



RETIREMENT BOARD CALENDAR SHEET
Investment Committee Meeting of July 15th, 2020

To: The Retirement Board, Investment Committee

Through: Jay Huish *JH*
Executive Director

From: William Coaker, Jr. – CFA
Chief Investment Officer

Anna Langs, CFA, FRM
Managing Director, Asset Allocation, Risk
Management and Innovative Solutions

David E. Francl
Managing Director, Absolute Return

Date: July 15, 2020

Agenda Item:

Education on Global Tactical Asset Allocation (GTAA)

Background:

NEPC and Staff present educational material on Global Tactical Asset Allocation (GTAA).

At the May 23, 2017 Investment Committee Meeting, NEPC presented a chart which noted how SFERS asset allocation differed versus peers (both public funds > \$1 billion, and all public funds). This chart reflected an average GTAA allocation by peers of 4% and SFERS at 0% (see page 7 of attached NEPC 2017 Asset-Liability Study for SFERS).

Staff has been working with NEPC to design a custom GTAA program for over a year. Some organizations implement GTAA as a component of an absolute return allocation whereas others treat it as a strategic asset class. Implementing GTAA as a strategic asset class and part of a diversified asset allocation can significantly improve the liquidity profile of a portfolio, especially in periods of market stress. SFERS' experience during the Q1 2020 market dislocation related to Covid-19 highlighted the importance of maintaining sufficient liquidity, and how an allocation to GTAA could provide significant incremental liquidity and downside protection.

SFERS' research on GTAA has focused on the following four main objectives:

1. An additional source of high risk-adjusted returns across market cycles
2. Significant incremental downside protection for the portfolio
3. Increased diversification of the strategic asset allocation
4. Significant incremental liquidity, especially in periods of stress.

NEPC and Staff worked with the investment manager community to create custom GTAA strategies that best meet these four objectives. In February 2020 in collaboration with NEPC and Albourne, SFERS sent out Request For Information (RFI) to 27 GTAA managers and received responses in April, 2020 from 25 GTAA managers for 34 investment strategies designed to complement the specific objectives of SFERS' strategic asset allocation. After further analysis, the SFERS custom GTAA universe was reduced to 14 managers with 15 investment strategies that best met the stated objectives.

NEPC and Staff present the results of the analysis quantifying and confirming how a custom GTAA program for SFERS could achieve the following:

1. High risk-adjusted returns
2. Incremental downside protection for the portfolio
3. Increased diversification
4. Incremental liquidity, especially in periods of stress

NEPC and Staff researched GTAA as both an evolution of SFERS Absolute Return program that offers higher liquidity and downside risk protection and a total plan overlay program. SFERS Asset and Liabilities Study includes proposals for direct allocation to GTAA as a strategic asset class.

Recommendation:

This is a discussion item.

Attachments:

- NEPC Global Tactical Asset Allocation (GTAA) Education for SFERS
- NEPC 2017 Asset-Liability Study for SFERS

GLOBAL TACTICAL ASSET ALLOCATION (GTAA) EDUCATION

SAN FRANCISCO EMPLOYEES' RETIREMENT SYSTEM



Investment Committee Meeting July 15, 2020

Phil Nelson, Partner

Allan Martin, Partner

Dan Hennessy, Senior Consultant



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GTAA OVERVIEW

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GTAA OVERVIEW

- **Global Tactical Asset Allocation (GTAA) enhances and complements a diversified asset allocation**
 - GTAA managers invest across equities, fixed income, currencies and commodities globally, enhancing overall diversification
 - GTAA targets a liquid, diversified asset allocation, that is tactically positioned to enhance long-term strategic asset allocation
 - A separate account mandate provides customization, full transparency and immediate liquidity
- **GTAA programs are designed to limit drawdowns and underperformance in adverse market environments**
- **Introduction of a GTAA program represents an evolution of Absolute Return**
 - While similar to Absolute Return, GTAA is differentiated by high levels of liquidity, capital efficiency, and transparency
- **Liquidity is a key focus of a GTAA program providing cash when needed**
 - A GTAA program may be used as a liquidity source to support portfolio rebalancing, benefit payments, and private market capital calls
- **GTAA strategies depend on investment manager skill to diversify and add alpha to total plan results**
 - GTAA program must be paired with clearly defined objectives to understand and weather periods of underperformance

BENEFITS OF A GTAA MANDATE

A custom GTAA program can offer SFERS numerous benefits:

1. An additional source of high risk-adjusted returns across market cycles
2. Significant incremental downside protection for the portfolio
3. Increased diversification of the strategic asset allocation
4. Significant incremental liquidity, especially in periods of stress

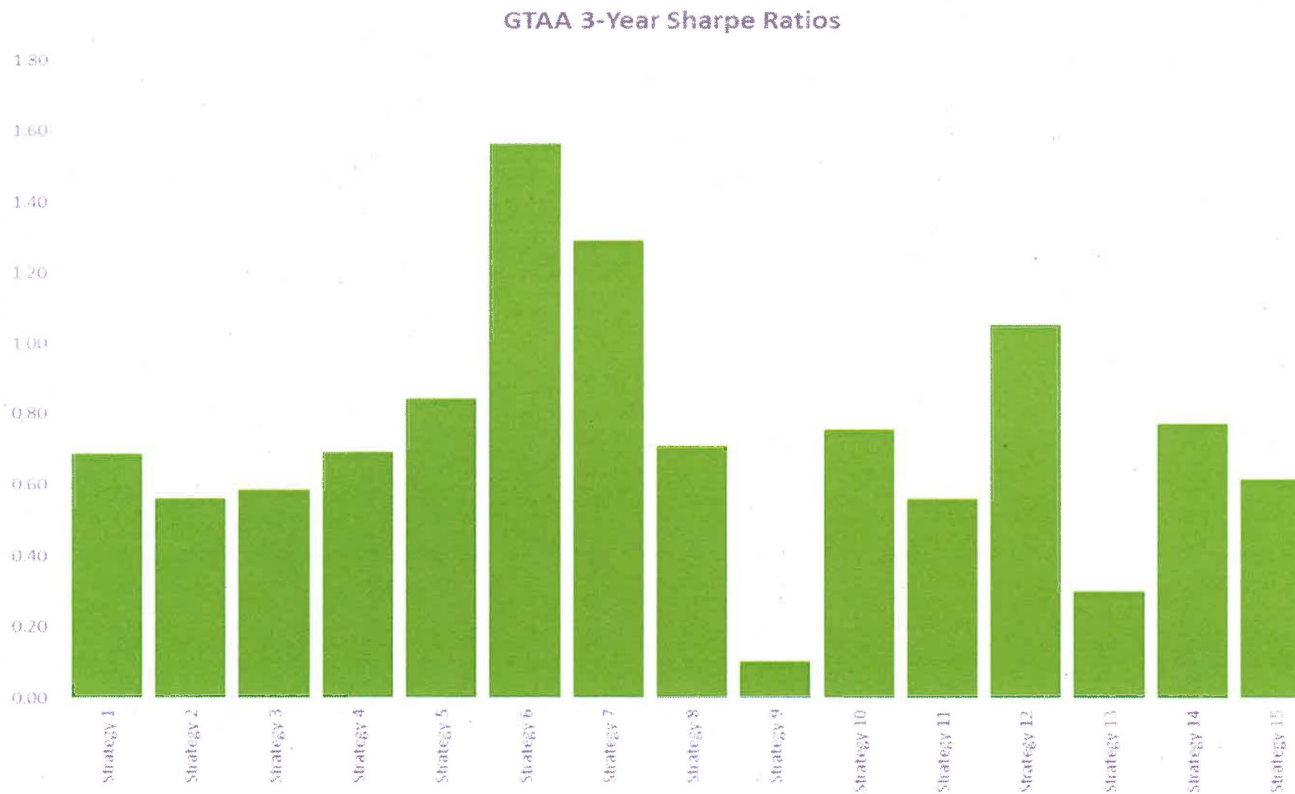


SFERS GTAA CUSTOM STRATEGY UNIVERSE

- **Surveying the broad GTAA universe, NEPC/SFERS investment team constructed a custom GTAA strategy universe**
- **GTAA is a strategy that allows for a high degree of customization to construct solutions specific to unique client objectives**
- **The team screened for approaches that would likely provide a benefit for the overall SFERS plan, focusing on four key objectives**
 1. High risk-adjusted returns
 2. Downside protection
 3. Increased diversification
 4. Incremental liquidity, especially in periods of stress
- **Working with the investment manager community, the investment team was able to customize the GTAA strategies to best meet the core objectives of a SFERS GTAA mandate**
- **The SFERS custom GTAA universe totals 25 GTAA managers with 34 investment strategies designed to complement the specific objectives of the SFERS asset allocation and portfolio**
 - A reduced universe of 14 managers with 15 investment strategies was constructed using managers that best meet the objectives of SFERS' GTAA mandate



GTAA OBJECTIVE 1 - RISK ADJUSTED RETURNS



- **GTAA has exhibited high positive Sharpe ratios**
- **GTAA has provided high risk-adjusted returns and is expected to be additive to the total SFERS portfolio**

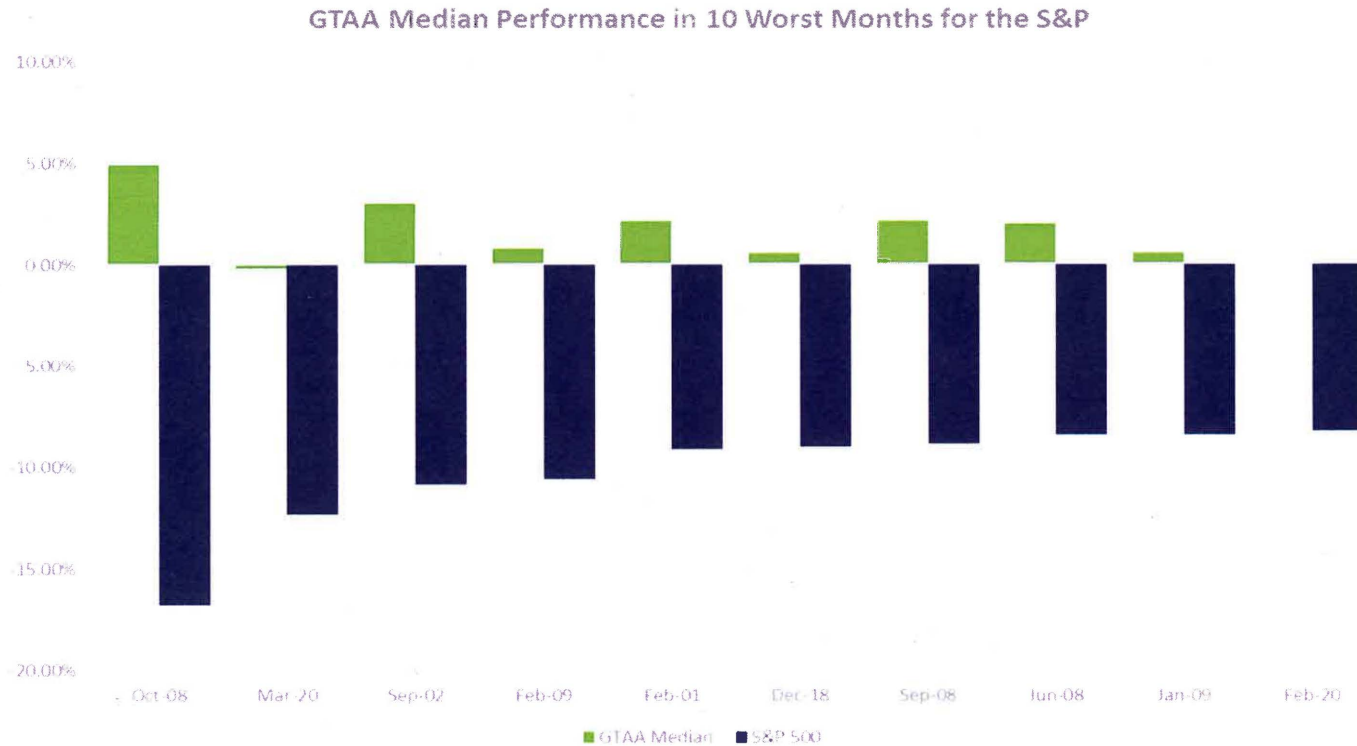
**15 GTAA strategies shown here are a subset of the total universe which best meet SFERS' objectives for the GTAA mandate*

***Volatility scaled up to 8% for all GTAA managers that responded with lower targeted volatility strategies assuming a tactical overlay implementation*

****Since inception Sharpe Ratio depicted for strategies 11 and 14 as 3-year history not available*



GTAA OBJECTIVE 2 - DOWNSIDE PROTECTION



- GTAA has provided significant downside protection in times of market stress**

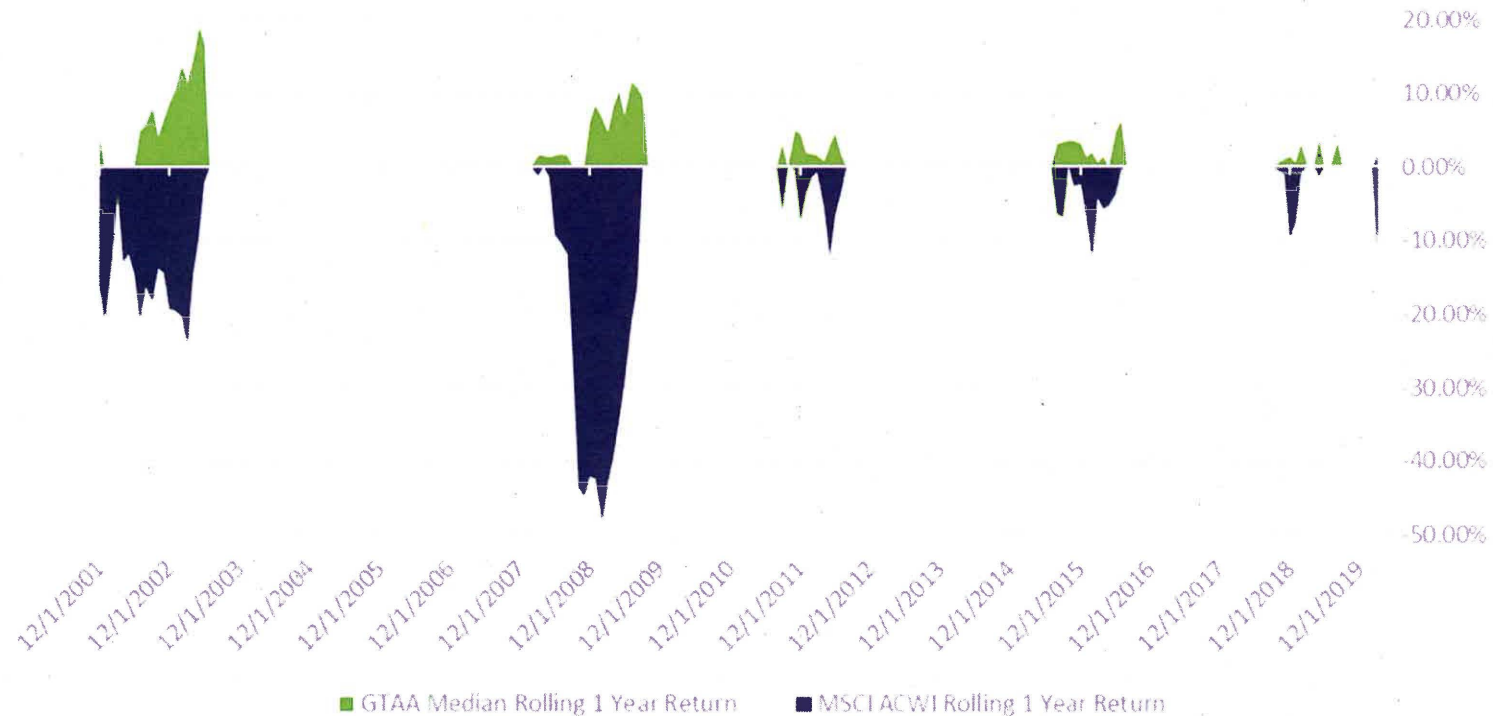
**Universe constructed with 15 GTAA strategies which best meet SFERS' objectives for the GTAA mandate; 2 strategies have a track record dating back to 09/2002 and 7 strategies have a track record dating back to 10/2008*

