ARIZONA STATE RETIREMENT SYSTEM

NEPC 2018 SAAP REVIEW

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ASRS PROCESS

- NEPC updates 5-7 and 30 year asset class forecasts annually
- Every 3 years, NEPC evaluates the ASRS long-term Strategic Asset Allocation Policy (SAAP) and works with staff as well as independently to identify changes to SAAP targets to improve the probability of producing high expected returns at a comparable level of risk
- Multiple tools are used to assess the potential advantages and challenges of proposing a new SAAP or retaining the current SAAP
- One methodology employed involves projected mean/variance analysis (Modern Portfolio Theory) to project likely outcomes from alternative asset mixes. Page 21 contains a summary and recommendation for new SAAP Targets
- Once the Investment Committee selects a target mix, NEPC will work with staff to develop ranges and benchmarks for each asset class for final approval by the Board

CURRENT ASSET ALLOCATION AND RANGES

Assets	Current Allocation	SAAP	Policy Range	Within Range	Benchmark
Total Domestic and International Equity	**51.2%**	**50%**			
Domestic Equity	**27.0%**	**26%**	**16% - 36%**	**Yes**	
U.S. Large Cap	*19.5%*	*20%*			**S&P 500 Index**
U.S. Mid Cap	*3.3%*	*3%*			**S&P 400 Index**
U.S. Small Cap	*3.3%*	*3%*			**S&P 600 Index**
Public Opportunistic Equity					**Investment Specific**
International Equity	**24.2%**	**24%**	**14% - 34%**	**Yes**	
Developed Large Cap	*17.6%*	*17%*			**MSCI EAFE Index**
Developed Small Cap	*1.5%*	*2%*			**MSCI EAFE Small Cap Index**
Emerging Markets	*4.4%*	*5%*			**MSCI Emerging Markets Index**
Private Equity	**8.1%**	**8%**	**6% - 10%**	**Yes**	**Russell 2000 Index**
Private Opportunistic Equity	**0.7%**	**0%**			**Investment Specific**
Total Equity	**60.0%**	**58%**	**48% - 65%**	**Yes**	
Public Markets Fixed Income	**11.4%**	**13%**			
Treasuries Long Duration	*0.0%*	*0%*	*0% - 10%*	*Yes*	**Bbg Barclays Long-Term Treasuries Index**
Interest Rate Sensitive	*10.6%*	*11%*			**Bbg Barclays US Aggregate Bond Index**
High Yield	*0.8%*	*2%*			**Bbg Barclays US High Yield Index**
Private Debt[2]	**10.9%**	**12%**	**8% - 12%**	**Yes**	**S&P/ LSTA Leveraged Loan Index + 2.5%**
Opportunistic Debt	**3.9%**	**0%**			
Total Fixed Income	**26.2%**	**25%**	**18% - 35%**	**Yes**	
Commodities	**0.6%**	**2%**	**0% - 4%**	**Yes**	**Bloomberg Commodities Index**
Real Estate	**8.9%**	**10%**	**8% - 12%**	**Yes**	**NCREIF ODCE Index**
Infrastructure	**0.9%**	**0%**	**0% - 3%**	**Yes**	**Investment Specific**
Farmland and Timber	**0.5%**	**0%**	**0% - 3%**	**Yes**	**Investment Specific**
Opportunistic Inflation-Linked	**0.0%**	**0%**			**Investment Specific**
Total Inflation-Linked	**10.9%**	**12%**	**10% - 16%**	**Yes**	
Multi-Asset Class Strategies	**3.0%**	**5%**	**0% - 12%**	**Yes**	**91 Day T-Bill**
Operating Cash (Non Assetized)	**0.0%**				**91 Day T-Bill**

Note: As of 12/31/2017

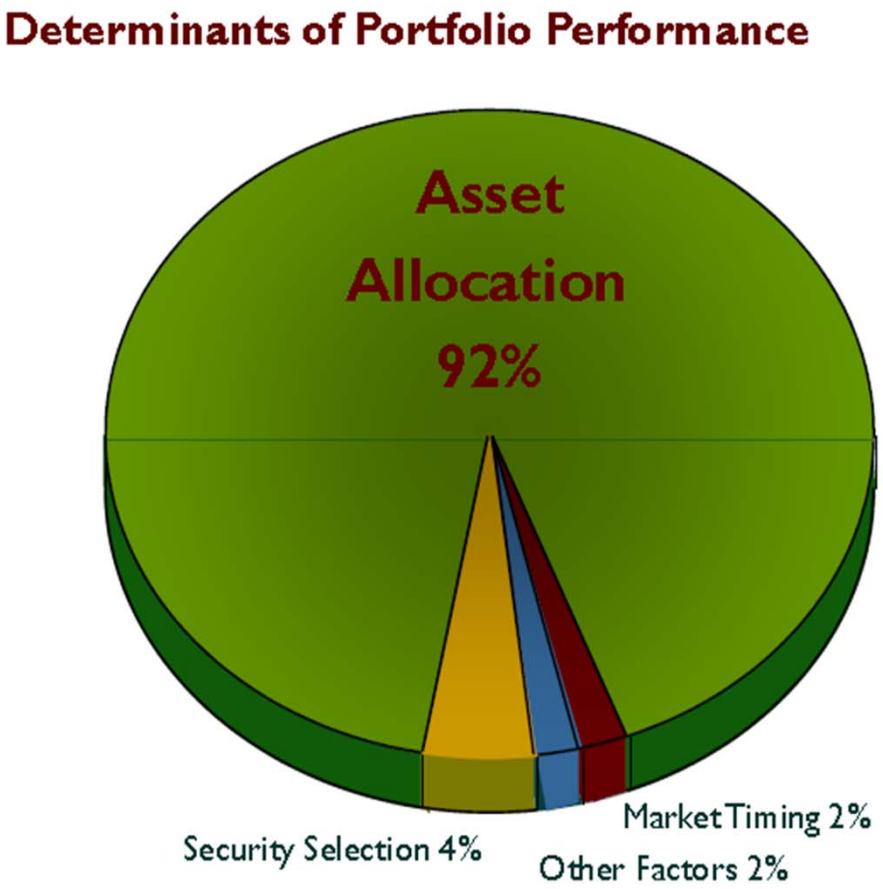
ASSET ALLOCATION DEFINED

- **The process of allocating assets across a spectrum of investments to achieve an expected return at an expected level of risk**
  - "Expected" is a statistics term, which is different from the common use of the word.
  - Expected return is the weighted average of all possible returns, where the weights are the probabilities that each return will occur.

- **Asset allocation decisions include, but are not limited to:**
  - Equity/Fixed Income/Cash/Real Estate/Private Equity/Private Debt etc.
  - Domestic/International/Global
  - Liquid vs. illiquid

- **Structure: refers to implementation decision**
  - Core vs. Value/Growth
  - All Cap vs. Large/Medium/Small Cap
  - Active vs. Passive
  - Global vs. US/Foreign

ASSET ALLOCATION: THE KEY INVESTMENT DECISION



Source: Determinants of Portfolio Performance II: An Update, Brinson, et al, Financial Analysts Journal, May/June 1991, pp 40-48.

ASSET ALLOCATION – A PROGRESSIVE APPROACH

Be Dynamic

Build a **long-term** strategic allocation that can meet long-term objectives

Look for **medium-term** "opportunistic ideas" to tilt away from the strategic allocation to add value, AND

Build a Mosaic

No single asset allocation approach or model has all the answers

Minimize exposure to the shortcomings of any individual approach by using multiple perspectives and approaches

All analytical tools have the potential to provide useful insights but also including shortcomings

ANALYTICAL MODELING CAPABILITIES – PROPRIETARY TOOLS

- **NEPC uses a variety of proprietary tools developed internally to better assess strategic asset allocation changes and the impact of tactical adjustments**

Approach	Advantages	Shortcomings
Mean-Variance	• Calculates most efficient portfolio for given volatility • Produces range of portfolios	• Relies on static assumptions and assumes normal distribution • Chosen constraints can drive results • Limits risk definition to volatility
Risk Budgeting	• Provides risk allocations • Recognizes that less efficient portfolios may have better risk balance	• Relies on Mean-Variance optimization assumptions • Defines risk as standard deviation • Ignores tail risks
Scenario Analysis	• Focuses on low-probability, high magnitude economic environments (tail risks) • Recognizes environmental biases of each asset class	• Offers opportunity to test risk tolerance to various outcomes but should not be used to construct best portfolio for each environment
Liquidity Analysis	• Recognizes a "risk" not captured in traditional tools: illiquidity • Highlights impact of changing cash flows (both investment-driven and exogenous)	• Requires portfolio specific cash flow and partnership details • Long-term planning tool – cannot easily adjust portfolio or compare different portfolios

- Final Result = Revised Asset Class Targets, Ranges, Benchmarks
- Remainder of this Document Focuses on Determining Asset Class Targets

Please note that all investments carry some level of risk. No investment strategy or risk management technique can guarantee returns or eliminate risk in any market environment.

ASSET ALLOCATION PROCESS

- **Capital markets assumptions**
  - Expected Return
  - Expected Risk (Volatility, Standard Deviation)
  - Expected Correlation

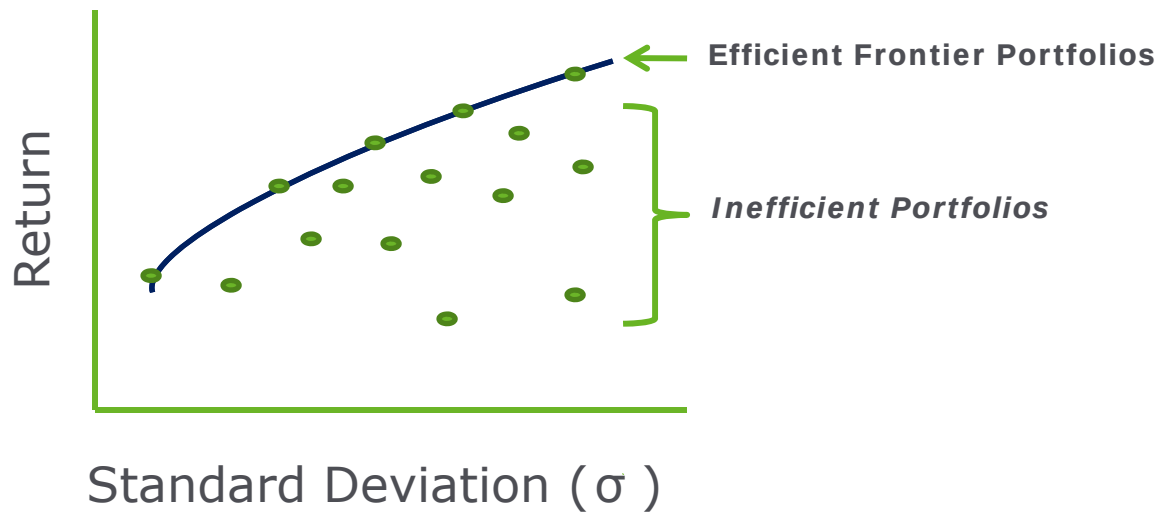
- **A portfolio is comprised of a set of asset classes, each of which has a return distribution, which can be summarized by return and variance**

- **The expected return of the total fund is simply a weighted average of the expected returns of its component asset classes**

- **The standard deviation of the total fund is more complex**

ASSET ALLOCATION MODEL: MEAN-VARIANCE OPTIMIZATION

- **Mean-Variance Optimization: Asset allocation model based on Nobel-Prize winning theory**
- **Mathematical solution to determine the "best" mix of assets that will create an efficient frontier**
  - Highest return for expected risk (volatility), or
  - Lowest expected risk (volatility) for expected return
  - Stated another way, it builds portfolios with the highest expected risk-adjusted returns – Efficient Frontier:



MODEL INPUTS

- **Permissible Asset Classes and Weighting Constraints**
  - Constraints may reflect legal restrictions, liquidity, time horizon and marginal benefit analyses
    - Example: RE constrained to 20% to reflect liquidity concerns
  - Not all asset classes may be permissible by some plans (e.g. Hedge Funds, Emerging Market Debt)

- **Return and Risk Assumptions**
  - Based on historic data, academic theory, and NEPC's assessment of current and future market conditions
  - Uncertainty Risk measured by Standard Deviation (volatility)

- **Correlation Assumptions**
  - Measure of similarity/dissimilarity between asset class returns
  - Based on historic data, adjusted for current market conditions

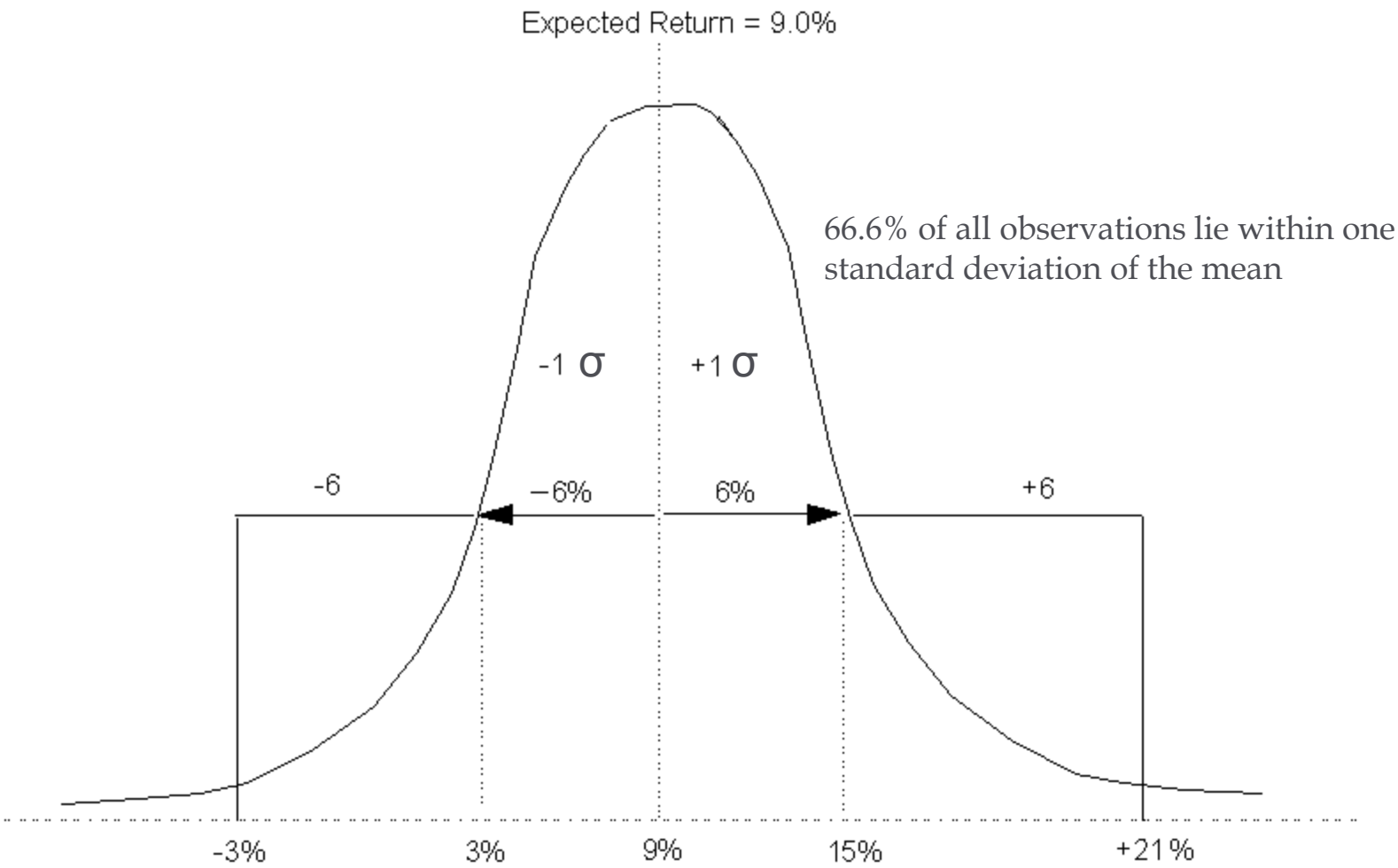
INPUT 1: RETURNS

- **Arithmetic – simple average of annual returns**
  - Example
    - Year 1: 10%
    - Year 2: -4%
    - Year 3: 15%
    - Average (arithmetic) return is 7% (21% cumulative divided by 3 years)

- **Geometric – Our reports reflect compounding of annual returns**
  - Example
    - Year 1: 10%
    - Year 2: -4%
    - Year 3: 15%
    - Compounded annualized (geometric) return is 6.69%

- **Geometric returns are <u>always</u> less than arithmetic returns**
  - Reflects the fact that a given loss (say 10%) is worse than it's equivalent gain
    - For example, you start with $100 and lose 50%. You now have $50. To get back to $100, you will need to earn 100%
    - Highlights the need to consider variance as a key element – Two portfolios with the same average return will exhibit significantly different compound returns
      - Portfolio 1 Annual Returns (%): 8, 8, 8, 8, 8
      - Portfolio 2 Annual Returns (%): 10, -5, 15, 12, 8
      - Portfolios 1 and 2 exhibit the same average arithmetic return (8%), however Portfolio 2 has a lower geometric return (7.77%) caused by additional volatility

The Bell Curve - One Standard Deviation



Standard Deviation (Risk, Volatility)

INPUT 2: STANDARD DEVIATION NOTES

- **Standard Deviation is not risk, but it helps understand an element of risk**
- **Most asset class returns approximate a Bell Curve (normal distribution)**
  - But not a perfect fit.
- **So, take Standard Deviation with a grain of salt**

INPUT 3: CORRELATION

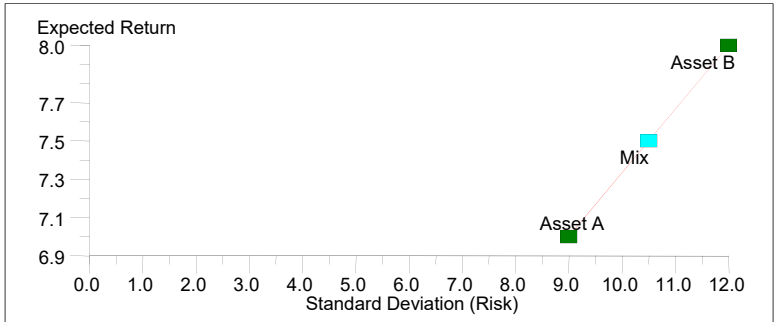
- **Measures how two things vary relative to each other**
- **Scale is from –1.0 to 1.0**
  - **+1.0** is perfect correlation
    - The two things behave exactly alike
  - **0.0** indicates no correlation
  - **–1.0** is perfect negative correlation
    - The two things behave exactly opposite of each other
      - One goes up while the other goes down

