Rhode Island State Investment Commission

2014 ASSET ALLOCATION REVIEW

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AGENDA ITEMS

I. Asset Allocation Background & Investment Concepts

    a. Asset Allocation Process

    b. Model Inputs

    c. Investment Principles & Concepts

II. Model Output & Initial Findings

    I. Efficient Frontier – Unconstrained

    II. Efficient Frontier – Constrained

III. Sources of Risk

IV. Risk Management

    I. Optimizing Risk and Return

    II. Risk Management: The Challenge for Institutional Investors

Appendix A – model input construction

ISSUES FOR DISCUSSION

- **Asset Allocation**

  - Capital market conditions have changed since the current asset allocation policy was adopted in May 2012

  - The asset allocation review is a check on the Fund's progress on meeting its investment return objectives

- **Risk Management**

  - Optimizing risk and return in a diversified portfolio

  - Risk management strategies

ASSET ALLOCATION PROCESS

Asset allocation is the most important determinant of the portfolio return and risk

- Modeling Process
  - Determination of Assets to include in the modeling

  - Determination of asset class assumptions
    - Expected Return
    - Expected Risk
    - Expected correlations
    - Asset class constraints (minimum and maximum allocations)

  - Run model – check for reasonableness

  - SIC review and discussion of model output given investor risk preferences

  - Adoption of allocation

General Characteristics of the Fund

- Plan is very underfunded (approx. 60% funded)

- Plan is mature: Benefit payments > Employer + Employee contributions
  - Requires liquidity to pay benefits

- Underfunded status and negative cash flow reduce the funds' ability to recover from a large negative market event (large drawdown – similar to 2008)

- As a result, the fund, though a long-term investor, has to also be concerned with performance in the near-term

The Overall Fund Goal:

- An investment portfolio in a defined benefit plan exists to provide liquidity to meet required benefit payments both now and in the future

Asset Allocation Objective:

- Build a portfolio to achieve the highest return with lowest risk that achieves the fund's overall goal

Analysis

- One tool to analyze total portfolio risk and return choices is a Mean Variance Optimization (MVO)

MEAN-VARIANCE OPTIMIZATION (MVO)

- Pioneered by Harry Markowitz in the 1950's in his Modern Portfolio Theory

- Risk is quantified as return volatility (Standard Deviation)

- All else equal, investors will seek to avoid risk where possible

- Mode Inputs: expected return, standard deviation and correlation (the extent asset returns move together)

- Model output: "Efficient Frontier" of optimal portfolios

- Optimal Portfolio (Efficient Portfolios): expected to offer the maximum possible return for each level or risk or, the minimum level of risk for each level of return

- Model Theory: any return correlation between asset classes that is less than one must reduce overall risk of the potential portfolio

- Therefore: the model is attracted to higher returning assets and finding low correlation relationships

MEAN-VARIANCE OPTIMIZATION (MVO) LIMITATIONS

Model Limitations:

- Model assumes returns are normally distributed
  - In the real world – returns have "fat tails"
  - Extreme outcomes, both good and bad, are more frequent than the model assumes
    - An Optimal portfolio may be more risky (volatile) than the model assumes

- Model assumes correlations are fixed over time
  - In the real world correlations fluctuate

- Model assumes risk is static
  - In the real world risk is variable

- Model assumes market expectations are realized
  - An optimal portfolio may not be optimal if the return expectations are not realized
    - Model is subject to estimation error (actual returns may differ from model assumptions)

Developing Investment Assumptions (model inputs)

- For strategic purposes, the objective is to develop reasonable, consensus expectations for asset classes exhibiting different risk characteristics

- Expectations are developed for expected returns and risks for each asset class, and correlations among each pair of classes

- Most critical step: estimating the publicly-traded equity risk premium

- PCA, like other practitioners, utilizes a "building block" approach to arrive at estimates for the equity (and other classes') risk premium

- Illiquid assets (such as real estate, private equity, etc.) are more difficult to model due to (i) low frequency of marking-to-market, (ii) lack of pricing sources (i.e., reliance on appraisals), (iii) lack of history

ASSET ALLOCATION: DEVELOPING MODEL INPUTS

Developing Investment Assumptions (model inputs)

- Model input was derived from PCA capital market assumptions and in collaboration with the Chief Investment Officer (CIO)

- Cash, Core Fixed Income, Global Equity and Private Equity are standard PCA capital market assumptions

- Real Estate, Real Return, Absolute return HFs, and Equity HFs are customized to reflect the unique characteristics of the ERSRI portfolio

- Hedge fund data supplied by Cliffwater in collaboration with the CIO

- Capital Market data assumes a 10 year investment horizon

- Details of model input assumptions in Attached memo (Appendix A)

ASSET ALLOCATION MODEL ASSUMPTIONS

Asset Class Input Assumptions

- 10 Year Investment Horizon

	Cash	Core Fixed	Real Estate	Real Return	Abs Ret HFs	Equity LS HFs	Global Equity	Private Equity
Annual Arithmetic Mean	2.25%	3.00%	7.20%	6.60%	5.70%	7.50%	8.80%	11.80%
Annual Standard Deviation	2.00%	4.80%	12.00%	11.00%	6.30%	10.00%	18.50%	26.00%
annual geometric	2.20%	2.90%	6.50%	6.00%	5.50%	7.00%	7.20%	8.70%

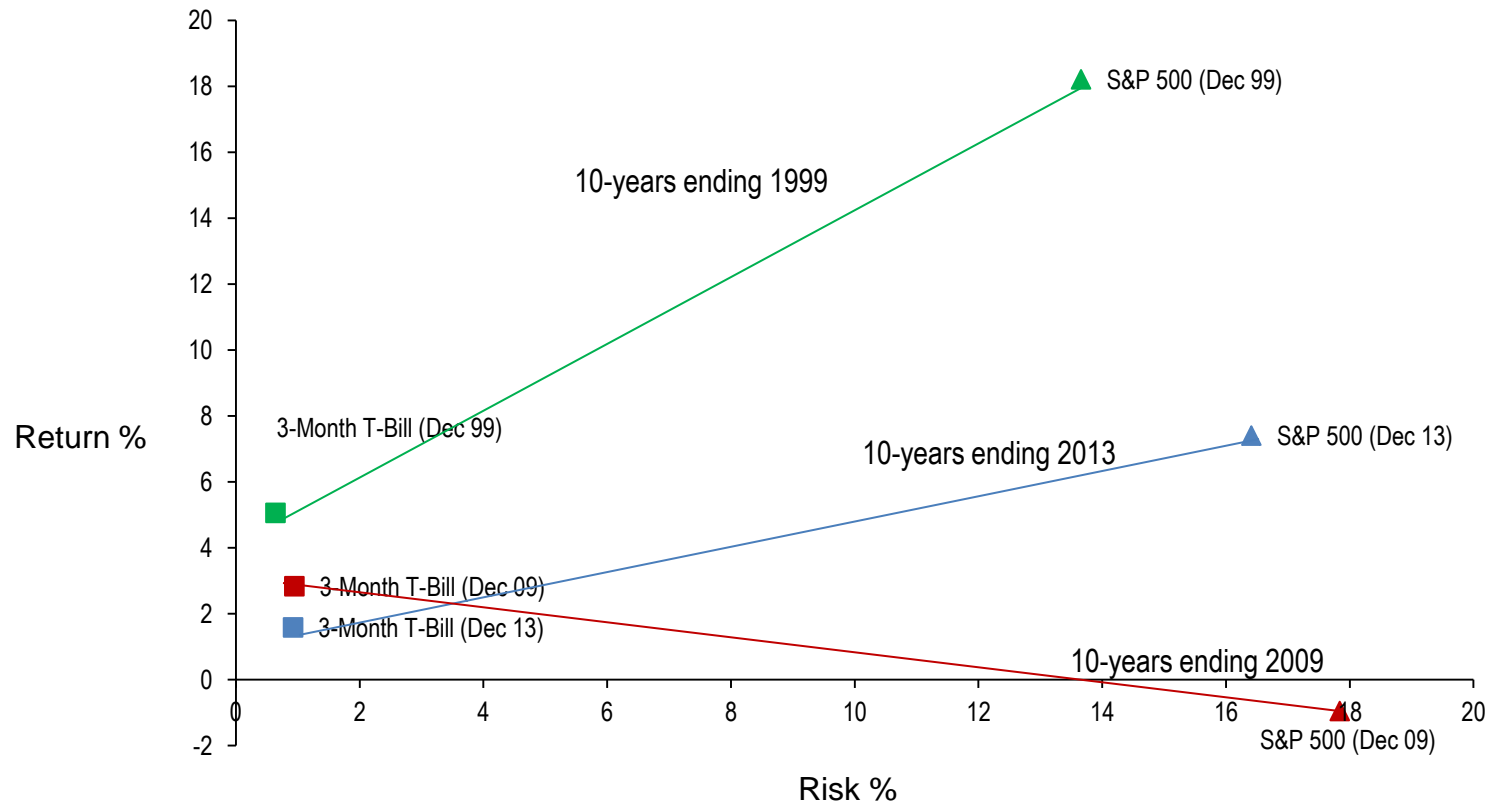| Correlations	Cash	Core Fixed	Real Estate	Real Return	Abs Ret HFs	Equity LS HFs	Global Equity	Private Equity
Cash	1.00							
Core Fixed	0.30	1.00						
Real Estate	0.30	0.30	1.00					
Real Return	0.00	0.50	0.10	1.00				
Abs Return Hedge Funds	0.20	0.20	0.10	0.50	1.00			
Equity Long-Short HFs	0.30	0.10	0.20	0.40	0.70	1.00		
Global Equity	0.00	0.30	0.40	0.70	0.40	0.60	1.00	
Private Equity	0.00	0.00	0.40	0.50	0.40	0.60	0.85	1.00

Note: 10 year investment horizon is shorter than the investment horizon used by the actuary (30+ years) when calculating their investment assumptions