***Volatility scaled up to 8% for all GTAA managers that responded with lower targeted volatility strategies assuming a tactical overlay implementation*

GTAA OBJECTIVE 2 - DOWNSIDE PROTECTION

GTAA Strategies Mitigate Drawdowns

MSCI ACWI Periods of Negative 12 Month Rolling Returns



- **GTAA has mitigated the effects of equity market sell-offs and demonstrated an ability to limit drawdowns**

**Universe constructed with 15 GTAA strategies which best meet SFERS' objectives for the GTAA mandate; 2 strategies have a track record dating back to 12/2001 and 7 strategies have a track record dating back to 10/2008*

***Volatility scaled up to 8% for all GTAA managers that responded with lower targeted volatility strategies assuming a tactical overlay implementation*



GTAA OBJECTIVE 3 - DIVERSIFICATION

	Annlzd. Stand. Dev.	Risk- Adjusted Ratio
1 Year Ending 3/31/2020		
SFERS Total Fund	7.84%	0.04
SFERS Total Fund w/ GTAA	6.97%	0.11
3 Years Ending 3/31/2020		
SFERS Total Fund	6.32%	1.01
SFERS Total Fund w/ GTAA	5.78%	1.09
5 Years Ending 3/31/2020		
SFERS Total Fund	6.24%	1.01
SFERS Total Fund w/ GTAA	5.91%	1.05

- **GTAA would have reduced volatility and enhanced the risk-adjusted return characteristics of the total SFERS portfolio**

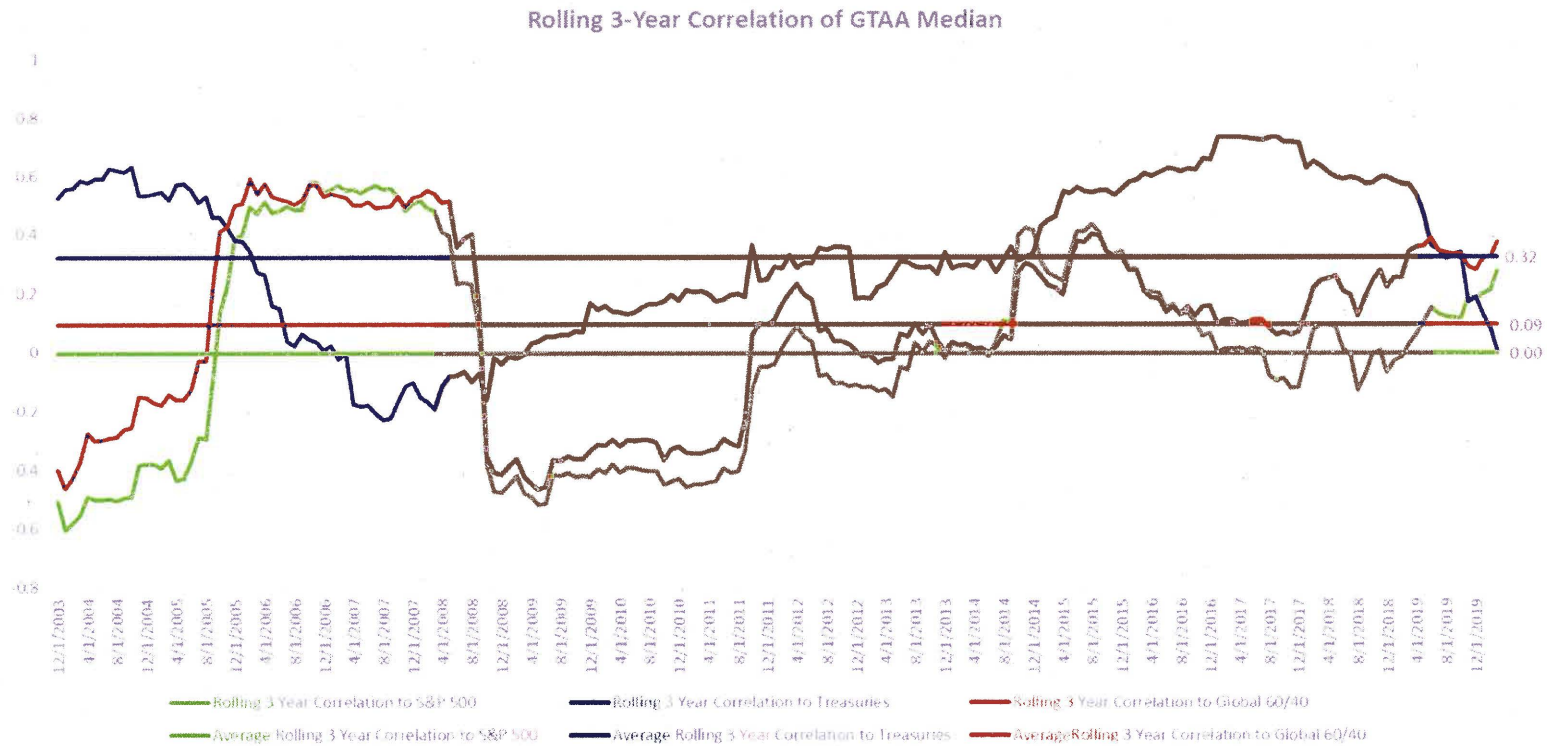
**Universe constructed with 15 GTAA strategies which best meet SFERS' objectives for the GTAA mandate*

***Volatility scaled up to 8% for all GTAA managers that responded with lower targeted volatility strategies assuming a tactical overlay implementation*

****SFERS Total Fund w/ GTAA assumes the current portfolio was re-weighted to include an allocation to the GTAA median fund in time periods over which Absolute Return existed with a maximum weight of 5%*



GTAA OBJECTIVE 3 - DIVERSIFICATION



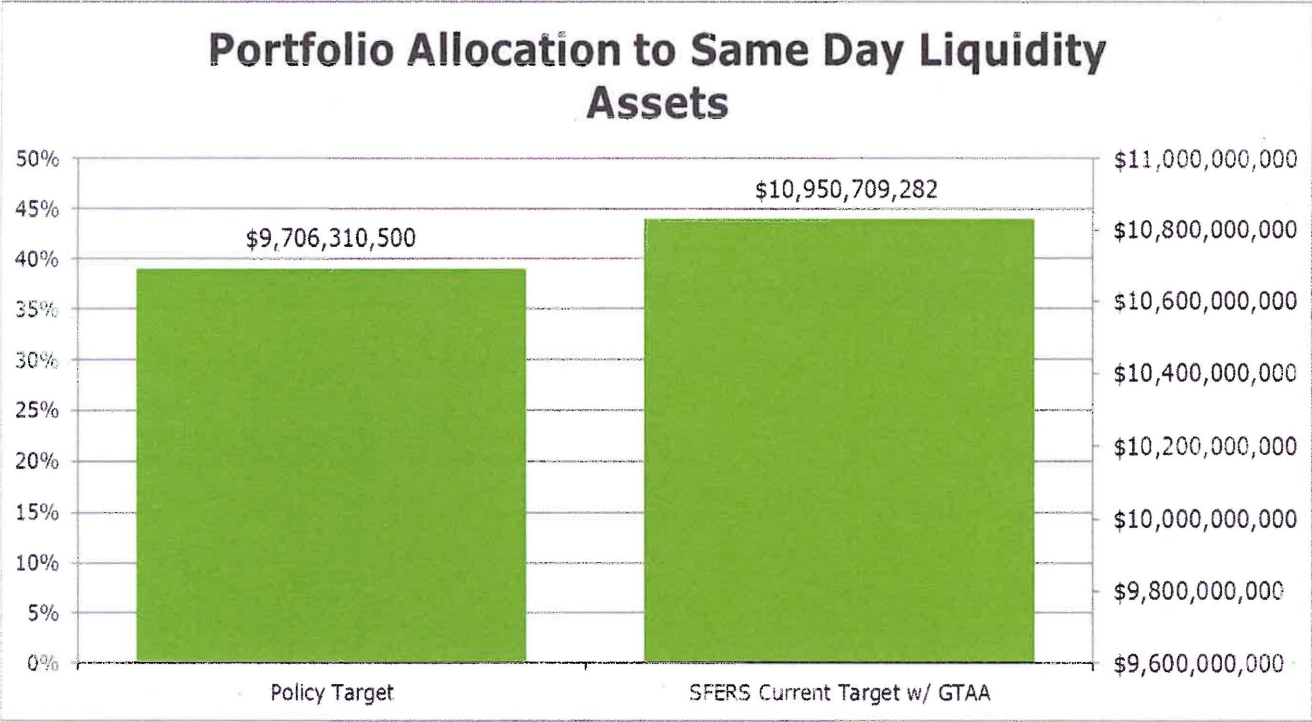
- **GTAA has had a relatively low correlation to equities**
- **GTAA tactical positioning is designed to offer an improved diversification profile in periods of market stress**

*Universe constructed with 15 GTAA strategies which best meet SFERS' objectives for the GTAA mandate

**Volatility scaled up to 8% for all GTAA managers that responded with lower targeted volatility strategies assuming a tactical overlay implementation



GTAA OBJECTIVE 4 - LIQUIDITY



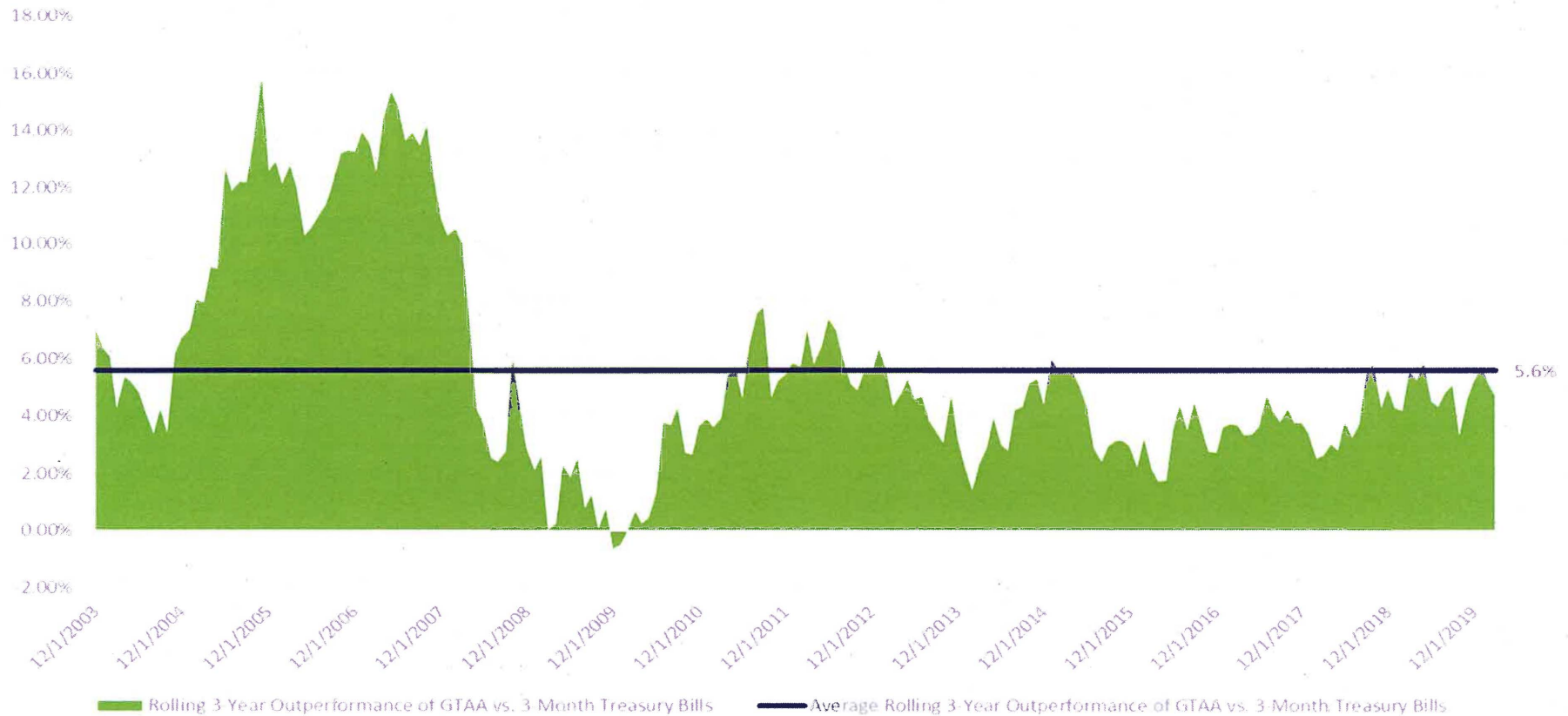
- **GTAA can be used as a source of liquidity, especially in a period of market stress**
- **A 5% allocation to GTAA would increase same day liquidity by \$1.2B**



**SFERS Total Fund w/ GTAA assumes the current portfolio was re-weighted to include a 5% allocation of GTAA*

GTAA PERFORMANCE CAN BE CYCLICAL

Rolling 3-Year Outperformance of GTAA vs. 3-Month Treasury Bills



- **While the long-term returns of GTAA are strong, there have been periods of underperformance**
- **Despite periods of underperformance, long-term average GTAA performance is consistent with Absolute Return return objectives**



**Universe constructed with 15 GTAA strategies which best meet SFERS' objectives for the GTAA mandate*

***Volatility scaled up to 8% for all GTAA managers that responded with lower targeted volatility strategies assuming a tactical overlay implementation*

IMPLICATIONS FOR ASSET ALLOCATION

- **GTAA complements strategic asset allocation and offers a faster response to market shifts**
 - By design, a strategic asset allocation does not easily allow for a rapid response to changes in market regimes
 - A GTAA program offers a more flexible and timely ability to exploit market opportunities or hedge potential adverse market outcomes
- **GTAA is expected to enhance the fund's diversification while providing liquidity during crisis periods**
- **The core objectives of a GTAA program offer clear benefits for asset allocation but must be meaningfully sized**
 - GTAA allocation of 5% or more is needed to influence plan-level outcomes
- **Allocation to defensive GTAA strategies can present an opportunity cost as GTAA may underperform during extended equity rallies**



GTAA IMPLEMENTATION AND GOVERNANCE CONSIDERATIONS

APPROACHES TO IMPLEMENTING GTAA

- **A GTAA strategic allocation may be implemented using different approaches**
 - Strategic Asset Class within a portfolio
 - Most common approach with long history of client usage
 - 36 of NEPCs 76 Public Funds currently retain a GTAA manager
 - Effective usage requires a dedicated separate account, although many smaller funds retain a commingled fund GTAA manager
 - Tactical Overlay to total portfolio
 - Provides the same benefits of the asset class approach, but use of derivatives provides the ability to add leverage to total portfolio and is highly cash efficient
 - At the same time, program oversight becomes more complex
- **GTAA is a source of liquidity during adverse market periods**
 - This requires the strategies to rely heavily on synthetic and derivative instruments for implementation
 - The use of synthetic exposures allows for greater capital efficiency and provides flexibility to implement the GTAA program as an overlay using plan-level leverage
 - A GTAA program funded with cash would not introduce plan-level leverage
- **Asset liability study models both approaches: Direct allocation to a Strategic Asset Class and Total Fund Overlay**

GTAA BENEFITS AND CONSIDERATIONS

- **GTAA strategies can offer a robust benefit to the overall portfolio but we encourage an acknowledgement of the potential implementation and governance risks**
- **Use of a GTAA program must be aligned with clearly defined objectives and a governance discipline to weather periods of strategy underperformance**

GTAA Benefits

- Provides source of liquidity to support the SFERS portfolio, especially in periods of market stress
- Designed to mitigate equity market declines and ideally provide equity tail-risk
- Offers a diversification benefit to the strategic asset allocation and seeks to minimize the periods of underperformance from the strategic asset allocation that will occur during periods of market stress
- Additional source of high risk-adjusted returns

GTAA Considerations

- Management fees for a GTAA program are generally higher than traditional public market investments
- Benchmarking a GTAA program and individual strategies are a challenge as the approach deviates from consistent market beta exposure. Comfort with higher tracking error levels is required.
- Complexity of various GTAA approaches hinder the ability to clearly communicate performance drivers of the strategies

NEXT STEPS

- **Determine GTAA strategic approach for SFERS (A/L study)**
 - While the GTAA program can be treated as an asset class, the underlying derivative instruments can easily be utilized to create efficient, low-cost leverage
- **Define GTAA program in IPS, including specific objectives, selection and oversight processes, and monitoring and reporting changes**
- **Determine staff oversight responsibility**
- **Complete manager evaluation with consultant, propose separate account manager structure for Board approval**



SFERS
San Francisco Employees' Retirement System

City and County of San Francisco
Employees' Retirement System
Investments Division

RETIREMENT BOARD CALENDAR SHEET
Investment Committee Meeting of May 23, 2017

To: Retirement Board

Through: Jay Huish *JH*
Executive Director

From: William J. Coaker, Jr. – CFA, MBA
Chief Investment Officer

Date: May 23, 2017

Agenda Item:

Asset Liability Modeling Process Part II– Review of Asset Liability Analysis and Discussion of Recommendation to Revise Asset Allocation

Background:

Every three years, the Retirement System, working with the General Consultant, (NEPC) conducts an Asset Liability and Asset Allocation Study. The attached materials include the Asset Liability Study and recommendations for changes to Fund Asset Allocation.