- **Partial Correlation is common**

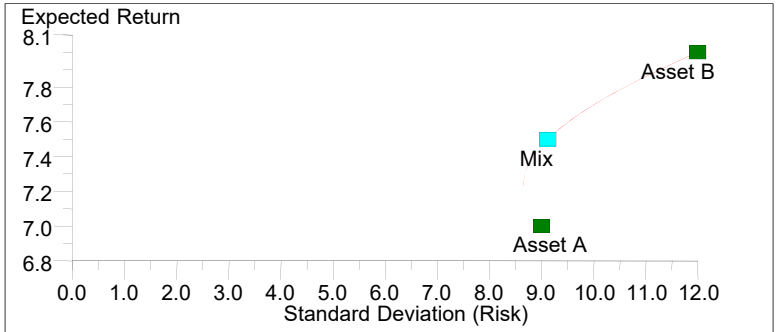
- **Correlations between assets are very important in the asset allocation process**
    - Combining unlike assets lessens portfolio volatility

	Year 1	Year 2	Year 3
A	20%	-5%	0%
B	-10%	15%	10%
Portfolio	10%	10%	10%

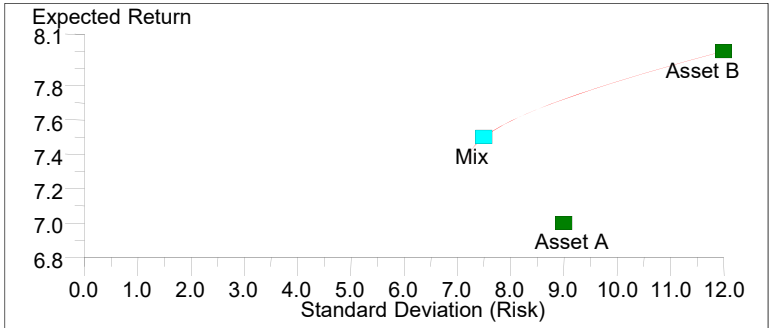
INPUT 3: CORRELATION ILLUSTRATIONS



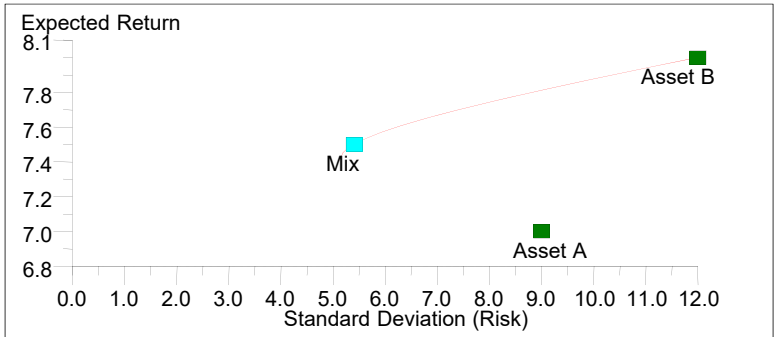
Perfect Positive Correlation: +1.0



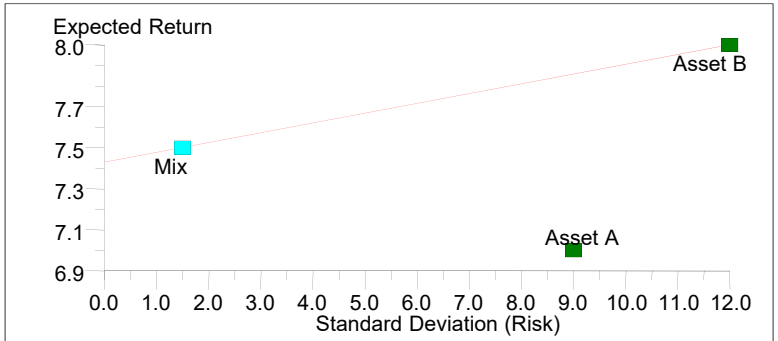
Positive Correlation: +0.5



Zero Correlation: 0.0



Negative Correlation: -0.5



Perfect Negative Correlation: -1.0

- **The lower the correlation, the greater the risk reduction**

INPUT 3: CORRELATION NOTES

- **Correlations are normally fairly stable**
- **Market crisis: Correlations = 1.0**
  - Diversification fails when you need it most
- **So, take correlation with a grain of salt**

2018 ASSET CLASS ASSUMPTIONS

NEPC asset class assumptions offer both an intermediate (5-7 years) and long term (30 years) forecast horizon

- November 30th market data is used for inputs to the asset class models

The 5-7 year return expectations for US credit and equity asset classes are broadly lower due to continued increases in valuation levels

- Credit-based asset class expectations have declined considerably from prior year, with credit spreads moving below long-term medians across most sectors

The outlook for non-US equities remains attractive over 5-7 years supported by improvement in corporate earnings and economic growth

We anticipate US inflation will gradually move higher and average 2.5%

We continue to refine and enhance our process where appropriate

- The asset class assumption for Real Estate reflects specific structure of ASRS program
- We have developed forecasted returns for global factor portfolios

ASSUMPTION DEVELOPMENT

Capital market assumptions are published for over 40 asset classes

Assumptions include 5-7 year and 30 year return forecasts, average annual volatility expectations, and correlations

The 5-7 year forecast is designed to capture the return outlook for the current investment cycle

30 year return assumptions reflect a long-term outlook and are informed by the historical relationships among asset classes

Assumptions are published annually on December 15th and use market data as of November 30th

Assumptions are developed by the Asset Allocation Committee and approved by the Partners Research Committee (PRC)

Return assumptions are developed with proprietary valuation models and rely on a core building block methodology

Asset Allocation Committee	
September	Asset Allocation Committee Assumptions Kickoff Finalize List of New Asset Class Assumptions
October	Review Draft of Asset Class Return Assumptions Discuss Outlook with NEPC Research Beta Groups
November	Finalize Volatility and Correlation Assumptions Final Update of Asset Class Models (As of 11/30)
December	Review Model Output and Create Return Assumptions Present Draft to the PRC Publish Assumptions on December 15th

ASRS PORTFOLIO

NEPC, LLC

ASRS PORTFOLIO – 2018 ASSUMPTIONS

	Current Target	ASRS / NEPC Recommendation	Alternate Mix	Current Allocation
Public Equity	**50.00%**	**40.00%**	**41.7%**	**51.10%**
Private Equity	**8.00%**	**10.00%**	**10.0%**	**8.80%**
Total Equity	**58.00%**	**50.00%**	**51.7%**	**59.90%**
Interest Rate Sensitive Bonds	**11.00%**	**10.00%**	**18.3%**	**10.60%**
Credit	**14.00%**	**20.00%**	**10.0%**	**15.60%**
Private Real Assets - Infrastructure/Land	0.00%	0.00%		1.40%
Commodities	2.00%	0.00%		0.60%
Real Estate	**10.00%**	**20.00%**	**20.0%**	**8.90%**
Total Multi Asset	**5.00%**	**0.00%**		**3.00%**
Expected Return 5-7 yrs	**6.9%**	**7.3%**	**7.1%**	**7.0%**
Expected Return 30 yrs	**8.1%**	**8.6%**	**8.4%**	**8.3%**
Standard Dev	**12.0%**	**10.9%**	**10.9%**	**12.2%**
Sharpe Ratio (5-7 years)	**0.41**	**0.49**	**0.47**	**0.41**
Sharpe Ratio (30 years)	**0.45**	**0.54**	**0.52**	**0.45**
Probability of 1-Year Return Under 0%	28.4%	25.1%	25.8%	28.2%
Probability of 6-Year Return Under 0%	8.1%	5.0%	5.6%	7.9%
Probability of 6-Year Return Over 7.5%	45.0%	48.3%	46.4%	46.0%
Probability of 30-Year Return Over 7.5%	61.4%	70.6%	67.1%	63.3%

Note:
- Real Estate assumption from RCLCo
- Factor portfolio modeled using Momentum, Value, Size, Min Vol.
- Includes accounting volatility in Private Equity and Private Debt
- Securities lending modeled based on spread over US Leverage Cost

ASRS PORTFOLIO – 2018 ASSUMPTIONS

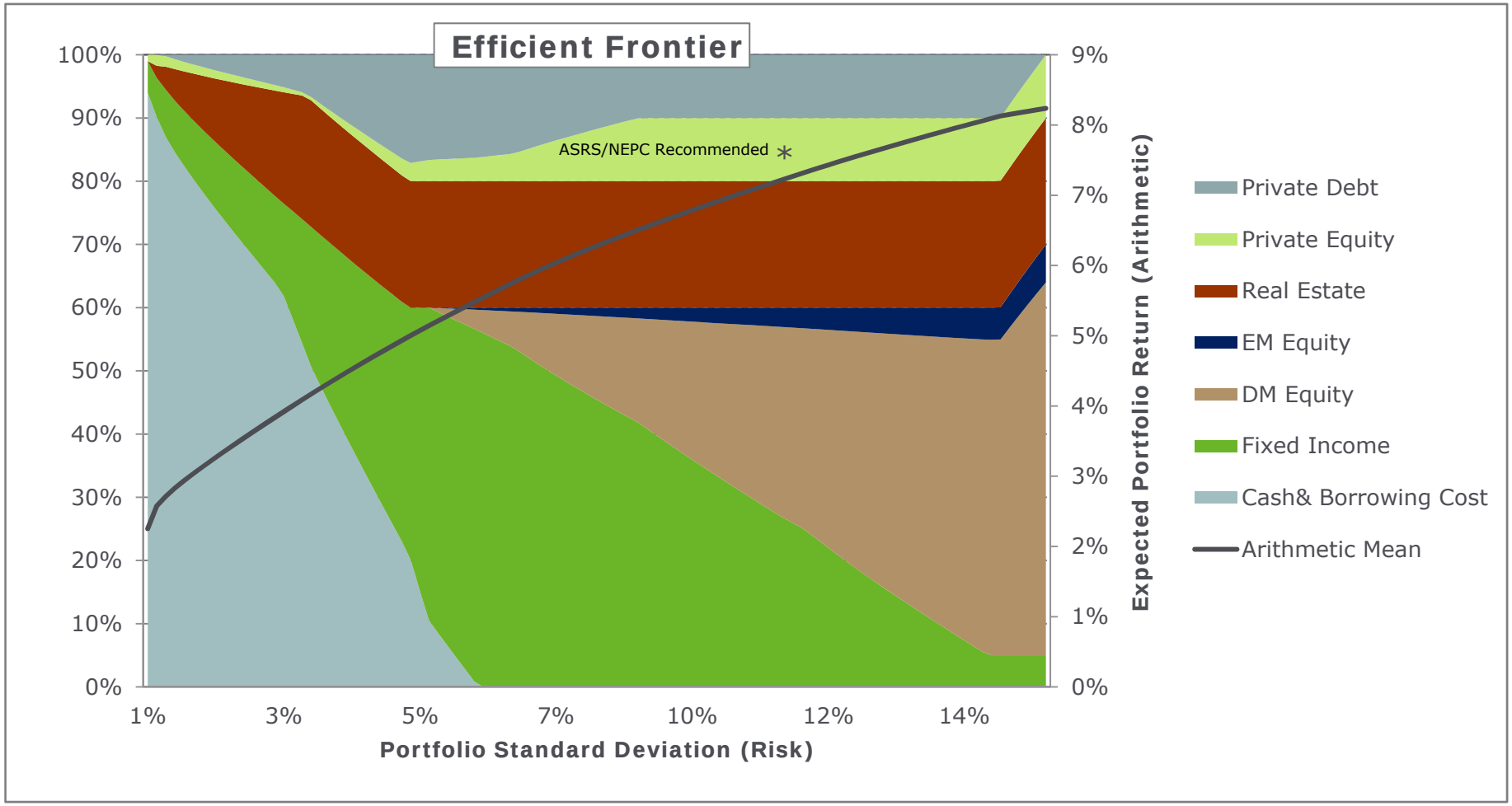
	Current Target	ASRS / NEPC Recommendation	Alternative Mix	Current Allocation
Large Cap Equities	20.0%	12.1%	14.2%	15.2%
Large Cap Factors				4.8%
Global Equity Factors		10.0%	6.7%	
Small/Mid Cap Equities	6.0%	4.5%	5.2%	6.6%
Int'l Equities (Unhedged)	19.0%	8.5%	9.9%	18.6%
Int'l Sm Cap Equities (Unhedged)	0.0%	1.5%	1.7%	1.5%
Emerging Int'l Equities	5.0%	3.0%	3.4%	4.4%
Emerging Int'l Sm Cap Equities	0.0%	0.5%	0.5%	0.0%
Private Equity	8.0%	10.0%	10.0%	8.8%
Total Equity	**58.0%**	**50.1%**	**51.7%**	**59.9%**
Interest Rate Sensitive Bonds	**11.0%**	**10.0%**	**18.3%**	**10.6%**
High Yield Bonds	2.0%	0.0%		0.8%
Credit	**12.0%**	**20.0%**	**10.0%**	**14.8%**
Total Fixed Income	**25.0%**	**30.0%**	**28.3%**	**26.2%**
Private Real Assets - Infrastructure/Land	0.0%	0.0%		1.4%
Commodities	2.0%	0.0%		0.6%
REITs	0.0%	0.0%		0.0%
Real Estate	**10.0%**	**20.0%**	**20%**	**8.9%**
Total Real Assets	**12.0%**	**20.0%**	**20.0%**	**10.9%**
Global Asset Allocation	5.0%	0.0%		3.0%
Total Multi Asset	**5.0%**	**0.0%**		**3.0%**

Expected Return 5-7 yrs	**6.9%**	**7.3%**	**7.1%**	**7.0%**
Expected Return 30 yrs	**8.1%**	**8.6%**	**8.4%**	**8.3%**
Standard Dev	**12.0%**	**10.9%**	**10.9%**	**12.2%**
Sharpe Ratio (5-7 years)	**41.0%**	**49.0%**	**0.47**	**41.0%**
Sharpe Ratio (30 years)	**45.0%**	**54.0%**	**0.52**	**45.0%**

Probability of 1-Year Return Under 0%	**28.4%**	**25.1%**	**25.8%**	**28.2%**
Probability of 6-Year Return Under 0%	**8.1%**	**5.0%**	**5.6%**	**7.9%**
Probability of 6-Year Return Over 7.5%	**45.0%**	**48.3%**	**46.4%**	**46.0%**
Probability of 30-Year Return Over 7.5%	**61.4%**	**70.6%**	**67.1%**	**63.3%**

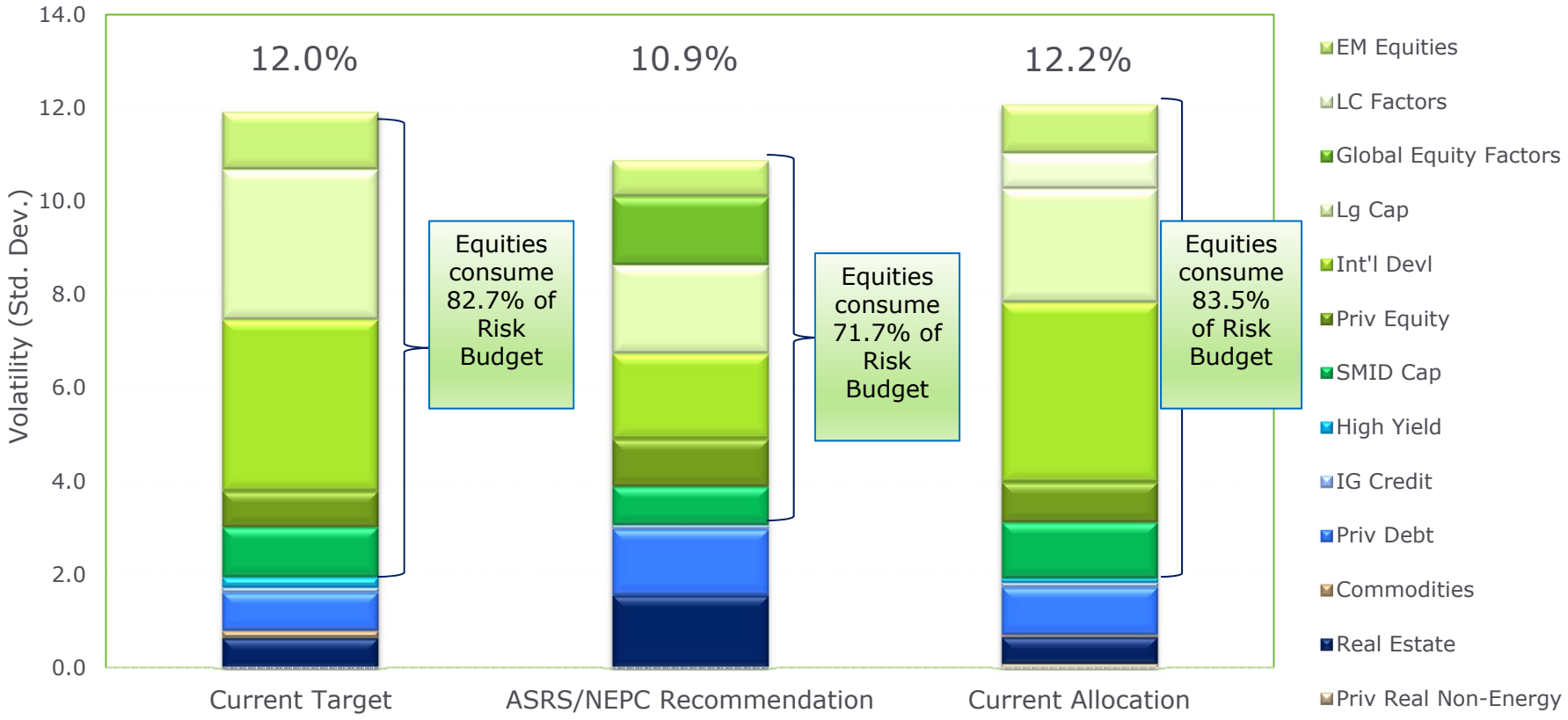
Note:
- Real Estate assumption from RCLCo
- Factor portfolio modeled using Momentum, Value, Size, Min Vol.
- Includes accounting volatility in Private Equity and Private Debt
- Securities lending modeled based on spread over US Leverage Cost