MODEL INPUT: CAPITAL MARKET LINE

Capital Market Line – 10 Year Horizon
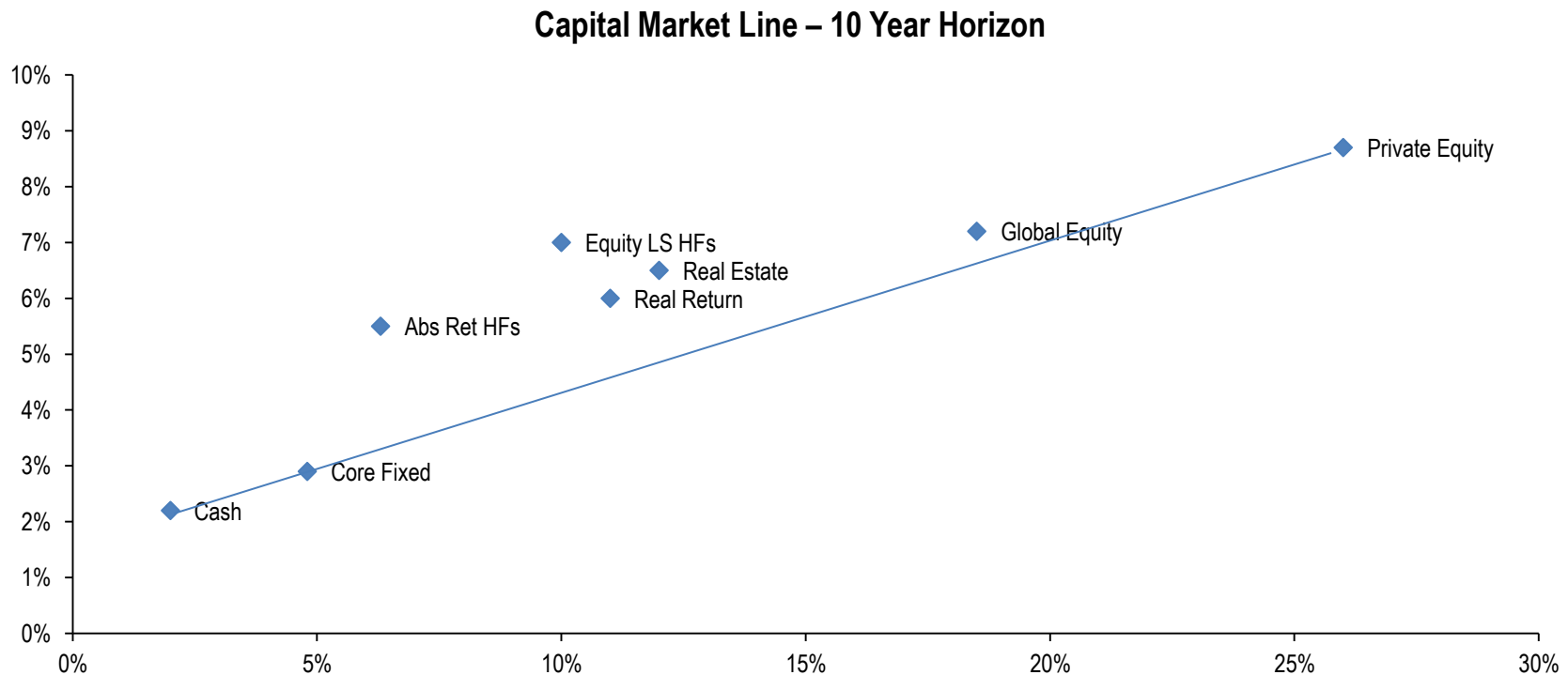
- Capital Market Expectations: Riskier Assets have higher expected returns (Investors are compensated for taking risk)

10 YEAR CAPITAL MARKET LINES

Return %

Risk %

- S&P 500 (Dec 99)
- 10-years ending 1999
- 3-Month T-Bill (Dec 99)
- S&P 500 (Dec 13)
- 10-years ending 2013
- 3-Month T-Bill (Dec 09)
- 3-Month T-Bill (Dec 13)
- 10-years ending 2009
- S&P 500 (Dec 09)

- Investors are usually rewarded for taking investment risk

- However, risk is not rewarded in every 10 year time period

- Asset allocation reviews conducted in 1999 underestimated the market risk environment over the next decade

- Model assumptions that miss the actual outcome are called estimation errors

ASSET ALLOCATION MODEL ASSUMPTIONS

Asset Class Constraints

	Min	Max
Cash	0%	3%
Core Fixed	10%	50%
Real Estate	0%	10%
Real Return	0%	30%
Abs Return Hedge Funds	0%	10%
Equity Long-Short HFs	0%	10%
Global Equity	20%	80%
Private Equity	7%	12%

- Asset class constraints represent the investor's custom allocation preferences
- Constrains may include legal restrictions or the investor's perception of portfolios that are un-investable due to expected return volatility or other risk characteristic
- Investor constraints / preferences reflect the investor's management environment

ROLE OF ASSETS

- Each asset class has unique investment characteristics

- Each asset can be used in portfolio construction to bring a unique risk, return or correlation characteristic to the portfolio

- Individual asset can play several roles in the portfolio depending on how they are structured

- Knowing the role an asset plays in the portfolio minimizes (but does not eliminate) negative return surprises

Asset Class	Role	Risk
Core Fixed Income	Stability / Liquidity	Interest Rate
Absolute Return HFs	Stability / Diversification	Active management
Real Return	Inflation Protection	Credit / Growth
Real Estate	Income / Growth	Interest Rate
Equity HFs	Growth / Diversification	Active management
Global Equity	Growth / Liquidity	Equity (Growth)
Private Equity	Growth	Equity / Illiquidity

ASSET ALLOCATION : DIVERSIFICATION

Diversification:

- A risk management investment strategy in which a wide variety of investments are mixed within a portfolio; the rationale is that in the long-term a portfolio of uncorrelated investments will yield higher returns and provide a lower risk than any individual investment within the portfolio

- Diversification strives to smooth out unsystematic risk in a portfolio so that the positive performance of some investments will neutralize the negative performance of others.

- Requires you look at the portfolio as a whole, not as an individual asset class or investment

- "If you aren't worried about some segment of your portfolio you aren't really diversified." – Peter Bernstein

- Trustees of public pension funds are bound by fiduciary duties, one of which is the Duty to Diversify
  o A fiduciary must diversify the plan's investments so as to minimize the risk of large losses, unless under the circumstances it is clearly prudent not to do so.

ASSET ALLOCATION : STANDARD DEVIATION

Normal Distribution of Returns
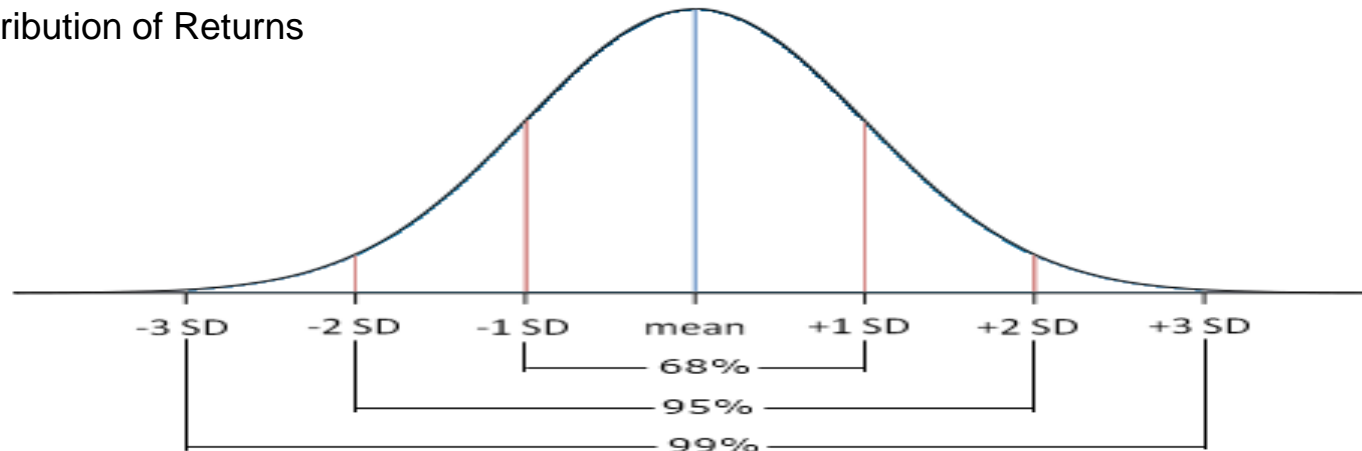
Assume:
8.75%   Average Annual Return
18%   Standard Deviation
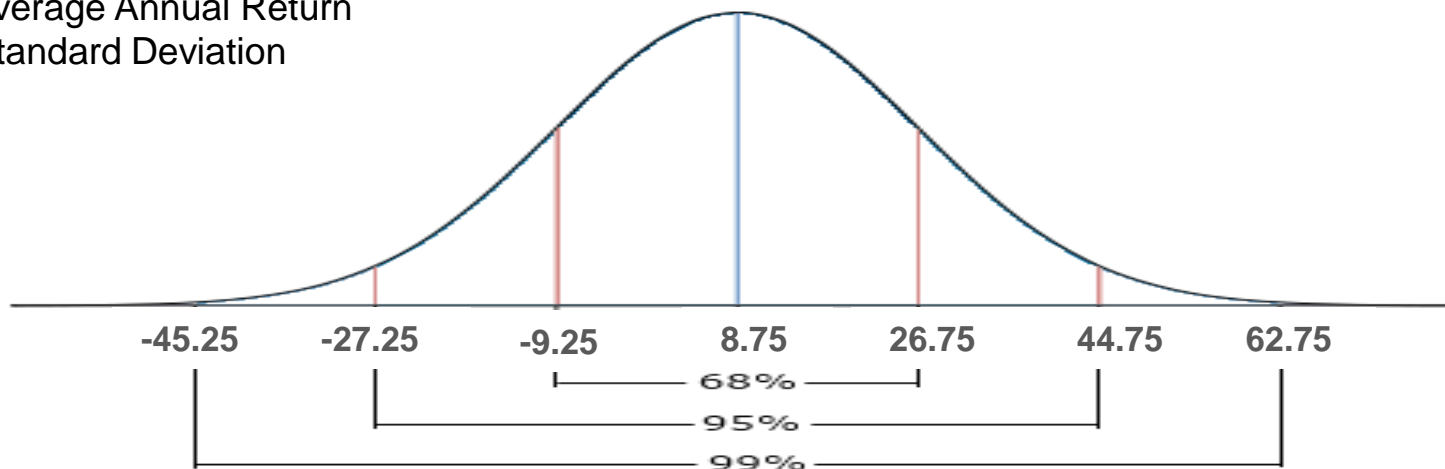
- Two-thirds of the time annual return is expected to be between -9.25% and 26.75%
- Ninety-five percent of the time annual return is expected to be between -27.25% and 44.75%

Correlation:

- Correlation is the extent to which the returns of different types of investments move in tandem with one another in response to changing economic and market conditions.