Action:

This is a discussion only item.

Attachment:

Staff Cover Memo
NEPC ALM Presentation



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SFERS

San Francisco Employees' Retirement System

San Francisco Employees' Retirement System

Asset/Liability Modeling

May 23, 2017

Allan Martin, Partner

Phil Nelson, Director of Asset Allocation

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Agenda

- **Asset Liability Modeling**
 - Asset class capital market assumptions
 - Alternative mixes
- **Exhibits**
 - NEPC 2017 Capital Market Assumptions

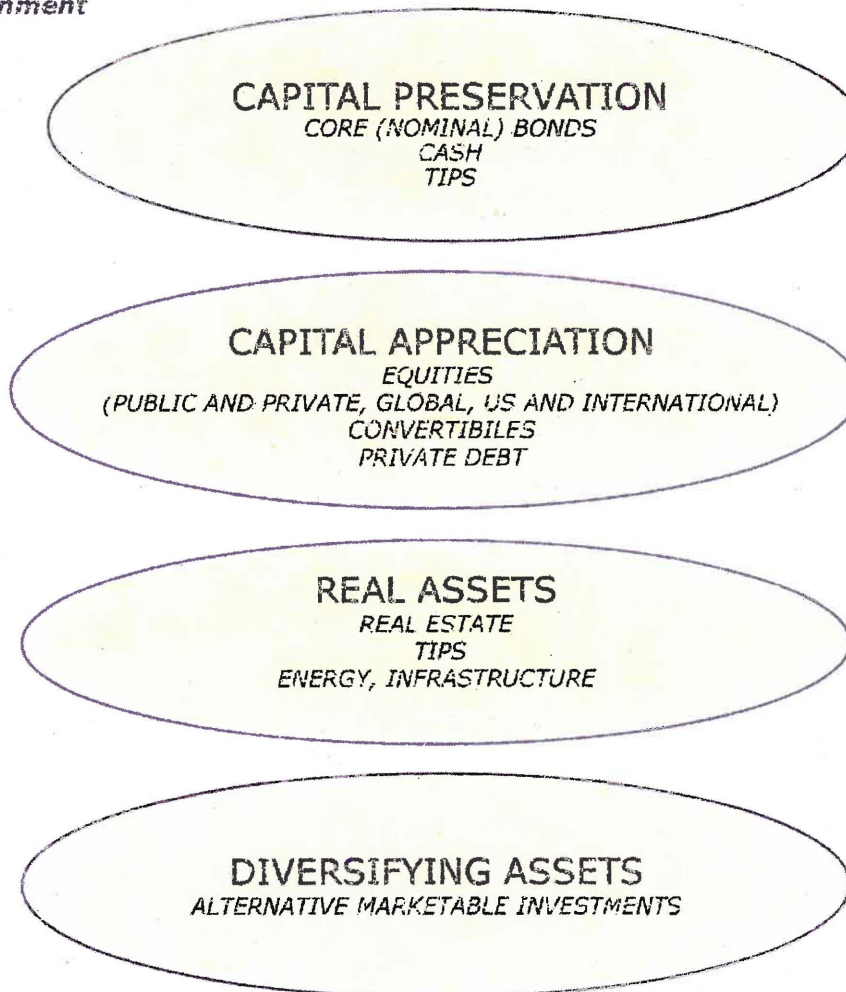
Overview of ALM-Related Calendar for SFERS Board

February 15, 2017 (Investment Committee)	Review Asset Liability Process/ Capital Market Assumptions
May 23, 2017 (Investment Committee)	Review and seek Board Direction on: <ul style="list-style-type: none"> • Eligible asset classes • Capital market assumptions • 5-6 asset mixes to model fully
June 14, 2017 (Board Meeting)	Investment Committee will report on May Investment Committee Meeting to full Board
August 16, 2017 (Investment Committee)	Review and seek direction on: <ul style="list-style-type: none"> • Asset allocation policy
September 13, 2017 (Board Meeting)	Board approval of asset allocation policy
October 11, 2017 (Board Meeting)	Board approval of Revised Investment Policy Statement

Asset Allocation Framework

NEPC utilizes a diversified range of asset classes to support the portfolio in a variety of economic conditions:

Inflation Environment



Role: Nominal capital preservation
Pros: Maintains value during economic weakness
 Maintains value during periods of deflation and low inflation
 Low volatility
Cons: Limited long-term growth
 Value eroded by inflation

Role: Long-term growth
Pros: Expected to perform well in periods of rising growth and low-moderate inflation
Cons: Higher volatility
 Suffers during economic weakness
 Suffers during periods of high inflation or deflation

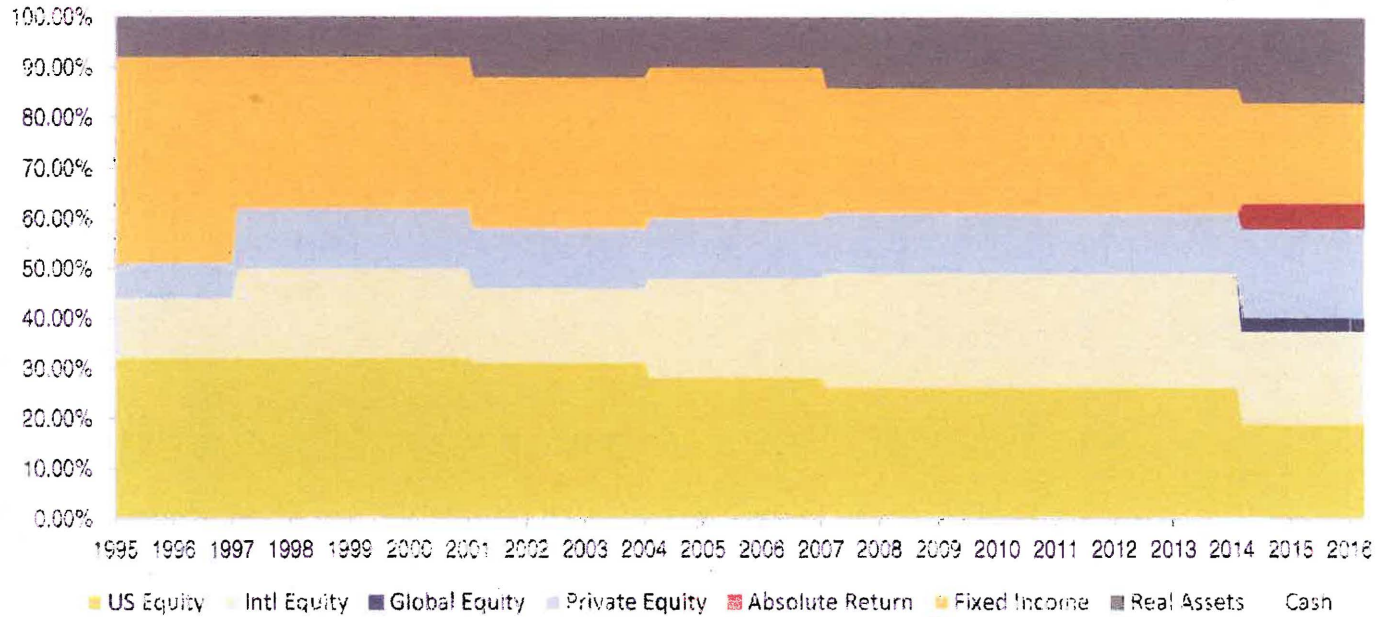
Role: Inflation protection
Pros: Diversification Inflation hedge
Cons: Moderate volatility
 Moderate long-term growth
 Underperforms in periods of deflation Sensitive to leverage

Role: Stable returns, low correlation and beta to growth, rates
Pros: Add diversified source of alpha to core portfolio, generate positive returns in most environments
Cons: Execution risk
 Moderate long-term growth

Current Asset Allocation Policy & Ranges

	SFERS Policy	Range	SFERS Actual 3/31/2017	Composite Benchmark
US Equity	18.8	18 - 25	23.6	Russell 3000
Int'l Equity	18.8	18 - 25	21.8	MSCI ACWI ex US IMI
Global Equity	2.5	0 - 5	2.6	MSCI ACWI
Private Equity	18.0	10 - 20	14.5	S&P 500 + 5%
Fixed Income	20.0	20 - 30	20.8	Bloomberg Barclays US Universal
Real Assets	17.0	9 - 15	13.9	8% Absolute Return
Absolute Return	5.0	0 - 5	2.5	91 Day T-bill + 5%
Cash	0.0	0 - 1	0.3	91 Day T-bill

SFERS Asset Allocation Policy



	1995	1998	2002	2005	2008	2011	Current
US Equity	32.00%	32.00%	31.00%	28.00%	26.00%	26.00%	18.75%
Intl Equity	12.00%	18.00%	15.00%	20.00%	23.00%	23.00%	18.75%
Global Equity	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.50%
Fixed income	41.00%	30.00%	30.00%	30.00%	25.00%	25.00%	20.00%
Real Assets	8.00%	3.00%	12.00%	10.00%	12.00%	12.00%	17.00%
Private Equity	7.00%	12.00%	12.00%	12.00%	14.00%	14.00%	18.00%
Absolute Return	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	5.00%
Cash	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
<i>Total Public Equity</i>	44.00%	50.00%	46.00%	48.00%	49.00%	49.00%	40.00%
<i>Total Fixed income</i>	41.00%	30.00%	30.00%	30.00%	25.00%	25.00%	20.00%
<i>Total Alternatives</i>	15.00%	20.00%	24.00%	22.00%	26.00%	26.00%	40.00%

SFERS Asset Allocation Versus Peers

	SFERS Policy	SFERS' Actual 12/31/2016	All Public Funds >\$1 Billion	All Public Funds	NACUBO Endowments >\$1 Billion
US Equity	18.8	23.6	26.4	30.9	13.0
Global and Intl Equity	21.3	24.4	20.2	17.7	19.0
Private Equity	18.0	14.5	7.2	3.9	19.0
Fixed Income	20.0	20.8	22.4	27.5	7.0
Real Assets	17.0	13.9	8.0	6.1	15.0
Absolute Return	5.0	2.5	4.4	2.7	20.0
GAA/Multi-Asset	0.0	0.0	4.3	3.9	0.0
Cash	0.0	0.3	1.2	1.2	3.0
Other	0.0	0.0	6.1	6.2	4.0
Universe Observations			68	247	91

Note: InvestorForce peer universe average asset allocation data as of 12/31/2016; equal weighted, including \$2.5 trillion in assets.

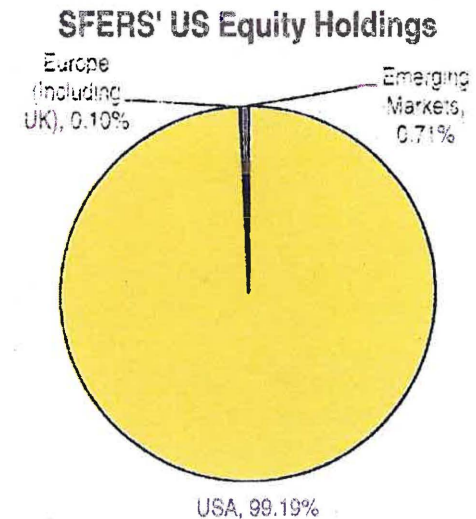
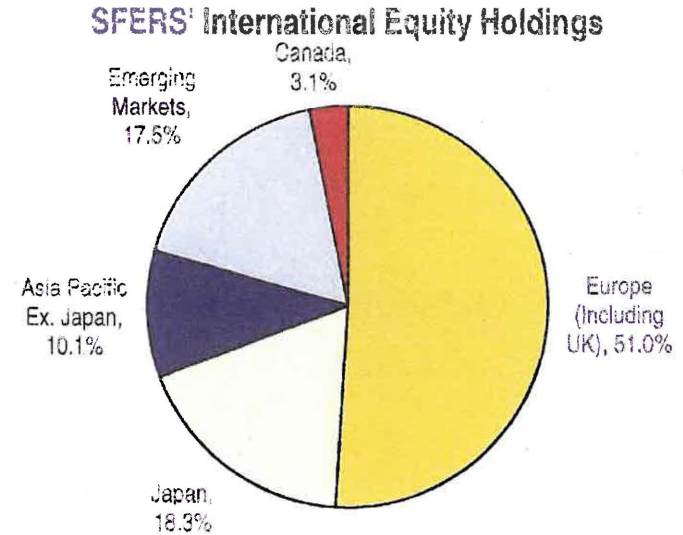
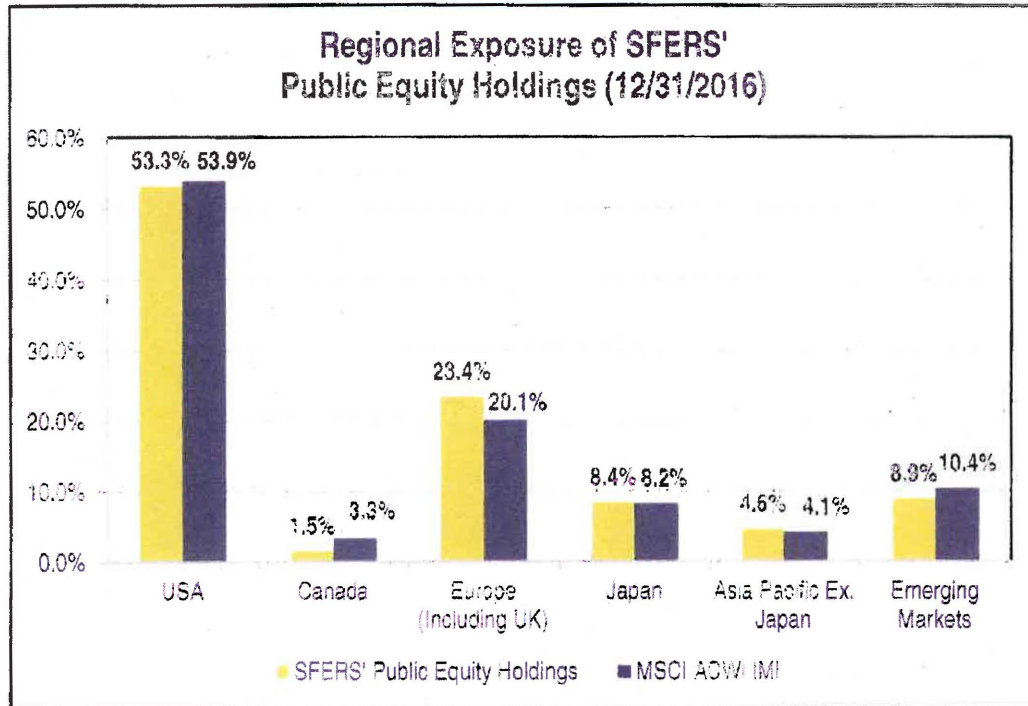
Other includes Miscellaneous and Undefined categories

