks).

Capital Market Assumption Development Example

Equities

- We use a fundamental model for equities that combines income and capital appreciation.

E(R) = Dividend Yield + Expected Earnings Growth + Multiple Effect + Currency Effect

- Meketa Investment Group evaluates historical data statistically to develop expectations for dividend yield, earnings growth, the multiple effect and currency effect.
- Our models assume that there is a reversion to the mean over long time periods.

Capital Market Assumption Development Example

Bonds

- The short version for investment grade bond models is:

E(R) = Current YTW (yield to worst)

- Our models assume that there is a reversion to the mean for spreads (though not yields).
- For TIPS, we add the real yield of the TIPS index to the breakeven inflation rate.
- As with equities, we make currency adjustments when necessary for foreign bonds.
- For bonds with credit risk, Meketa Investment Group estimates default rates and loss rates, in order to project an expected return:

E(R) = YTW - (Annual Default Rate * Loss Rate)

The other inputs: Standard deviation and correlation

- Standard deviation:
  - We review the trailing ten-year standard deviation, as well as the trailing ten-year skewness.
  - Historical standard deviation serves as the base for our assumptions.
  - We increase or decrease the assumptions based on the size and sign of the historical skewness.

Asset Class	Standard Deviation	Skewness	Assumption
Bank Loans	7.9%	-2.1	10.0%

  - We look at performance during the GFC to see if further changes were warranted (e.g., hedge funds).
  - We also adjust for private market asset classes with “smoothed” return streams.
- Correlation:
  - We use trailing ten-year correlations as our guide.
  - Again, we make adjustments for performance during the GFC and “smoothed” return streams.
- Most of our adjustments are conservative in nature (i.e., they increase the standard deviation and correlation).

Horizon Peer Study

- Annually, Horizon Actuarial Services, LLC publishes a survey of capital market assumptions that they collect from various investment advisors.
  - In the 2017[1] survey there were 35 respondents.
- The Horizon survey is a useful tool for Board members to determine whether their consultant's expectations for returns (and risk) are reasonable.

Asset Class	10-Year Average (%)	20-Year Average (%)	MIG 20-Year (%)
U.S. Equity (large cap)	6.5	7.8	7.8
Non-U.S. – Developed	7.0	7.6	8.1
Non-U.S. – Emerging	8.0	8.7	10.5
U.S. Corporate Bonds – Core	3.2	4.4	4.4
U.S Corporate Bonds – High Yield	5.1	6.2	6.8
Non-U.S. Debt – Emerging	5.3	6.2	6.3
U.S. Treasuries (cash)	2.3	3.2	2.3
TIPS	2.8	4.0	3.3
Real Estate	6.2	6.7	5.9
Hedge Funds	4.9	6.0	5.6
Commodities	4.0	5.0	4.1
Infrastructure	6.7	7.1	6.7
Private Equity	9.0	10.1	9.4
Inflation	2.2	2.4	2.5

[1] The 10-year horizon includes all 35 respondents and the 20-year horizon includes 12 respondents.

Meketa Investment Group 2018 Annual Asset Study
Twenty-Year Annualized Return and Volatility Expectations for Major Asset Classes

Asset Class	Annualized Compounded Return (%)	Annualized Average Return (%)	Annualized Standard Deviation (%)
Rate Sensitive			
Cash Equivalents	2.9	2.9	1.0
Investment Grade Bonds	3.6	3.7	4.0
Intermediate Government Bonds	2.7	2.8	3.5
Long-term Government Bonds	3.5	4.3	13.0
TIPS	3.3	3.6	7.5
Credit			
High Yield Bonds	6.4	6.2	12.5
Bank Loans	5.0	5.5	10.0
Emerging Market Bonds (major; unhedged)	4.9	5.6	11.5
Emerging Market Bonds (local; unhedged)	5.4	6.5	14.5
Private Credit	6.7	8.2	17.0
Equities			
Public U.S. Equity	7.3	8.9	18.0
Public Developed Market Equity	7.1	9.1	20.0
Public Emerging Market Equity	9.4	12.5	25.0
Global Equities	7.5	9.4	19.0
Private Equity	9.3	12.9	27.0
Real Assets			
REITs	6.8	10.9	28.5
Core Private Real Estate	5.5	6.2	12.0
Value Added Real Estate	6.9	8.7	19.0
Opportunistic Real Estate	8.5	11.6	25.0
Natural Resources (Private)	8.8	11.4	23.0
Commodities	4.6	6.2	18.0
Infrastructure (Core)	6.6	7.7	15.0
Infrastructure (Non-Core)	8.5	11.1	23.0
Other			
Hedge Funds	5.2	5.5	8.5

Meketa Investment Group 2018 Annual Asset Study: Correlation Expectations

	TIPS	Investment Grade Bonds	High Yield Bonds	U.S. Equity	Developed Market Equity	Emerging Market Equity	Private Equity	Real Estate	Natural Resources (private)	Commodities	Core Infrastructure (private)	Hedge Funds
TIPS	1.00											
Investment Grade Bonds	0.80	1.00										
High Yield Bonds	0.30	0.20	1.00									
U.S. Equity	0.00	0.05	0.70	1.00								
Developed Market Equity	0.15	0.05	0.70	0.90	1.00							
Emerging Market Equity	0.15	0.05	0.70	0.80	0.90	1.00						
Private Equity	0.05	0.05	0.65	0.85	0.80	0.75	1.00					
Real Estate	0.10	0.20	0.50	0.50	0.45	0.40	0.45	1.00				
Natural Resources (private)	0.10	0.10	0.45	0.65	0.60	0.60	0.55	0.45	1.00			
Commodities	0.35	0.05	0.40	0.35	0.55	0.60	0.30	0.15	0.65	1.00		
Core Infrastructure (private)	0.30	0.30	0.60	0.55	0.55	0.50	0.45	0.60	0.60	0.40	1.00	
Hedge Funds	0.20	0.05	0.70	0.80	0.85	0.85	0.65	0.45	0.65	0.35	0.60	1.00