- Typically the lower the correlation of the assets in the portfolio, the lower is its risk in the total portfolio context.
  - A correlation of 1 means the two assets move in perfect lockstep
  - A correlation of -1 means the two assets move in exactly the opposite directions
  - A correlation of 0 means the two assets are totally uncorrelated – there's no relationship in their returns

- Correlations are not stable over time

- In a financial market crisis many uncorrelated assets become very correlated ("correlations go to 1")
  - That may or may not be the case in the future

Sharpe Ratio:

Portfolio Return – Risk Free Rate

　　　Standard Deviation

- Sharpe Ratio is an "absolute" measure of risk and is the industry standard for measuring risk-adjusted return

- Sharpe Ratio incorporates both return and total risk in one metric

- Sharpe ratios are ideal for comparing investment efficiency across multiple asset classes

- Adding investments (assets or products) with high Sharpe Ratios to a diversified portfolio increases the total portfolio's efficiency (return per unit of risk)

ASSET ALLOCATION : SHARPE RATIO

Expected Sharpe Ratios Capital Market Assumptions
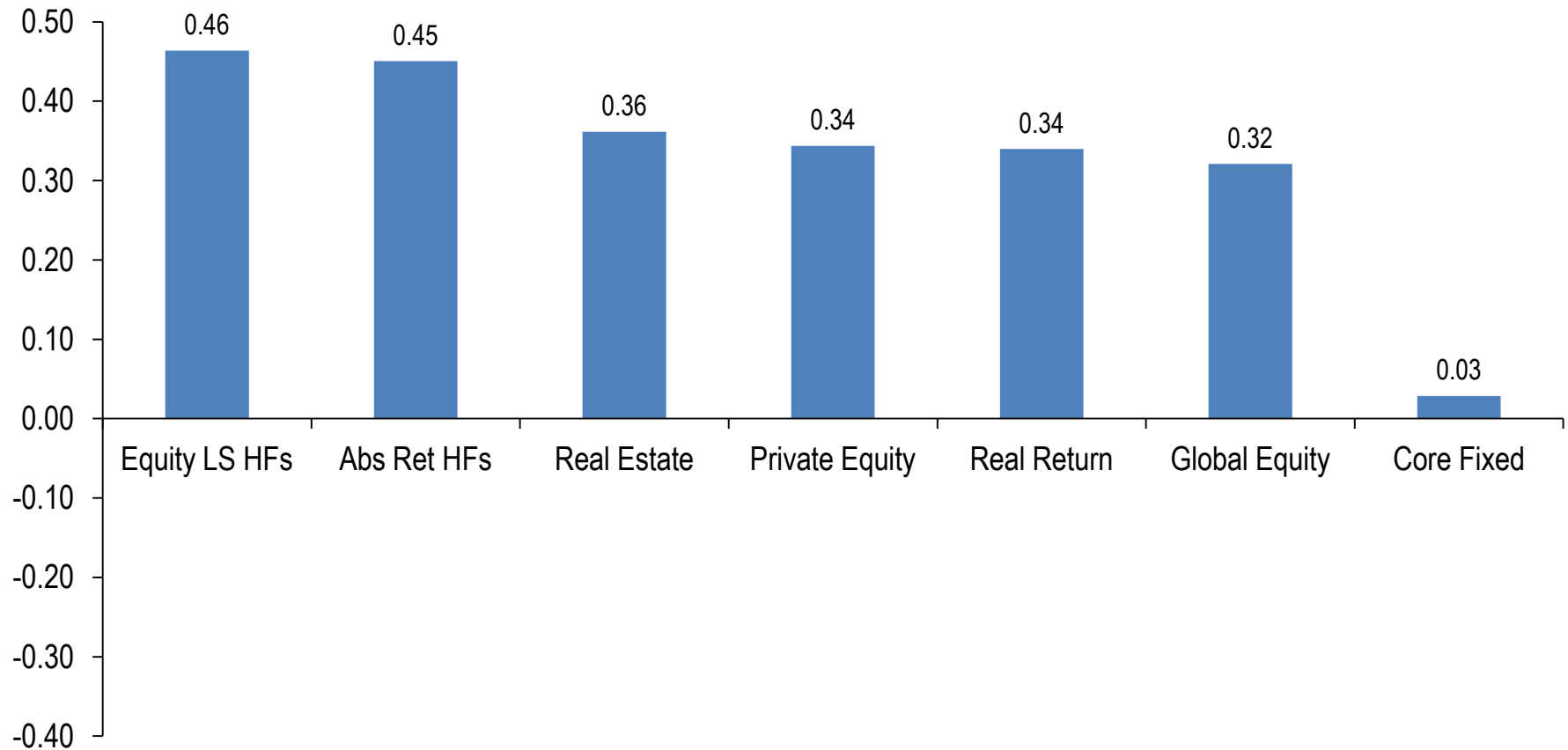
ASSET ALLOCATION : OTHER TERMS

Arithmetic Returns

- Sum of annual returns divided by the number of annual returns
- Also know as simple average

Geometric Returns

- Also know as average compounded returns
- Value is negatively impacted by return volatility (standard deviation)

Model Input / Output

- The Mean Variance Optimization (MVO) utilizes arithmetic returns in its calculation and expressing output

- For our purposes of discussing return in the real world – the arithmetic output is converted to **geometric returns** for analysis purposes

- The Fund's return target is expressed as an annual geometric return (7.5%)

60% Equity / 40% Fixed Income Portfolio ("60/40")

- Traditional asset allocation policy
  - Simple to implement, monitor and manage
  - If passively implemented – very low investment management fees

- Lessons of 2008
  - The portfolio is not really diversified
    - It is primarily Equity (growth) risk

- In today's market environment the 60 / 40 portfolio allocation is not efficient and has many negative characteristics

ASSET ALLOCATION: 60 / 40 PORTFOLIO

The Challenge with a 60/40 allocation

- Although the Fixed Income portfolio has a low correlation (0.30) with the Equity portfolio,
  - o Fixed Income has a low expected return, and
  - o The volatility of the equity portfolio swamps the volatility of the Fixed Income portfolio
  - o As a result, the portfolio risk is overwhelming driven by equity risk (93% of total risk)

The Challenge today

- Fixed Income has an asymmetric risk return profile
  - o Very low starting yield – with low prospect for falling interest rates (capital appreciation) and a large probability that rates rise
    - ♦ Very little upside with a large looming downside

- Equity markets have risen sharply over the past 3-4 years
  - o The prospects for continued high equity market returns are dim

- Equity markets are still subject to large return declines (drawdown risk) – that won't be offset by returns from the Fixed Income portfolio

ASSET ALLOCATION: 60 / 40 PORTFOLIO

Given the relatively unattractive risk and return characteristics of a 60/40 policy allocation

- Long-term institutional investors are looking to <u>improve</u> on the 60/40 portfolio
  - Managing risk smarter
  - Paying closer attention to drawdown risk
  - Adding Diversifying (uncorrelated) assets or strategies to the portfolio

- Diversifying strategies often require use of:
  - Leverage
  - Shorting
  - Derivative
    - That require special skills

- Strategies involving these activities typically have higher fees

- **Take-away:** finding uncorrelated assets / strategies is challenging and will entail paying higher fees than for a traditional stock and bond portfolio

MODEL OUTPUT

## Efficient Frontier Analysis - Unconstrained
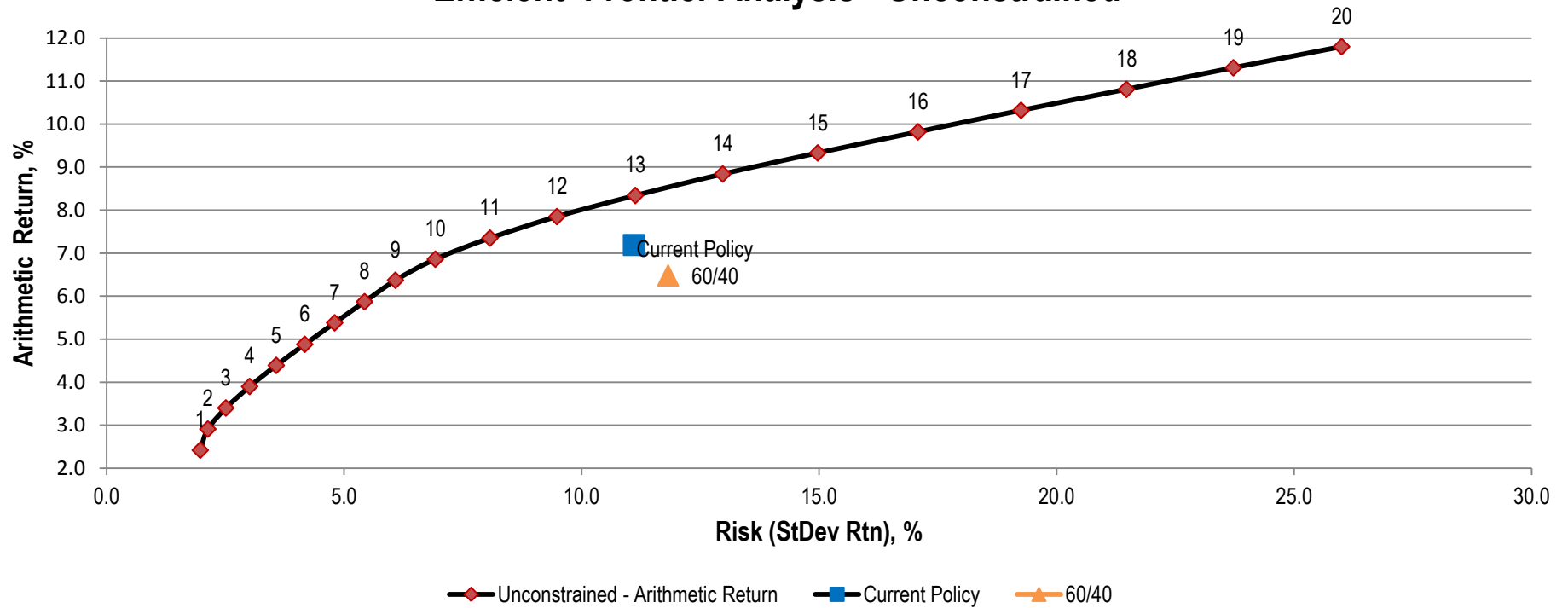
Unconstrained Efficient Frontier

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	CP	60/40
Arithmetic Return, %	2.4	2.9	3.4	3.9	4.4	4.9	5.4	5.9	6.4	6.9	7.4	7.9	8.3	8.8	9.3	9.8	10.3	10.8	11.3	11.8	7.2	6.5
Risk (StDev Rtn), %	2.0	2.1	2.5	3.0	3.6	4.2	4.8	5.4	6.1	6.9	8.1	9.5	11.1	13.0	15.0	17.1	19.3	21.5	23.7	26.0	11.1	11.8
Sharpe Ratio	-0.22	0.03	0.24	0.35	0.43	0.49	0.53	0.56	0.58	0.58	0.56	0.53	0.49	0.46	0.43	0.41	0.39	0.37	0.36	0.34	0.39	0.31
Geometric Return	2.4%	2.9%	3.4%	3.9%	4.3%	4.8%	5.3%	5.7%	6.2%	6.6%	7.0%	7.4%	7.8%	8.1%	8.3%	8.5%	8.6%	8.7%	8.8%	8.7%	6.6%	5.8%