MEAN-VARIANCE OPTIMIZATION



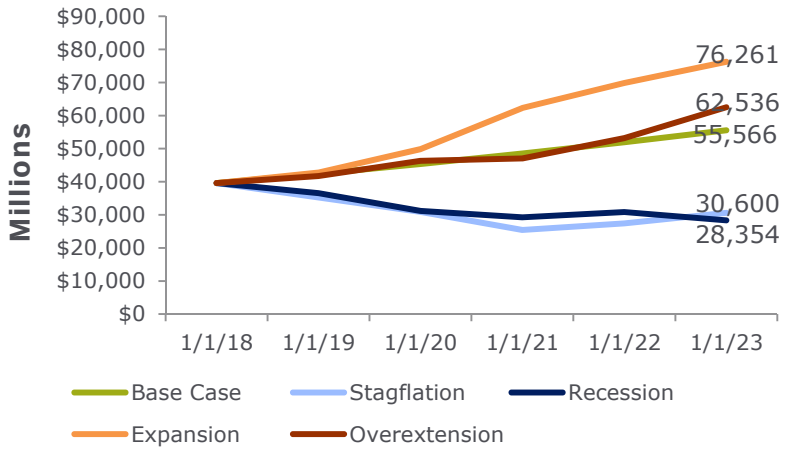
Constraints: - Private Equity + Private Debt + Real Estate <= 40%
- Public Equity constrained at market cap weights
- Global Factors max 25% of Global Equity
- Interest sensitive bonds constrained at >=5%

RISK BUDGETING

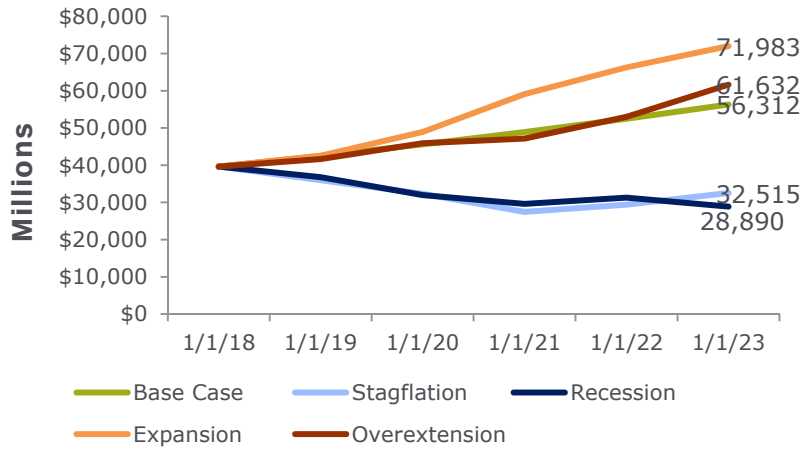


SCENARIO ANALYSIS

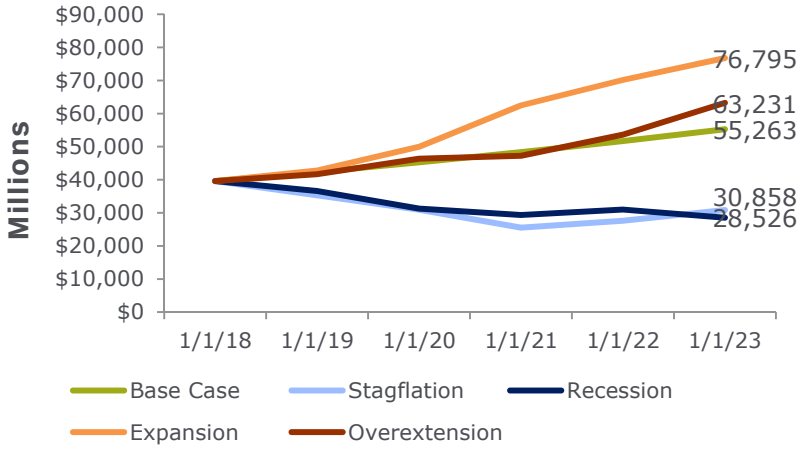
Current Allocation



ASRS/NEPC Recommendation

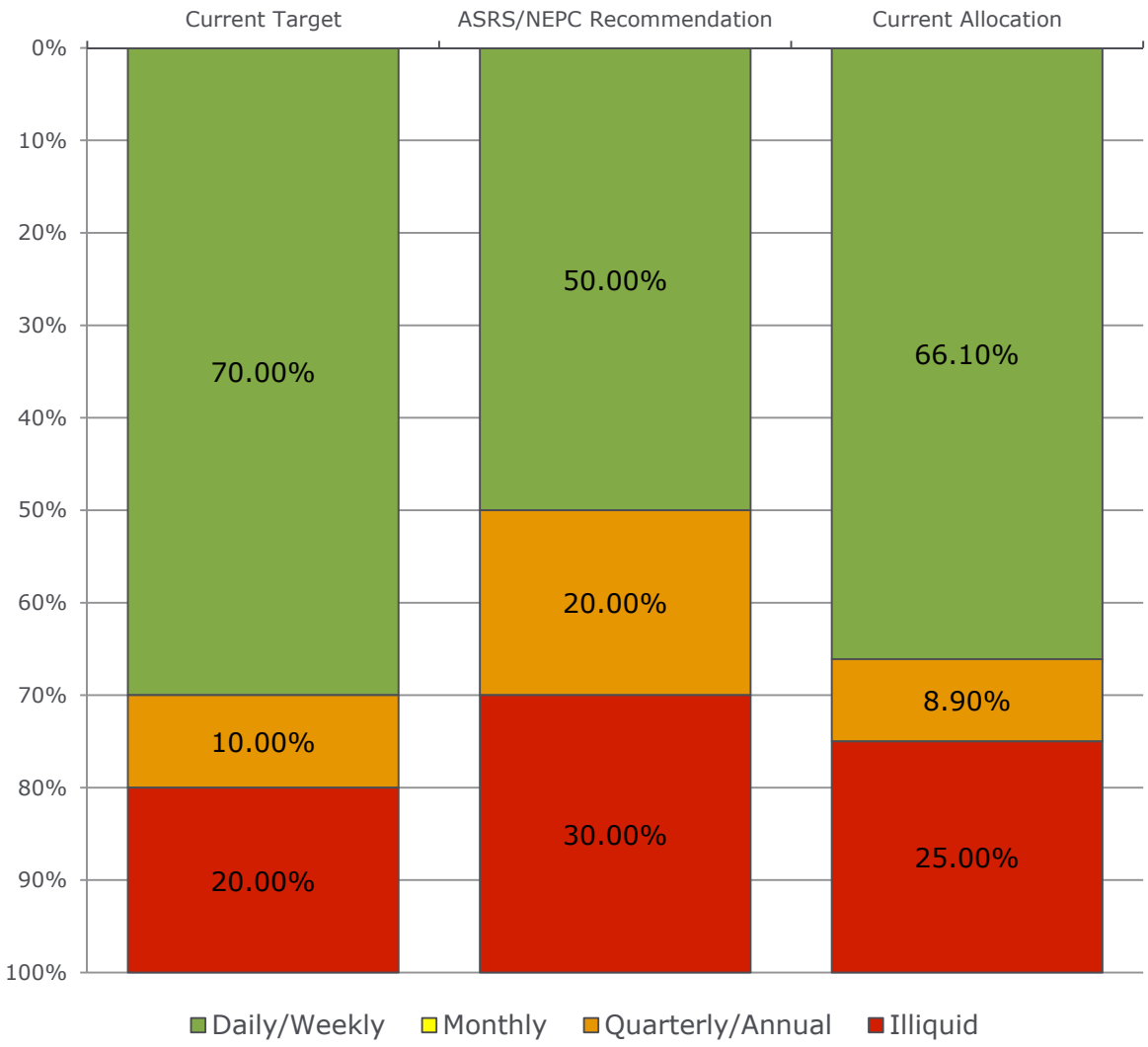


Current Target



- In the Base Case scenario the ASRS/ NEPC Recommendation captures less upside potential as equity risk is reduced in favor of Credit and Real Assets
- In the Recession scenario the ASRS/NEPC Recommendation captures less downside risk
- Overall, the dispersion of outcomes in the ASRS/NEPC Recommendation is tighter; suggests greater efficiency

LIQUIDITY ANALYSIS



- The ASRS/NEPC Recommendation assumes more illiquidity risk; attempts to capture associated risk premium
- Suggests sufficient liquidity in the plan exists to meet obligations
- A more detailed liquidity analysis may be warranted in order to stress test liquidity constraints

KEY MARKET THEMES

THEMES - INTRODUCTION

The outlook for developed market equities outside the US has improved

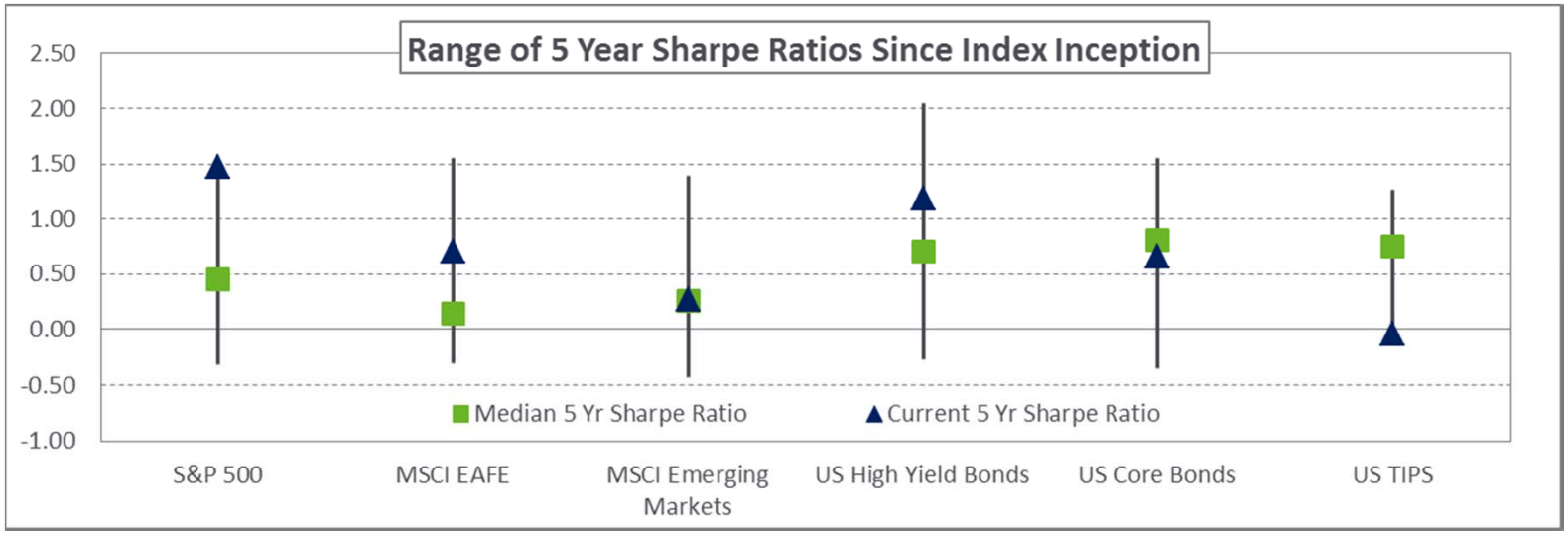
Growth conditions across the globe are on the upswing supported by easy financial conditions and an improved corporate earnings outlook

We encourage reducing exposure to assets that have outperformed expectations over a prolonged period such as US stocks and high yield

Tilt exposure to assets underperforming expectations in recent years, particularly emerging market equities, developed market equities, and US TIPS

Market stability must not elicit complacency, we encourage investors to increase exposure to strategies that mitigate market drawdowns

Look to rebalance "safe haven" fixed income exposure back to strategic targets



Index Inception: S&P 500 - 1926, MSCI EAFE – 1970, MSCI EM – 1988, US High Yield – 1983, US Core Bonds – 1976, US TIPS – 1997

Source: Ibbotson-Morningstar, eVestment, Sharpe Ratio range spans 5th to 95th percentile

KEY MARKET THEMES

Extended US Economic Cycle

Synchronized Economic Resurgence

Federal Reserve Gradualism

China Transitions

Globalization Backlash

KEY MARKET THEMES

Extended US Economic Cycle

Economic cycles do not die of old age

The US economy is in an extended expansionary cycle despite being eight years removed from the last recession

Financial health of US consumers and ongoing recovery of the housing market continue to drive economic growth

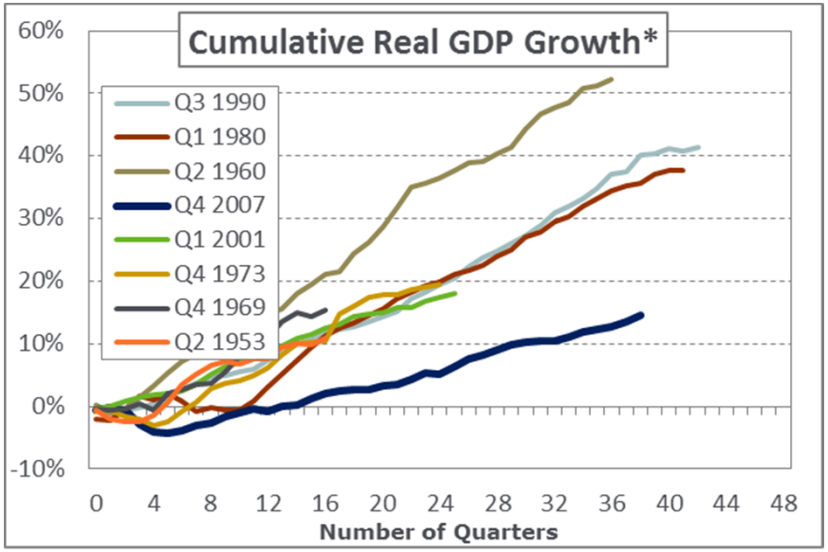
A prolonged US economic expansion can support a continued rally for US equities despite elevated valuation levels

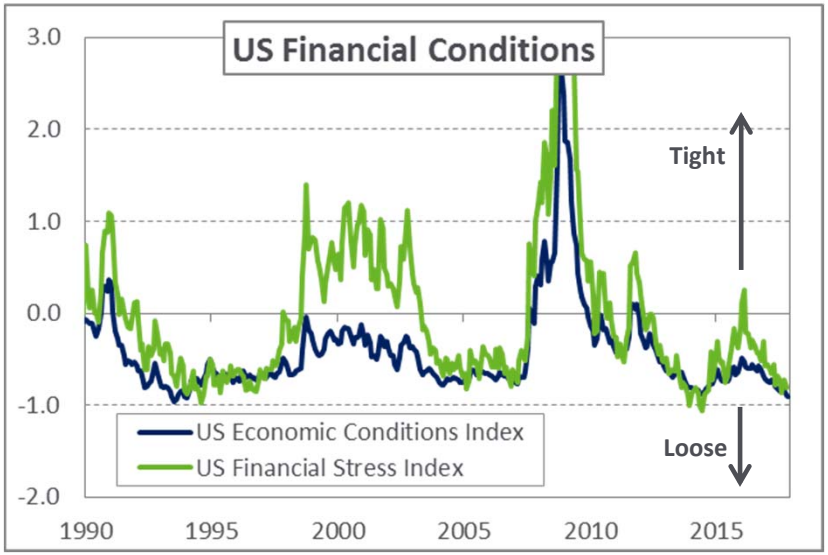
US financial conditions remain loose and support steady economic gains

Low inflation provides a foundation for positive economic conditions and reinforces the Fed's gradual monetary policy approach

Moderating US dollar strength is another form of easy financial conditions, benefiting global trade flows and credit creation

Reversal in these easy conditions may be fueled by actions outside the US, such as a misstep by global central banks and/or increased volatility in the Chinese yuan





*Source: (Top) Bloomberg, *Cumulative GDP growth from prior cycle peak*
Source: (Bottom) Federal Reserve Bank of Chicago and Kansas City

KEY MARKET THEMES

Extended US Economic Cycle

Excess capacity remains in the system and provides fuel for the expansion

Labor market gains have been robust but slack remains as many have not returned to the workforce

Muted wage gains and low inflation metrics are reflective of the excess capacity remaining in the US economy

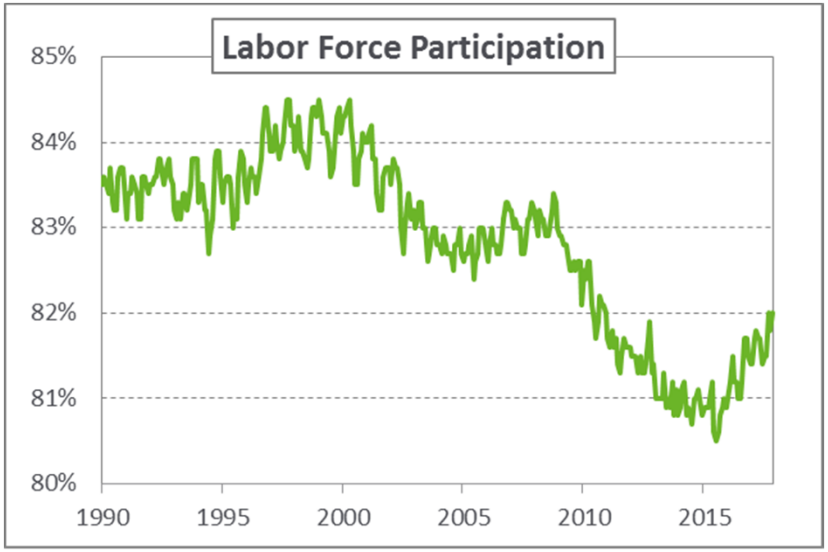
Tax cuts and fiscal stimulus can potentially remove spare economic capacity and be a catalyst for an uptick in inflation measures

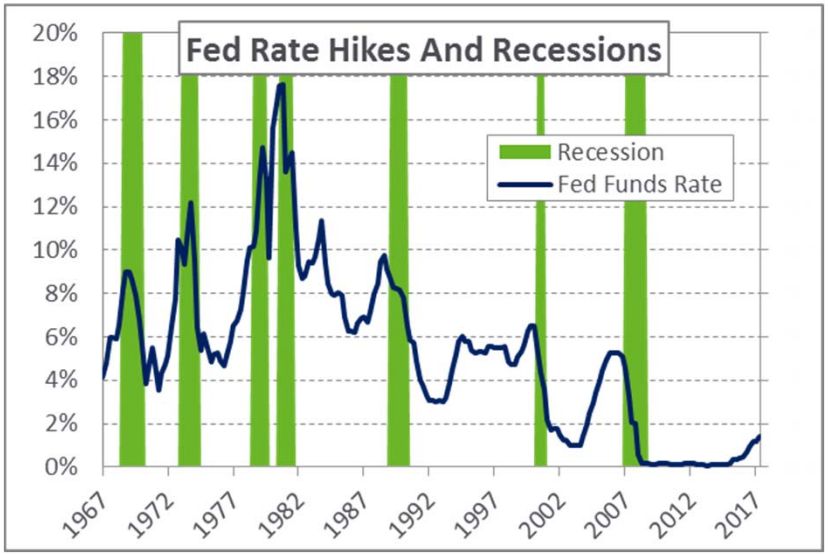
US recession concerns are muted

An acceleration in inflation leading to a tightening of financial conditions has historically been a catalyst to end economic expansions