Asset Classes by Most Severe Historical Drawdown

	Max Drawdown Historically (%)	Months of Drawdown	Months of Recovery	Valley to Full Recovery
Short Term Recovery Assets (1-12 months):				
Short-term Bonds	-3.3	1	2	2/80-4/80
U.S. Treasuries (Intermediate)	-5.2	2	2	2/80-4/80
Investment Grade Bonds	-12.7	7	3	2/80-5/80
Private Debt	-23.8	15	9	3/09-12/09
High Yield	-33.3	18	9	11/08-8/09
U.S. Treasuries (LT)	-20.1	27	10	9/81-7/82
TIPS	-12.2	8	11	10/08-9/09
Bank Loans	-29.9	18	12	12/08-12/09
Intermediate Recovery Assets (13-36 months):				
Infrastructure (Core Private)	-12.2	18	13	3/95-4/96
Global Macro	-13.2	18	15	9/74-12/75
Emerging Market Debt (Major)	-32.7	4	16	8/98-12/99
Emerging Market Debt (Local)	-39.0	4	16	8/98-12/99
Hedge Funds Non-PA	-21.4	16	20	2/09-10/10
Option-based Equity	-32.7	9	21	2/09-11/10
Private Equity	-31.1	15	22	3/09-1/11
Tactical Asset Allocation	-36.6	16	22	2/09-12/10
Risk Parity	-28.6	8	24	10/08-10/10
Core Private Real Estate	-24.1	18	27	12/09-3/12
Longer Term Recovery Assets (37+ months):				
U.S. Equity	-51.0	16	37	2/09-3/12
REITs	-68.3	25	41	2/09-7/12
Infrastructure (Public)	-55.0	26	42	2/03-8/06
Non-Core Private Real Estate	-46.5	21	57	3/10-12/14
Developed Market Equity (Non-U.S)	-56.7	16	64	2/09-6/14
Emerging Market Equity	-61.6	16	101	2/09-7/17

- Most assets have recovered in less than 36 months from each respective maximum drawdown.

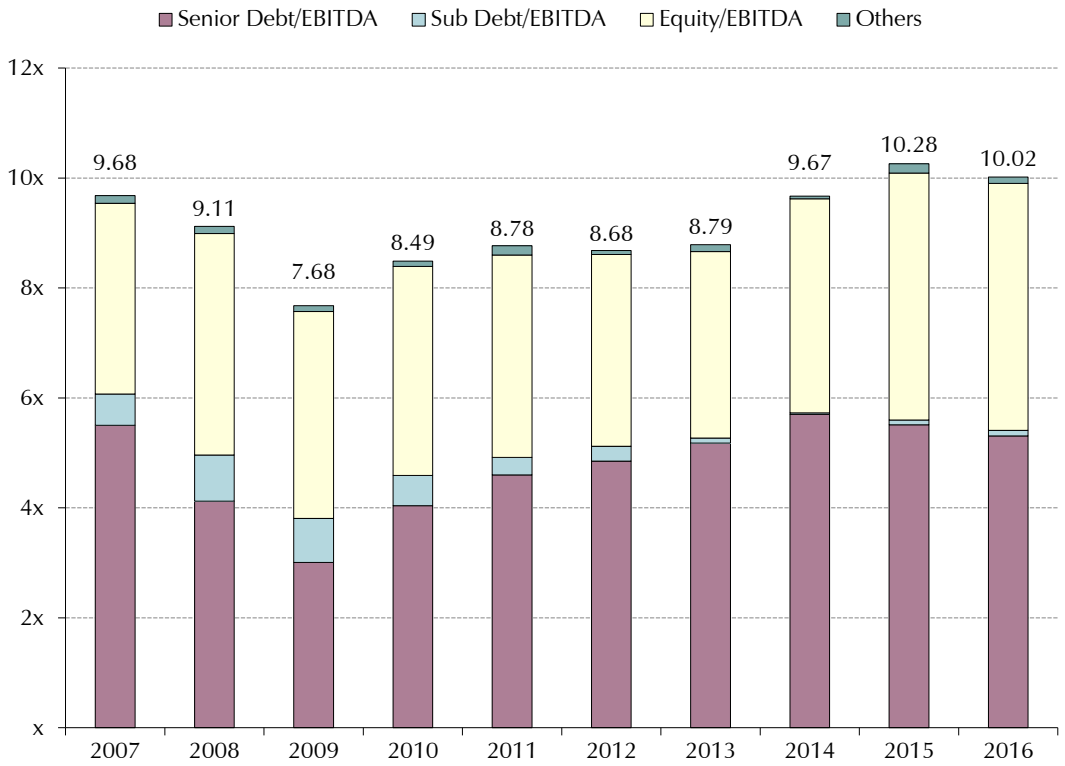
Asset Grouping By Historical Drawdown

	Current Net Exposure (%)	Policy X (%)	Policy Y (%)	Policy Z (%)	Peer Average (%)
Short Term Recovery Assets (1-12 months):	**25**	**27**	**25**	**24**	**22**
Cash and Short Duration	3	1	1	1	1
Core Bonds	10	15	13	13	17
Private Debt	6	7	7	7	1
Mixed Credit	6	4	4	3	3
Intermediate Recovery Assets (13-36 months):	**30**	**28**	**28**	**28**	**22**
Emerging Market Debt	5	4	4	4	3
Hedge Funds Non-PA	1	0	0	0	8
Option-based Equity	6	6	7	7	0
Private Equity	7	9	9	10	9
Tactical Asset Allocation	7	7	7	6	2
Risk Parity	4	2	1	1	0
Longer Term Recovery Assets (37+ months):	**45**	**45**	**47**	**48**	**56**
Global Public Equity[1]	35	33	35	37	44
Infrastructure	2	3	3	2	2
Commodities	0	0	0	0	1
Real Estate	8	9	9	9	9