## Unconstrained Efficient Frontier Asset Allocations
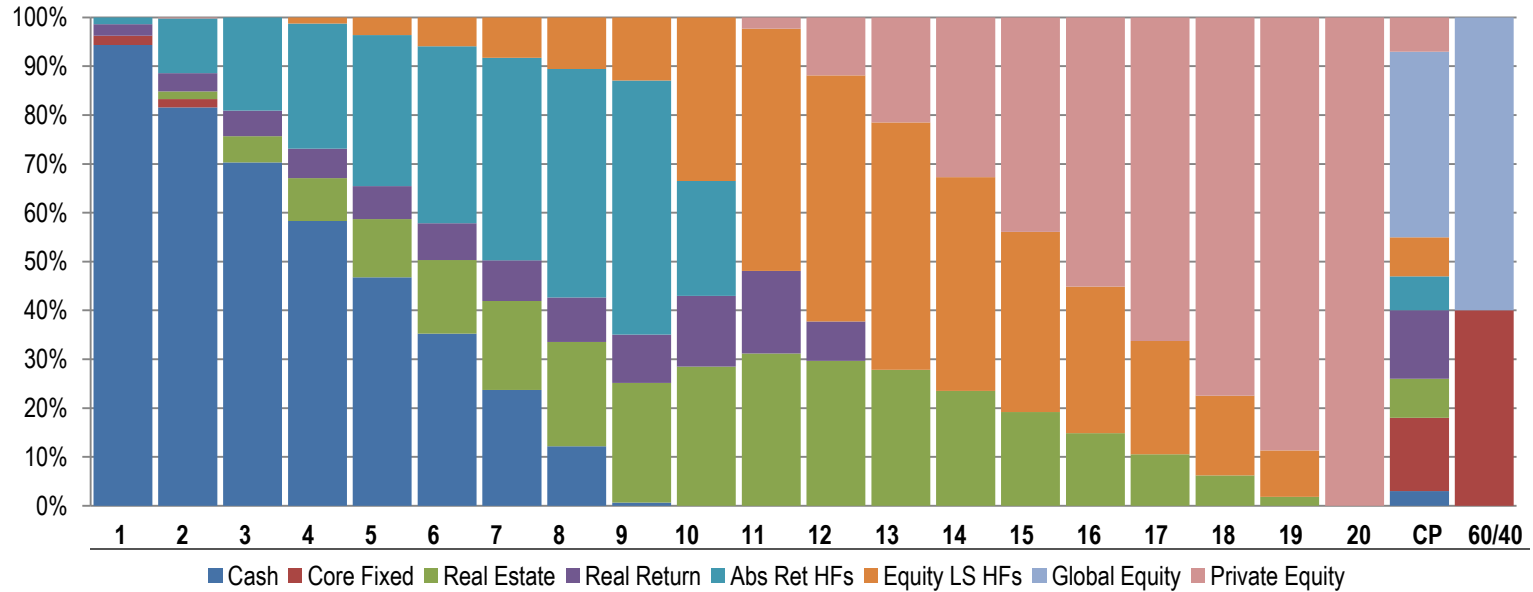
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	CP	60/40
Cash	94%	82%	70%	58%	47%	35%	24%	12%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%
Core Fixed	2%	2%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	15%	40%
Real Estate	0%	2%	5%	9%	12%	15%	18%	21%	25%	29%	31%	30%	28%	24%	19%	15%	11%	6%	2%	0%	8%	0%
Real Return	2%	4%	5%	6%	7%	8%	8%	9%	10%	14%	17%	8%	0%	0%	0%	0%	0%	0%	0%	0%	14%	0%
Abs Ret HFs	1%	11%	19%	26%	31%	36%	41%	47%	52%	24%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	7%	0%
Equity LS HFs	0%	0%	0%	1%	4%	6%	8%	11%	13%	33%	50%	50%	51%	44%	37%	30%	23%	16%	10%	0%	8%	0%
Global Equity	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	38%	60%
Private Equity	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	2%	12%	22%	33%	44%	55%	66%	77%	89%	100%	7%	0%

CP = Current Policy
60 / 40 = 60% Global Equity / 40% Fixed Income

INITIAL FINDINGS: UNCONSTRAINED PORTFOLIOS

- Expected return is increasing at a slower rate as risk increases
  - This is a normal condition

  - To achieve higher expected return, an investor must be less risk averse to reach out further on the risk spectrum

- Based on the model input assumptions and investing with no constraints on how the portfolio is constructed
  - It's possible to construct very efficient portfolios (Sharpe ratio of 0.58)

  - Eight (8) optimal portfolios have expected Geometric return > 7.5%

Efficient Frontier Analysis - Constrained
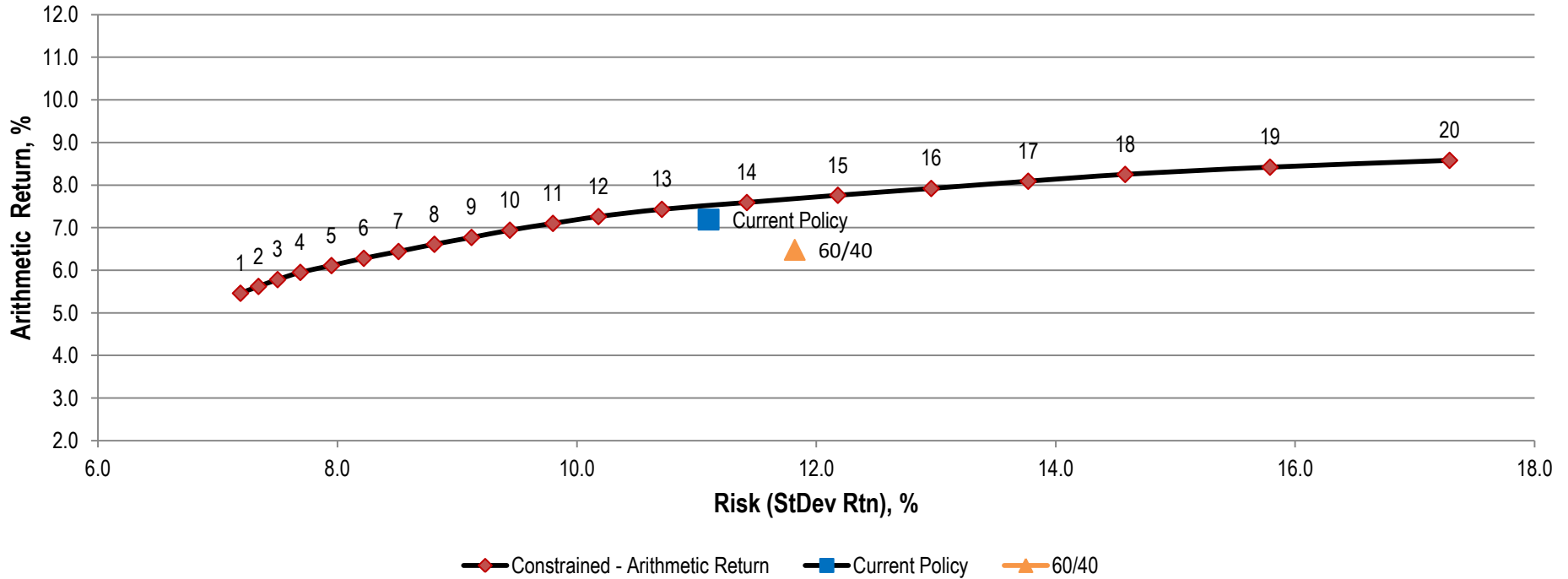
Constrained Efficient Frontier

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	CP	60/40
Arithmetic Return, %	5.5	5.6	5.8	6.0	6.1	6.3	6.4	6.6	6.8	6.9	7.1	7.3	7.4	7.6	7.8	7.9	8.1	8.3	8.4	8.6	7.2	6.5
Risk (StDev), %	7.2	7.3	7.5	7.7	8.0	8.2	8.5	8.8	9.1	9.4	9.8	10.2	10.7	11.4	12.2	13.0	13.8	14.6	15.8	17.3	11.1	11.8
Sharpe Ratio	0.36	0.38	0.39	0.40	0.41	0.42	0.42	0.43	0.43	0.43	0.43	0.43	0.43	0.41	0.40	0.39	0.38	0.37	0.35	0.33	0.39	0.31
Geometric Return, %	5.2%	5.4%	5.5%	5.7%	5.8%	6.0%	6.1%	6.2%	6.4%	6.5%	6.7%	6.8%	6.9%	7.0%	7.1%	7.1%	7.2%	7.3%	7.3%	7.2%	6.6%	5.8%

Constrained Efficient Frontier Asset Allocations
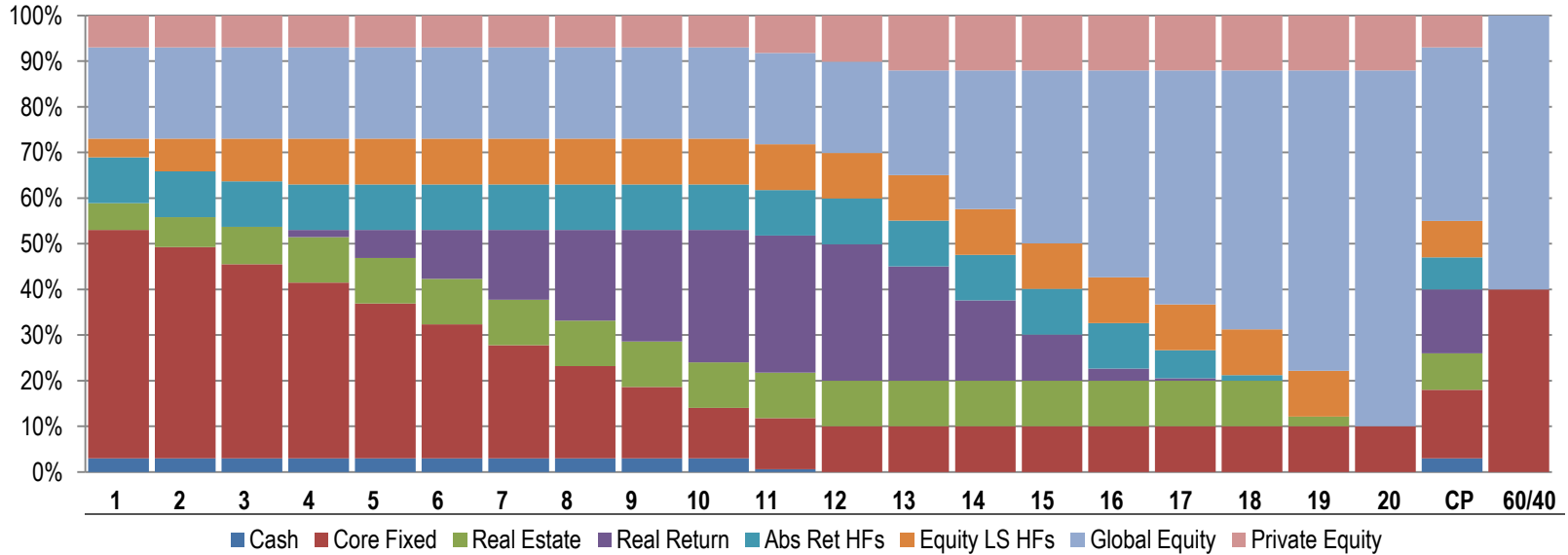
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	CP	60/40
Cash	3%	3%	3%	3%	3%	3%	3%	3%	3%	3%	1%	0%	0%	0%	0%	0%	0%	0%	0%	0%	3%	0%
Core Fixed	50%	46%	43%	38%	34%	29%	25%	20%	16%	11%	11%	10%	10%	10%	10%	10%	10%	10%	10%	10%	15%	40%
Real Estate	6%	7%	8%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	2%	0%	8%	0%
Real Return	0%	0%	0%	2%	6%	11%	15%	20%	24%	29%	30%	30%	25%	18%	10%	3%	1%	0%	0%	0%	14%	0%
Abs Ret HFs	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	6%	1%	0%	0%	7%	0%
Equity LS HFs	4%	7%	9%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	10%	0%	8%	0%
Global Equity	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	20%	23%	30%	38%	45%	51%	57%	66%	78%	38%	60%
Private Equity	7%	7%	7%	7%	7%	7%	7%	7%	7%	7%	8%	10%	12%	12%	12%	12%	12%	12%	12%	12%	7%	0%