Real Assets includes Real Estate and Commodities

Source: NACUBO Commonfund Study of Endowments 2016; peer universe average asset allocation data as of 6/30/2016, dollar weighted

SFERS' Equity Portfolio

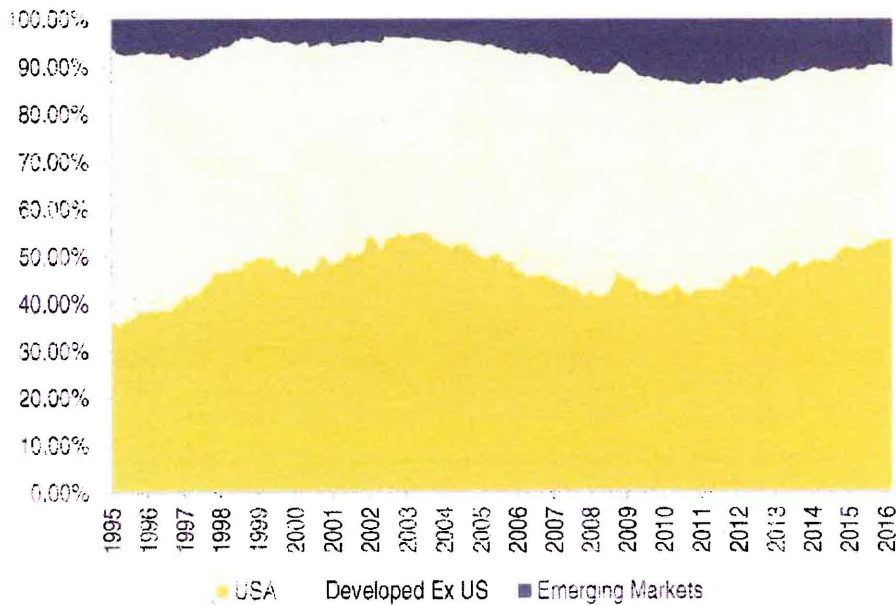
- On a combined basis, SFERS' US and International Equity portfolio is generally in line with the global equity market



Global Equity Market Breakdown

- SFERS's current allocation is generally in line with global markets. However, the current allocation is overweight U.S. equities versus the current target and underweight international equity markets versus the current target

MSCI ACWI IMI Historical Allocation

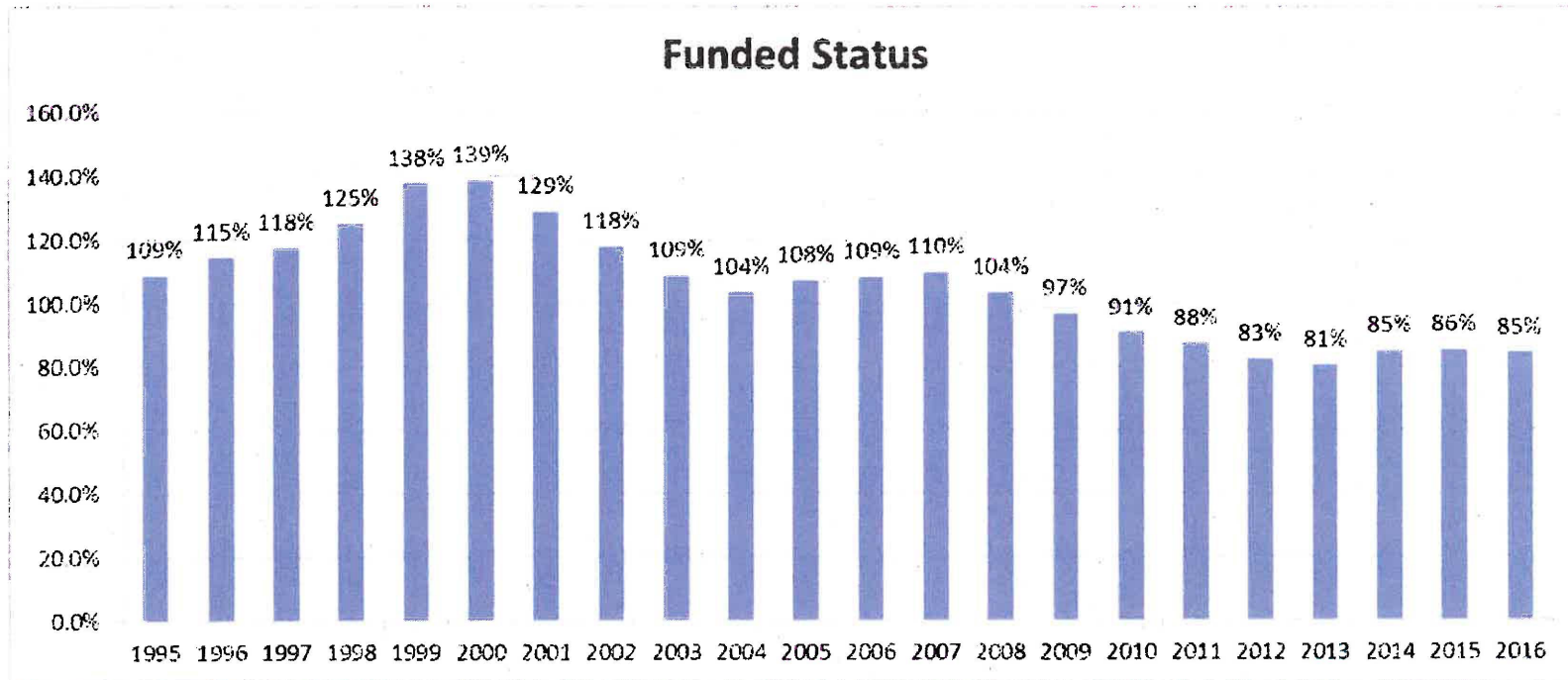


	MSCI ACWI IMI 12/31/2016	Current Target	Current Allocation
US Equity	54%	48%	53%
Developed Ex US	36%	41%	38%
EM	10%	11%	9%

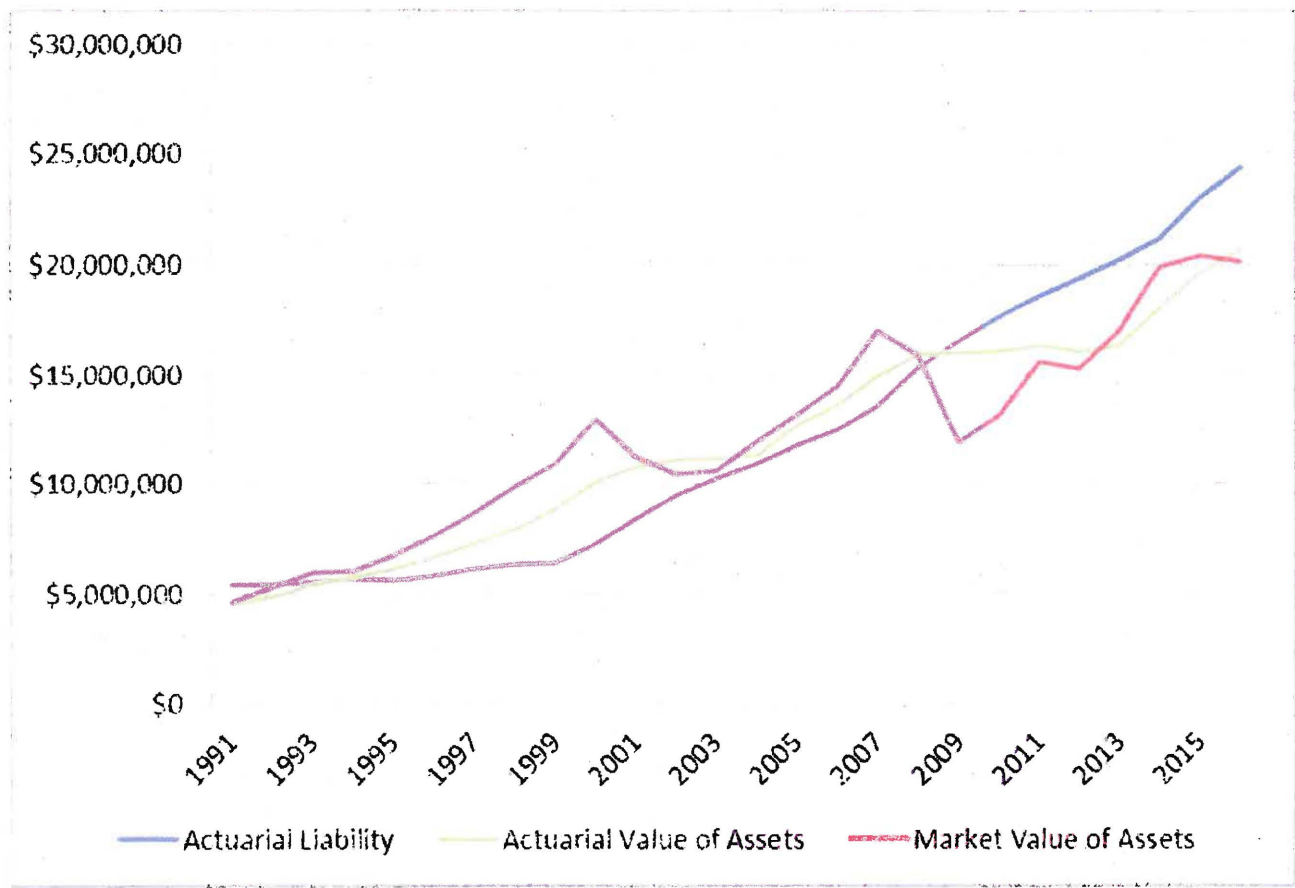
	USA	Developed Ex Us	EM
Avg Since 1995	47%	45%	8%
Avg Last 5 Years	48%	40%	11%
Avg Last 10 Years	46%	43%	11%

Data as of 3/31/2016

SFERS Funded Ratio (Actuarial Assets vs. Actuarial Liabilities)



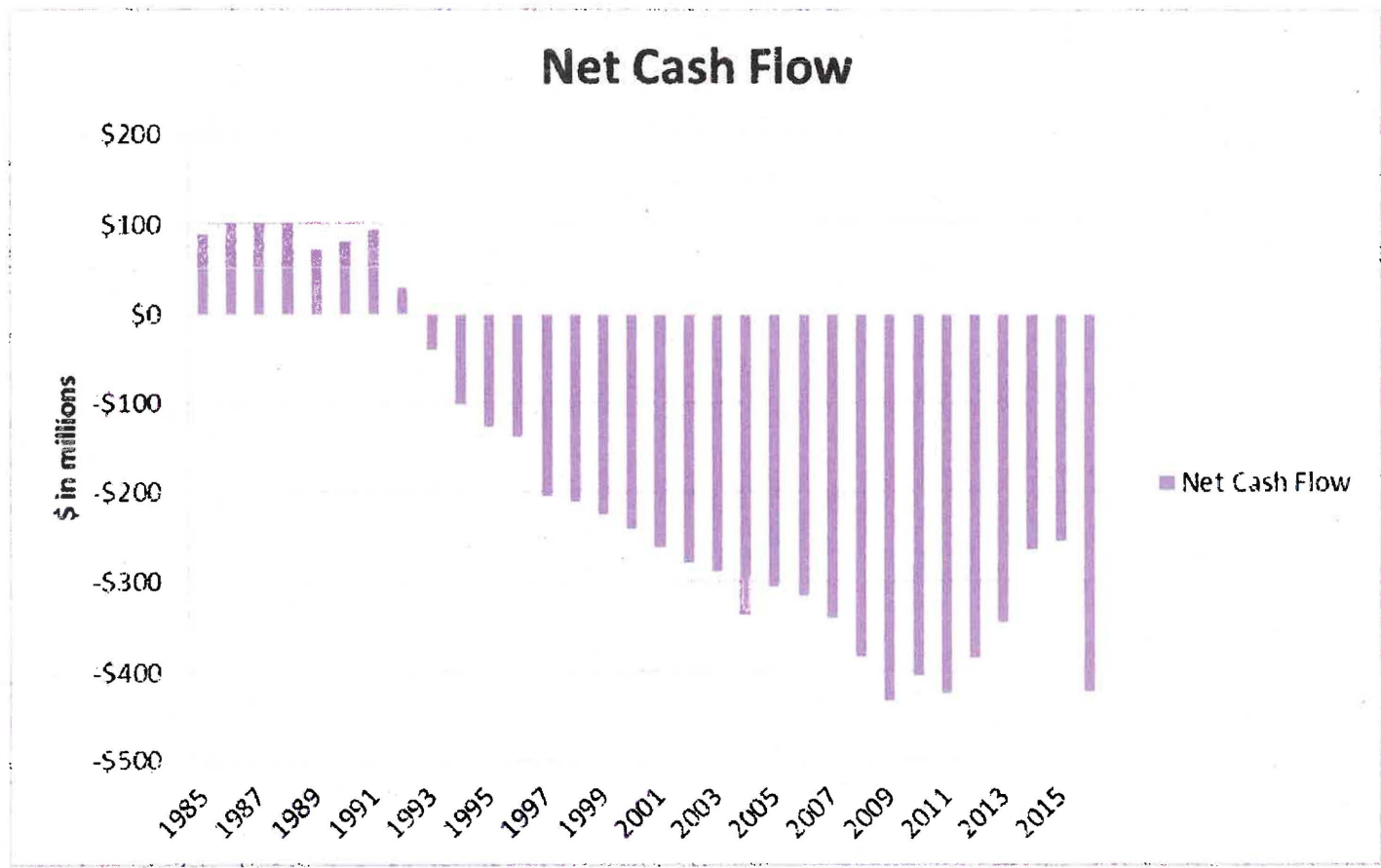
SFERS Assets vs. Liabilities



Source: Cheiron & Towers Perrin Actuarial Reports



SFERS Non-Investment Cash Flows



Source: Audited Financial Statements

Non investment net cash flow is employer and employee contributions paid in less benefits and administrative expenses paid out.