- Approximately 55% of the Retirement System's current exposure falls into the short term and intermediate recovery groupings (i.e., less 36 month recovery from worst historical drawdown).
- The other policy mixes have similar exposure and all have less exposure to Longer Term Recovery Assets relative to the Peer Average.

[1] Excluding option-based equity.

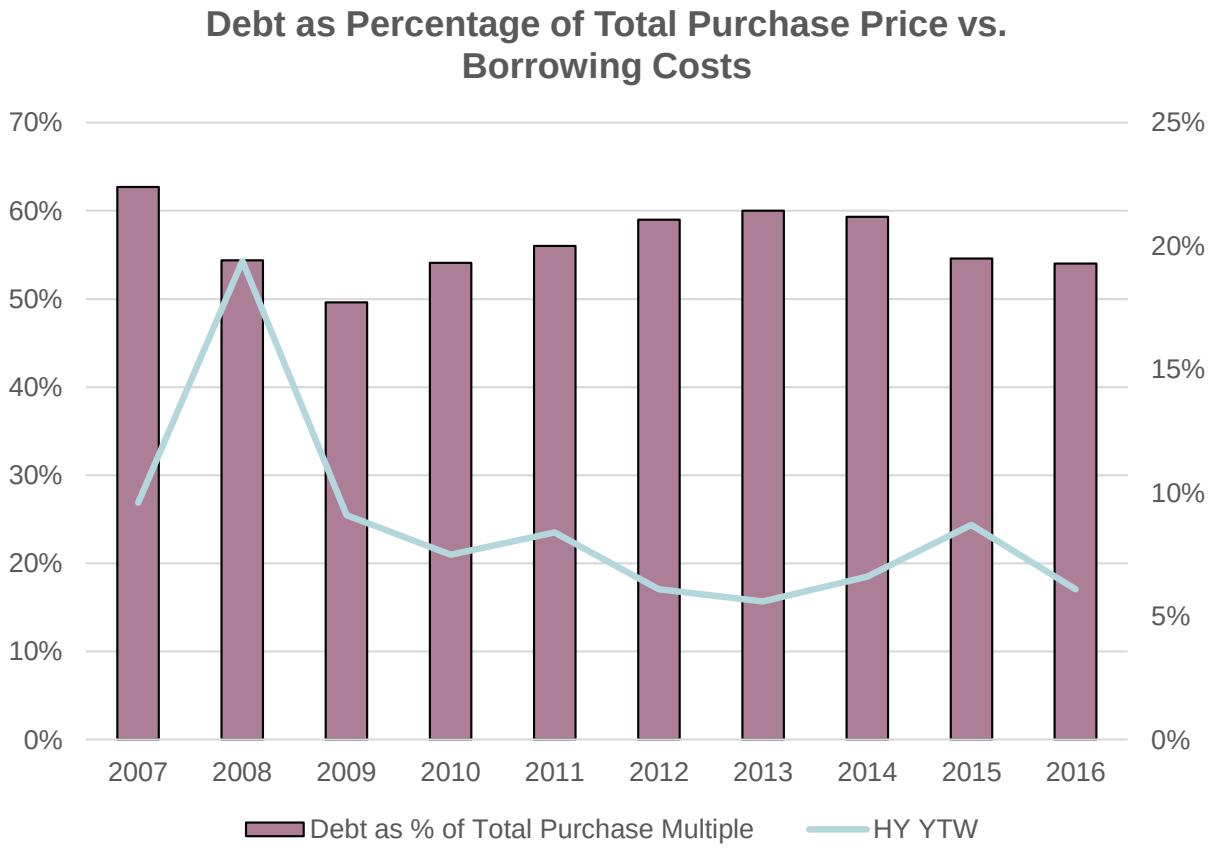
Purchase Price Break-down of All LBO, North America[1]



- Purchase price multiples in private equity have increased since the global financial crises (increasing from 7.7x EBITDA to 10.0x EBITDA), surpassing pre-crises purchase pricing.
- The use of debt has increased from approximately 4.0x EBITDA to 5.4x EBITDA.

[1] S&P Leverage Finance.