However, improved US household balance sheets have room to expand and support further consumer spending gains

Improving global economic conditions reinforce an expansion of the US economy as global growth factors synchronize





Source: (Top) Federal Reserve Bank of St. Louis
Source: (Bottom) Federal Reserve, NEPC

KEY MARKET THEMES

Synchronized Economic Resurgence

Global economic conditions are improving in a synchronized fashion

Coordinated global growth factors reinforce economic gains across the globe and are distinct from the extension of the US economic cycle

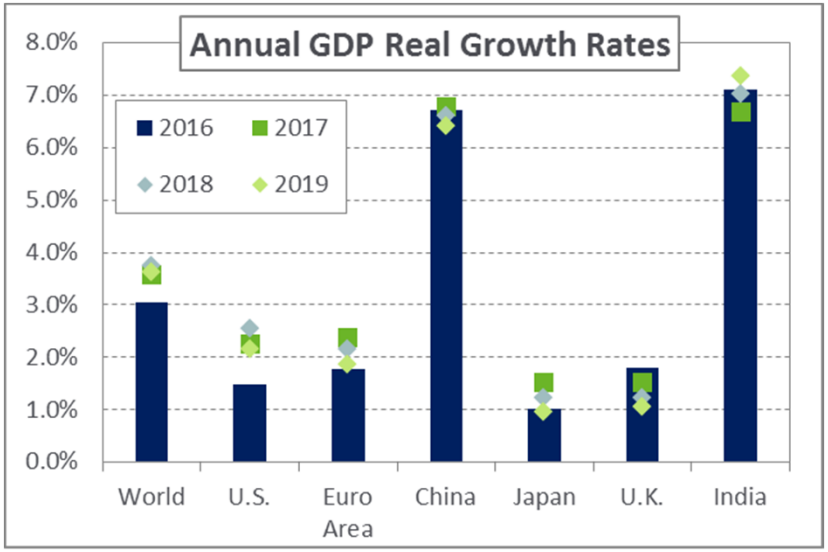
Non-US corporate revenues and equities are best positioned to benefit from a widespread boost in global economic conditions

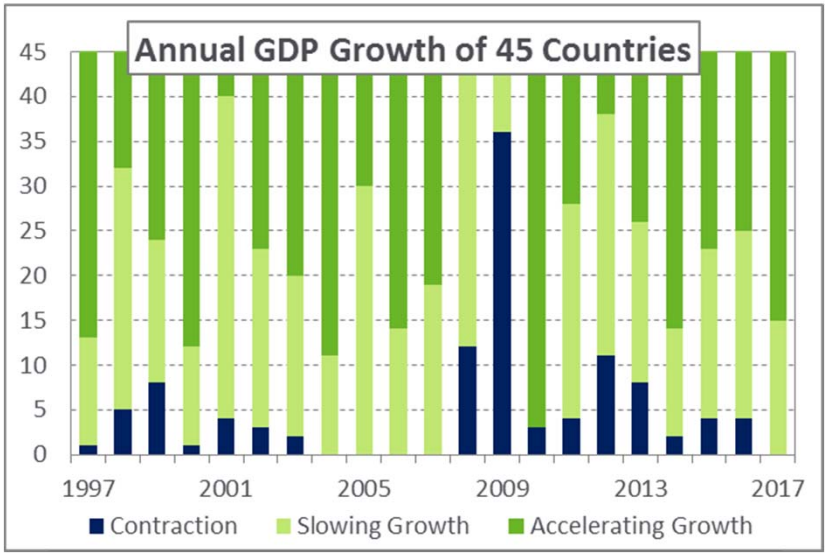
Positive growth rates harmonized across the globe are relatively rare

Conditions are the result of Europe, Japan, and large parts of the emerging world transitioning out of economic malaise

Persistence of the theme over several years would provide a substantial benefit to equity markets globally – specifically in Europe and Japan

Historically, periods of synchronized growth have been derailed by higher inflation levels and central banks tightening policy





Source: (Top) OECD
Source: (Bottom) OECD

KEY MARKET THEMES

Synchronized Economic Resurgence

Erosion of excess economic capacity is a catalyst to boost economic gains

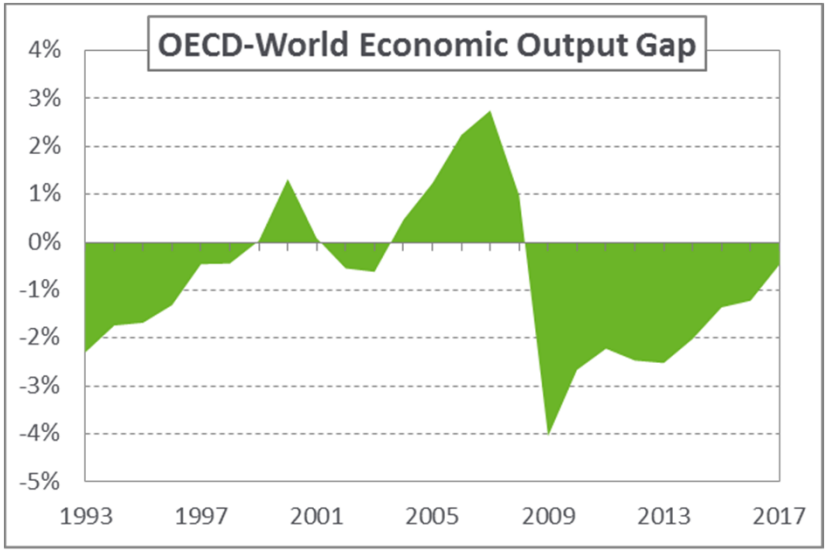
Despite recent labor market improvements, potential for labor reform in Europe and improved workforce participation in Japan offer multi-year benefits to economic growth

Material decline in emerging market inflation provides a cushion for real interest rates to fall and fuel an expansion of economic activity

Economic resurgence is delicate and can be disrupted by lingering global risk factors

US dollar strength, dislocation in China's credit expansion, and restrictive US trade policy pose the greatest threats

The foundation of synchronized economic resurgence is the continuation of positive trends associated with the other key market themes



Source: (Top) OECD
Source: (Bottom) IMF

KEY MARKET THEMES

Federal Reserve Gradualism

The Federal Reserve is expected to slowly increase interest rates

Expected path of Fed policy through 2020 matters more than timing of the next hike as the disconnect between market expectations and Fed signaling has grown

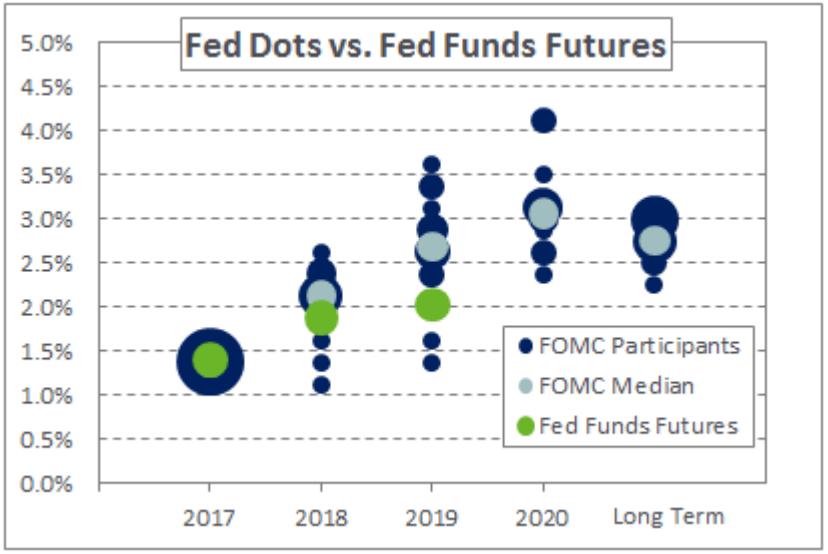
A relatively accommodative Fed is likely to continue, unless there is a dramatic acceleration in inflation

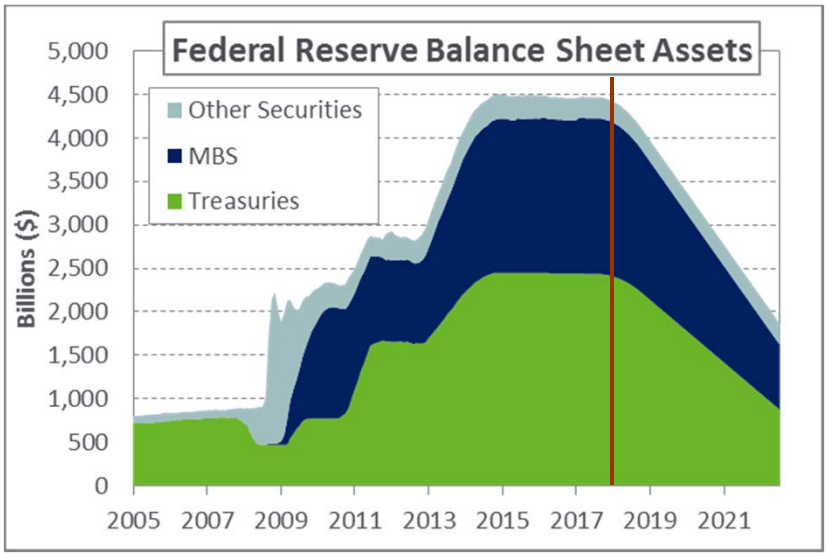
The Fed's balance sheet normalization is a low grade tightening of monetary policy but its impact is untested

Fed is expected to be careful and data dependent yet balance sheet disbursement into a strong economy will likely have tightening effects – in the same way balance sheet expansion had easing effects

The balance sheet will gradually shrink over time assuming conditions remain supportive

The gradual progression of balance sheet reduction combined with the accommodative policies of global central banks supports easy global financial conditions





Source: (Top) Bloomberg, NEPC
Source: (Bottom) Bloomberg, NEPC

KEY MARKET THEMES

Federal Reserve Gradualism

Gradualism is the policy of choice globally as the major central banks manage unprecedented initiatives

ECB's QE program is expanding but at a slower rate

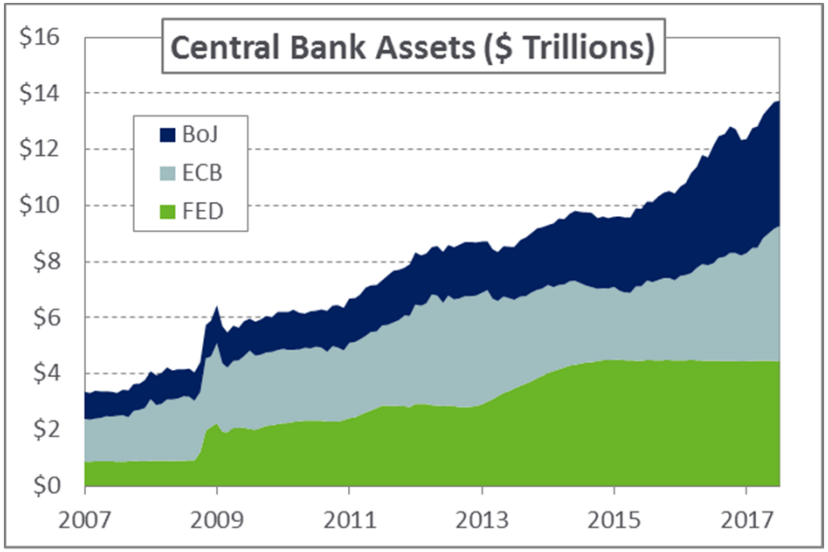
However, the reinvestment of balance sheet holdings is likely to continue for an extended period of time

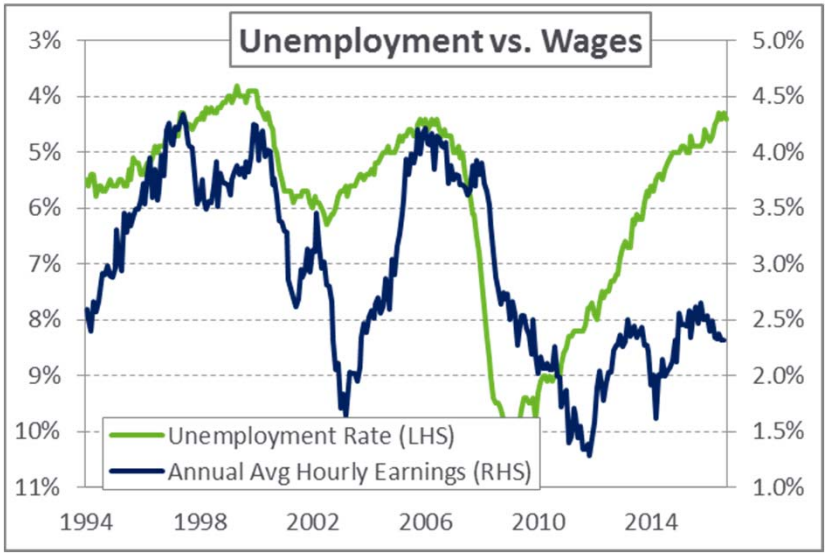
Bank of Japan's QE yield-curve control program has rapidly slowed bond purchases but solidified steepness in the yield curve

Inflation expected to shift marginally higher in the coming years

Improvements in wage growth and aggregate economic activity support modest upticks in inflation but still within the Fed's tolerance bands to gradually raise rates

Fed has stated a willingness to let the economy "run hot" and accept some inflation to repair the deflationary effects of the past decade





Source: (Top) Bloomberg, NEPC
Source: (Bottom): Bloomberg, FRED

KEY MARKET THEMES

China Transitions

China is the global growth engine but faces fundamental transitions

China's economic transition is pivoting from production and investment focused to a service and consumption based economy

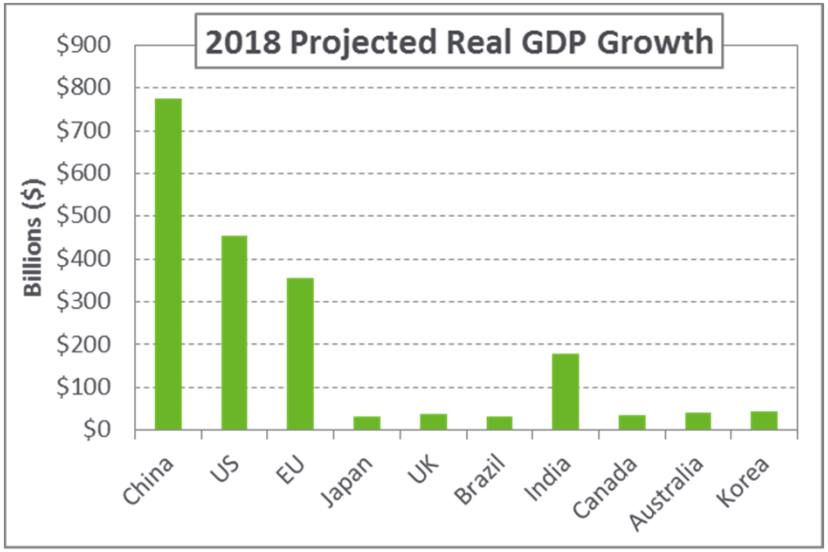
Fixed investment is required to sustain the production based economy and support employment as the rural population moves to urban centers

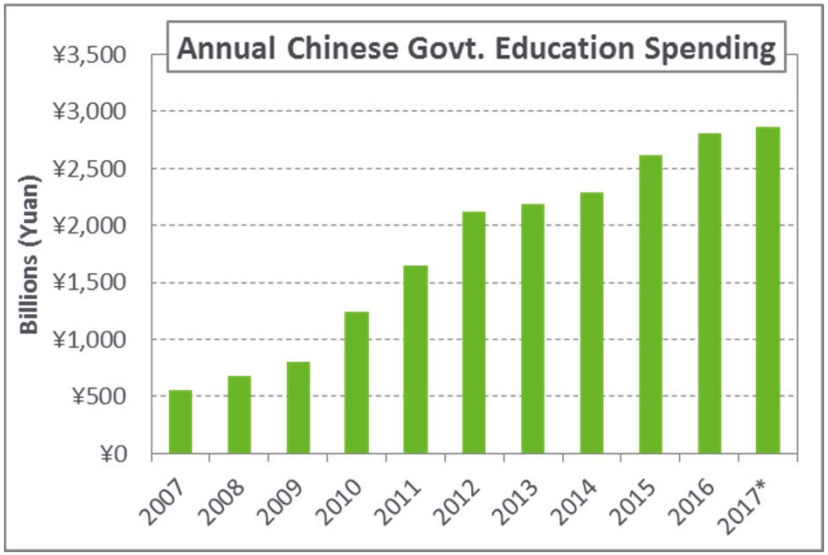
Any disruption to these transitions will have global repercussions due to China's role in the global economy

China must manage competing social goals in attempting to sustain growth

Engineering an orderly transition to a consumer-led economy requires supporting employment outside the major cities and improving quality of life metrics such as air quality in the urban centers

Future growth in a services based economy requires advancement in productivity, technology, and a more skilled labor force





Source: (Top) Bloomberg

*Source: (Bottom) Bloomberg, *Includes estimate for Nov/Dec 2017*

KEY MARKET THEMES

Globalization Backlash

Uneven economic growth and wage gains have fueled political discontent in the developed world

Election results in France have assuaged fears of political gridlock in the EU

Italian election in first half of 2018 is another potential flashpoint on globalization

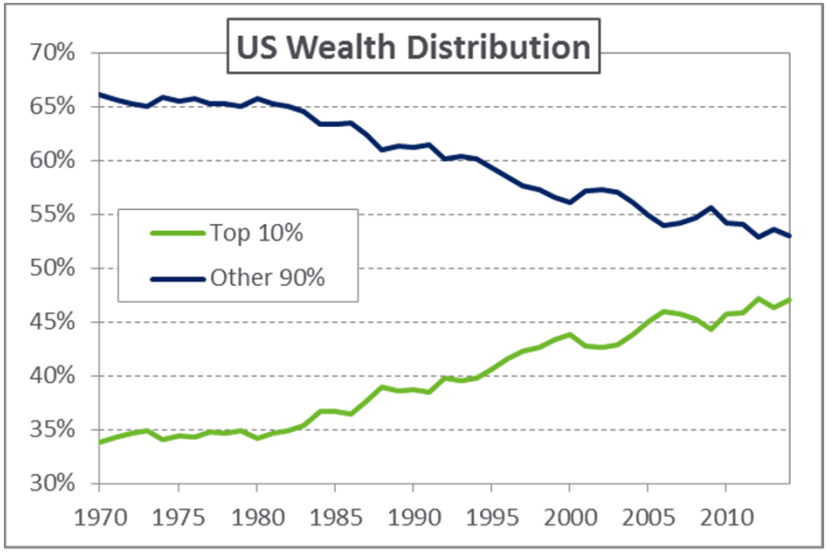
Anti-establishment political bias is likely a long term trend and potentially leads to higher levels of currency volatility over time