- **SFERS investment objectives (stated in its Investment Policy Statement):**
 - To provide participants with required retirement benefits
 - Manage assets on a total return basis
 - Exceed the assumed actuarial rate of return (7.50% currently) over five-year rolling periods
 - Exceed the weighted index based on SFERS' asset allocation policy and respective asset class component benchmarks over rolling five year periods
 - To set asset allocation policy in a manner that encompasses a strategic, long-term perspective of capital markets as well as the nature and structure of SFERS' liabilities
- **Important Risks to the Plan:**
 - Volatility of returns/drawdown risk
 - Volatility of funded status
 - Volatility of contributions

- **Key Inputs**

- Eligible asset classes
- Expected return over a 5-7 year and 30 year horizon for eligible asset classes
- Expected risk over a 5-7 year and 30 year horizon for eligible asset classes
- Expected correlations between eligible asset classes
- Modeling constraints on holdings of eligible asset classes

- **Key Output:**

- Projected 5-7 year and 30 year Portfolio Return and Risk

SFERS Portfolio

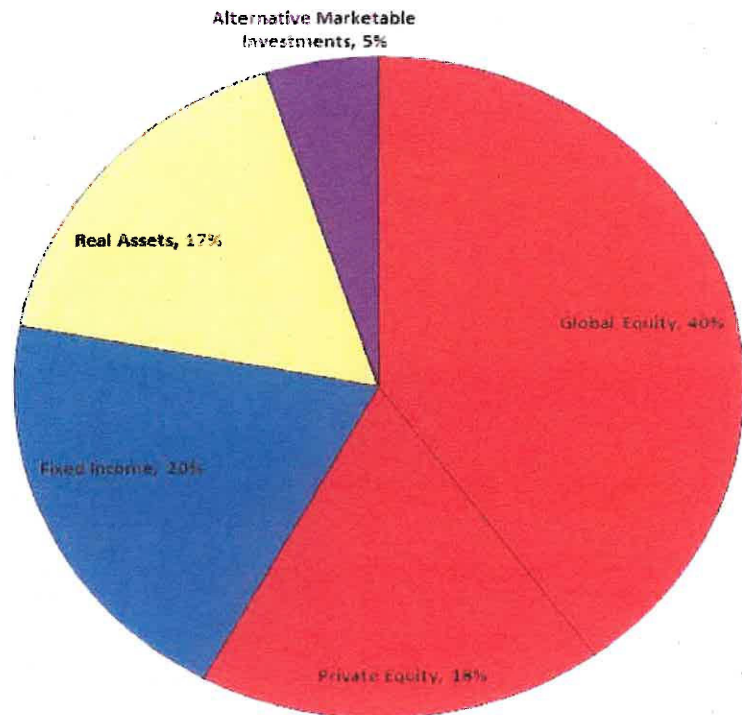


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Allowable Asset Classes

		Comments
<u>Capital Appreciation</u>		
US Equity	Included	Includes convertibles in US equities
International Equity	Included	Includes Emerging Market Equities
Private Equity	Included	
Private Credit	Included	
<u>Capital Preservation</u>		
Core Fixed Income	Included	
TIPS	Included	
Cash	Not Included	Not modeled as a strategic asset class; cash will retain an allowable range of 0-2%
<u>Real Assets</u>		
Real Estate	Included	includes both public and private real estate
TIPS	Included	
Real Assets (Energy/Infrastructure)	Included	
<u>Diversifying Assets</u>		
Alternative Marketable Investments	Included	

SFERS 2017 Target Mix – Using NEPC’s 2017 Assumptions



- Total Growth/Capital Appreciation – 58%
- Total Capital Preservation/Risk Reduction – 20%
- Total Real Assets/Inflation Hedge – 17%
- Total Diversifying Assets – 5%

	5-7 Year	30 Year
	2017	2017
<i>Expected Return</i>	6.90%	7.90%
<i>Expected Volatility</i>	13.50%	13.50%
<i>Sharpe Ratio</i>	0.38	0.36
<i>Sortino Ratio</i>	0.62	0.73

Probabilities using NEPC’s 2017 Capital Market Assumptions

Probability of 1 Year Return Under 0.0%	30.5%
Probability of 5-7 Year Return Under 0.0%	10.5%
Probability of 5-7 Year Return Over 7.50%	45.6%
Probability of 30 Year Return Over 7.50%	56.3%

SFERS Actuarial Assumed Rate:
7.5%

*Expected Returns are Geometric

Source: NEPC’s 2016 and 2017 Capital Market Assumptions; Asset Allocation targets shown approved in February 2015

Projected Risk and Return

- NEPC capital market forecasted returns have declined over the last several years
- Using NEPC 2017 capital market assumptions, SFERS' Current Long Term Target is projected to return 6.9% over 5-7 years, below the actuarial assumed rate of 7.5%

	Using 2017 Assumptions	Using 2016 Assumptions	Using 2015 Assumptions
Cash	0.0%	0.0%	0.0%
Global Public Equity	40.0%	40.0%	40.0%
Private Equity	18.0%	18.0%	18.0%
Credit/Private Debt	6.2%	6.2%	6.2%
Total Growth/Capital Appreciation	64.2%	64.2%	64.2%
Treasuries	2.0%	2.0%	2.0%
Core Fixed Income	11.8%	11.8%	11.8%
Total Capital Preservation/Risk Reduction	13.8%	13.8%	13.8%
Other Real Assets	8.5%	8.5%	8.5%
Real Estate	8.5%	8.5%	8.5%
Total Real Assets/Inflation Hedge	17.0%	17.0%	17.0%
Alternative Marketable Securities	5.0%	5.0%	5.0%
Total Diversifying Assets	5.0%	5.0%	5.0%
Expected Return 5-7 yrs	6.9%	7.0%	7.0%
Expected Return 30 yrs	7.9%	8.0%	8.1%
Standard Dev of Asset Return	13.5%	12.3%	12.5%
Sharpe Ratio (5-7 years)	0.32	0.45	0.42
Sortino Ratio (5-7 years)	0.62	0.71	0.68
Sharpe Ratio (30 years)	0.26	0.41	0.39
Probability of 5-7 Year Return Over 7.5%	45.6%	46.4%	46.0%
Probability of 5-7 Year Return Under 0.0%	10.5%	8.0%	8.6%

Source: NEPC's 2017, 2016, 2015 Capital Market Assumptions
 Note: Credit/Private Debt includes both public and private markets



Current and Actual Asset Allocation Expected Return, Standard Deviation and Sharpe Ratio

	Long Term Target	Actual 3/31/17	Intermediate Target	80/20
Cash	0.0%	0.3%	0.0%	0.0%
Global Public Equity	40.0%	48.1%	40.0%	80.0%
Private Equity	18.0%	14.5%	16.0%*	0.0%
Credit/Private Debt	6.2%	8.5%	13.0%	0.0%
Total Growth/Capital Appreciation	64.2%	71.1%	69.0%	70.0%
Treasuries	2.0%	3.3%	2.0%	0.0%
Core Fixed Income	11.8%	9.0%	7.0%	20.0%
TIPS	0.0%	0.0%	2.0%	0.0%
Total Capital Preservation/Risk Reduction	13.8%	12.3%	11.0%	20.0%
Other Real Assets	8.5%	3.2%	5.0%*	0.0%
Real Estate	8.5%	10.6%	10.0%*	0.0%
Total Real Assets/Inflation Hedge	17.0%	13.8%	15.0%*	0.0%
Alternative Marketable Investments	5.0%	2.5%	5.0%*	0.0%
Total Diversifying Assets	5.0%	2.5%	5.0%	0.0%
Expected Return 5-7 yrs	6.9%	6.7%	7.1%	6.5%
Expected Return 30 yrs	7.9%	7.8%	8.1%	7.7%
Standard Dev	13.5%	13.4%	13.6%	14.8%
Sharpe Ratio (5-7 years)	0.38	0.37	0.39	0.32
Sortino Ratio (5-7 years)	0.62	0.60	0.64	0.32
Probability of 5-7 Year Return over 7.5%	45.6%	44.5%	46.9%	43.4%
Probability of 5-7 Year Return under 0.0%	10.5%	10.8%	10.1%	14.2%

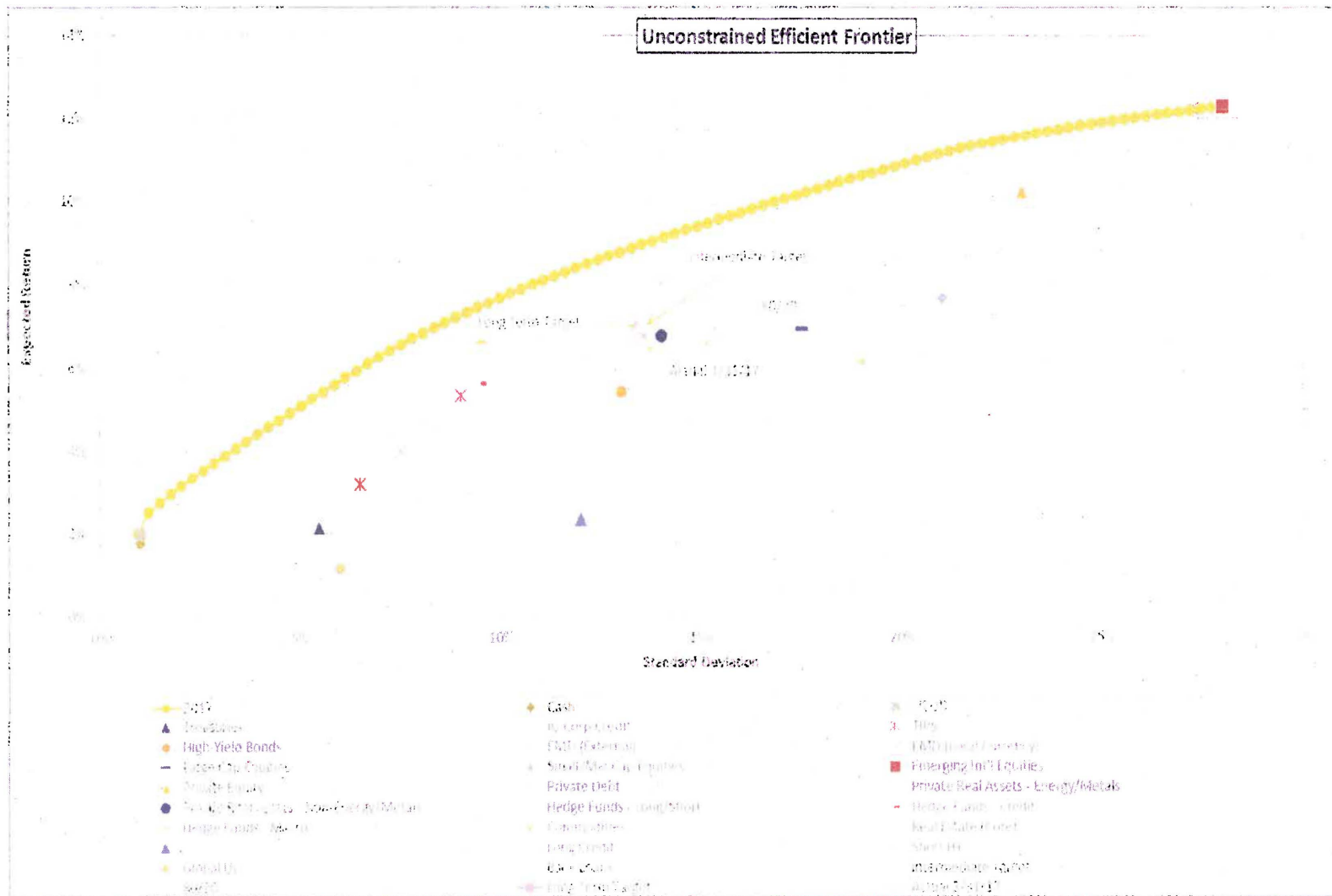
Note: Credit/Private Debt includes both public and private markets

Source: NEPC's 2017 Capital Market Assumptions

*Constrained targets



Efficient Frontier Comparison



- **June 14, 2017 Board Meeting**
 - Board will approve recommended capital market assumptions and mixes, recommendation will be based on direction received at the Investment Committee meeting

- **August 16, 2017 Investment Committee**
 - Board will review asset-liability modeling, and the impact of different mixes on Plan funding status, contributions, market values and other measures

 - NEPC will seek direction on a revised policy

- **September 13, 2017**
 - Board will approve revised asset allocation policy

Asset Class Assumptions



We use market data for all asset class assumptions as of November 30th

Assumptions combine historical data and forward looking analysis

Expected returns based on current market pricing and forward looking estimates

Volatility informed by history but adjusted to reflect non-normality

Correlations based on long-term data but recognize ongoing shifts in asset relationships

Forward-looking asset class models to determine expected return are based on current market pricing and a building blocks approach

Expected return equals yield plus change in price (valuation, roll down, defaults, etc.)

Country/regional inflation and real growth estimates are key economic observations

Qualitative inputs and investor sentiment (capital flows, etc.) inform the return outlook

Asset class assumptions are prepared by the Asset Allocation Committee

Asset Allocation team plus members from consulting practice groups meet to develop ideas for Key Market Themes, Strategic Policy Actions, and Current Opportunities

Partners Research Committee approves asset class assumptions

We continue to refine our assumptions process where appropriate and changes are evolutionary rather than revolutionary

Separated the asset class assumption for private real assets into two categories; energy/metals and infrastructure/land

Draws a more clear distinction between the volatility and return profile of the two assets

Energy/metals reflects the higher volatility of the underlying commodity input

Infrastructure/land reflects the lower volatility of infrastructure, timber, and farmland

Refined our equity models to reflect market specific growth and inflation building blocks for each equity asset class

Building blocks are constructed from country growth and inflation inputs derived from the allocation of revenues across geographic regions

International equity models expanded to include both a top-down index view and bottom-up country models based upon underlying country index weights

Broadened our global bond country list to reflect a wider range of potential index exposures for both developed and emerging markets

Global fixed income model now captures more than 30 local interest rate markets

Our outlook for US CPI is 2.5% over 5-7 years and 2.75% over 30 years

Our assumption is informed by break-even inflation expectations and local price indices

Inflation is an integral component of our asset allocation assumptions

Represents an essential building block for creating asset class returns

There are multiple inflation sources used to inform our asset class views

Includes forecasts from international organizations (e.g. IMF), local consumer and producer price indices, and break-even inflation expectations

Asset classes include various inflation inputs incorporating global inflation data and/or local market inputs

Equity inflation expectations over 5-7 years are each constructed from country inflation inputs derived from the allocation of revenues across geographic regions

Over 30 years we assume equity markets will converge to a global inflation building block that assumes a terminal value of 3.25%

Fixed income assumptions for developed and emerging markets incorporate country specific inflation expectations as implied by forward interest rate curves

2017 5-to-7 Year Return Forecasts

Geometric Expected Return				
Asset Class	2016	2017	2017-2016	5-7 Year Forecasted Sharpe Ratio
Private Credit	7.50%	7.25%	-0.25%	0.75
Alternative Marketable Investments**	5.25%	5.95%	0.50%	0.48
Absolute Return Fixed Income*	3.31%	3.62%	0.31%	0.45
Emerging Market Debt (Local)	6.50%	6.75%	0.25%	0.33
Real Assets	7.65%	7.09%	-0.56%	0.32
Global Equities*	7.23%	7.08%	-0.15%	0.3
Private Equity	8.50%	8.25%	-0.25%	0.28
Real Estate	6.50%	6.00%	-0.50%	0.28
Emerging Int'l Equities	9.75%	9.50%	-0.25%	0.28
IG Corp Credit	3.75%	3.75%	-	0.27
Emerging Int'l Sm Cap Equities	10.00%	10.00%	-	0.27
Int'l Equities	7.25%	7.25%	-	0.26
Int'l Sm Cap Equities	7.50%	7.50%	-	0.26
High-Yield Bonds	5.25%	4.75%	-0.50%	0.23
Large Cap Equities	6.00%	5.75%	-0.25%	0.23
Small/Mid Cap Equities	6.25%	6.00%	-0.25%	0.2
TIPS	2.50%	3.00%	0.50%	0.19
Core Bonds*	2.46%	2.65%	0.19%	0.15
MBS	2.00%	2.25%	0.25%	0.07
US Treasuries	1.75%	2.00%	0.25%	0.03
Cash	1.50%	1.75%	0.25%	0
Global Bonds (Hedged)	1.09%	1.09%	-	-0.13

* Assumption based on market weighted blend of relative sub-components.