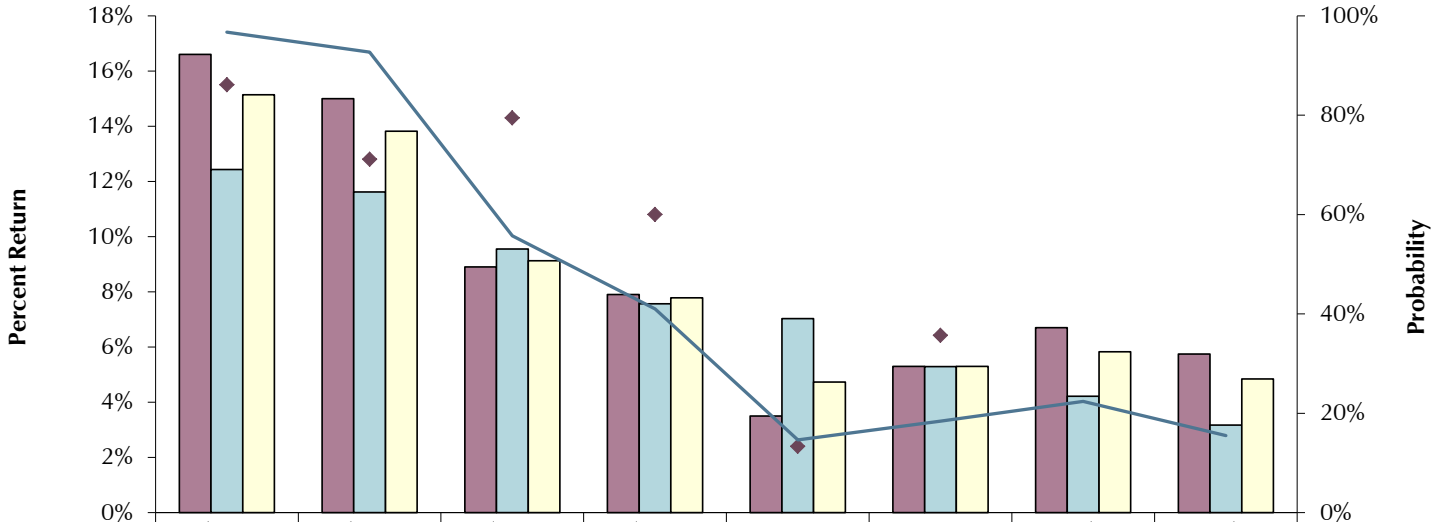
Use of Debt[1]



- The use of debt (as a percentage of total purchase price) has remained mostly consistent despite lower borrowing costs (i.e., interest rates).

[1] S&P Leverage Finance and Barclays High Yield YTW.

The Secular Decline in Investment Returns[1]



	1980	1985	1990	1995	2000	2005	2010	2015
Equity Expected Return	16.6%	15.0%	8.9%	7.9%	3.5%	5.3%	6.7%	5.8%
Bond Expected Return	12.4%	11.6%	9.6%	7.6%	7.0%	5.3%	4.2%	3.2%
65/35 Eq/Bond Exp. Ret.	15.1%	13.8%	9.1%	7.8%	4.7%	5.3%	5.8%	4.8%
Actual 10-year Return	15.5%	12.8%	14.3%	10.8%	2.4%	6.4%		
Probability of earning 8%	97%	93%	56%	41%	15%	18%	22%	16%

- A portfolio comprised of 65% domestic stocks and 35% investment grade bonds has produced diminishing expected returns as well as actual returns over the past thirty years.

[1] Expected return assumptions for 1) Bonds equals the yield of the ten-year Treasury plus 100 basis points, and 2) Equities equals the dividend yield plus the earnings yield of the S&P 500 index (using the inflation-adjusted trailing 10-year earnings). Probability calculation is for the subsequent ten years.

Notes and Disclaimers

[1] The returns shown in the Policy Options and Risk Analysis sections rely on estimates of expected return, standard deviation, and correlation developed by Meketa Investment Group. To the extent that actual return patterns to the asset classes differ from our expectations, the results in the table will be incorrect. However, our inputs represent our best unbiased estimates of these simple parameters.

[2] The returns shown in the Policy Options and Risk Analysis sections use a lognormal distribution, which may or may not be an accurate representation of each asset classes' future return distribution. To the extent that it is not accurate in whole or in part, the probabilities listed in the table will be incorrect. As an example, if some asset classes' actual distributions are even more right-skewed than the lognormal distribution (i.e., more frequent low returns and less frequent high returns), then the probability of the portfolio hitting a given annual return will be lower than that stated in the table.

[3] The standard deviation bars in the chart in the Risk Analysis section do not indicate the likelihood of a 1, 2, or 3 standard deviation event—they simply indicate the return we expect if such an event occurs. Since the likelihood of such an event is the same across allocations regardless of the underlying distribution, a relative comparison across policy choices remains valid.

Scenario Return Inputs

Asset Class	Benchmark Used
Investment Grade Bonds	Barclays Aggregate
TIPS	Barclays U.S. TIPS
Intermediate-term Government Bonds	Barclays Treasury Intermediate
Long-term Government Bonds	Barclays Long U.S. Treasury
EM Bonds (local)	JPM GBI-EM Global Diversified Composite
Bank Loans	CSFB Leveraged Loan
High Yield Bonds	Barclays High Yield
Direct Lending - First Lien	Cliffwater Direct Lending Index
Direct Lending - Second Lien	Cliffwater Direct Lending Index
Mezzanine Debt	Cambridge Associates Mezzanine
Distressed Debt	Cambridge Associates Distressed Debt Index
Core Real Estate	NCREIF Property
Value-Added RE	NCREIF Townsend Value Added
Opportunistic RE	NCREIF Townsend Opportunistic
REITs	NAREIT Equity
Infrastructure (private)	S&P Global Infrastructure
Natural Resources (private)	S&P Global Natural Resources
Timber	NCREIF Timberland
Commodities	Bloomberg Commodity Index
U.S. Equity	Russell 3000
Public Foreign Equity (Developed)	MSCI EAFE
Public Foreign Equity (Emerging)	MSCI Emerging Markets
Private Equity	Cambridge Associates Private Equity Composite
Long-short Equity	HFRI Equity Hedge
Global Macro	HFRI Macro
Hedge Funds	HFRI Fund Weighted Composite
Private Debt	Barclays High Yield and CSFB Leveraged Loan