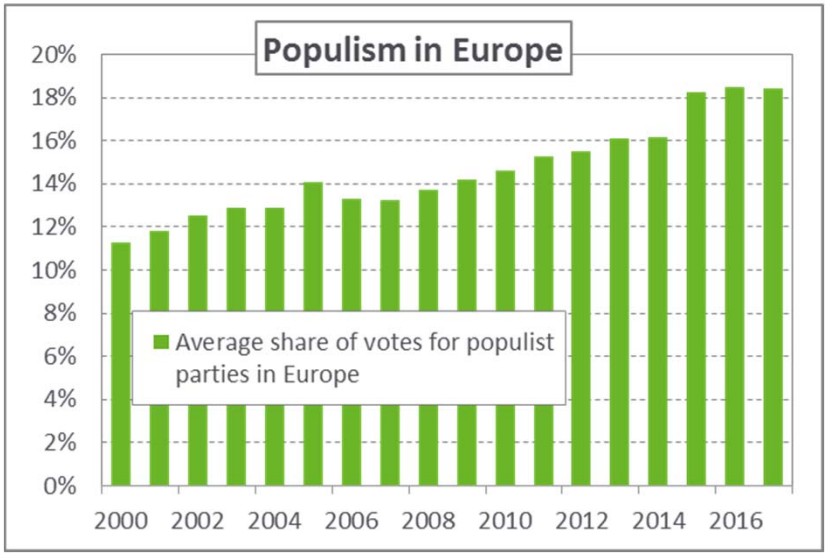
For many nations, a turn inward is associated with globalization fatigue

Often fuels greater expression of nationalism and increased geopolitical risks as multilateral relationships are reassessed

Populist movements destabilize the political order and shifts away from political orthodoxy heighten tail risks

However, equity markets often overreact to geopolitical concerns and sell-offs can be a buying opportunity for investors





Source: (Top) World Wealth & Income Database
Source: (Bottom) World Bank

KEY MARKET THEMES

Globalization Backlash

Major shifts in US trade policy did not materialize in 2017

However, a more aggressive protectionist policy would represent a material risk to global markets and the world economy

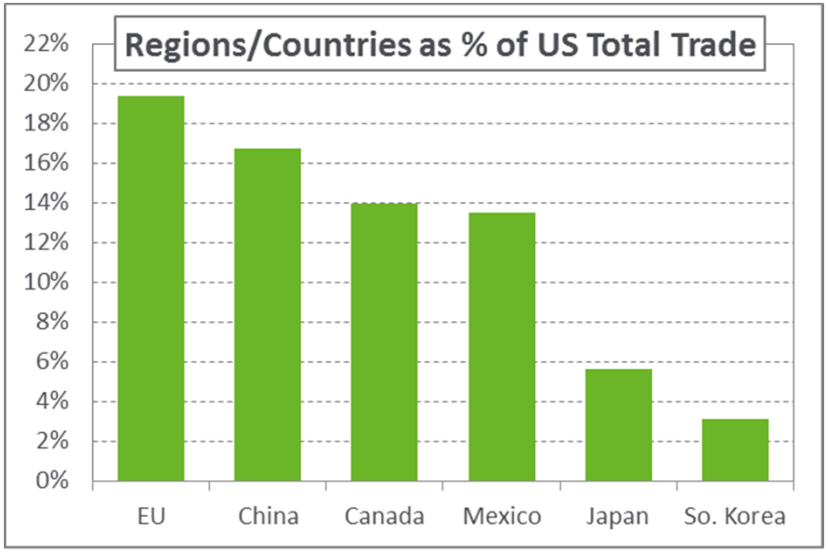
Markets have taken to interpreting the US administration's rhetoric with a grain of salt but ongoing NAFTA negotiations are a concern

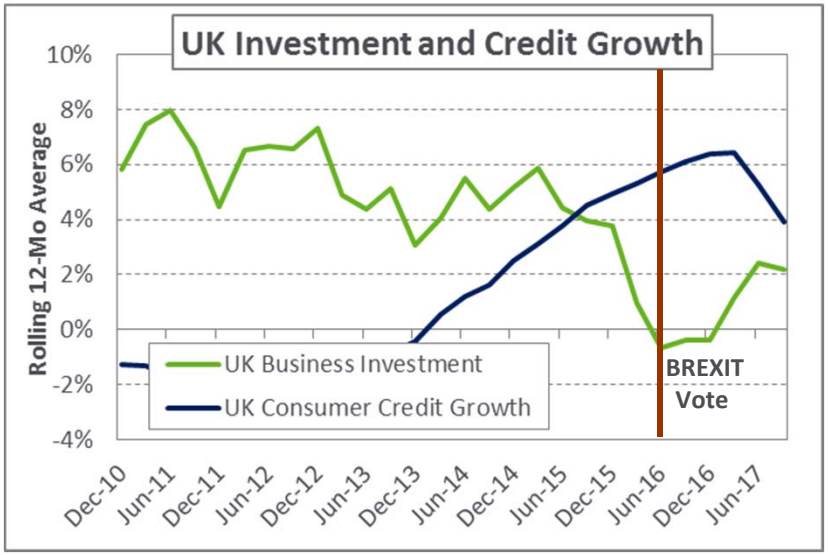
The UK serves as a live case study for the effects of globalization backlash

While it is early in the process, economic metrics across the country have turned lower in the 18 months since UK voted to leave the European Union

Expected disruption to financial regulations, customs controls, and business confidence in the UK are proving to be a cautionary tale for a turn away from globalization

However, the economic unease of voters remain and popularity of anti-establishment political parties poses a risk to the global economic order





Source: (Top) Federal Reserve Bank of St. Louis
Source: (Bottom) Bloomberg

INTRODUCTION
ASSET CLASS ASSUMPTIONS

NEPC, LLC

INFLATION OVERVIEW

Inflation is an integral component of our asset allocation assumptions

Represents an essential building block for developing asset class returns

Inflation building blocks are model driven and informed by multiple sources for both the US and global asset classes

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

US inflation is based upon the TIPS breakeven inflation curve adjusted for expectations of economic activity, employment, and capacity levels

Global inflation expectations are informed by consensus forecasts across countries along with implied inputs from global bond curves

The 30 year global inflation forecast assumes purchase power parity holds across the globe and country specific inflation levels converge to a terminal value

Region	5-7 Year Inflation Assumption	30-Year Inflation Assumption
United States	2.50%	2.75%
Global	3.00%	3.25%

2018 5-7 YEAR RETURN FORECASTS

Geometric Expected Return			
Asset Class	2018	2017	2018-2017
Cash	2.00%	1.75%	+0.25%
Treasuries	2.25%	2.00%	+0.25%
IG Corp Credit	3.50%	3.75%	-0.25%
MBS	2.50%	2.25%	+0.25%
Core Bonds*	2.75%	2.65%	+0.10%
Non-US Bonds (Unhedged)	0.50%	1.00%	-0.50%
EMD Local Currency	6.00%	6.75%	-0.75%
Large Cap Equities	5.25%	5.75%	-0.50%
Small/Mid Cap Equities	5.75%	6.00%	-0.25%
Int'l Equities (Unhedged)	7.50%	7.25%	+0.25%
Int'l Equities (Hedged)	7.82%	7.57%	+0.25%
Emerging Int'l Equities	9.00%	9.50%	-0.50%
Private Equity	8.00%	8.25%	-0.25%
Private Debt	6.50%	7.25%	-0.75%
ASRS Real Estate	7.60%	-	-

* Core Bonds assumption based on market weighted blend of components of Aggregate Index (Treasuries, IG Corp Credit, and MBS).
** Hedge Funds is a calculated blend of 40% Equity, 40% Credit, 20% Macro-related strategies.

2018 30 YEAR RETURN FORECASTS

Geometric Expected Return			
Asset Class	2018	2017	2018-2017
Cash	2.75%	3.00%	-0.25%
Treasuries	3.25%	3.50%	-0.25%
IG Corp Credit	4.75%	5.00%	-0.25%
MBS	3.25%	3.50%	-0.25%
Core Bonds*	3.75%	4.00%	-0.25%
Non-US Bonds (Unhedged)	2.50%	2.75%	-0.25%
EMD Local Currency	6.50%	6.50%	-
Large Cap Equities	7.50%	7.50%	-
Small/Mid Cap Equities	7.75%	7.75%	-
Int'l Equities (Unhedged)	7.75%	7.75%	-
Int'l Equities (Hedged)	8.14%	8.14%	-
Emerging Int'l Equities	9.25%	9.50%	-0.25%
Private Equity	9.50%	9.50%	-
Private Debt	7.50%	8.00%	-0.50%
ASRS Real Estate	8.60%	-	-

* Core Bonds assumption based on market weighted blend of components of Aggregate Index (Treasuries, IG Corp Credit, and MBS).
** Hedge Funds is a calculated blend of 40% Equity, 40% Credit, 20% Macro-related strategies.

2018 VOLATILITY FORECASTS

Volatility		
Asset Class	**Capital Market Volatility**	**Accounting Volatility**
Cash	1.00%	1.00%
Treasuries	5.50%	5.50%
IG Corp Credit	7.50%	7.50%
MBS	7.00%	6.50%
Core Bonds*	5.99%	5.85%
Non-US Bonds (Hedged)	4.50%	3.50%
EMD Local Currency	13.00%	13.00%
Large Cap Equities	17.50%	16.00%
Small/Mid Cap Equities	21.00%	20.50%
Int'l Equities (Unhedged)	21.00%	18.50%
Int'l Equities (Hedged)	18.00%	15.50%
Emerging Int'l Equities	28.00%	25.00%
Private Equity	23.00%	12.50%
Private Debt	13.00%	8.50%
ASRS Real Estate	12.50%	

* Core Bonds assumption based on market weighted blend of components of Aggregate Index (Treasuries, IG Corp Credit, and MBS).
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APPENDIX

ASSUMPTION DEVELOPMENT

Capital market assumptions are published for over 40 asset classes

Assumptions include 5-7 year and 30 year return forecasts, average annual volatility expectations, and correlations

The 5-7 year forecast is designed to capture the return outlook for the current investment cycle

30 year return assumptions reflect a long-term outlook and are informed by the historical relationships among asset classes

Assumptions are published annually on December 15th and use market data as of November 30th

Assumptions are developed by the Asset Allocation Committee and approved by the Partners Research Committee (PRC)

Return assumptions are developed with proprietary valuation models and rely on a core building block methodology

Asset Allocation Committee	
September	Asset Allocation Committee Assumptions Kickoff Finalize List of New Asset Class Assumptions
October	Review Draft of Asset Class Return Assumptions Discuss Outlook with NEPC Research Beta Groups
November	Finalize Volatility and Correlation Assumptions Final Update of Asset Class Models (As of 11/30)
December	Review Model Output and Create Return Assumptions Present Draft to the PRC Publish Assumptions on December 15th

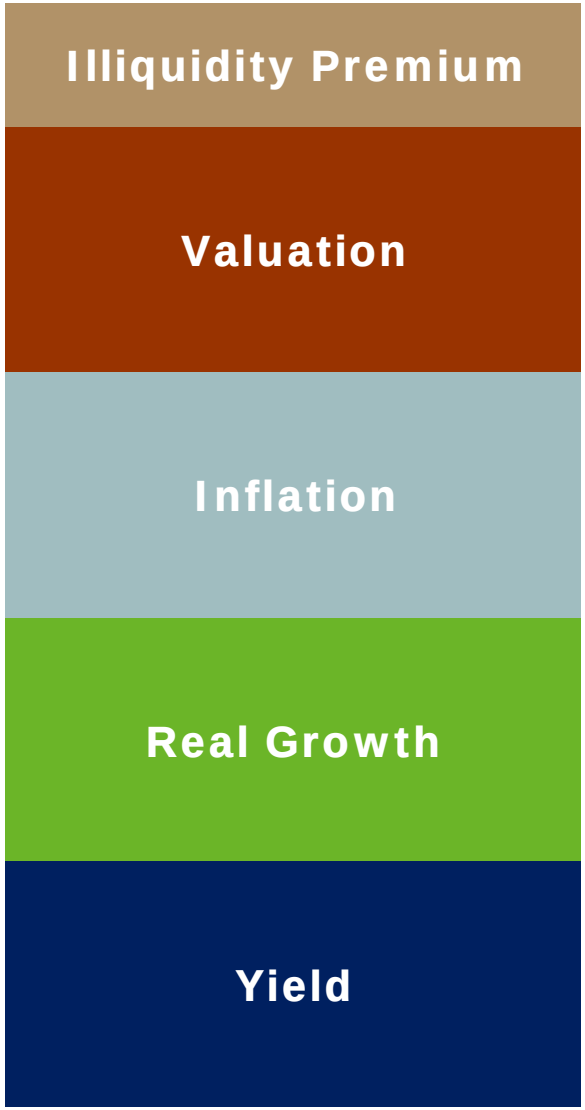
BUILDING BLOCKS METHODOLOGY

Forward-looking asset class models incorporate current and forecasted market and economic data to inform expected returns

Quantitative inputs combined with qualitative factors and investor sentiment (capital flows, etc.) drive the 5 to 7 year return outlook

Components are combined to capture core drivers of return across asset classes – forming the foundation of our building blocks framework

Building blocks will vary across equity, credit, and real assets



5-7 YEAR RETURN ASSUMPTIONS

	Asset Class	5-7 Year Return	Change 2018-2017	Volatility
	Cash	2.00%	+.25%	1.00%
	US Inflation	2.50%	-	-
Equity	Large Cap Equities	5.25%	-.50%	17.50%
Equity	International Equities (Unhedged)	7.50%	+.25%	21.00%
Equity	Emerging International Equities	9.00%	-.50%	28.00%
Equity	Private Equity	8.00%	-.25%	23.00%
Rates/Credit	Treasuries	2.25%	+.25%	5.50%
Rates/Credit	Core Bonds	2.75%	+.10%	5.99%
Rates/Credit	Municipal Bonds 1-10 Year	2.50%	-	5.50%
Rates/Credit	High Yield Bonds	3.75%	-1.00%	13.00%
Rates/Credit	Private Debt	6.50%	-.75%	13.00%
Real Assets	Commodities	4.75%	-	19.00%
Real Assets	REITs	6.50%	-	21.00%
Real Assets	Core Real Estate	5.75%	-.25%	13.00%
Multi-Asset	US 60/40*	4.54%	-.24%	10.99%
Multi-Asset	Global 60/40*	4.91%	-.13%	11.78%
Multi-Asset	Global Trading Strategies*	5.83%	-.10%	9.07%

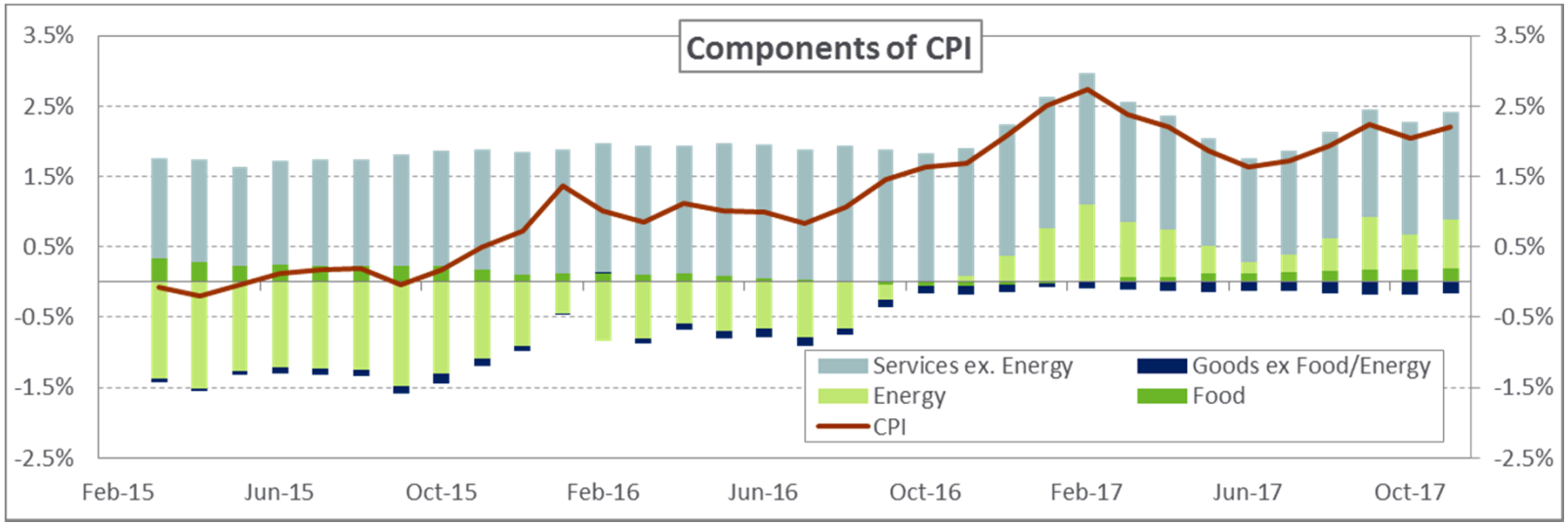
*Each calculated as a blend of other asset classes