** Alternative Marketable Investments is a calculated blend of 40% Equity, 40% Credit, 20% Macro-related strategies.

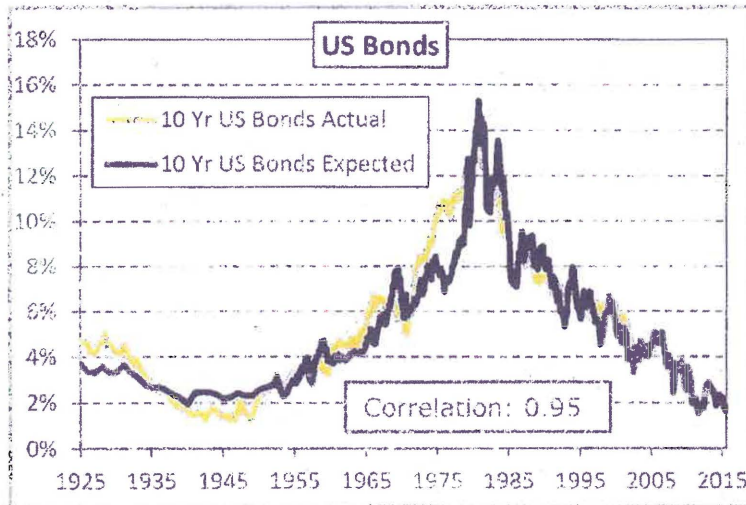
*** All asset classes are US, unless labeled otherwise (Int'l and Global), except absolute return, real assets, risk parity, private equity and real estate which are global.



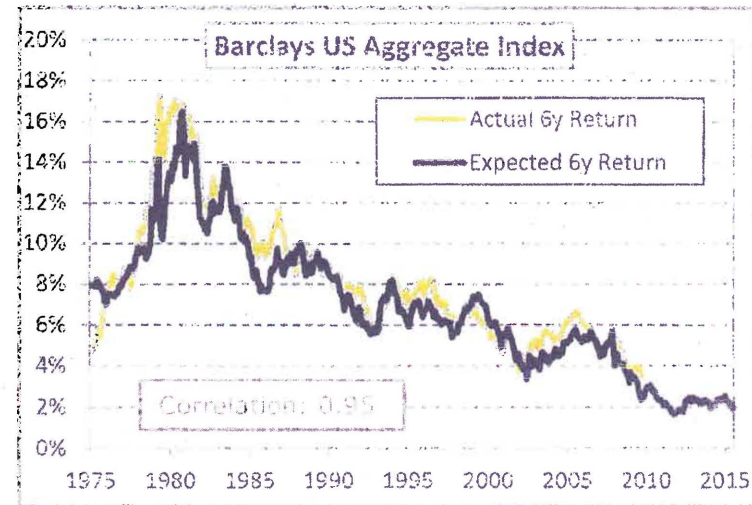
Asset Class Building Blocks Summary

- **Global Equity Building Blocks**
 - **Inflation:** Represents global inflation expectation over forecast period
 - **Real Earnings Growth:** Represents assumption for real growth for each market
 - **Profit Margin Adjustment:** Return due to shift of profit margins to forecast value
 - **Dividend Yield:** Represents dividend yield expectation over forecast period
 - **Valuation:** Return due to shift of current price/earnings ratio to forecast value
- **Commodities Building Blocks**
 - **Valuation:** Return from commodity spot price reverting to long term real average
 - **Roll yield:** Average annual yield to roll futures contract over forecast period
 - **Cash:** Expected US cash rate over forecast period
- **Fixed Income Building Blocks**
 - **Sovereign Yield:** Average expected government bond yield over forecast period
 - **Sovereign Price Change:** Expected price change due to changes in interest rates
 - **Roll Down:** Expected price change due to ageing of a bond along the yield curve
 - **Credit Spread:** Average expected credit spread over forecast period
 - **Spread Price Change:** Return due to shift of current credit spread to forecast value
 - **Credit Deterioration:** Return from credit downgrade and default over forecast period
 - **Real Yield:** Average expected government real yield over forecast period (TIPS)
 - **Real Yield Price Change:** Expected price change due to changes in real rates
 - **Inflation Expectation:** Expected inflation accrual over the forecast period (TIPS)
- **Private Markets Building Blocks**
 - **Illiquidity Premium:** Return associated with illiquidity factor specific to asset class
 - **Relative Valuation Adjustment:** Qualitative adjustment reflecting asset class views
 - **Public Market Return:** Return associated with equivalent public market beta

US Treasury Spot and Forward Curves are the Backdrop for Lower Bond Returns



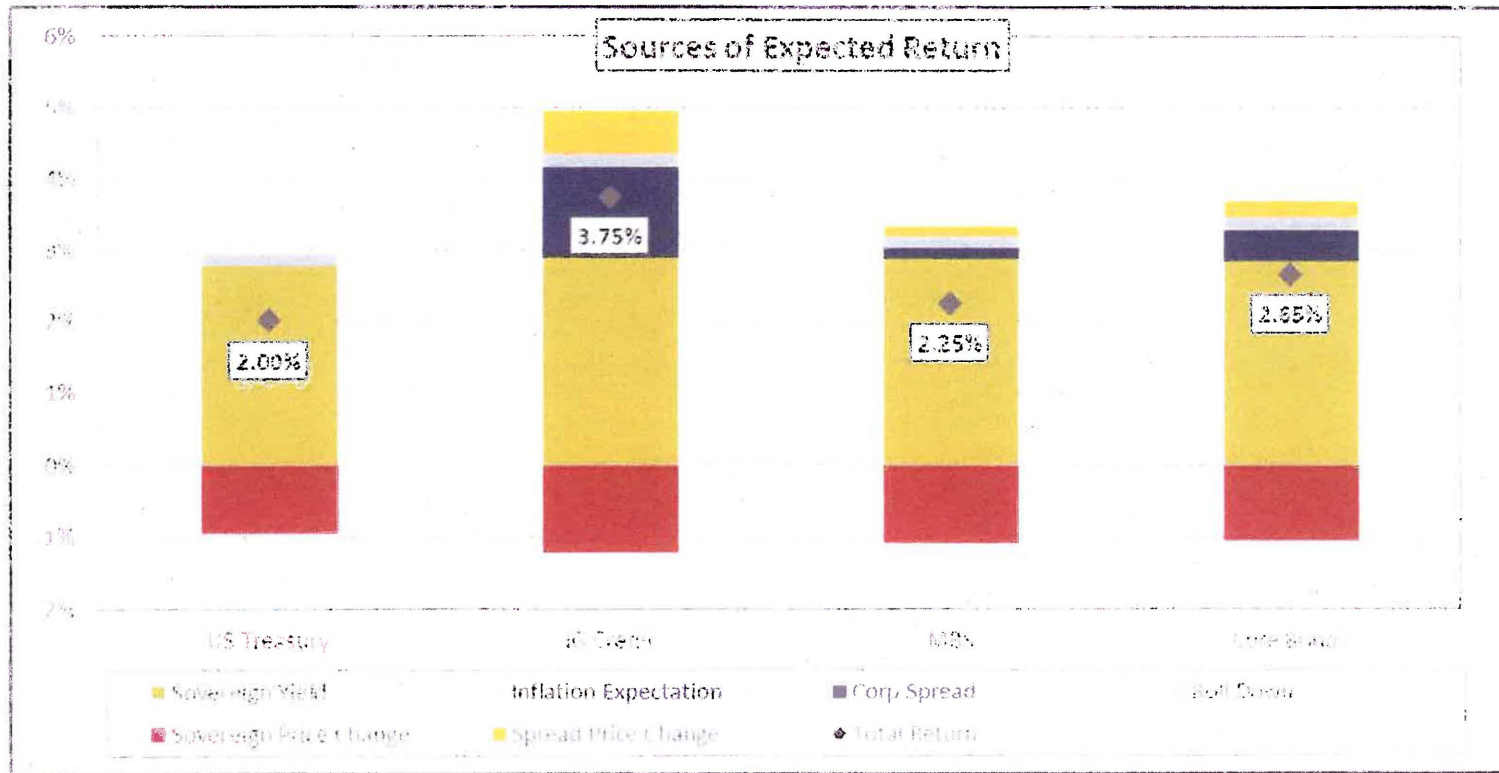
Source: Bloomberg



Source: Bloomberg

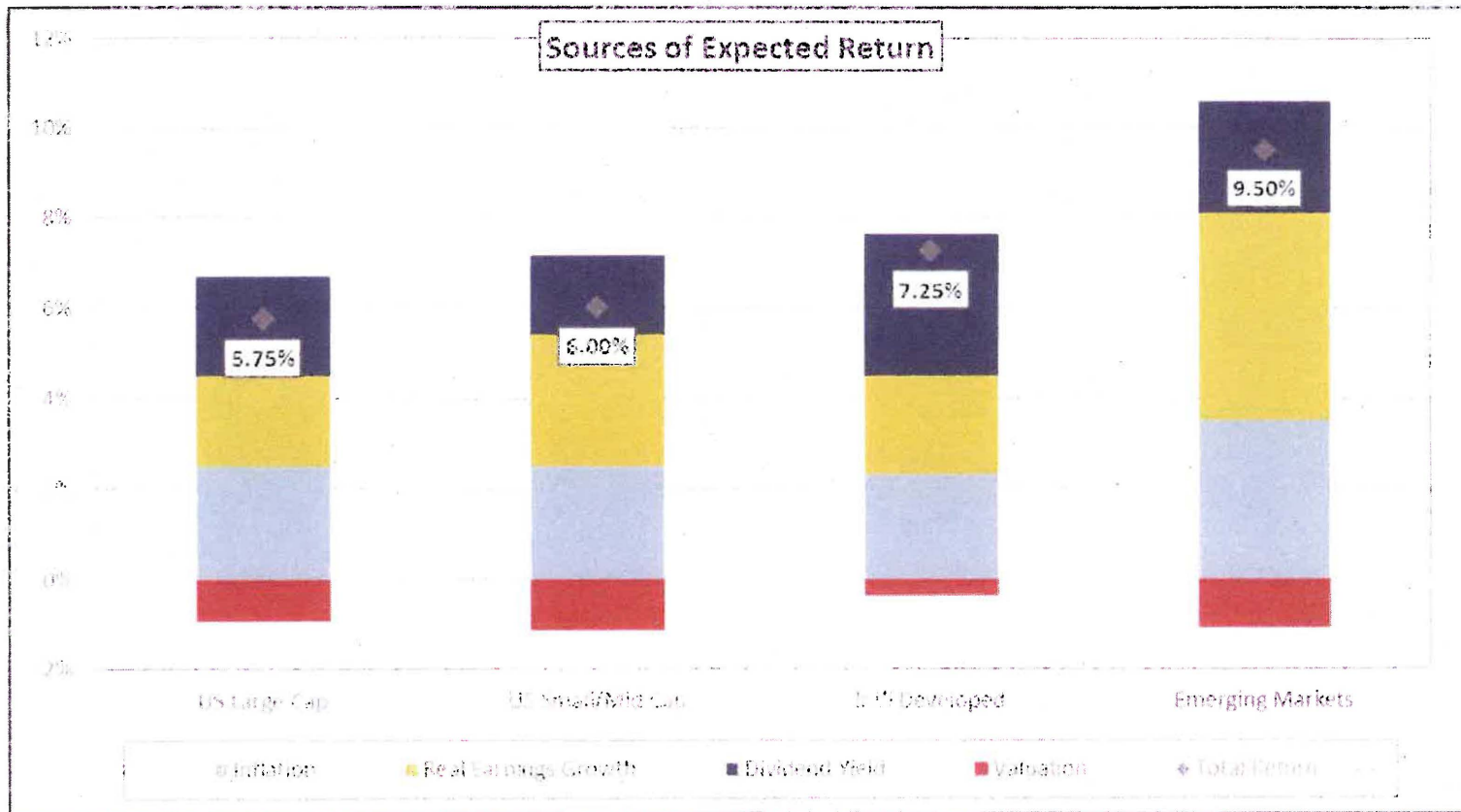
- **10 year bond yield is excellent predictor of 5-7 year holding period returns**
- **10 year bond yields are at historic lows, anchoring expected returns at a low level by an historic standard**

Assumption Development – Core Bonds



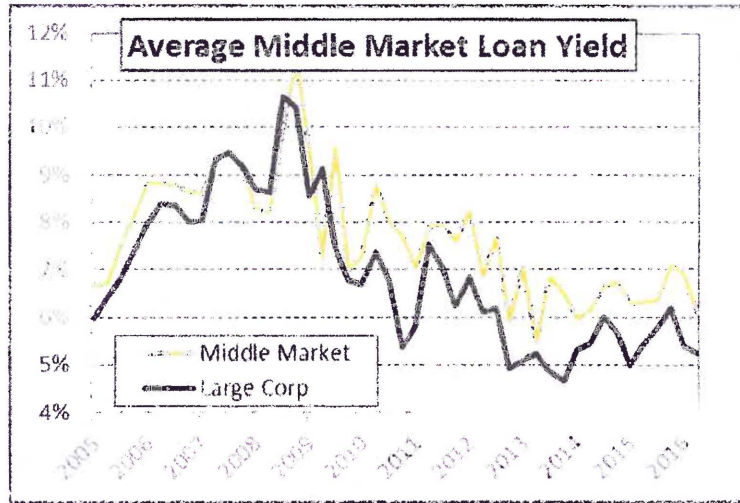
Index Current	US Treasury	US Credit	US MBS	US Aggregate
Yield	1.83	3.3	2.8	2.6
OAS	-	1.2	0.2	0.5
Duration	6.1	7.0	4.5	5.9
Quality	AA+/Aaa	A-/A3	AAA/Aaa	A/Aa2
MV (Millions)	5,861,998	5,942,232	5,353,011	19,034,388

Assumption Development – Global Equities

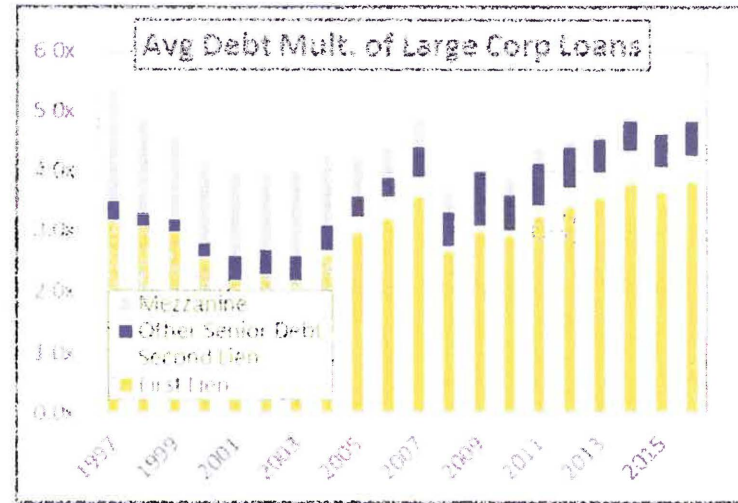


Index Current	US Large Cap	US Small/Mid Cap	Int'l Developed	Emerging Markets
Trailing P/E	20.6	31.6	16.9	14.3
Profit Margin	9.5%	4.2%	6.2%	8.0%
Dividend Yield	2.1%	1.7%	3.3%	2.5%