Negative Historical Scenario Returns - Sample Inputs

	Taper Tantrum (May - Aug 2013)	Global Financial Crisis (Oct 2007 - Mar 2009)	2008 Calendar Year	Popping of the TMT Bubble (Apr 2000 - Sep 2002)	LTCM (Jul - Aug 1998)	Asian Financial Crisis (Aug 1997 - Jan 1998)	Rate spike (1994 Calendar Year)	Crash of 1987 (Sep - Nov 1987)	Strong dollar (Jan 1981 - Sep 1982)	Stagflation (Jan - Mar 1980)	Stagflation (Jan 1973 - Sep 1974)
Cash Equivalents	0.0	3.1	1.7	9.9	0.8	2.4	3.9	1.4	24.4	2.9	13.5
Short-term Investment Grade Bonds	-0.1	8.7	5.0	21.9	1.6	3.5	0.5	2.3	29.9	-2.6	4.3
Investment Grade Bonds	-3.7	9.3	5.2	28.6	1.8	4.9	-2.9	2.2	29.9	-8.7	7.9
Long-term Corporate Bonds	-9.3	-9.4	-5.2	26.9	-0.6	5.4	-5.8	1.5	29.6	-14.1	-12.0
Long-term Government Bonds	-11.6	24.5	24.0	35.5	4.1	8.6	-7.6	2.6	28.4	-13.6	-1.8
TIPS	-8.5	9.6	-2.4	37.4	0.7	2.0	-7.5	2.8	15.6	-7.8	4.3
Global ILBs	-7.4	-1.5	-7.7	39.7	0.7	2.2	-7.9	2.9	16.5	-8.3	4.5
High Yield Bonds	-2.0	-20.7	-26.2	-6.3	-5.0	5.6	-1.0	-3.6	6.9	-2.3	-15.5
Bank Loans	0.8	-22.5	-28.8	6.3	0.7	3.3	10.3	-1.7	3.3	-1.1	-7.5
Direct Lending - First Lien	3.4	-2.1	-5.8	-0.7	-0.7	1.7	0.7	-0.2	2.0	-0.6	-4.4
Direct Lending - Second Lien	4.6	-2.9	-7.8	-1.0	-0.9	2.3	1.0	-0.3	2.6	-0.8	-5.9
Foreign Bonds	-3.2	5.3	4.4	8.5	3.5	3.3	5.3	-0.3	34.8	-6.5	-1.4
Mezzanine Debt	4.6	-25.5	-25.9	-2.0	-2.6	10.3	7.6	0.4	3.2	-1.0	-7.2
Distressed Debt	4.6	-25.5	-25.9	-2.0	-2.6	10.3	7.6	0.4	3.2	-1.0	-7.2
Emerging Market Bonds (major)	-11.5	-2.7	-9.7	6.3	-28.2	-1.8	-18.9	-9.2	-1.6	-2.6	-20.2
Emerging Market Bonds (local)	-14.3	-2.3	-5.2	7.2	-34.1	-2.4	-22.8	-11.0	-2.0	-3.2	-23.9
US Equity	3.0	-43.8	-37.0	-43.8	-15.4	3.6	1.3	-29.5	-2.3	-4.1	-42.6
Developed Market Equity (non-US)	-2.2	-49.6	-43.4	-46.7	-11.5	-5.8	7.8	-14.5	-18.0	-7.0	-36.3
Emerging Market Equity	-9.4	-45.8	-53.3	-43.9	-26.7	-31.8	-7.3	-25.3	-12.1	-6.6	-44.2
Global Equity	-0.7	-46.6	-42.2	-46.7	-14.0	-3.2	5.0	-21.5	-11.2	-5.8	-39.3
Private Equity/Debt	5.7	-25.6	-27.2	-23.4	-3.2	15.7	13.2	0.6	-2.7	-2.5	-18.2
Private Equity	5.8	-25.8	-27.6	-26.0	-3.3	16.7	14.2	0.6	-3.9	-2.7	-20.1
Private Debt Composite	4.6	-21.3	-22.5	-1.7	-2.3	8.7	6.2	0.2	3.0	-1.0	-6.9
REITs	-13.3	-61.3	-37.7	45.4	-15.3	9.8	-3.5	-19.5	2.5	-3.6	-33.9
Core Private Real Estate	3.6	-7.3	-6.5	23.6	2.3	8.5	6.4	0.7	23.9	5.5	-4.4
Value-Added Real Estate	3.8	-18.0	-13.4	177.0	1.8	11.4	11.2	1.2	44.2	9.6	-7.6
Opportunistic Real Estate	4.0	-24.7	-21.8	21.4	1.5	20.0	18.8	0.9	30.7	7.0	-5.6
Natural Resources (Private)	2.5	-26.2	-34.1	-3.9	-16.9	-7.8	12.6	-10.8	-9.4	-9.2	19.3
Timberland	1.3	25.4	9.5	-1.5	0.5	12.0	15.4	3.8	23.6	-7.4	5.5
Farmland	3.3	30.2	15.8	11.4	0.8	3.9	9.4	2.2	13.3	-4.2	3.1
Commodities (naïve)	-2.4	-31.8	-35.6	18.5	-12.0	-6.2	16.6	1.8	-16.0	-9.6	139.5
Core Infrastructure	3.7	0.2	-0.6	24.8	-0.3	6.1	-11.5	0.0	-0.2	-0.1	-0.5
Hedge Funds	-0.4	-15.6	-19.0	-2.1	-9.4	1.7	4.1	-7.8	-3.8	-1.9	-15.7
Long-Short	1.0	-24.0	-26.6	-8.8	-8.3	7.9	2.6	-10.0	-4.9	-2.5	-19.8
Hedge Fund of Funds	-0.5	-17.8	-21.4	-0.4	-7.7	0.5	-3.5	-5.7	-2.7	-1.4	-11.5