2018 CORRELATIONS

Asset Class	Cash	US Lev	Tsy	IG	MBS	TIPS	HY	Non-US Bonds (U)	Non-US Bonds (H)	EMD (Ext)	EMD (Loc)	Large Cap	SMID	Int'l (U)	Int'l (H)	EME	PE	PD	PRA - Egy/Met	PRA: Infra/ Land	Core RE	Commodities
Cash	1.00	0.90	0.20	0.10	0.25	0.35	-0.05	0.10	0.15	0.05	0.05	-0.10	-0.15	-0.10	-0.10	-0.10	-0.20	0.00	-0.05	0.15	0.10	0.10
US Lev	0.90	1.00	0.20	0.10	0.25	0.35	-0.05	0.10	0.15	0.05	0.05	-0.10	-0.15	-0.10	-0.10	-0.10	-0.25	0.00	-0.05	0.15	0.10	0.10
Treasuries	0.20	0.20	1.00	0.65	0.85	0.65	0.10	0.45	0.70	0.20	0.10	-0.10	-0.15	-0.10	-0.10	-0.20	-0.15	-0.35	-0.20	-0.05	0.10	-0.10
IG	0.10	0.10	0.65	1.00	0.75	0.65	0.55	0.45	0.60	0.60	0.50	0.25	0.25	0.30	0.30	0.35	0.30	0.15	0.20	0.10	0.15	0.15
MBS	0.25	0.25	0.85	0.75	1.00	0.65	0.30	0.45	0.60	0.35	0.25	0.10	0.10	0.05	0.05	-0.10	0.10	-0.15	-0.05	-0.05	0.05	0.00
TIPS	0.35	0.35	0.65	0.65	0.65	1.00	0.20	0.40	0.65	0.30	0.25	-0.10	-0.10	-0.05	-0.05	-0.10	-0.10	-0.10	-0.05	0.05	0.10	0.30
HY	-0.05	-0.05	0.10	0.55	0.30	0.20	1.00	0.10	0.20	0.70	0.55	0.65	0.70	0.65	0.65	0.70	0.60	0.65	0.50	0.40	0.35	0.20
Non-US Bonds (U)	0.10	0.10	0.45	0.45	0.45	0.40	0.10	1.00	0.40	0.30	0.35	0.00	-0.05	0.35	0.05	0.25	-0.15	-0.10	-0.10	0.05	0.15	0.10
Non-US Bonds (H)	0.15	0.15	0.70	0.60	0.60	0.65	0.20	0.40	1.00	0.30	0.20	-0.10	-0.15	-0.10	-0.10	-0.20	-0.20	-0.10	-0.15	0.00	0.05	-0.10
EMD (Ext)	0.05	0.05	0.20	0.60	0.35	0.30	0.70	0.30	0.30	1.00	0.75	0.55	0.55	0.60	0.60	0.70	0.35	0.50	0.40	0.35	0.25	0.35
EMD (Local)	0.05	0.05	0.10	0.50	0.25	0.25	0.55	0.35	0.20	0.75	1.00	0.60	0.50	0.70	0.65	0.80	0.40	0.60	0.40	0.40	0.40	0.50
Large Cap	-0.10	-0.10	-0.10	0.25	0.10	-0.10	0.65	0.00	-0.10	0.55	0.60	1.00	0.90	0.70	0.75	0.65	0.70	0.60	0.65	0.50	0.40	0.30
SMID Cap	-0.15	-0.15	-0.15	0.25	0.10	-0.10	0.70	-0.05	-0.15	0.55	0.50	0.90	1.00	0.65	0.70	0.65	0.75	0.65	0.70	0.50	0.40	0.30
Int'l Eqty (U)	-0.10	-0.10	-0.10	0.30	0.05	-0.05	0.65	0.35	-0.10	0.60	0.70	0.70	0.65	1.00	0.85	0.70	0.60	0.75	0.55	0.45	0.35	0.40
Int'l Eqty (H)	-0.10	-0.10	-0.10	0.30	0.05	-0.05	0.65	0.05	-0.10	0.60	0.65	0.75	0.70	0.85	1.00	0.70	0.65	0.75	0.60	0.45	0.40	0.30
EM	-0.10	-0.10	-0.20	0.35	-0.10	-0.10	0.70	0.25	-0.20	0.70	0.80	0.65	0.65	0.70	0.70	1.00	0.45	0.80	0.50	0.40	0.30	0.55
PE	-0.20	-0.25	-0.15	0.30	0.10	-0.10	0.60	-0.15	-0.20	0.35	0.40	0.70	0.75	0.60	0.65	0.45	1.00	0.65	0.85	0.60	0.50	0.25
PD	0.00	0.00	-0.35	0.15	-0.15	-0.10	0.65	-0.10	-0.10	0.50	0.60	0.60	0.65	0.75	0.75	0.80	0.65	1.00	0.65	0.50	0.40	0.30
PRA - Egy/Met	-0.05	-0.05	-0.20	0.20	-0.05	-0.05	0.50	-0.10	-0.15	0.40	0.40	0.65	0.70	0.55	0.60	0.50	0.85	0.65	1.00	0.75	0.45	0.35
PRA – Infra/Land	0.15	0.15	-0.05	0.10	-0.05	0.05	0.40	0.05	0.00	0.35	0.40	0.50	0.50	0.45	0.45	0.40	0.60	0.50	0.75	1.00	0.70	0.40
Core RE	0.10	0.10	0.10	0.15	0.05	0.10	0.35	0.15	0.05	0.25	0.40	0.40	0.40	0.35	0.40	0.30	0.50	0.40	0.45	0.70	1.00	0.30
Commodities	0.10	0.10	-0.10	0.15	0.00	0.30	0.20	0.10	-0.10	0.35	0.50	0.30	0.30	0.40	0.30	0.55	0.25	0.30	0.35	0.40	0.30	1.00

MACRO ASSUMPTIONS

US INFLATION



Source: Bloomberg, NEPC

Low inflation continued throughout 2017 despite strong economic growth, tightening labor market, and early signs of wage gains

These metrics were thought to help inflation accelerate, yet the Fed's 2% inflation target has been a difficult target for the US economy to maintain

A seemingly transitory drop in certain CPI elements, such as healthcare costs and vehicles, have minimized price pressures in 2017 even as the impact from energy prices has turned positive

The Fed's preferred inflation measure, the personal consumption expenditures (PCE), remains below their 2% target

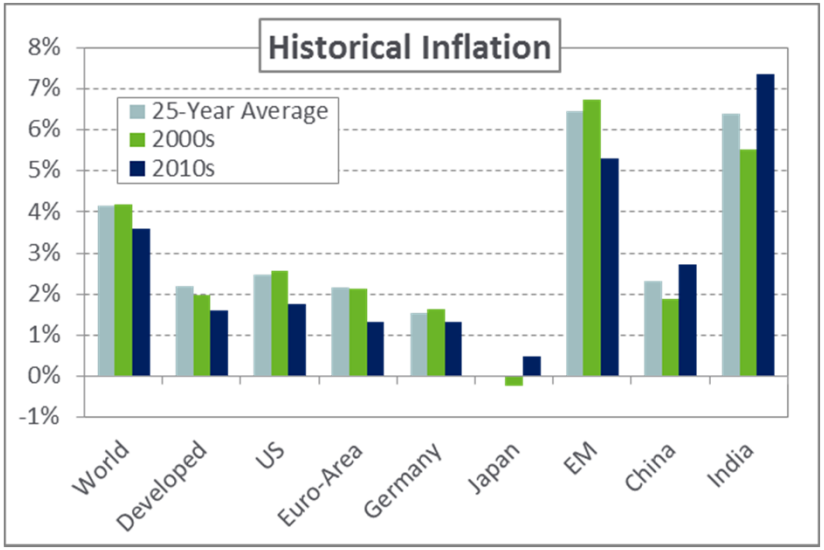
However, other more inclusive indicators such as the NY Fed Underlying Inflation Gauge, point to an increase in inflation in the coming years, but still below the long-term average

GLOBAL INFLATION

In most developed economies, core inflation has failed to reach or exceed central bank targets despite improved domestic demand and labor markets

Ultra accommodative monetary policy remains in place for Europe and Japan to fuel higher levels of inflation

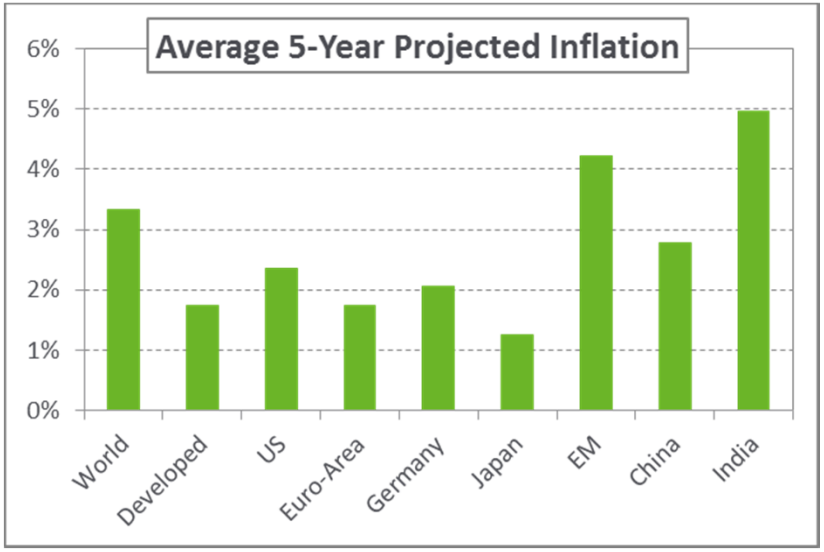
The UK is an exception to this trend as significant depreciation of the pound has led to higher consumer prices



Emerging market inflation has broadly declined over the last 24 months

This is in part due to the large fiscal correction and prudent monetary policy actions that followed the currency declines of prior years

Core inflation particularly in Russia and Brazil have declined significantly as the effect of high real interest rates weakens inflationary trends



Source: (Top) IMF, NEPC
Source: (Bottom) IMF, NEPC

US CASH EXPECTATIONS

Cash is the basic cornerstone of all asset class forecasts

The assumption flows through as a direct building block component or as a relative value adjustment (cash + risk premia)

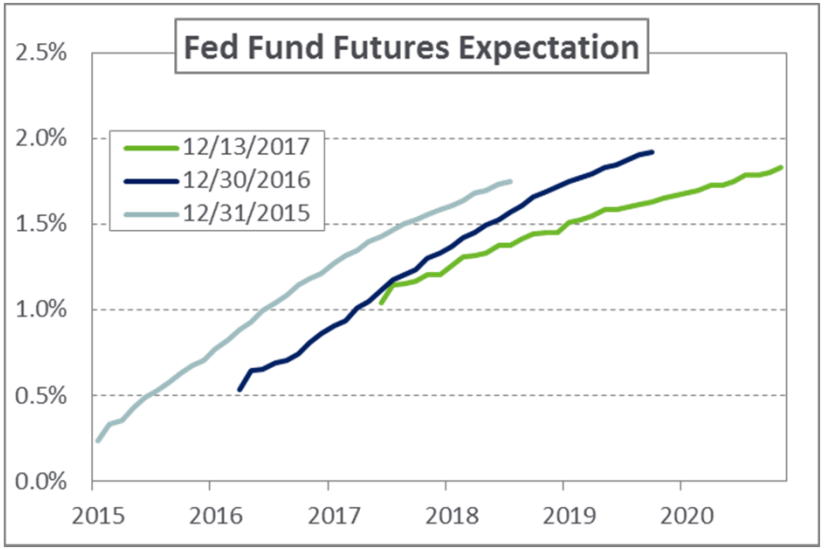
The longer-term cash assumption is a result of the inflation assumption in conjunction with our forecasted real interest rate path

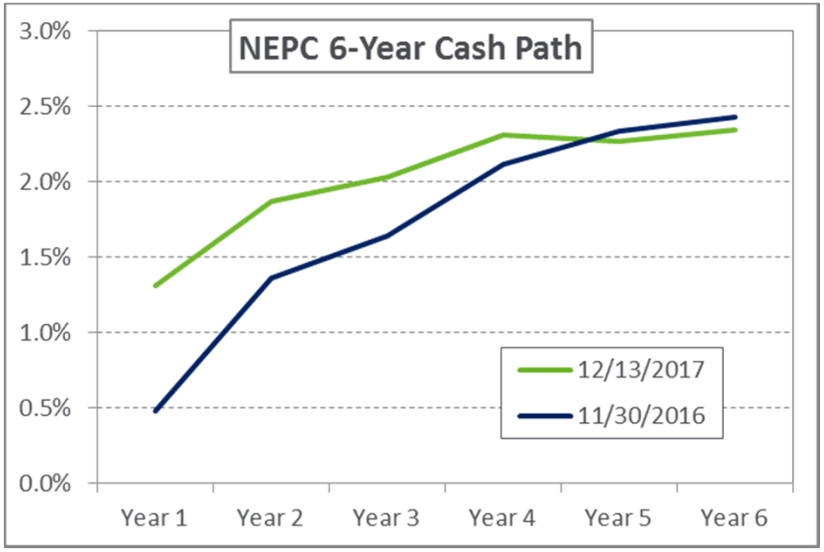
After three Fed rate hikes in 2017, expectations for increased short term interest rates project higher still

A progressively flatter yield curve has formed as longer-term rate expectations remain muted

Market prices reflect only two rate hikes in 2018, despite FOMC expectations of three

A key risk to our overall investment outlook is the ending of Fed gradualism and rate increases beyond market expectations





Source: (Top) Bloomberg
Source: (Bottom) Bloomberg, NEPC
Charts as of 12/13/2017

US INTEREST RATE EXPECTATIONS

Real yields are marginally higher relative to last year

Continued strength in economic data and expectation of future Fed rate hikes have improved the outlook for real yields

While higher, real rates remain below long-term averages, reinforcing the subdued outlook for fixed income

Long-term expectations for real yields remain positive but low in the US

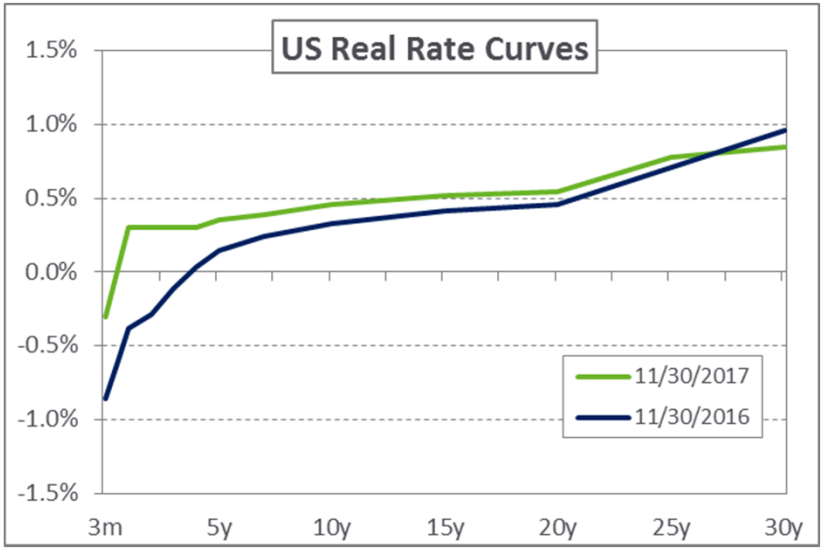
Low real rates depress the return outlook for risk assets over the long-term

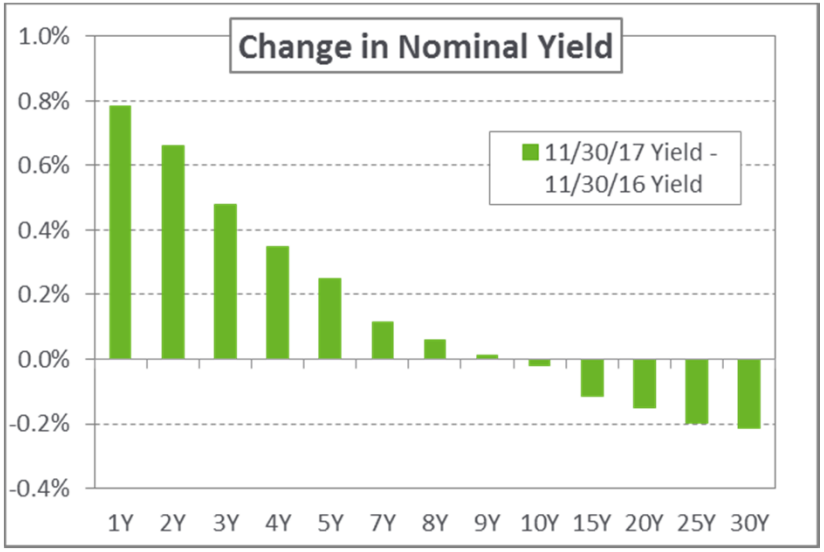
Interest rate increases have been slower than what the market has discounted

Additional uncertainty surrounding the path of rates is possible in 2018

Potential disruption with the confirmation of new Fed Chairman Jerome Powell

Tax cuts could push interest rates higher due to the larger federal deficits and debt issuance needs





Source: (Top) Bloomberg, NEPC
Source: (Bottom) Bloomberg

GLOBAL INTEREST RATE EXPECTATIONS

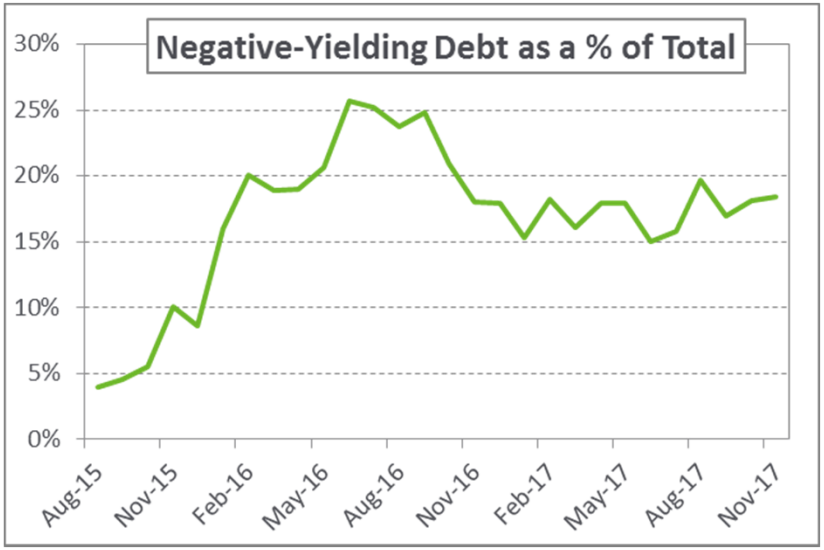
Government bond yields remain low and negative in much of the developed world

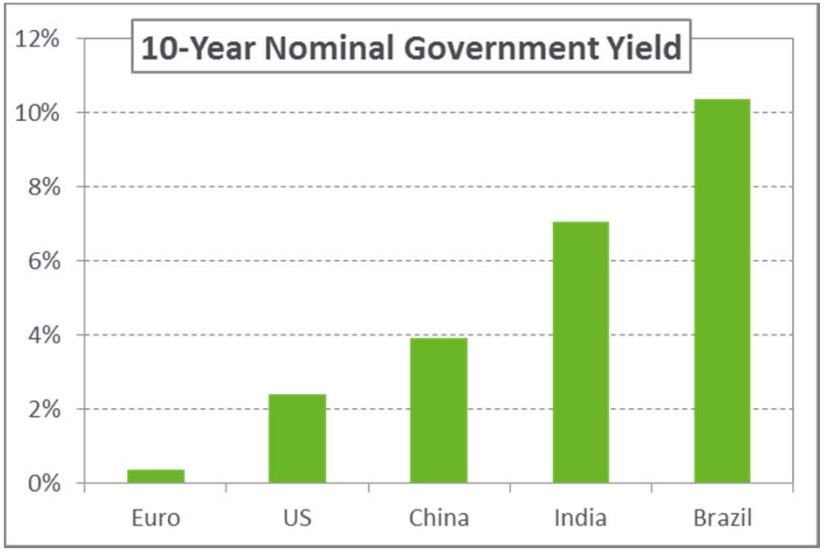
European sovereign yields have declined relative to Germany as political and economic risk declines