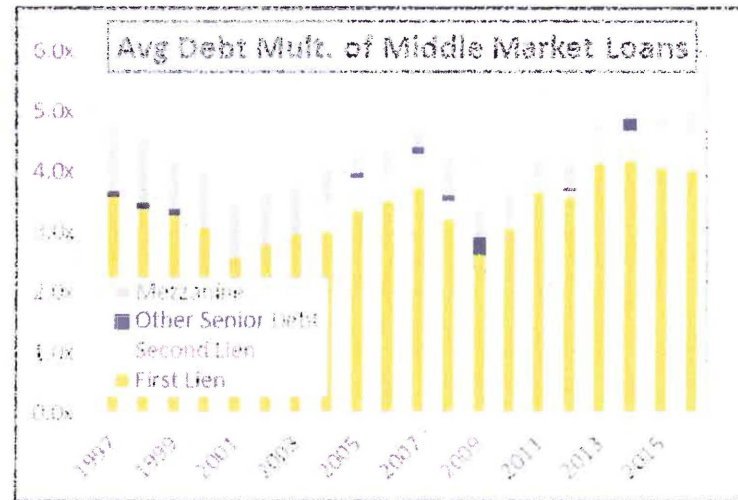
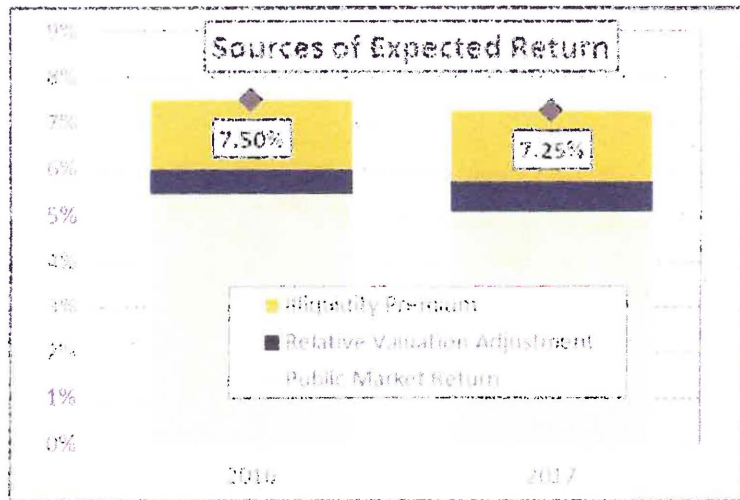
Assumption Development – Private Credit



Source: S&P Capital IQ LCD

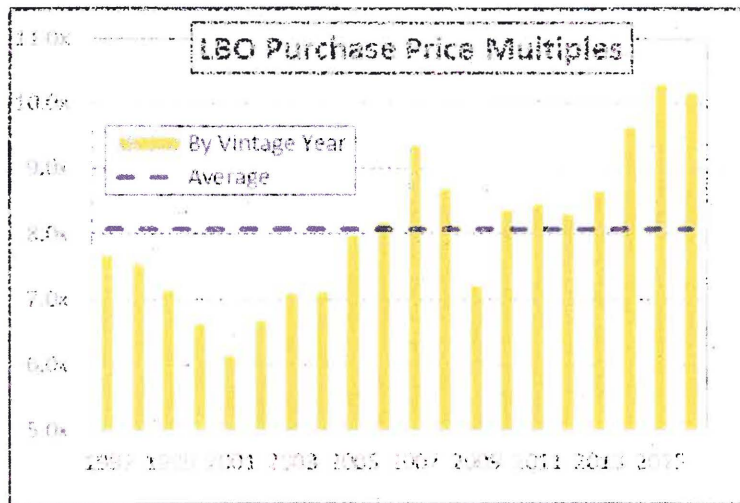


Source: S&P Capital IQ

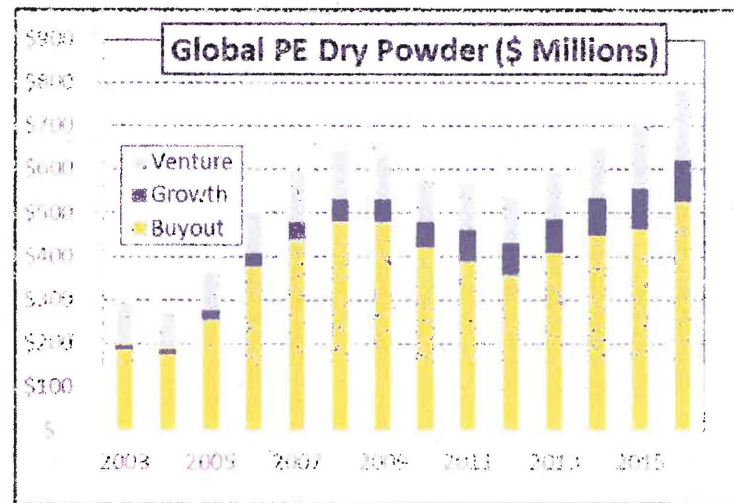


Private debt assumption reflects 50% direct lending, 25% mezzanine, 25% distressed debt. Public market equivalent defined as blend of 50% high yield bonds and 50% bank loans.

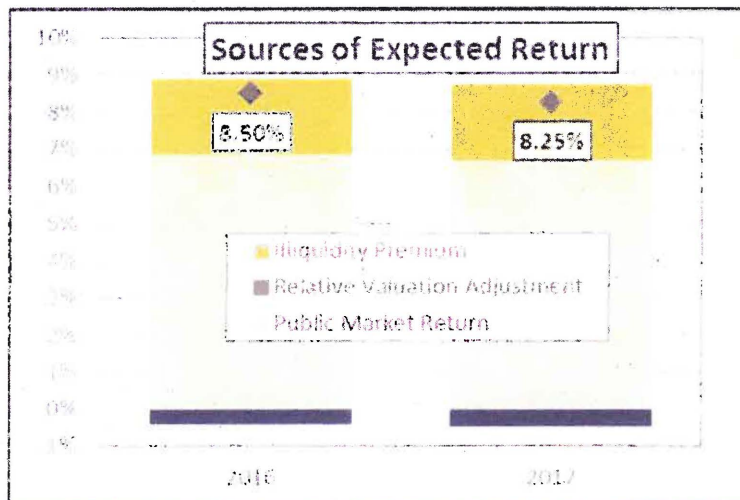
Assumption Development – Private Equity



Source: S&P Capital IQ LCD



Source: Preqin

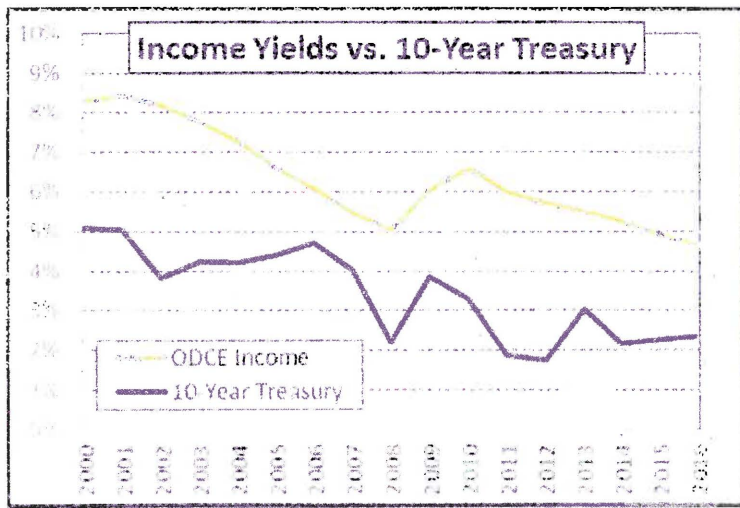


Lower return expectation for private equity driven by:

- Lower public market return expectation
- Broad increase in private commitments crowding the marketplace
- Relatively high purchase price multiples

Private equity assumption reflects 40% buyout, 25% growth equity, 20% secondaries, 15% venture. Public market equivalent defined as blend of 70% US small/mid cap equities and 30% non-US developed market equities.

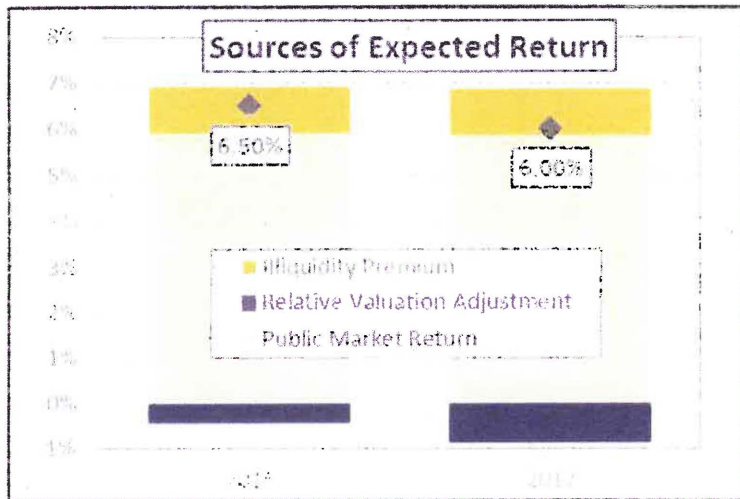
Assumption Development – Real Estate and REITs



Sources: NCREIF, US Department of Treasury



Source: NAREIT, Bloomberg



Core real estate expected return has decreased due to above average valuations and lower income yields

Despite a lower return assumption, real estate remains an important asset allocation tool for diversification and correlation benefits

Real estate assumption reflects US core holdings as represented by the NCREIF ODCE. REIT assumption represented by the FTSE NAREIT Index. Public market equivalent defined as 100% REITs with embedded leverage adjustment (21% for ODCE vs. 41% for NAREIT)

2017 30-Year Return Forecasts

Asset Class	Geometric Expected Return		
	2016	2017	2017-2016
Cash	3.00%	3.00%	
Treasuries	3.25%	3.50%	0.25%
IG Corp Credit	5.00%	5.00%	
MBS (US)	3.50%	3.50%	
Core Bonds*	3.89%	4.00%	0.11%
TIPS (US)	4.00%	3.75%	-0.25%
High-Yield Bonds	5.75%	5.75%	
Global Bonds (Unhedged)	2.75%	2.75%	
Global Bonds (Hedged)	2.87%	2.87%	
Absolute Return Fixed Income*	4.41%	4.51%	0.10%
Emerging Market Debt (Local)	6.50%	6.50%	
Large Cap Equities	7.50%	7.50%	
Small/Mid Cap Equities	7.75%	7.75%	
Int'l Equities (Unhedged)	8.00%	7.75%	-0.25%
Emerging Int'l Equities	9.50%	9.50%	
Private Equity	9.50%	9.50%	
Private Credit	8.00%	8.00%	
Real Assets	7.37%	7.27%	-0.10%
Real Estate	6.50%	6.50%	
Alternative Marketable Investments	6.50%	6.47%	-0.03%
GTAA*	6.78%	6.71%	-0.07%

* Assumption based on market weighted blend of relative sub-components.

** Alternative Marketable Investments is a calculated blend of 40% Equity, 40% Credit, 20% Macro-related strategies.

*** All asset classes are US, unless labeled otherwise (Int'l and Global), except absolute return, real assets, risk parity, private equity, and real estate which are global.



2017 Volatility Forecasts

Asset Class	Volatility		
	2016	2017	2017-2016
Cash	1.00%	1.00%	
Treasuries	5.50%	5.50%	
IG Corp Credit	7.50%	7.50%	
MBS	7.00%	7.00%	
Core Bonds*	6.03%	6.03%	
TIPS	6.50%	6.50%	
High-Yield Bonds	13.00%	13.00%	
Global Bonds (Unhedged)	8.50%	8.50%	
Global Bonds (Hedged)	5.00%	5.00%	
Absolute Return Fixed Income*	4.81%	4.13%	-0.68%
Emerging Market Debt (Local)	15.00%	15.00%	
Large Cap Equities	17.50%	17.50%	
Small/Mid Cap Equities	21.00%	21.00%	
Int'l Equities (Unhedged)	21.00%	21.00%	
Emerging Int'l Equities	27.00%	28.00%	1.00%
Private Equity***	23.00%	23.00%	
Private Credit***	8.00%	8.00%	
Real Assets	16.40%	16.92%	0.52%
Real Estate	15.00%	15.00%	
Alternative Marketable Investments**	9.00%	8.74%	-0.26%

* Assumption based on market weighted blend of relative sub-components.

** Alternative Marketable Investments is a calculated blend of 40% Equity, 40% Credit, 20% Macro-related strategies.

***Volatility adjusted to reflect smoothing methodology.

****All asset classes are US, unless labeled otherwise (Int'l and Global), except absolute return, real assets, risk parity, private equity and real estate which are global.



2017 Correlations

Asset Class	Cash	Treas.	IG Corp Credit	MBS	TIPS	HY Bonds	Global Bonds	EMD (Ext)	EMD (Loc)	Large Cap	Small/Mid Cap	Int'l Eqty	EM Int'l	Priv Equity	Priv Debt	PRA - Energy	PRA - Infr/Land	Real Estate (Core)	Bank Loans	HF - L/S	HF - Credit	HF - Macro	
Cash	1.00																						
Treasuries	0.20	1.00																					
IG Corp Credit	0.10	0.65	1.00																				
MBS	0.25	0.90	0.75	1.00																			
TIPS	0.35	0.65	0.60	0.70	1.00																		
High-Yield Bonds	-0.05	0.20	0.55	0.30	0.20	1.00																	
Global Bonds	0.10	0.50	0.50	0.45	0.40	0.10	1.00																
EMD (External)	0.05	0.35	0.65	0.35	0.20	0.60	0.25	1.00															
EMD (Local)	0.05	0.30	0.60	0.25	0.25	0.60	0.30	0.80	1.00														
Large Cap Equities	-0.10	-0.10	0.45	0.10	0.00	0.65	0.00	0.55	0.55	1.00													
Small/Mid Cap Equities	-0.15	-0.15	0.45	0.10	-0.10	0.70	-0.05	0.55	0.60	0.90	1.00												
Int'l Equities	-0.10	0.00	0.30	0.05	-0.05	0.65	0.35	0.60	0.70	0.70	0.60	1.00											
Emerging Int'l Equities	-0.10	-0.10	0.25	-0.10	-0.10	0.70	0.05	0.70	0.80	0.60	0.65	0.70	1.00										
Private Equity	-0.20	-0.15	0.30	0.10	-0.10	0.60	-0.15	0.35	0.40	0.70	0.75	0.60	0.45	1.00									
Private Debt	0.00	-0.35	0.15	-0.15	-0.10	0.65	-0.10	0.50	0.60	0.60	0.65	0.75	0.80	0.65	1.00								
Private Real Assets Energy/Metals	-0.05	-0.20	0.20	-0.05	-0.05	0.50	-0.10	0.40	0.40	0.65	0.70	0.55	0.50	0.85	0.65	1.00							
Private Real Assets Infrastructure/Land	0.15	-0.05	0.10	-0.05	0.05	0.40	0.05	0.35	0.40	0.50	0.50	0.45	0.40	0.60	0.50	0.75	1.00						
Real Estate (Core)	0.10	0.10	0.15	0.05	0.10	0.35	0.15	0.25	0.40	0.40	0.40	0.35	0.30	0.50	0.40	0.45	0.70	1.00					
AMS - L/S	0.00	-0.25	0.35	-0.10	0.15	0.60	0.15	0.60	0.70	0.75	0.80	0.80	0.80	0.75	0.80	0.70	0.45	0.20	0.50	1.00			
AMS - Credit	0.00	-0.10	0.40	0.00	0.25	0.65	0.00	0.55	0.55	0.55	0.55	0.50	0.60	0.70	0.75	0.65	0.40	0.15	0.65	0.70	1.00		
AMS - Macro	0.00	0.15	0.45	0.25	0.45	0.35	0.30	0.45	0.45	0.25	0.25	0.30	0.40	0.40	0.40	0.40	0.30	0.15	0.25	0.50	0.50	1.00	