Positive Historical Scenario Returns - Sample Inputs

	Global Financial Crisis Recovery (Mar 2009 - Nov 2009)	Best of Great Moderation (Apr 2003 - Feb 2004)	Peak of the TMT Bubble (Oct 1998 - Mar 2000)	Pre-Recession (Jun - Oct 1990)	Plummeting Dollar (Jan 1986 - Aug 1987)	Volcker Recovery (Aug 1982 - Apr 1983)	Bretton Wood Recovery (Oct 1974 - Jun 1975)
Cash Equivalents	0.1	0.9	6.7	3.3	10.0	6.0	4.5
Short-term Investment Grade Bonds	4.3	2.8	5.3	4.5	13.2	15.4	5.0
Investment Grade Bonds	9.0	4.6	1.7	3.8	14.4	26.4	9.2
Long-term Corporate Bonds	28.8	11.3	-3.1	1.5	15.9	42.1	17.5
Long-term Government Bonds	2.0	4.9	-2.3	2.4	15.4	33.6	11.8
TIPS	14.3	9.1	6.3	2.2	10.2	11.5	4.1
Global ILBs	24.7	9.6	6.6	2.3	10.8	12.1	4.3
High Yield Bonds	49.1	21.8	2.1	-12.9	24.9	23.3	19.3
Bank Loans	32.9	10.1	6.1	-6.1	11.1	10.4	8.7
Direct Lending - First Lien	10.6	5.7	1.1	-1.9	5.8	5.0	5.1
Direct Lending - Second Lien	14.3	7.7	1.4	-2.5	7.8	6.7	6.8
Foreign Bonds	23.4	15.2	-7.0	15.8	44.5	32.3	17.9
Mezzanine Debt	30.8	23.7	26.8	0.7	5.4	8.2	8.3
Distressed Debt	30.8	23.7	26.8	0.7	5.4	8.2	8.3
Emerging Market Bonds (major)	27.0	20.6	49.0	-8.7	38.9	21.6	21.0
Emerging Market Bonds (local)	37.5	25.2	61.0	-10.5	48.4	26.5	25.7
US Equity	51.6	37.2	50.2	-14.7	64.8	59.3	55.1
Developed Market Equity (non-US)	60.5	56.7	53.0	-9.7	140.0	29.6	34.6
Emerging Market Equity	94.6	79.4	101.3	-15.9	126.5	52.1	53.4
Global Equity	59.9	46.2	54.8	-11.1	108.4	43.0	44.6
Private Equity/Debt	15.4	23.3	84.6	4.6	19.1	13.7	18.4
Private Equity	13.0	23.7	92.1	5.5	21.7	14.8	20.2
Private Debt Composite	27.5	20.4	21.4	0.1	5.9	7.9	8.0
REITs	82.5	44.6	-5.2	-15.6	51.8	47.4	42.5
Core Private Real Estate	-16.4	9.0	18.1	1.9	13.1	6.8	4.5
Value-Added Real Estate	-32.7	11.4	19.6	3.2	23.6	11.9	7.8
Opportunistic Real Estate	-19.0	13.6	27.9	0.4	16.7	8.6	5.7
Natural Resources (Private)	57.8	36.1	22.2	6.0	78.3	30.2	14.8
Timberland	-3.3	8.5	20.5	5.7	28.6	20.0	8.7
Farmland	5.4	9.6	10.4	3.3	15.9	11.3	5.0
Commodities (naïve)	28.9	30.6	17.1	43.5	27.6	6.2	-20.2
Core Infrastructure	2.1	8.5	33.0	0.0	1.4	0.6	0.6
Hedge Funds	20.1	22.4	52.8	-1.9	30.6	13.8	14.5
Long-Short	25.9	25.3	81.4	5.1	40.8	18.0	18.9
Hedge Fund of Funds	10.3	13.3	36.8	11.9	21.3	9.7	10.3

"Positive" Stress Test Return Assumptions - Sample Inputs[1]