INITIAL FINDINGS: CONSTRAINED PORTFOLIOS

- Expected return is increasing at a slower rate as risk increases
  - This is a normal condition

  - To achieve higher expected return, an investor must be less risk averse to reach out further on the risk spectrum

- Based on the model input assumptions and investing with the investor's constraints on how the portfolio is constructed
  - The most efficient portfolios have a Sharpe ratio of 0.43

  - Neither the Current Policy or the 60 / 40 portfolio are on the efficient frontier
    - The most efficient portfolios have a higher Sharpe ratio than the current policy (0.39)
    - The 60 / 40 portfolio is very inefficient (Sharpe ratio 0.31)

  - The constraint on diversifying assets limits the efficiency of the optimal portfolios

  - No optimal portfolios have an expected Geometric return > 7.5%

Efficient Frontier - Comparison
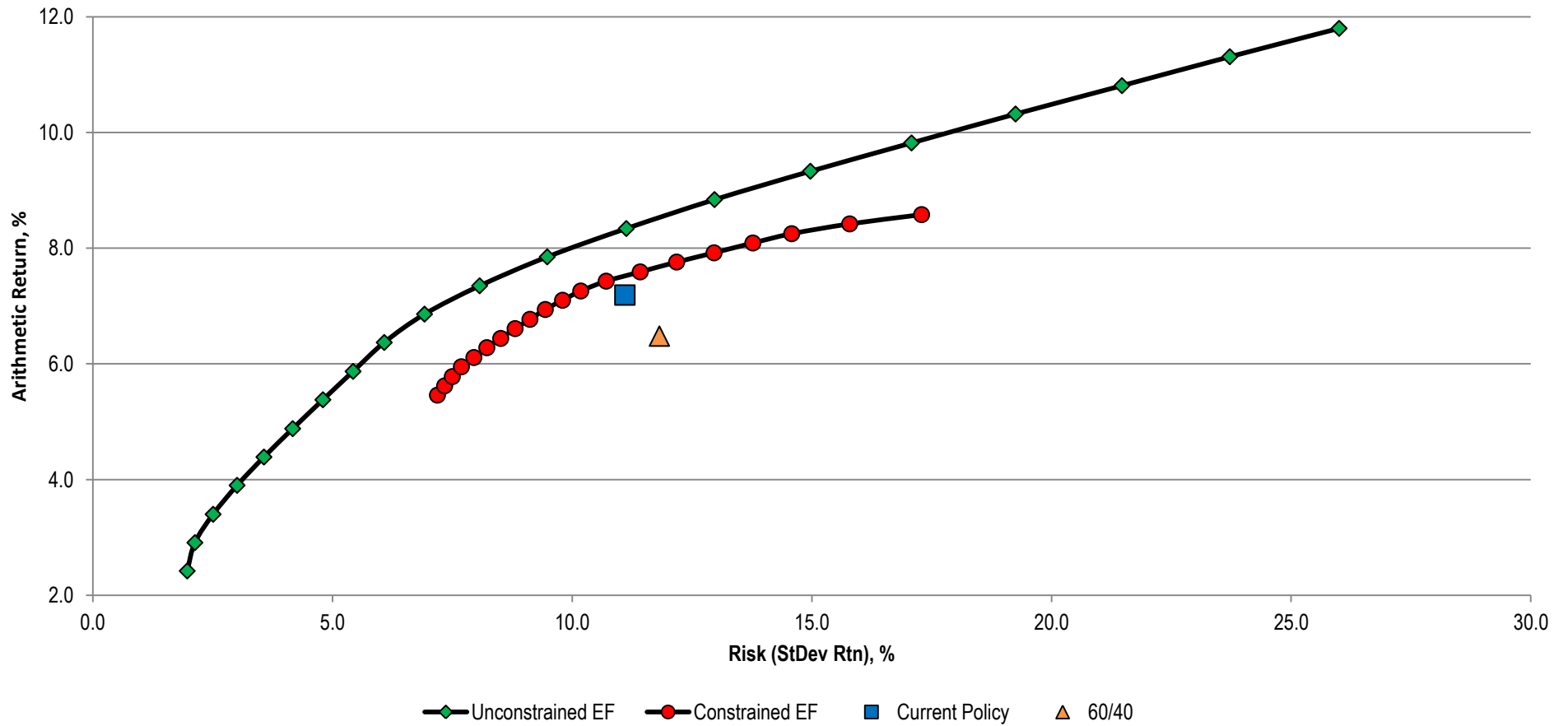
- The unconstrained frontier is more efficient than the constrained frontier

PORTFOLIO SOURCES OF RISK

SOURCES OF PORTFOLIO RISK: 60/40 PORTFOLIO

Portfolio Arithmetic Return: 6.5%
Portfolio Geometric Return: 5.8%
Portfolio Standard Deviation: 11.8%

Porfolio Dollar Allocation

Core Fixed
40%

Global
Equity
60%

Porfolio Risk Allocation

Core Fixed
7%

Global
Equity
93%
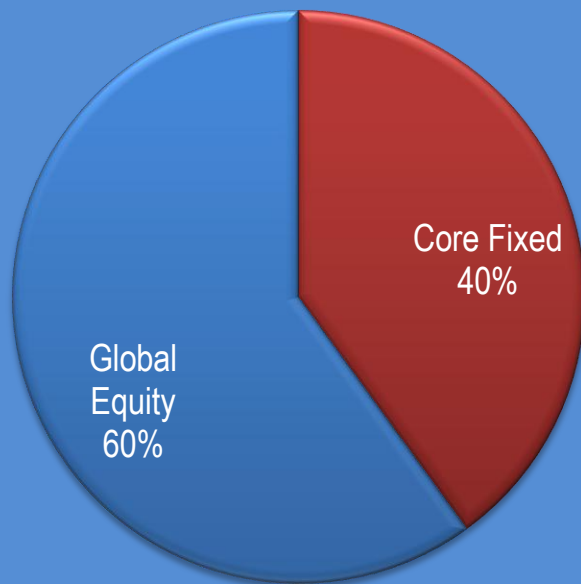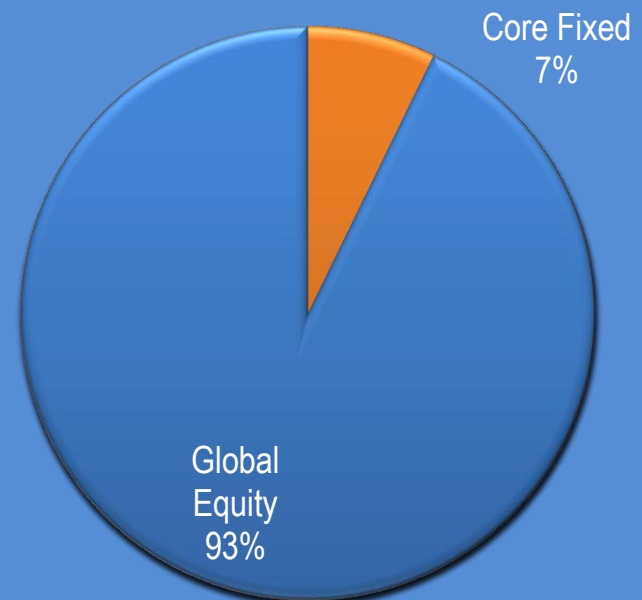
- Total portfolio risk (volatility) is dominated by equity (growth) risk

SOURCES OF PORTFOLIO RISK: CURRENT POLICY

Portfolio Arithmetic Return: 7.2%
Portfolio Geometric Return: 6.6%
Portfolio Standard Deviation: 11.1%

Porfolio Dollar Allocation

- Cash 3%
- Private Equity 7%
- Core Fixed 15%
- Real Estate 8%
- Real Return 14%
- Abs Return Hedge Funds 7%
- Equity Long-Short HFs 8%
- Global Equity 38%

Porfolio Risk Allocation

- Core Fixed 2%
- Cash 0%
- Private Equity 14%
- Real Return 11%
- Real Estate 4%
- Abs Return Hedge Funds 2%
- Equity Long-Short HFs 5%
- Global Equity 62%

Portfolio Arithmetic Return: 7.4%
Portfolio Geometric Return: 6.9%
Portfolio Standard Deviation: 10.7%

Portfolio #13

Porfolio Dollar Allocation

- Cash 0%
- Private Equity 12%
- Core Fixed 10%
- Real Estate 10%
- Global Equity 23%
- Real Return 25%
- Abs Return Hedge Funds 10%
- Equity Long-Short HFs 10%

Porfolio Risk Allocation

- Core Fixed 2%
- Real Estate 5%
- Private Equity 26%
- Real Return 20%
- Abs Return Hedge Funds 3%
- Global Equity 38%
- Equity Long-Short HFs 6%
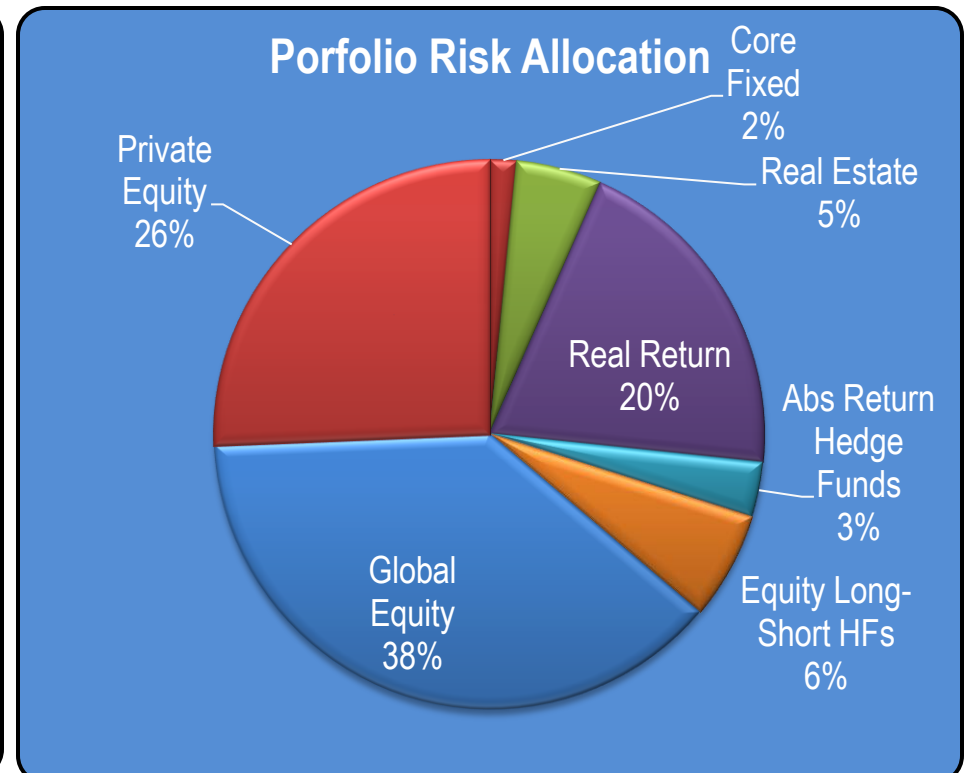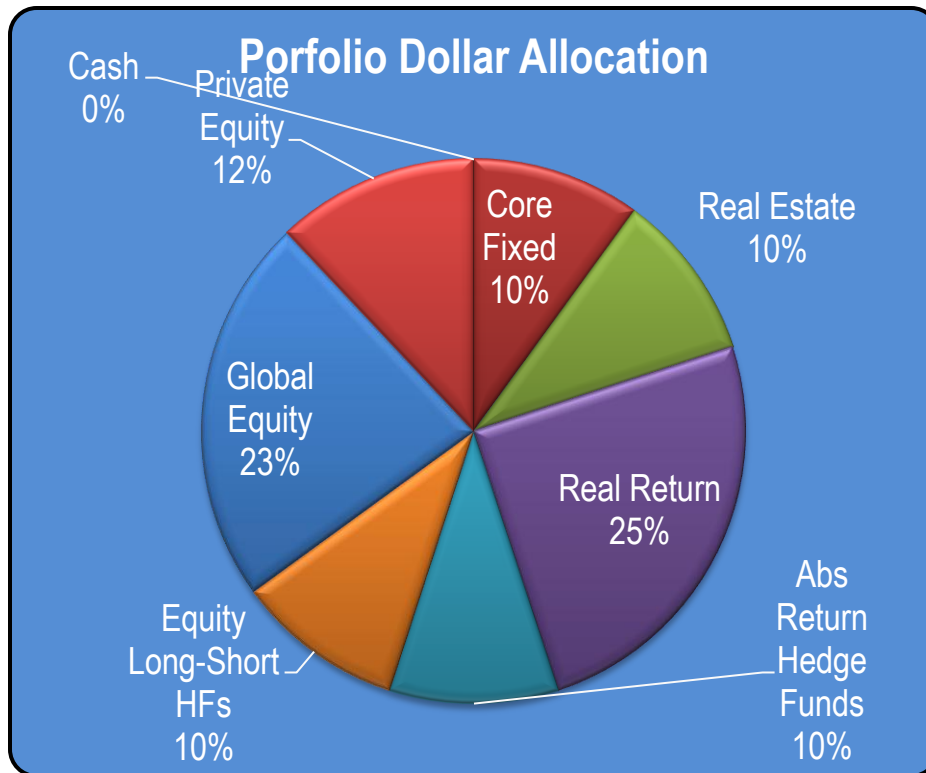
SOURCES OF PORTFOLIO RISK COMPARISON