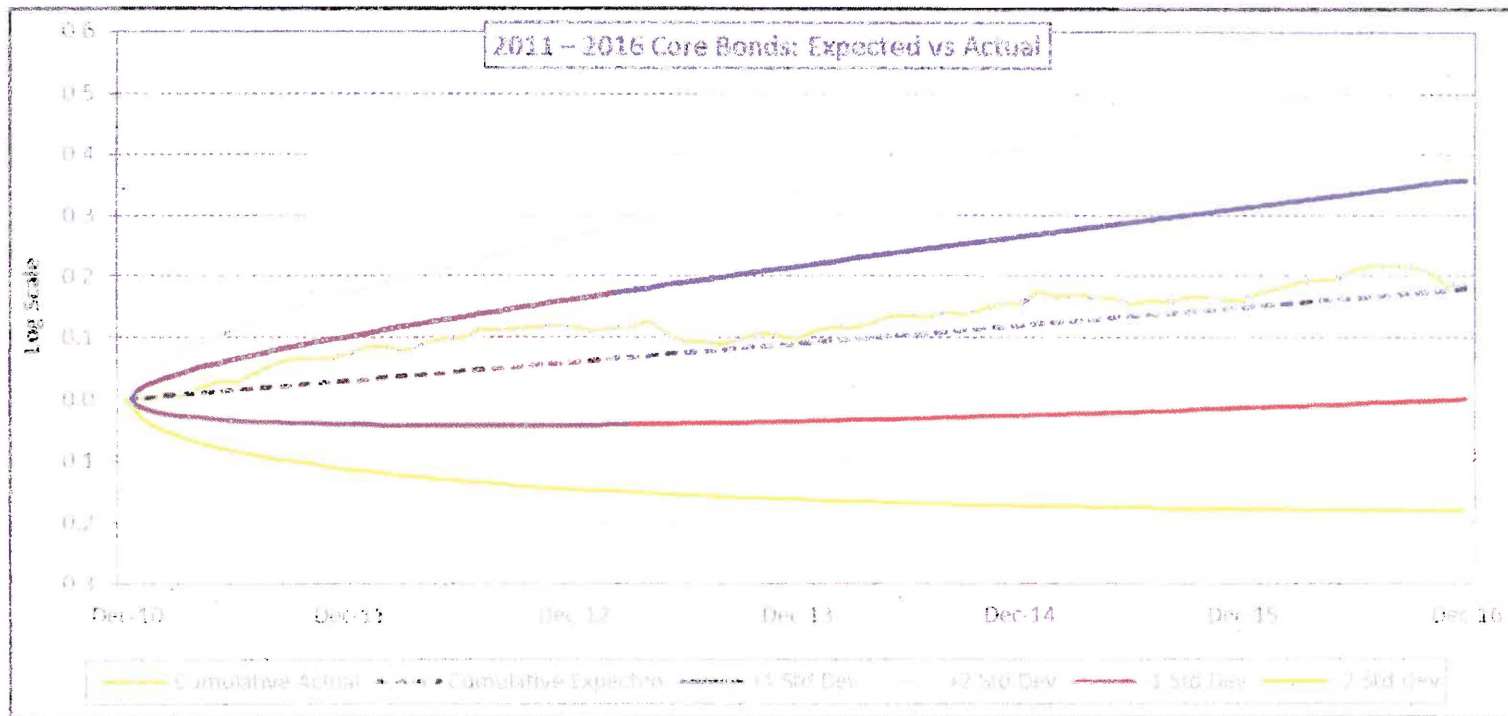
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NEPC Assumptions vs. Actual Results



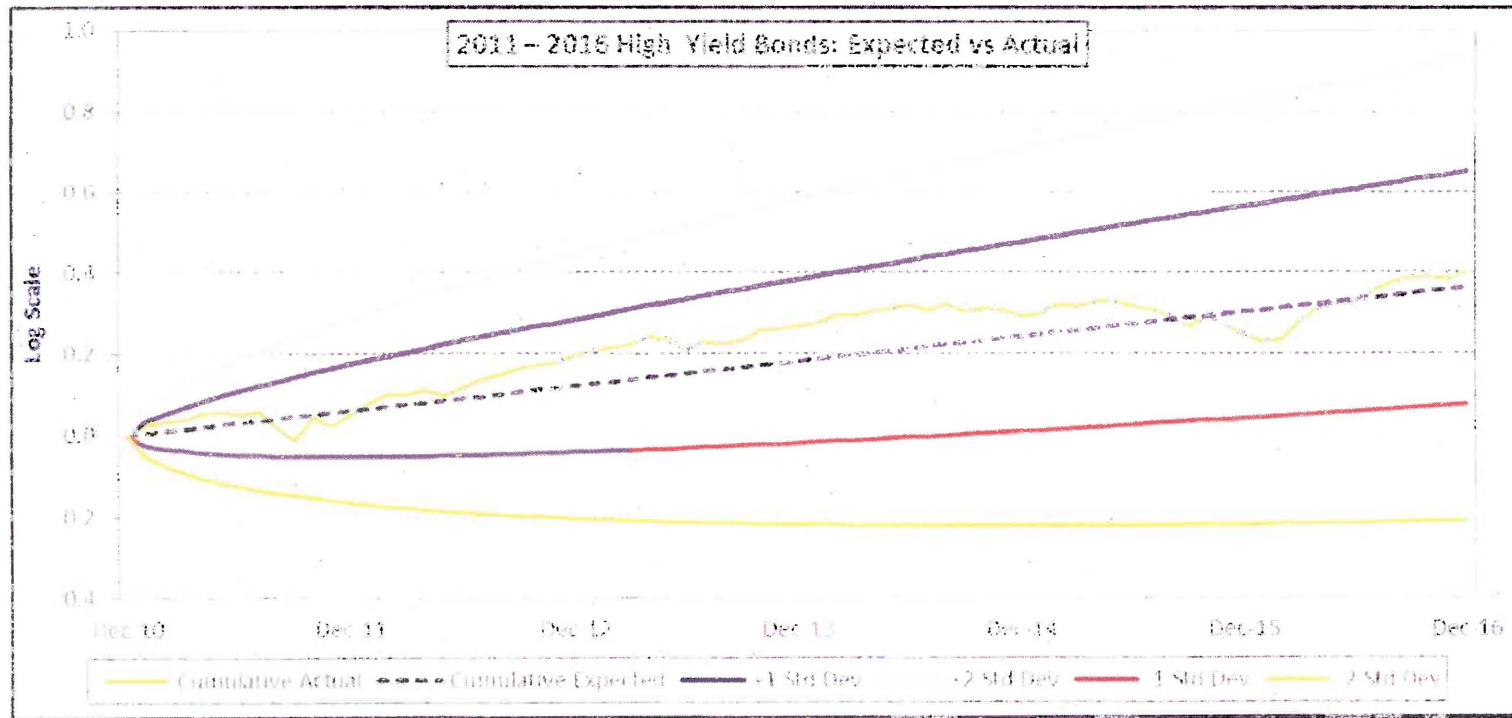
- **NEPC's return assumptions are 5-7 year forward looking assumptions**
 - At its core, we assume the riskier an asset, the higher its expected return over time
 - However, probability implies this does not hold in all market periods
- **We have analyzed our annual 5-7 year assumptions versus the actual 6 year returns starting in that same year**
 - Periods after 2012 do not reflect a complete 6 year return comparison
- **Return expectations are simply a baseline – one possible path of future market results**
 - A 1 standard deviation range of return outcomes is well within the band of expected outcomes
- **Market periods following the 2008 Financial Crisis have been characterized by the heavy influence of central banks**
 - The impact has been to distort return outcomes relative to projections of fundamental asset class models

Core Bonds Forecast Accuracy is High



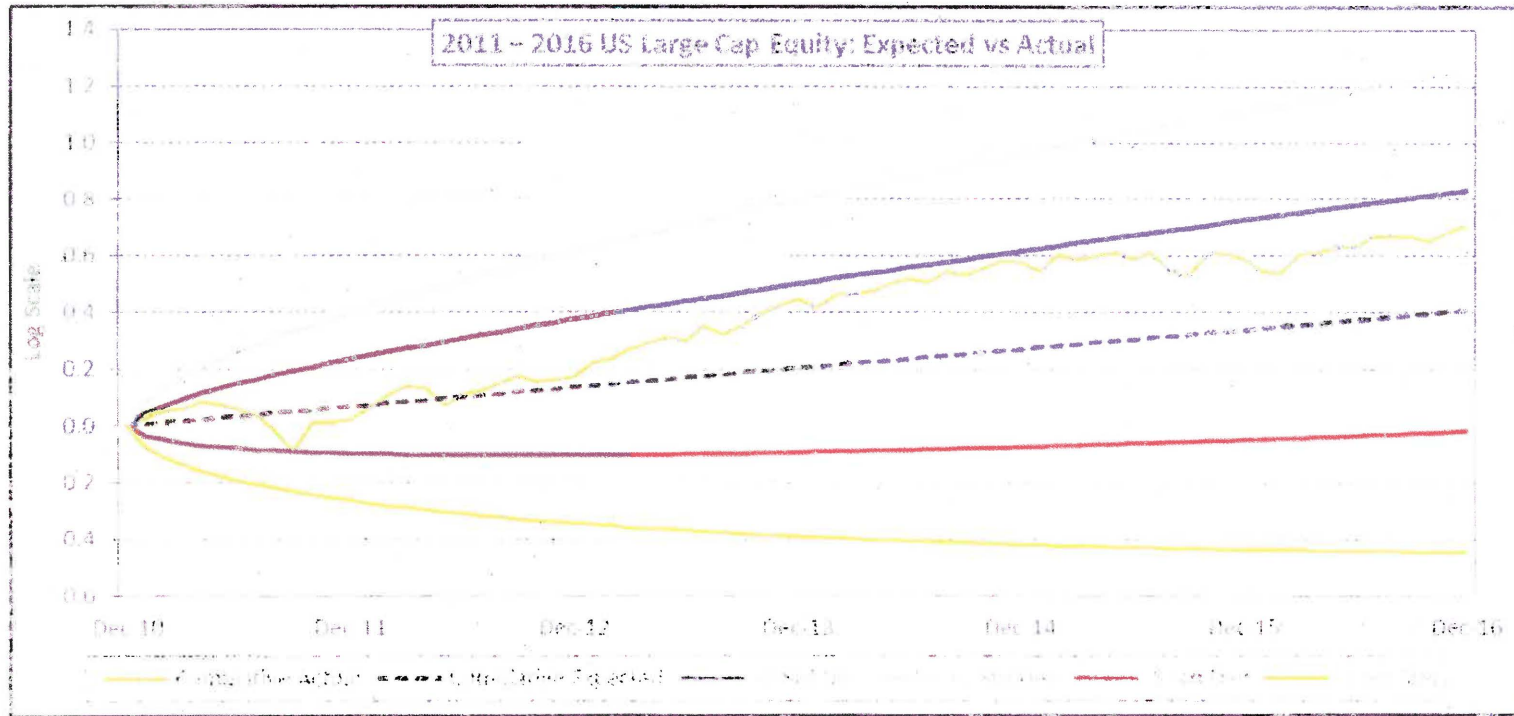
Assumption Year	Asset Class >>	Core Bonds	
2011	Expected Return	3.03%	Actual Return 3.15%
2010	Expected Return	3.75%	Actual Return 3.79%
2009	Expected Return	5.50%	Actual Return 4.69%
2008	Expected Return	5.00%	Actual Return 4.57%

High Yield Bond Forecast Accuracy is Directionally Accurate



Assumption Year	Asset Class >>	High Yield Bonds	
2011	Expected Return	6.25%	Actual Return 6.96%
2010	Expected Return	8.00%	Actual Return 7.69%
2009	Expected Return	11.00%	Actual Return 17.74%
2008	Expected Return	6.75%	Actual Return 9.80%

US Equity Assumptions Failed to Fully Incorporate Central Bank's Influence on Valuations



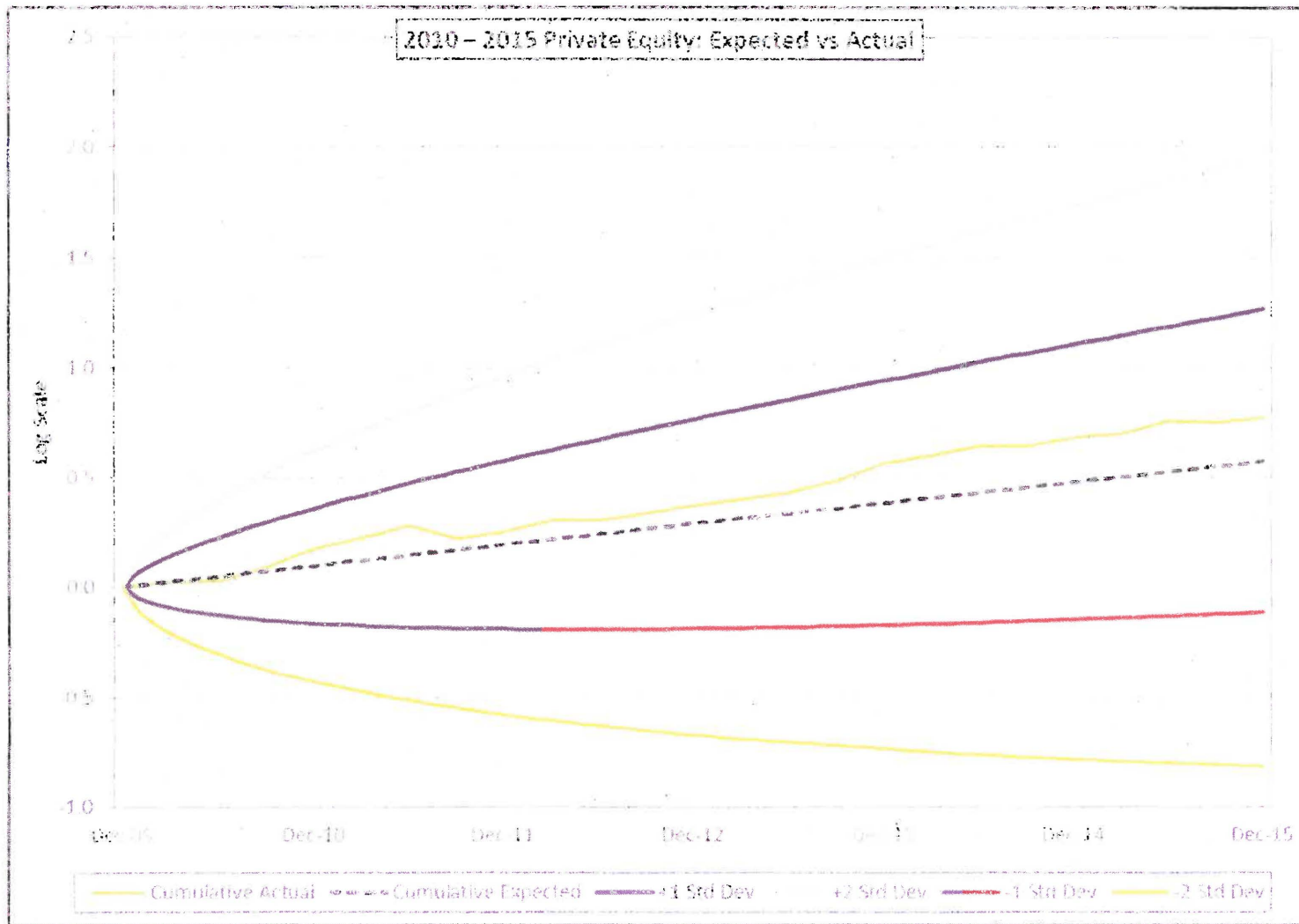
Assumption Year

Asset Class >>

US Large Cap Equity

2011	<i>Expected Return</i>	7.00%	Actual Return	12.47%
2010	<i>Expected Return</i>	7.75%	Actual Return	12.98%
2009	<i>Expected Return</i>	9.25%	Actual Return	17.22%
2008	<i>Expected Return</i>	8.50%	Actual Return	6.24%

Private Equity Assumption Slightly Underperformed Actual 6 Year Return



- **Global Public Equity**
 - U.S. Equity
 - Includes both large cap equities, small/mid cap equities, and convertible bonds
 - International Developed Equity
 - Includes both international developed equities and international developed small cap equities
 - Emerging Markets Equities
 - Includes both emerging markets equities and emerging markets small cap equities
- **Private Equity**
- **Credit/Private Debt**
 - Public Credit
 - Includes investment grade corporate bonds, high-yield bonds, emerging market debt and asset-backed securities
 - Private Debt
 - Includes distressed lending, direct lending, and structured credit
- **Treasuries**
- **Core Fixed Income**
 - Includes treasuries, investment grade bonds, and mortgage-backed securities
- **TIPS (Treasury Inflation Protected Securities)**
- **Private Real Assets**
 - Includes real estate and other private real assets (energy/infrastructure)
- **Alternative Marketable Investments**
 - Includes absolute return strategies