	10-year Treasury Bond rates drop 100 bps	10-year Treasury Bond rates drop 200 bps	Baa Spreads narrow by 30bps, High Yield by 100 bps	Baa Spreads narrow by 100bps, High Yield by 300 bps	Trade Weighted Dollar drops 10%	Trade Weighted Dollar drops 20%	U.S. Equities rise 10%	U.S. Equities rise 30%
Cash Equivalents	0.7	0.8	0.2	0.2	1.3	2.7	1.2	1.7
Short-term Investment Grade Bonds	3.4	5.3	1.1	2.6	2.5	3.6	1.7	3.1
Investment Grade Bonds	8.5	14.4	2.7	5.0	3.4	6.6	2.3	4.6
Long-term Corporate Bonds	18.4	32.3	7.1	16.5	6.2	10.6	3.8	8.2
Long-term Government Bonds	20.5	38.0	3.4	0.5	5.1	13.0	2.8	6.9
TIPS	7.1	12.0	3.3	7.0	4.6	4.1	2.2	4.3
Global ILBs	3.1	3.0	4.5	8.5	6.5	3.9	2.7	5.8
High Yield Bonds	9.2	13.1	8.9	27.5	4.7	5.1	6.0	13.7
Bank Loans	4.4	2.2	5.0	17.5	1.9	1.3	3.7	8.6
Direct Lending - First Lien	3.2	2.0	7.6	9.4	0.7	7.7	2.9	5.0
Direct Lending - Second Lien	3.6	2.4	10.2	12.7	0.8	11.0	4.1	7.1
Foreign Bonds	8.6	16.4	4.5	9.0	11.1	12.3	3.3	7.8
Mezzanine Debt	5.8	7.2	9.8	18.5	4.5	13.1	6.6	9.9
Distressed Debt	5.8	7.4	9.9	18.9	4.8	15.2	7.2	11.2
Emerging Market Bonds (major)	7.9	12.0	8.0	17.8	6.8	12.1	6.0	12.8
Emerging Market Bonds (local)	9.1	10.0	7.3	19.6	9.0	14.9	7.1	16.0
US Equity	8.9	22.7	11.2	16.8	5.4	21.5	10.0	30.0
Developed Market Equity (non-US)	3.9	21.4	12.5	19.9	15.9	28.2	8.3	20.2
Emerging Market Equity	5.8	21.1	13.2	37.8	16.6	33.5	13.0	27.8
Global Equity	6.5	21.9	12.0	22.1	11.3	26.3	10.0	26.1
Private Equity/Debt	7.3	12.3	10.7	13.2	6.6	19.5	9.0	19.0
Private Equity	7.7	14.1	10.9	13.1	6.9	20.7	9.5	21.5
Private Debt Composite	5.4	6.3	9.9	17.5	3.9	13.5	6.3	9.8
REITs	9.0	20.4	13.6	27.4	7.9	24.0	12.2	31.7
Core Private Real Estate	5.6	8.5	5.1	8.4	3.1	10.3	3.0	3.4
Value-Added Real Estate	8.0	15.0	5.0	10.3	4.6	16.4	4.3	6.5
Opportunistic Real Estate	8.0	15.0	3.6	8.7	2.7	18.2	4.0	5.5
Natural Resources (Private)	4.0	17.9	11.6	13.7	11.4	15.5	9.4	20.7
Timberland	6.0	15.5	3.8	5.5	4.6	15.4	4.8	5.8
Farmland	5.0	9.4	8.1	8.3	4.1	13.4	4.3	5.6
Commodities (naïve)	1.5	4.0	4.4	9.2	8.6	5.4	3.6	6.4
Core Infrastructure	5.0	6.0	6.9	4.0	4.8	11.2	2.6	4.3
Hedge Funds	8.2	11.8	5.7	11.9	4.6	7.8	6.0	11.9
Long-Short	8.3	13.0	6.2	12.8	5.8	12.4	7.1	15.0
Hedge Fund of Funds	6.6	10.0	4.3	10.1	3.2	6.2	4.5	10.2

[1] Assumptions are based on performance for each asset class during historical periods that resembled these situations.

Stress Test Return Assumptions - Sample Inputs[1]

	Rates Rise 100 bp %	Rates Rise 200 bp %	Rates Rise 300 bp %	BBB Spreads widen by 50 bp %	BBB Spreads widen by 300 bp %	USD Gains 10% %	USD Gains 20% %	Equities Decline 10% %	Equities Decline 25% %	Equities Decline 40% %	Rates Fall 100 bp %	Rates Fall 200 bp %
Public Domestic Equity	10.3	9.0	6.9	6.0	-42.0	3.5	7.0	-10.0	-25.0	-40.0	10.5	8.4
Public Foreign Equity (Developed)	10.3	9.0	6.9	5.5	-33.0	-7.0	-14.0	-10.5	-26.3	-42.0	10.5	8.4
Public Foreign Equity (Emerging)	10.3	9.0	6.9	5.0	-39.0	-7.0	-14.0	-11.0	-27.5	-44.0	10.5	8.4
Long-Short Hedge Funds	6.4	7.0	6.0	6.5	-21.0	2.1	4.2	-6.0	-15.0	-24.0	6.3	5.0
Private Equity	5.2	4.5	3.5	6.0	-42.0	3.5	7.0	-8.0	-20.0	-32.0	5.3	4.2
Core Real Estate	8.7	9.6	8.7	9.5	-12.0	4.0	8.0	-5.0	-12.5	-20.0	5.5	5.2
REITs	7.9	8.0	6.0	0.5	-36.0	1.0	2.0	-9.5	-23.8	-38.0	14.9	7.4
Non-Core Real Estate	7.1	10.4	9.3	11.5	-24.0	4.0	8.0	-7.0	-17.5	-28.0	3.6	7.6
Infrastructure (private)	4.3	2.6	2.9	3.5	-24.0	3.0	6.0	-5.0	-12.5	-20.0	5.3	5.5
Natural Resources (private)	8.6	12.2	13.5	2.0	-16.5	-3.1	-6.2	-5.0	-12.5	-20.0	2.5	2.0
Natural Resources (public)	11.4	16.2	18.0	4.0	-33.0	-6.2	-12.3	-9.5	-23.8	-38.0	5.0	4.0
Commodities	8.7	4.6	-0.6	-0.5	-21.0	-15.0	-30.0	-7.0	-17.5	-28.0	1.8	-4.8
Short-Term Bonds	-6.4	-12.2	-17.9	8.0	6.0	7.0	14.0	1.0	2.5	4.0	5.1	10.9
Long-Term Government Bonds	-15.3	-33.6	-52.0	12.0	15.0	10.0	20.0	5.0	12.5	20.0	21.6	40.0
TIPS	-7.0	-15.8	-24.6	8.5	12.0	8.0	16.0	1.0	2.5	4.0	10.6	19.4
Investment Grade Bonds	-3.4	-8.6	-13.9	-0.4	-4.6	8.0	16.0	2.0	5.0	8.0	7.2	12.5
Investment Grade Corporate Bonds	-4.3	-11.4	-18.5	-1.4	-18.5	8.0	16.0	-1.5	-3.8	-6.0	9.9	17.0
Foreign Developed Bonds	-5.1	-11.8	-18.5	0.0	-3.5	-6.3	-12.6	-2.0	-5.0	-8.0	8.4	15.2
Emerging Market Bonds (external)	-2.0	-7.9	-13.9	-2.7	-25.9	5.0	10.0	-2.0	-5.0	-8.0	10.0	16.0
Emerging Market Bonds (local)	-0.8	-6.6	-12.3	1.4	-8.0	-6.3	-12.6	-3.0	-7.5	-12.0	10.7	16.4
High Yield Bonds	1.5	-2.6	-6.7	-4.9	-35.9	4.5	9.0	-6.0	-15.0	-24.0	9.7	13.8
Bank Loans	5.0	6.0	7.5	2.5	-30.0	4.5	9.0	-6.0	-15.0	-24.0	3.0	2.0
Hedge Funds	5.8	6.2	3.6	3.5	-18.0	5.0	10.0	-5.0	-12.5	-20.0	8.1	4.4
TAA	7.8	5.7	3.1	6.5	-22.2	3.2	6.4	-7.0	-17.5	-28.0	10.8	11.8
Risk Parity	6.1	2.1	-2.5	5.6	-12.0	1.6	3.3	-2.0	-5.0	-8.0	10.2	12.3