- Spain and other periphery nations have showed positive economic momentum
- France's election of Emmanuel Macron was seen as a stabilizing event for the country and the EU as a whole

Emerging market local interest rates are attractively priced as real yields remain elevated

- Emerging market yields continue to retain a healthy premia over developed world rates
- Additionally, positive real rates provide a larger cushion for EM central banks to cut interest rates and ease monetary conditions





Source: (Top) Bloomberg
Source: (Bottom) Bloomberg

EQUITY: ASSUMPTIONS

Equity Building Blocks	
Illiquidity Premium	The additional return expected for investments carrying liquidity risk
Valuation	An input representing P/E multiple contraction or expansion relative to long-term trend
Inflation	Represents market-specific inflation derived from index country revenue contribution and region-specific forecasted inflation
Real Earnings Growth	Reflects market-specific real growth for each equity asset class as a weighted-average derived from index country revenue contribution and forecasted GDP growth
Dividend Yield	Informed by current income distributed to shareholders with adjustments made to reflect market conditions and trends

Asset Class	5-7 Year Return	Change 2018-2017
US Large Cap	5.25%	-.50%
US Small/Mid-Cap	5.75%	-.25%
International (Unhedged)	7.50%	+.25%
International (Hedged)	7.82%	+.25%
International Small Cap	7.75%	+.25%
Emerging International	9.00%	-.50%
Emerging Intl. Small Cap	9.25%	-.75%
Private Equity	8.00%	-.25%
Hedge Funds – Long/Short	6.25%	-
Global Equity	*6.88%*	*-.33%*

EQUITY: REAL EARNINGS GROWTH

Global growth was stronger than expected during 2017

Synchronized global growth is likely to persist with continued favorable market growth conditions

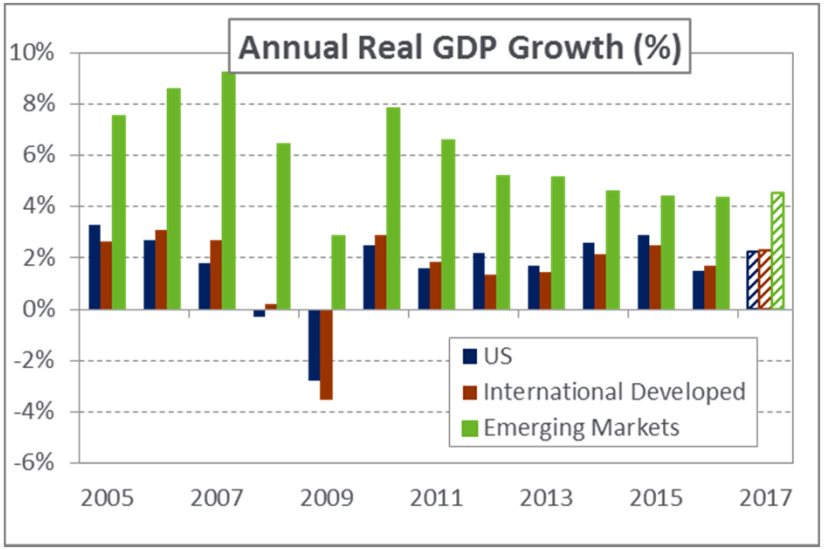
The broad outlook for developed economies has improved as a real earnings recovery has begun

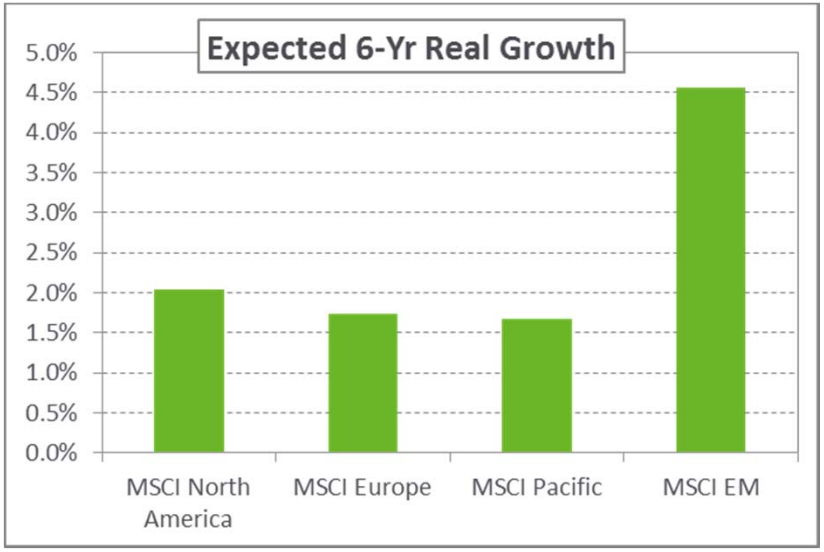
The UK remains a notable outlier as the country continues sorting through Brexit

Emerging economies are broadly expected to continue strong growth

Chinese real growth is expected to slow in future years as the country transitions to a more consumer based economy

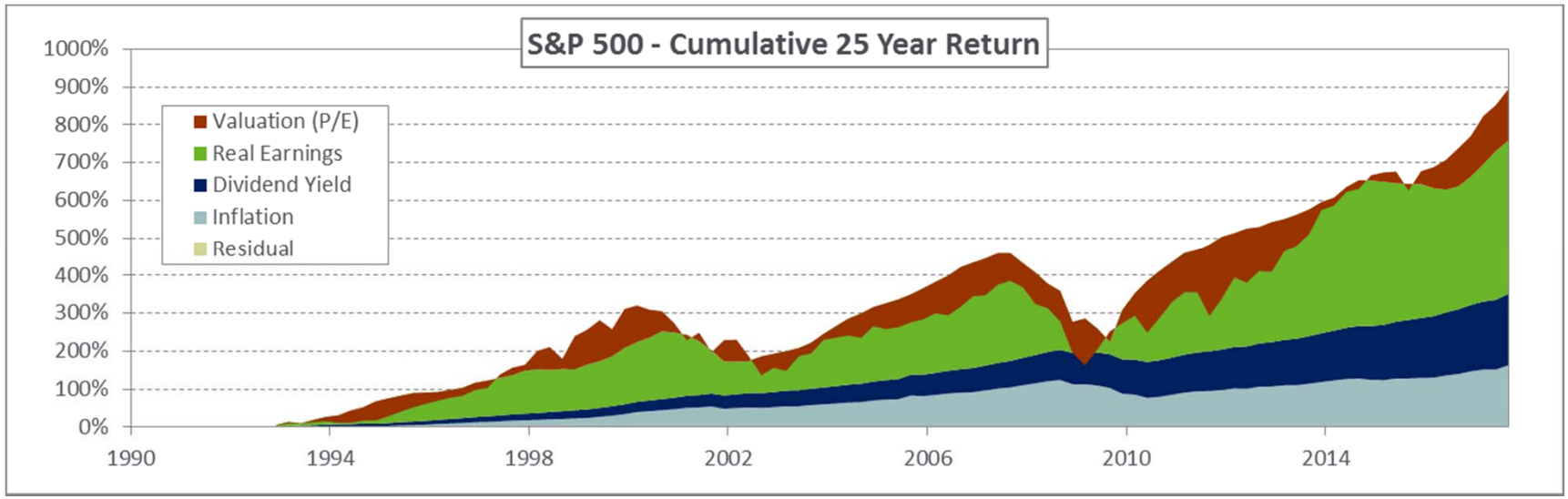
Reforms in India and southeast Asia are expected to boost investment, productivity, and per-capita growth





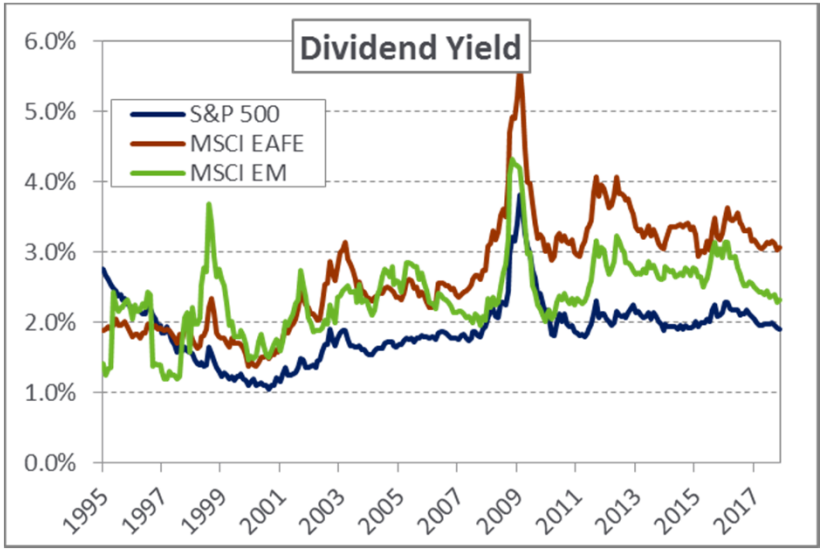
Source: (Top) Bloomberg, NEPC
Source: (Bottom) IMF, MSCI, Bloomberg

EQUITY: DIVIDEND YIELD



Real dividends per share have increased over time, but prices have increased at a faster rate, leading to falling yields

International and Emerging Markets continue to offer a more attractive dividend yield relative to the US



Source: (Top) S&P, NEPC, Bloomberg
Source: (Bottom) S&P, MSCI, Bloomberg

EQUITY: VALUATION

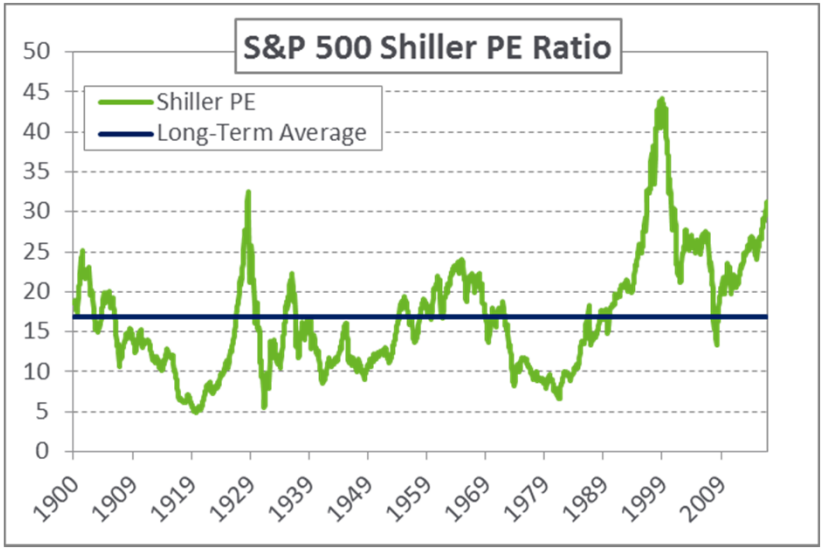
Global equities broadly pushed higher in 2017 supported by macroeconomic data, robust earnings, and easy financial conditions

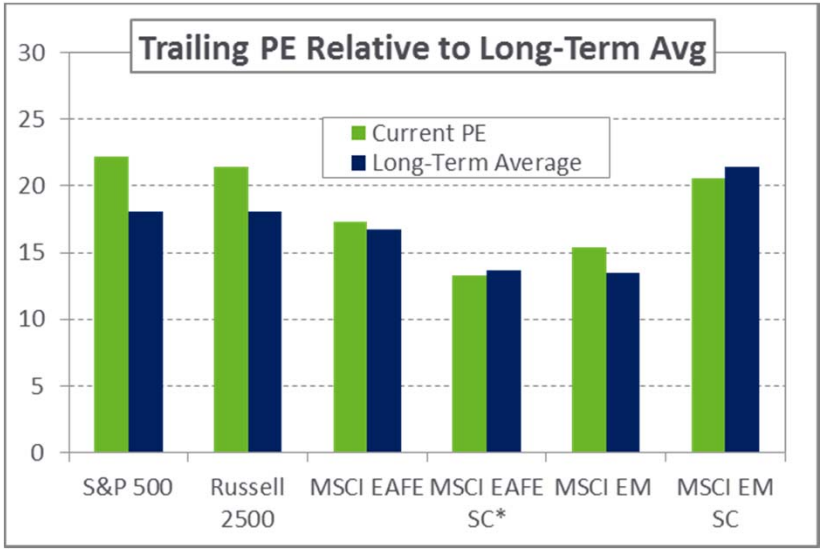
While earnings growth in the US came in stronger than expected, price gains continued to outpace – leading to further P/E multiple expansion

Recovering corporate earnings for international developed markets have allowed valuations to remain relatively attractive

A multi-year earnings recovery in Europe and Japan offers the potential for an elevated return in these markets

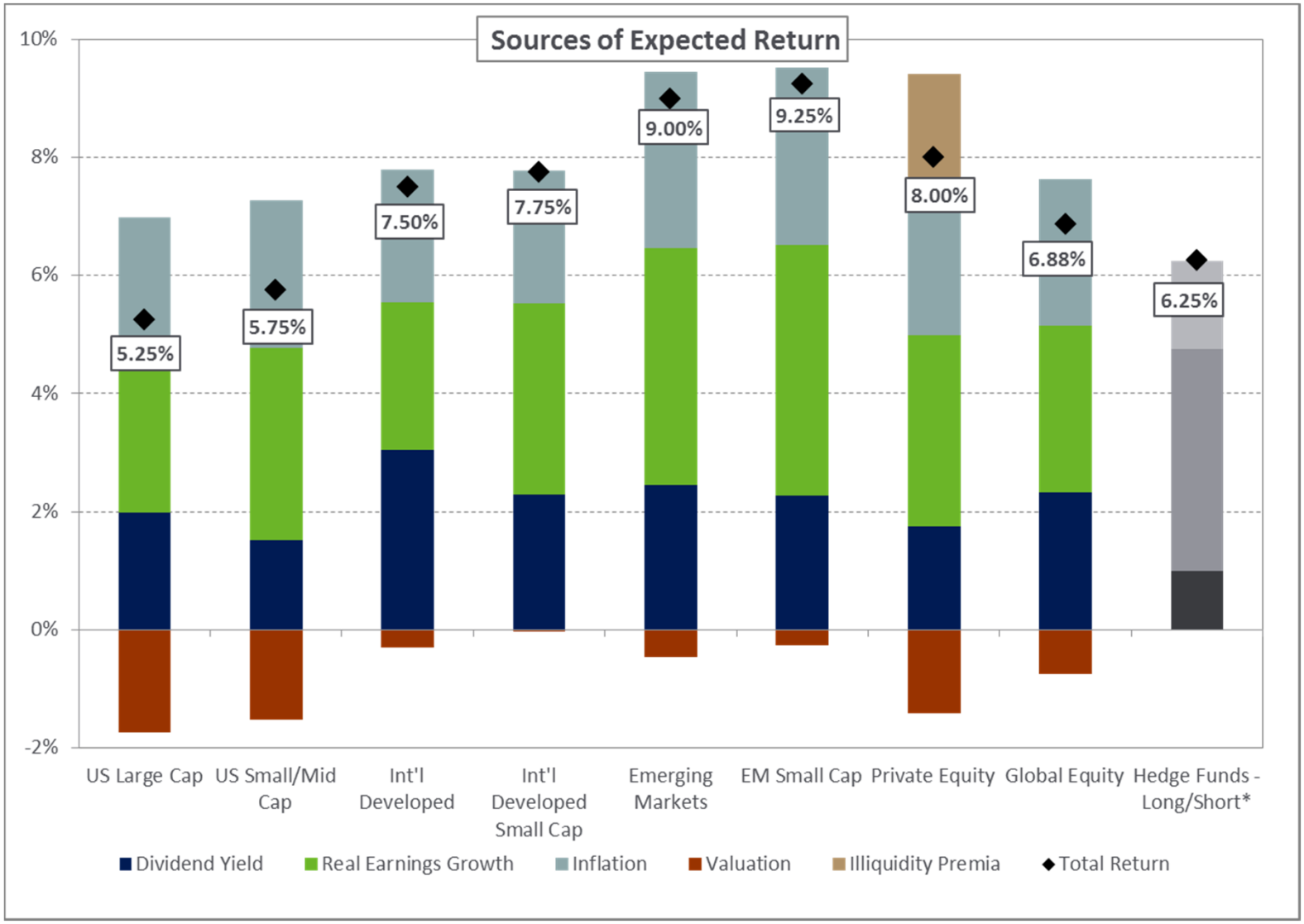
While emerging market equities posted the strongest gains for 2017, valuations remain close to long-term averages relative to domestic markets





Source: (Top) S&P, Shiller
Source: (Bottom) S&P, Russell, MSCI, Bloomberg
**Reflects index-adjusted positive P/E values*

EQUITY: BUILDING BLOCKS



Source: NEPC

**Hedge Funds are discussed in detail in the Multi-Asset section*

RATES & CREDIT: ASSUMPTIONS

Rate & Credit Building Blocks	
Illiquidity Premium	The additional return expected for investments carrying liquidity risk
Government Rates Price Change	The valuation change resulting from a change in the current yield curve to forecasted rates
Spread Price Change	The valuation change resulting from a change in credit spreads over the duration of the investment and highly sensitive to economic cycles
Credit Deterioration	The average loss for credit securities associated with an expected default cycle and recovery rates
Credit Spread	Additional yield premium provided by securities with credit risk
Government Rates	The yield attributed to sovereign bonds that do not have credit risk associated with their valuation

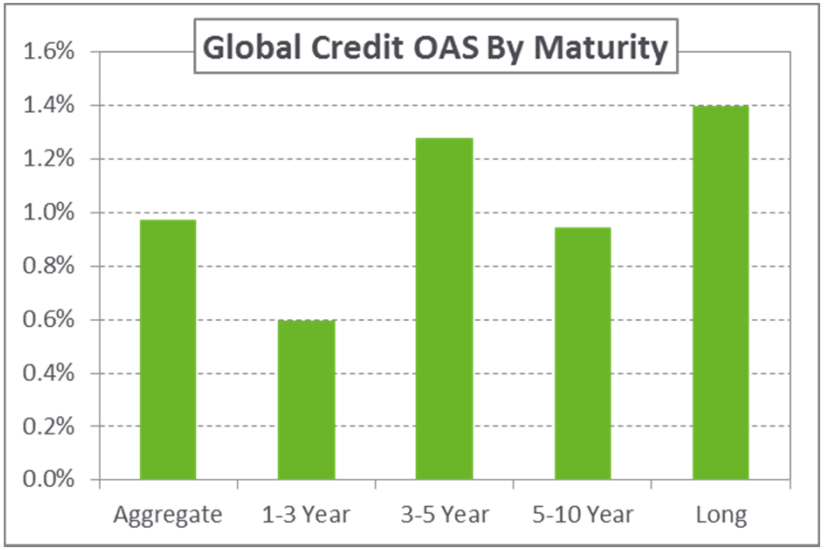
Asset Class	5-7 Year Return	Change 2018-2017
Treasuries	2.25%	+.25%
Investment-Grade Corporate Credit	3.50%	-.25%
Municipal Bonds	2.50%	+.25%
TIPS	3.25%	+.25%
High-Yield Bonds	3.75%	-1.00%
High-Yield Municipal Bonds	3.75%	-.50%
Bank Loans	4.50%	-.75%
Non-US Bonds (Unhedged)	0.50%	-.50%
EMD (External)	4.25%	-.50%
EMD (Local Currency)	6.00%	-.75%
Private Debt	6.50%	-.75%
Core Bonds	*2.75%*	*+.10%*