60/40 Portfolio

Porfolio Risk Allocation

Global Equity, 93%

Core Fixed, 7%

Current Policy

Porfolio Risk Allocation

Private Equity, 14%

Global Equity, 62%

Equity Long-Short HFs, 5%

Abs Return Hedge Funds, 2%

Real Return, 10%

Real Estate, 4%

Core Fixed, 2%

Highest Sharpe Ratio

Porfolio Risk Allocation
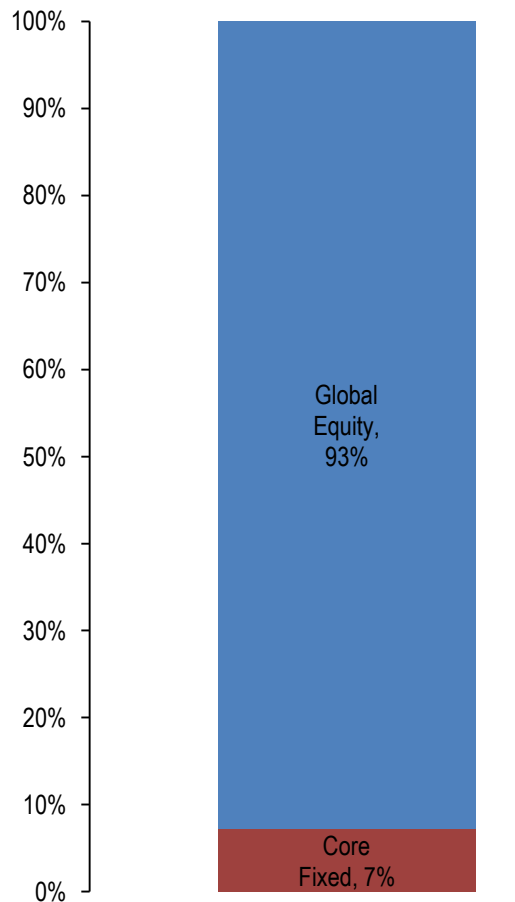
Private Equity, 26%

Global Equity, 38%

Equity Long-Short HFs, 6%

Abs Return Hedge Funds, 3%

Real Return, 20%

Real Estate, 5%

Core Fixed, 2%
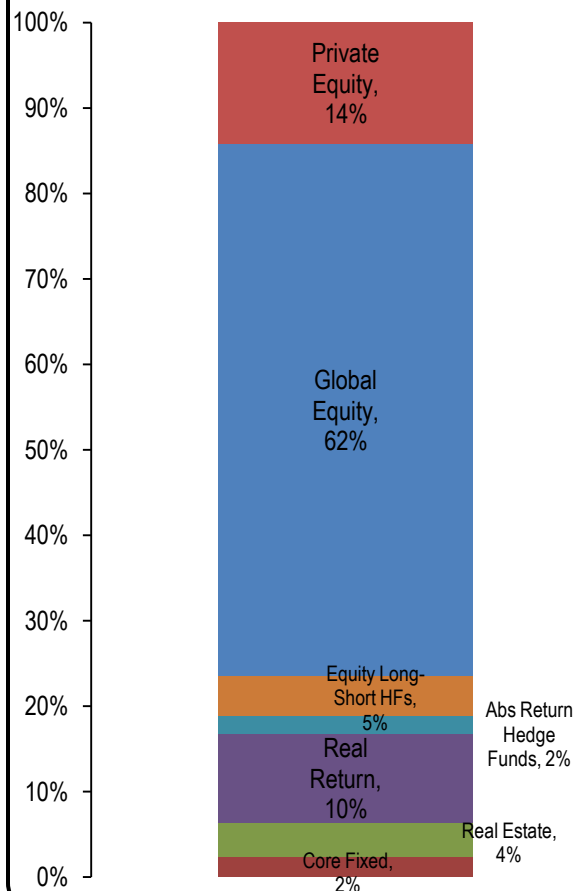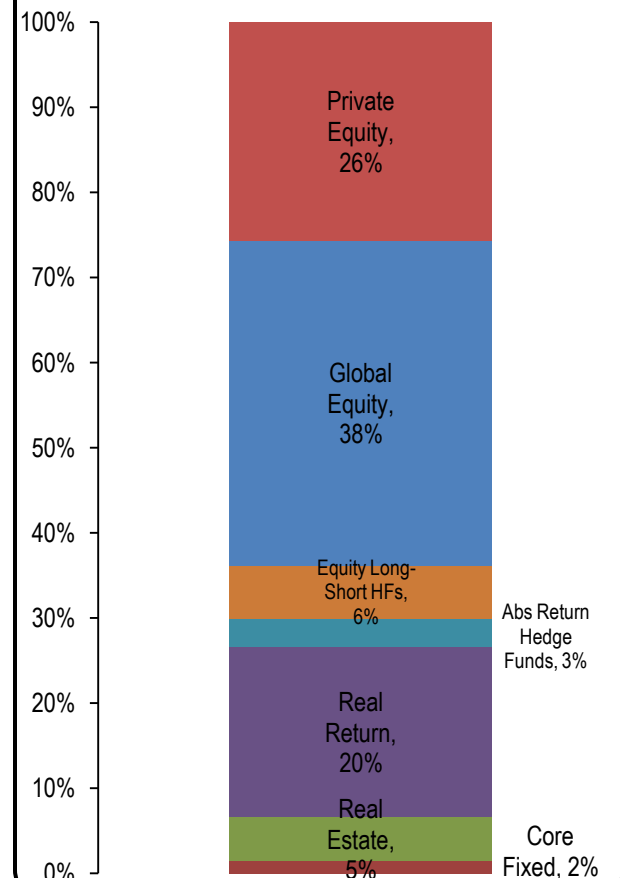
- Equity risk is the primary source of risk in <u>most</u> large institutional investors' portfolios
  - Given the current capital market return assumptions, institutional investors have relatively high return targets
  - Equity has a higher expected return than many capital market investments

- 60 / 40 Portfolio risk profile is dominated by one risk – equity (growth) risk
  - The success or failure of the portfolio meeting its investment objectives rest on one outcome – equity investments continue to rise in value

- The current portfolio and the highest efficient portfolio both have large allocations to equity risk, but their sources of risk are better diversified

RISK MANAGEMENT: LIQUIDITY

- The Fund is mature and as a result, is cash flow negative
  - Benefit payments > Employer + Employee contributions

- The Fund requires sufficient liquidity to meet monthly benefit obligations

- Cash outflows reduce the investment flexibility of a long-term investor

  - Large negative market movements (drawdown) are particularly harmful to plan solvency for mature funds
    - In a drawdown event "cheap" assets are liquidated to make benefit payments
    - Cash inflows are not available to invest in assets, that due to the market decline, have lower valuations

  - Liquidity considerations limit the investor's ability to capture the illiquidity premium that accrues to Private Equity and Private Real Estate investments

RISK MANAGEMENT: IMPACT OF CASH FLOW

- The Fund is mature and as a result, is cash flow negative
  - Benefit payments > Employer + Employee contributions

High Risk

Payout		Return	Value	Payout	Value	Payout
				Young Plan		**Mature Plan**
	Yr 0		$100		$100	
$5	Yr 1	-20%	$80	$0	$76	-$5
$5	Yr 2	24%	$99	$0	$88	-$5
$5	Yr 3	8%	$105	$0	$88	-$5
$5	Yr 4	10%	$116	$0	$91	-$5
	Average	5%				

Low Risk

Return	Value	Payout	Value
		Young Plan	
	$100		$100
-6%	$94	$0	$89
14%	$107	$0	$96
4%	$111	$0	$95
8%	$120	$0	$97
5%			

In both cases, the low-risk portfolio is better funded in the long-term.

The cash outflows from the mature portfolio magnify the difference.