[1] Assumptions are based on performance for each asset class during historical periods that resembled these situations.

Dataset for Drawdown Analysis

Asset Class	Index or Proxy Used
Short-term Bonds	Barclays 1-3 Year Gov't/Credit
U.S. Treasuries (Intermediate)	Barclays Treasury Intermediate
Investment Grade Bonds	Barclays Aggregate
Private Debt	Cambridge Associated Mezzanine and Distressed
High Yield	Barclays High Yield
U.S. Treasuries (LT)	Barclays Long US Treasury
TIPS	Barclays US TIPS
Bank Loans	CFSB Leveraged Loan Index
Infrastructure (Core Private)	Track record of common core infrastructure fund
Global Macro	HFRI Macro (Total) Index
Emerging Market Debt (Major)	JPM EMBI+ Composite
Emerging Market Debt (Local)	JPM GBI-EM Global Diversified Composite
Hedge Funds	HFRI Fund Weighted Composite
Option-based Equity	CBOE S&P 500 Put Write Index
Private Equity	Cambridge Associates Private Equity Composite
Tactical Asset Allocation	Weighted Average of Typical TAA Fund
Risk Parity	Track record of common risk parity fund
Core Private Real Estate	NCREIF Property Index
U.S. Equity	S&P 500
REITs	NAREIT Equity
Infrastructure (Public)	S&P Global Infrastructure Index
Non-Core Private Real Estate	NCREIF Closed End Value Add Fund Index
Developed Market Equity (Non-U.S)	MSCI EAFE
Emerging Market Equity	MSCI Emerging Markets

South Carolina Retirement System Investment Commission

Benchmark Review and Recommendations

MEKETA INVESTMENT GROUP
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Current Policy Benchmark Components and Recommended Changes

Asset Class	Current Policy Benchmark	Recommended Policy Benchmark	Recommended Secondary Benchmark
Global Equity	MSCI All Country World Investable Market Index	Weighted average of underlying regional sub-asset class targets[1] from selected policy mix	-
Private Equity	80% Russell 3000 Index/20% MSCI EAFE Index + 300 basis points on a 3-month lag	-	Cambridge Associates Peer Vintage Year
Equity Option Strategies	CBOE S&P 500 BuyWrite Index (BXM)	CBOE S&P 500 PutWrite Index	-
Cash & Short Duration	BofA Merrill Lynch 3-Month T-Bills	-	-
Core Bonds	Bloomberg Barclays Aggregate Index	-	-
Mixed Credit	50% S&P LSTA Leveraged Loan Index/50% Barclays High Yield Index	-	-
Private Debt	S&P LSTA Leveraged Loan Index +150 basis points on a 3-month lag	-	-
Emerging Market Debt	50% JP Morgan EMBI Global Diversified (USD)/50% JP Morgan GBI-EM Global Diversified (Local)	-	-
GAA	50% MSCI World Index (net of dividends)/50% Bloomberg Barclays Aggregate Bond Index	Total System Policy Benchmark ex-private equity, private debt and private real estate	-
Other Opportunistic Strategies	50% MSCI World Index (net of dividends)/50% Bloomberg Barclays Aggregate Bond Index	Total System Policy Benchmark ex-private equity, private debt and private real estate	-
Real Estate (REITs)	FTSE NAREIT Equity REITs Index	-	-
Real Estate (Private)	NCREIF ODCE Gross Index +75 basis points	NCREIF ODCE Equal Weight Net Index +100 basis points	-
World Infrastructure	Dow Jones Brookfield Global Infrastructure Index	-	-
Hedge Funds (Portable Alpha)	3 Month Libor	T-Bills + 250 basis points	HFRI: Macro Index

[1] Recommend Russell 3000 Index for U.S. Equity, MSCI EAFE Index for Developed Market Equity (non-U.S.) and MSCI EM Index for Emerging Market Equity.