RISK MANAGEMENT

Investment Risk can be managed by:

- Adopting a low risk asset allocation – low equity risk exposure
  - However, the investor may not attain their return target

- Maximizing Diversification
  - Reducing risk through diversification can be expensive

- Purchasing Risk Insurance or Risk Hedging
  - Insurance and hedging are costly

- Tactical Risk Management
  - Relies on management skill that can be fleeting

- Combination of the above

PORTFOLIO RISK MANAGEMENT: THE CHALLENGE

- Risk can not just be reduced. The portfolio must have a reasonable expectation of meeting the target return

- Diversifying strategies often require use of:
  - Leverage
  - Shorting
  - Derivatives

- Low correlated assets reduce risk. However,
  - They must be a large enough allocation to have a risk reduction impact
  - Low volatility assets do not have sufficient volatility to impact total portfolio return
  - Most diversifying assets / strategies reduce risk very slowly

- Most institutional investors' portfolios risk profiles are dominated by equity risk
  - It is challenging to construct a portfolio where that is not the case
  - A portfolio allocation that truly reduces return volatility most public fund policy-makers would not find acceptable (not within the model allocation constraints)

PORTFOLIO VOLATILITY – SOURCES OF RISK

- With parameters estimated for each portfolio component (e.g. each asset class)

- Portfolio volatility is conceptually driven as follows:

Portfolio Volatility Determinants	=	Volatility of components	and	Relationship of components to one another

Portfolio volatility in "math"	= sqrt	[Sum of the square of weighted component volatilities	+/-	Co-movement relationship of components]
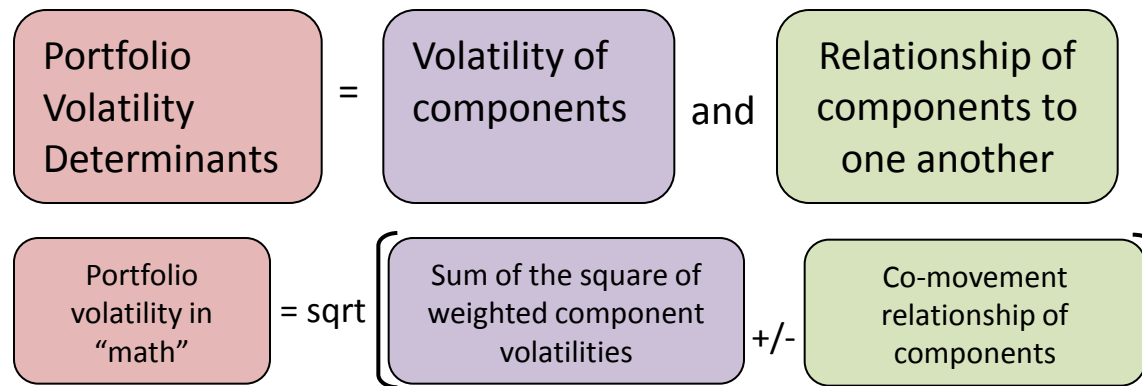
- In mathematical notation…

  o w = weight

  o σ = standard deviation

  o $\rho_{1,2}$ = correlation between components

  o For a 2 asset portfolio: $\sigma^2 = w_1^2\ \sigma_1^2 + w_2^2\ \sigma_2^2 + 2w_1w_2\sigma_1\sigma_2\rho_{1,2}$

  o Standard Deviation is the square root of σ^2

SIMPLE EXAMPLES OF PORTFOLIO RISK SENSITIVITIES

- The following examples are of two asset portfolios (stocks and bonds)

- Assume asset 1 is a stock portfolio, asset 2 is a core bond portfolio (60/40)

	w Weight	σ Volatility	$\rho_{1,2}$ Correlation	$w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\sigma_1\sigma_2\rho_{1,2}$ Variance	Covariance	Variance Contribution	% Contribution
Asset 1	60%	16%	0.5	0.00922	0.00077	0.00998	90.7%
Asset 2	40%	4%	0.5	0.00026	0.00077	0.00102	9.3%
Portfolio	100%			0.00947	0.00154	0.01101	100.0%

StDev = SQRT Portfolio Variance **10.49%**

	w Weight	σ Volatility	$\rho_{1,2}$ Correlation	$w_1^2\sigma_1^2 + w_2^2\sigma_2^2 + 2w_1w_2\sigma_1\sigma_2\rho_{1,2}$ Variance	Covariance	Variance Contribution	% Contribution
Asset 1	60%	16%	0.0	0.00922	0.00000	0.00922	97.3%
Asset 2	40%	4%	0.0	0.00026	0.00000	0.00026	2.7%
Portfolio	100%			0.00947	0.00000	0.00947	100.0%

StDev = SQRT Portfolio Variance **9.73%**

- The lower the correlation, the more beneficial the component's addition

- The higher the volatility, the more impact a component has on portfolio

SIMPLE EXAMPLES OF PORTFOLIO RISK SENSITIVITIES

- Start with an institutional allocation of 60 / 40 (stocks / bonds) with 0.20 correlation

- Risk contribution is dominated by stocks, because equity volatility is disproportionate

	w	σ	$\rho_{1,2}$	$w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2w_1w_2\sigma_1\sigma_2\rho_{1,2}$		Variance	%
	Weight	Volatility	Correlation	Variance	Covariance	Contribution	Contribution
Stocks	60%	16%	0.2	0.00922	0.00031	0.00952	94.4%
Bonds	40%	4%	0.2	0.00026	0.00031	0.00056	5.6%
Portfolio	100%			0.00947	0.00061	0.01009	100.0%
				StDev = SQRT Portfolio Variance		**10.04%**	

- To meaningfully change this, weighted component volatility = $w^2 \sigma^2$ has to change

	w	σ	$\rho_{1,2}$	$w_1^2 \sigma_1^2 + w_2^2 \sigma_2^2 + 2w_1w_2\sigma_1\sigma_2\rho_{1,2}$		Variance	%
	Weight	Volatility	Correlation	Variance	Covariance	Contribution	Contribution
Asset 1	60%	16%	0.2	0.00922	0.00123	0.01044	66.2%
Asset 2	40%	16%	0.2	0.00410	0.00123	0.00532	33.8%
Portfolio	100%			0.01331	0.00246	0.01577	100.0%
				StDev = SQRT Portfolio Variance		**12.56%**	

- Remember, risk cuts both ways.

RISK MANAGEMENT STRATEGIES

Investment Objective

- Lower total portfolio return volatility while maintaining reasonable expected return

- More specifically reduce the negative impact of severe equity market declines (drawdowns)

- Effort should be holistic – encompassing all aspects of the portfolio structure

Potential Assets or Investment Strategies for future consideration

- Global Tactical Asset Allocation – Tail Risk Management
- Covered Call Strategies – over the long term reduce the equity portfolio return volatility with little or no diminution of equity portfolio return
- Liquid Asset Partners – GMO, AQR style products [5% real return target with 10% risk target]
- Currency Overlay Management – partial hedging of uncompensated currency risk
- Equity Risk Factor Strategies (low vol. strategies)

APPENDIX A

MEMORANDUM

Date: December 31, 2013

To: Ann-Marie Fink, CIO

From: Pension Consulting Alliance, Inc. (PCA)   cc: John Burns (PCA)
                                                       Allan Emkin (PCA)
                                                       John Linder (PCA)

RE: Assumptions for ERSRI Asset Allocation Analysis

Summary:

PCA has been engaged to conduct an asset allocation analysis on behalf of ERSRI. As part of that analysis, we were asked to estimate asset class risk, return and correlation relationship assumptions for the major investment classes to which ERSRI allocates. Those classes and assumptions are as follows:

	Cash	Core Fixed	Real Estate	Real Return	Abs Ret HFs	Equity LS HFs	Global Equity	Private Equity
Annual Arithmetic Mean	2.25%	3.0%	7.2%	6.6%	5.7%	7.5%	8.8%	11.8%
Annual Standard Deviation	2.0%	4.8%	12.0%	11.0%	6.3%	10.0%	18.5%	26.0%

	Cash	Core Fixed	Real Estate	Real Return	Abs Ret HFs	Equity LS HFs	Global Equity	Private Equity
Cash	1.00							
Core Fixed	0.30	1.00						
Real Estate	0.30	0.30	1.00					
Real Return	0.00	0.50	0.10	1.00				
Abs Return Hedge Funds	0.20	0.20	0.10	0.50	1.00			
Equity Long-Short HFs	0.30	0.10	0.20	0.40	0.70	1.00		
Global Equity	0.00	0.30	0.40	0.70	0.40	0.60	1.00	
Private Equity	0.00	0.00	0.40	0.50	0.40	0.60	0.85	1.00
ERSRI Policy Allocation	3%	15%	8%	14%	7%	8%	38%	7%

Under a mean variance framework and assuming a normal distribution of returns, the portfolio return and risk expectations based on the above assumptions are calculated as:

Portfolio Compound Return	**6.6%**
Portfolio Arithmetic Return	**7.2%**
Portfolio Standard Deviation	**11.1%**

1

Discussion:

Estimates of risk, return and correlation were based on PCA's most recent general capital market assumptions as a starting point (attached as Appendix A), and then adjusted to consensus estimates after further analysis and discussion between PCA and staff. ERSRI specific, custom classes were modeled directly. The following ERSRI classes map similarly to PCA's general capital market assumptions: Cash, Core Fixed Income, Global Equity and Private Equity.

For ERSRI classes that do not map directly (Real Estate, Real Return, Absolute Return Hedge Funds and Equity Long-Short Hedge Funds), customized models of these classes were constructed based on the current construction of the class and input from ERSRI staff. A simplified description of inputs and process followed to develop these assumptions are as follows.

1. The ERSRI RE class is model is currently constructed with approximately 80% core real estate and 20% opportunistic and value add. PCA has used PCA's general capital market assumption for core unlevered real estate based on the NCREIF returns series as the base for the core real estate assumption and assumed leverage of 20%. We have assumed the cost of debt to be 4.3%, based on a 10 year treasury rate of 3.0% and a CMBS AA spread of 130 bps. PCA assumes the return profile of non-core real estate (opportunistic and value add) to be like lower-risk private equity, with 80% of the risk and return of the private equity class. The combination of these two pieces, 80% in levered core RE and 20% non-core RE, with a correlation expectation of 0.6 between core and non-core real estate, results in a return and volatility expectation of 7.2% and 12% respectively. The correlation assumption of the class is assumed to be similar to that of PCA's core real estate versus the other classes.

2. The ERSRI Real Return Class is a hybrid class that contains sub-allocations in the following percentages:

Real Return Class	Global ILBs	Bank Loans	Energy MLPs	Infra-structure	Total Class
% of Class	36%	29%	14%	21%	100%

PCA modeled the each of these classes individually under the following assumptions:

Global ILBs – Based on the BC Global TIPS series hedged return series (Barclays Live)

Bank Loans – Based on the following returns series: 1987-2005 Citigroup HY Loan Index, 2006-2008 Lehman US HY Loan Index, 2009 Barclays US HY Loan Index.

Energy MLPs – Based on the Alerian MLP Index return series.

Infrastructure - Based on the following return series: S&P Utilities 1977-2000, Macquarie Infrastructure 2001-2011, and Bloomberg MCGIIIDT Index, and 2012 FTSE Global Core Infrastructure Index Bloomberg FGCIIU.

Since data for each of the individual sub-allocations is only available from 1997-2012, PCA used this period to construct a Real Return aggregate portfolio return series over this time period, based on the above weights. This return series was used to estimate the standard deviation expectation for the class of 11%. This return series was also used to estimate correlations with the other (aforementioned classes), over the 1997-2012 time period. Finally, return estimate of the class was developed incorporating both the investment class objective of CPI + 4%, and forward looking estimates of return that approximate the following:

Sub-allocations	Compound Return Estimates
Global ILBs	3.6%
Bank Loans	5.5%
Energy MLPs	9.5%
Infrastructure	11%

The arithmetic return assumption for the real return class is 6.6% with 11% volatility.

3. The ERSRI Absolute Return Hedge Fund Class is based on HFRI return data supplied by Cliffwater, the return series reflects strategy weighting of ERSRI's Real Return Portfolio: 36% HFRI Macro Index, 32% HFRI Multi-Strategy Index, 21% HFRI Fixed Income-Corporate Index, 11% HFRI Market Neutral Index, from 1990-2012. This return series was also used to estimate correlations with the other (aforementioned classes), over the 1997-2012 time period. Forward looking risk and return estimates for this class are based on estimates of Cliffwater, a survey of other hedge fund return estimates, and discussions between Staff and PCA concerning underwriting goals. The arithmetic returns for the class are estimated at 5.7% with a standard deviation of 6.3%.

4. The ERSRI Equity Long-Short Hedge Fund class is constructed growth oriented, long-short equity hedge funds. Historically, the total return of the HFRI Equity Hedge Index versus broad equity indexes has been high, at approximately 0.7 over the full history, and 0.8 in the past 15 years. This return series was used to analyze correlations with the other (aforementioned classes), over the 1997-2012 time period. Forward looking risk and return estimates for this class are based on estimates of Cliffwater, a survey of other hedge fund return estimates, and discussions between Staff and PCA concerning underwriting goals. The arithmetic returns for the class are estimated at 7.5 % with a standard deviation of 10%.

Expected Inflation, Average Annual Risk Free Rates & Annual Risk Premiums for Various Classes - %

Category	Expectation – Annual %	Comments
Inflation	3.00	The 10-year TIPS breakeven inflation rate was approximately 2.25% in August 2013. PCA believes that while the TIPS breakeven inflation rate is one important data point indicative of equilibrium pricing of inflation expectations, there are other considerations. Real rates on 10-year TIPS are currently approximately 0.65% as of August 2013. Realized CPI over the last 12-months ending June 30, 2013, was 1.75% before seasonal adjustment. The University of Michigan Survey of 5-to-10 year annual inflation expectations fluctuated between 2.8% and 3.0% since January 2013. The unemployment rate has continued to decline, dropping to 7.6% in June 2013, from 7.8% in December 2012. The Producer Price Index (PPI) rose by 2.5% over the past 12 months, but commodity prices (broadly) were lower. Capacity utilization remains stable. While unemployment levels indicate some remaining slack in the U.S. economy, loose monetary policy (including negative real cash interest rates), quantitative easing in Europe and the U.S. despite the talk of "tapering" bond purchases, and improving U.S. economic news, point to higher future inflation long-term.
Real Risk-Free Rates		
Short-term (Cash)	-0.75	Federal Reserve short-term lending rates remain between 0.0% and 0.25%, which is currently much lower than long-term inflation expectations and recent realized inflation. Thus, the Fed's current short-term rates establish real lending rates that are significantly <u>negative</u>. Expectations are for these low short-term lending rates (thus negative real rates) to extend through 2016, but to rise slowly thereafter, leading to negative real rates over the investment horizon on average.
Longer-term (10-year TIPS yield)	0.75	The expected long-term real yield is projected as the current 10-year TIPS real yield. As of August 2013, the 10-Year TIPS real yield was approximately 0.65%, rising from -0.62% in December 2012.
Risk Premiums over Short-term Real Risk-free Rate:		
Domestic US Fixed Income International Fixed Income Global Fixed Income	0.85	Yield-to-maturity on the Barclays Capital Universal as of August 2013 was 2.94%. 2013 saw credit spreads near long-term average levels. However, interest rates on U.S. Treasury debt have risen off post-war lows across the maturity spectrum. While the Fed has indicated they will continue to hold down short-term interest rates through 2016, and has continued to buy down long-term rates through quantitative easening programs, their talk of potentially tapering bond purchases in autumn 2013 caused interest rates to rise. Current expected returns represent no spread compression and minimal increase in interest rates. Our longer-term, higher expected inflation level is expected to prove detrimental to fixed income returns. Thus, our estimate reflects reversion of the recent declining trend in the fixed income premium, to positive levels, hurting forward looking returns.
Core Real Estate	4.15	Assumes a mix of private core real estate and an allocation of 15% to public real estate securities. Estimate assumes stable interest rates (cost of leverage), and a stable to rising cap rate level, reverting towards historical averages.
Basic Real Return	4.30	Combination of TIPS, Timber, Commodities, and Hedge Funds of Funds. The projected return premium of TIPS is significantly higher than in January 2013. The trend for commodity price appreciation has leveled off. Extrapolation of historical premium trends is justified.
Domestic Equity International Equity Global Equity	6.50 7.00 6.75	Historical equity premium has declined over the past three years, trend is expected to adjust upward over next several years. Fundamental expectations are in line with trend extrapolations. Expectations since December 2011 were revised slightly downward due to a relative overachievement since then. For long-term planning purposes the Non-U.S. equity risk premiums are assumed to be higher than that of the U.S., due to currently depressed prices outside of the U.S.
Hedged International Equity	6.90	International equity premium less frictional cost of hedging.
Alternative Investments/Private Equity	9.75	Expected long-term illiquidity premium over global public equity of 3.0%.

Summary of Investment Class Assumptions

	Expected Arithmetic Average Nominal Annual Return	Expected Geometric[1] Compound Nominal Annual Return	Expected Risk of Nominal Returns (Annl. SD)	Cash	TIPS	CoreFxd	IntlBds	GlblBds	RealEst	RealRet	USEq	IntlEq	GlblEq	HIntlEq	PrivEq
Cash	2.25	2.20	2.00												
Treasury Infl. Protected Securities	3.75	3.60	6.00	0.20											
Domestic US Fixed Income	3.10	3.00	4.50	0.30	0.60										
International Fixed Income	3.10	2.60	10.00	-0.10	0.40	0.40									
Global Fixed Income	3.10	2.80	8.00	0.00	0.50	0.60	0.95								
Core Real Estate	6.40	5.90	10.00	0.30	0.00	0.00	-0.20	-0.20							
Real Return	6.55	6.25	8.00	0.20	0.60	0.30	0.00	0.00	0.25						
Domestic Equity	8.75	7.20	18.00	0.00	0.00	0.30	0.00	0.00	0.40	0.25					
International Equity	9.25	7.20	21.00	0.00	0.00	0.10	0.10	0.10	0.40	0.25	0.85				
Global Equity[2]	9.00	7.40	18.50	0.00	0.00	0.20	0.05	0.05	0.40	0.25	0.90	0.90			
Hedged International Equity	9.15	7.30	20.00	0.10	0.00	-0.10	-0.10	-0.10	0.50	0.35	0.90	0.90	0.90		
Private Equity/Venture Capital	12.00	8.90	26.00	0.00	0.00	0.00	0.00	0.00	0.40	0.25	0.90	0.80	0.85	0.90	
Inflation	3.00	3.00	2.00	0.50	0.50	-0.20	-0.15	-0.20	0.40	0.60	0.20	0.20	0.20	0.20	0.10

Significant Changes from Jan 2013 Projected Ten-Year Assumptions

- Fixed income expected returns have risen significantly, from 2.2% to 3.0%, due to rising longer-term interest rates.
- TIPS expected returns have risen from 2.1% to 3.6%, due to large upward shifts in real interest rates.

Indices Used in Modeling Asset Class Assumptions

Asset Class	Index
Cash	Citigroup 3 month US Treasury Bill Index
TIPS	Barclays Capital TIPS, simulated TIPS series per Bridgewater
Domestic US Fixed	Barclays Capital Universal, Barclays Capital Aggregate Index, Barclays Capital G/C Index, Barclays Capital Intermediate Govt. Index, Barclays Capital Corp/Credit Index
International Fixed	Barclays Capital Global Treasury ex-US Unhedged, Solomon/Citigroup World Non-US Government Bond Index
Global Fixed	Barclays Capital Global Treasury Index, Salomon/Citigroup World Government Bond Index
Core Real Estate	NCREIF NPI Index, Prior Indices, NAREIT Equity REIT Index
Real Return	Barclays Capital TIPS, various Hedge Fund Indices, NCREIF Timber Index, Dow Jones UBS Commodity Index
Domestic Equity	Russell 3000 Index, S&P 500 Index
International Equity	MSCI/Barra ACWI ex-US Index, MSCI/Barra EAFE Index
Global Equity	MSCI/Barra ACWI Index
Hedged Intl. Equity	Hedged MSCI/Barra EAFE Index, MSCI/Barra ACWI ex-US Index, MSCI/Barra EMF Index
Private Equity	Prior Brinson Venture Capital Index, VCJ Post Venture Capital Index

Notes:

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[1] Geometric returns are compareable to actuarial assumption rates for pension funds.

[2] The compound return estimate of Global Equity is not a simple average between Domestic Equity and International Equity compound returns. International Equity and Domestic Equity are not perfectly correlated. Therefore a Global Equity portfolio has lower volatility than the weighted average of component volatilities. Lower volatility results in higher compound returns.

PCA developed its average annual return premiums and standard deviation estimates using a combination of approaches. First, for major asset classes with an appropriate amount of history, PCA studied historical time series over both one-year and five-year holding periods to uncover any specific trends in the time series data. For example, domestic stock return premiums exhibit cyclical behavior, with each full cycle lasting approximately 40-50 years. Statistical procedures were used to identify such trends and extrapolate these trends 10-15 years forward. Second, PCA examined fundamental variables underlying several major asset classes and computed expectations based on consensus views of these variables. PCA also reviewed outlook opinions from a handful of leading investment banks and investment advisory firms. PCA compiled these opinions to develop consensus expectations for the major asset classes. PCA then used these consensus expectations as reference checks against its own expectations. Finally, PCA professionals discussed and debated asset expectations internally until a consensus view developed.

In recognizing that asset class risks are not always stable, PCA also examined risk trends utilizing similar statistical procedures. PCA also calculated risks weighting more recent periods heavier than earlier periods. In certain instances, weighted standard deviations differed materially from basic standard deviations. In these cases, PCA utilized weighted standard deviations as a base line for analysis.

In recognizing that correlations are also not always stable, PCA analyzed the current behavior of the correlations among major pairs of asset classes. In analyzing the correlation trends among pairs of assets, we focused on correlation trends across non-overlapping five-year holding periods. Using statistical procedures highlighted above, we extrapolated the trends of these correlations into the future to gain a sense of their level and direction. For correlation pairs containing short annual return histories, we analyzed correlations of annual returns. Similar to analyzing risks, we also applied a decay factor to return history and calculated weighted correlations where appropriate.

The investment class risk premia estimated for classes that consist of publicly traded securities are market "beta" returns, and do not assume returns to active management, nor active management fees. The risk premia for investment classes that, by definition, are actively managed (e.g. private real estate, hedge fund of funds, private equity), have been developed "net" of customary investment management fees, which are intrinsic to the indices from which the premia were developed.

Given the complexities associated with developing capital market expectations, we advise users of the above information to rely on judgment as well as optimization approaches in setting strategic allocations to any set of investment classes. Please note that all information shown is based on qualitative and quantitative analyses. Exclusive reliance on the above is not advised. This information is not intended as a recommendation to invest in any particular asset class or as a promise of future performance. References to future returns for either asset allocation strategies or asset classes are not promises or even estimates of actual returns a client portfolio may achieve.

Assumptions, opinions and estimates are provided for illustrative purposes only. They should not be relied upon as recommendations invest in or avoid certain investments. Forecasts of financial market trends that are based on current market conditions constitute our judgment and are subject to change. We believe the information provided here is reliable, but do not warrant its accuracy or completeness. This material has been prepared for information purposes only.