RATES & CREDIT: CREDIT SPREAD

Strong global growth and yield-seeking investor behavior has compressed credit spreads

Economic growth usually translates to tighter credit spreads due to a lower probability of defaults

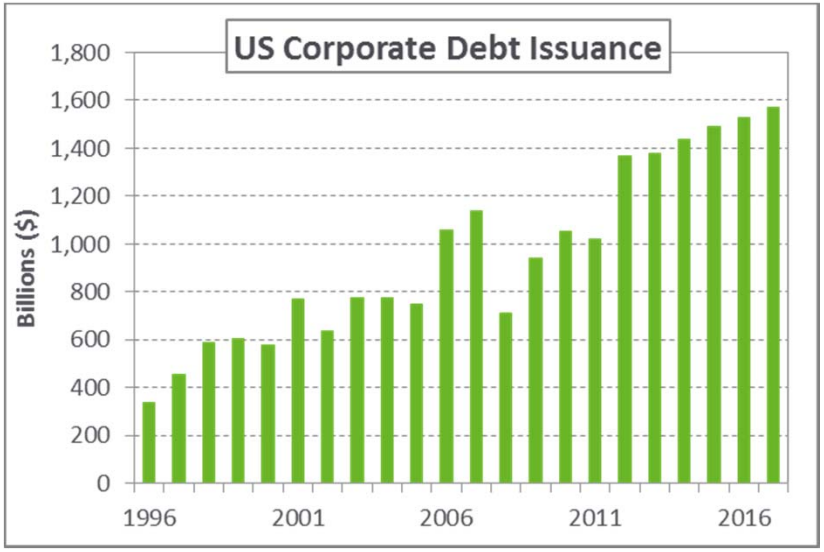
In Europe, the ECB's decision to include corporate bonds in its quantitative easing program has also contributed to smaller credit risk premiums globally



Low borrowing costs have encouraged record issuance in both investment grade and high yield bonds

Passive ownership of credit has increased significantly, even with a larger denominator

The outlook for US credit is subdued with limited return opportunities as credit spreads trade below long-term medians



Source: (Top) Barclays, Bloomberg
Source: (Bottom) SIFMA

RATES & CREDIT: RATES PRICE CHANGE

Rates price change include changes in the level of interest rates, changes to the shape of the curve, and roll down

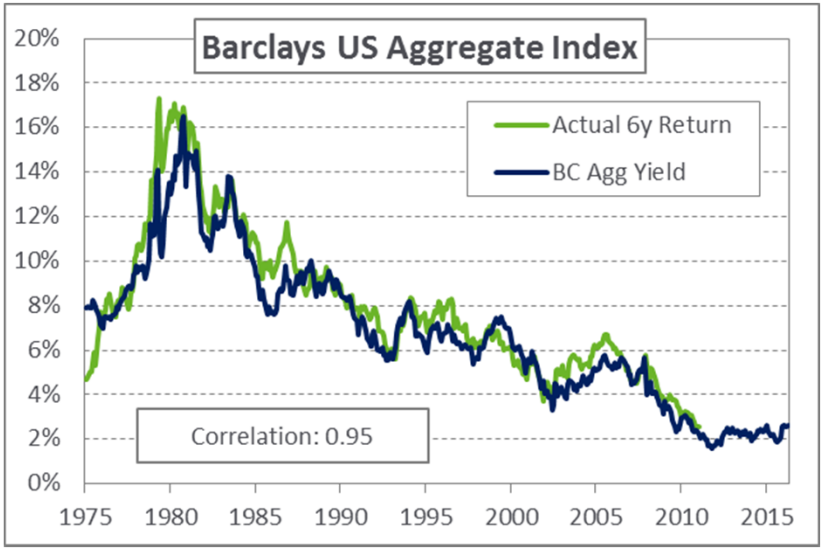
Roll down refers to expected price change due to aging of a bond along the curve

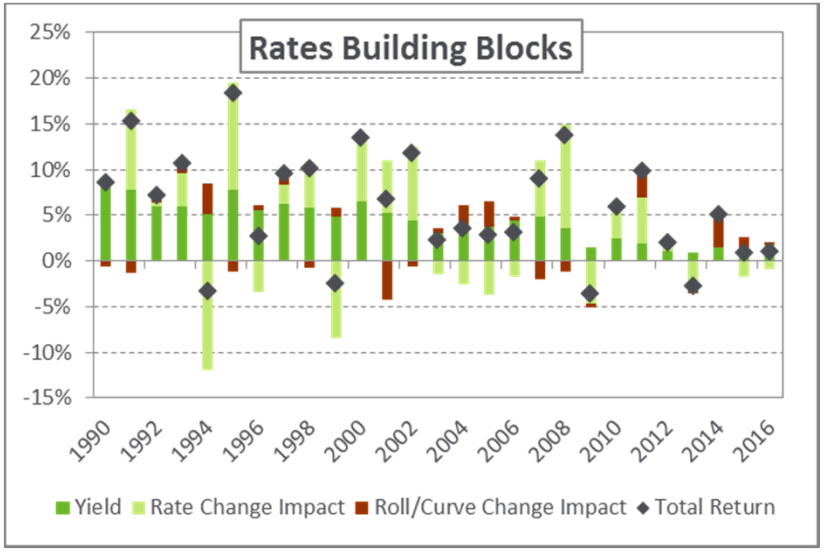
Rate change impact often dominates total return and is a likely detractor in the coming cycle, given expectations of modestly higher rates

Path of interest rates for each market is tied to both central bank actions and inflation expectations

Roll down offers some relief to rising rates when yield curves are steep

As yield curve flattens this can be a drag, pushing investors to shorter duration bonds





Source: (Top) Barclays, Bloomberg, NEPC
Source: (Bottom) Barclays, Bloomberg, NEPC

RATES & CREDIT: SPREAD PRICE CHANGE

Credit spreads continued to tighten throughout the year and remain below long-term averages

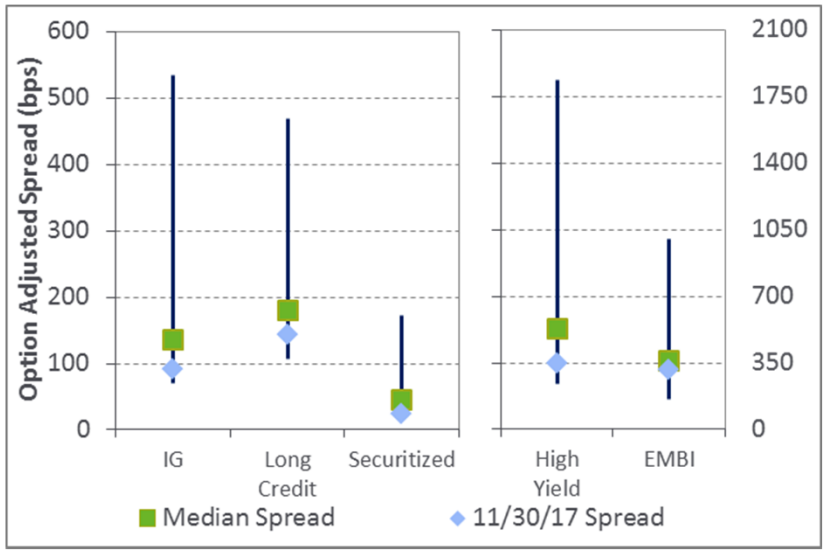
With positive economic indicators and strong technicals, spreads could grind lower

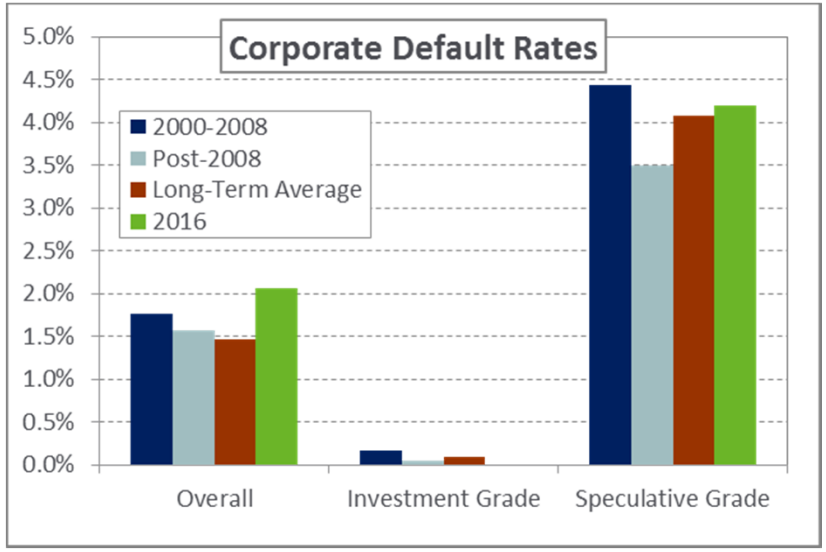
The number of defaults increased last year as a result of the depressed energy and natural resources sector

Over 50% of credit defaults occurred within the energy sector

Nearly all other sectors experienced default rates well below long-term averages

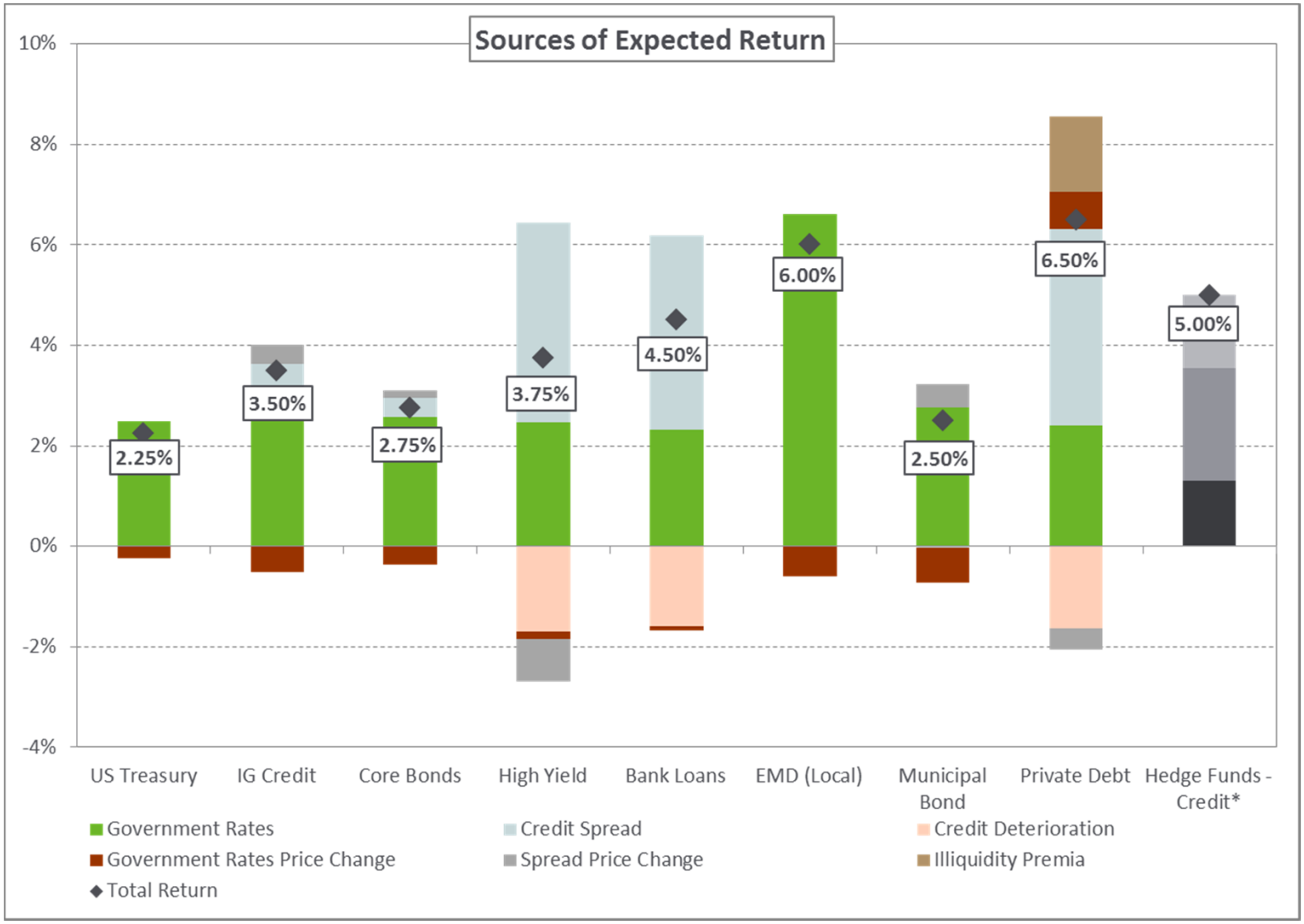
Credit spreads near historic lows suggest investors are receiving less compensation for taking on risk





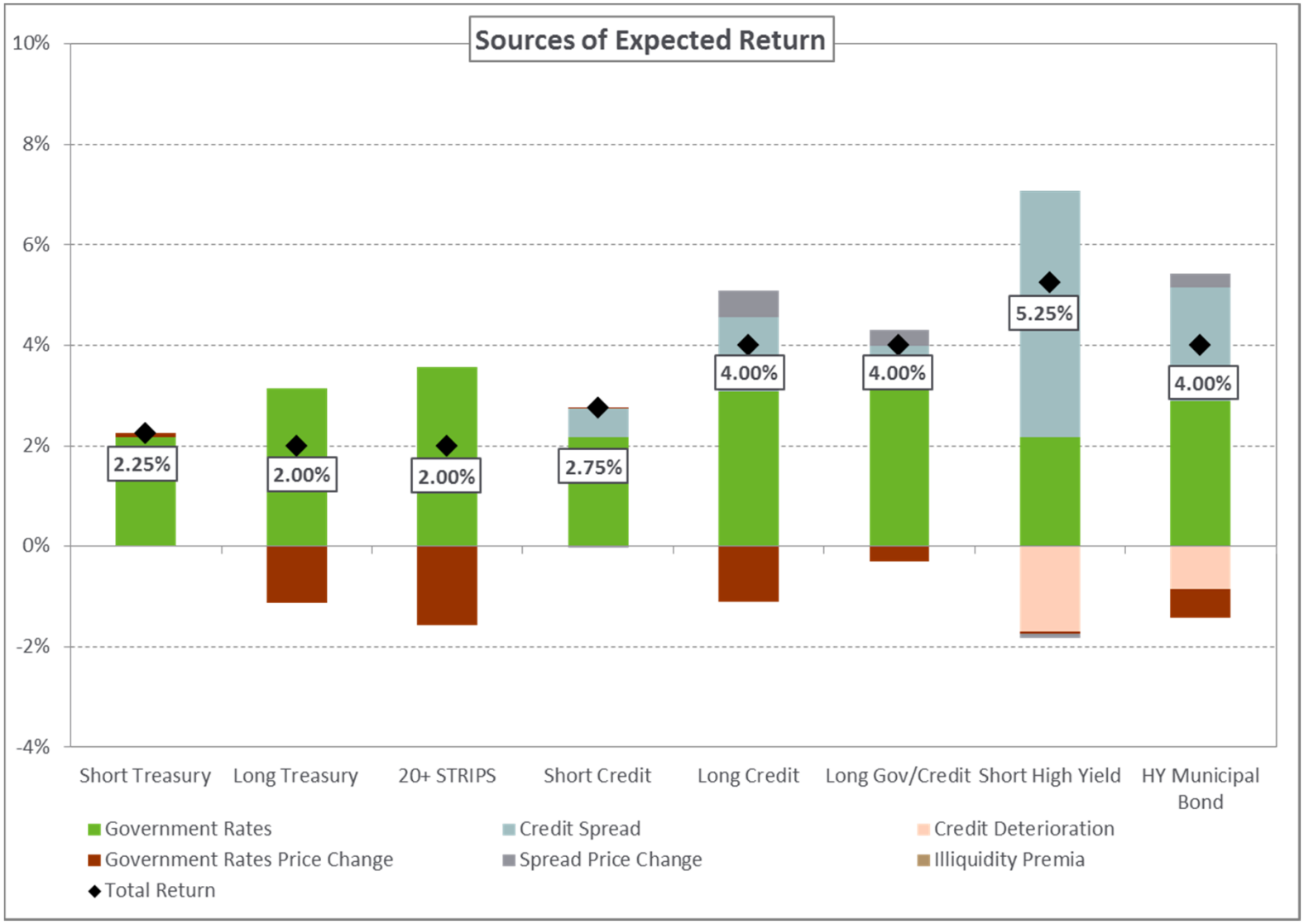
Source: (Top) JPM, Bloomberg, NEPC. As of 01/31/2000
Source: (Bottom) S&P, NEPC

CREDIT: BUILDING BLOCKS



Source: NEPC
**Hedge Funds are discussed in detail in the Multi-Asset section*

CREDIT: BUILDING BLOCKS



Source: NEPC

REAL ASSETS: ASSUMPTIONS

Real Assets Building Blocks	
Illiquidity Premium	The additional return expected for investments carrying liquidity risk
Valuation	The expected change in price of the underlying asset reverting to a long-term real average or terminal value assumption
Inflation	Incorporates the inflation paths as defined by TIPS breakeven expectations and NEPC expected inflation assumptions
Real Earnings Growth	Reflects market-specific real growth for each equity asset class as a weighted-average derived from index country revenue contribution and forecasted GDP growth
Real Income	Represents the inflation-adjusted income produced by the underlying tangible or physical asset

Asset Class	5-7 Year Return	Change 2018-2017
Commodities	4.75%	-
MLPs	7.25%	+.25%
REITs	6.50%	-
Core Real Estate	5.75%	-.25%
Non-Core Real Estate	7.00%	N/A
Private Real Assets: Energy/Metals	8.00%	-.25%
Private Real Assets: Infrastructure/Land	6.00%	-
Real Assets (Liquid)	*5.87%*	*-.05%*

REAL ASSETS: REAL INCOME

Equity-like investments: Real income represents the inflation-adjusted dividend yield

Includes MLPs, natural resource equities, global infrastructure equities, and REITs

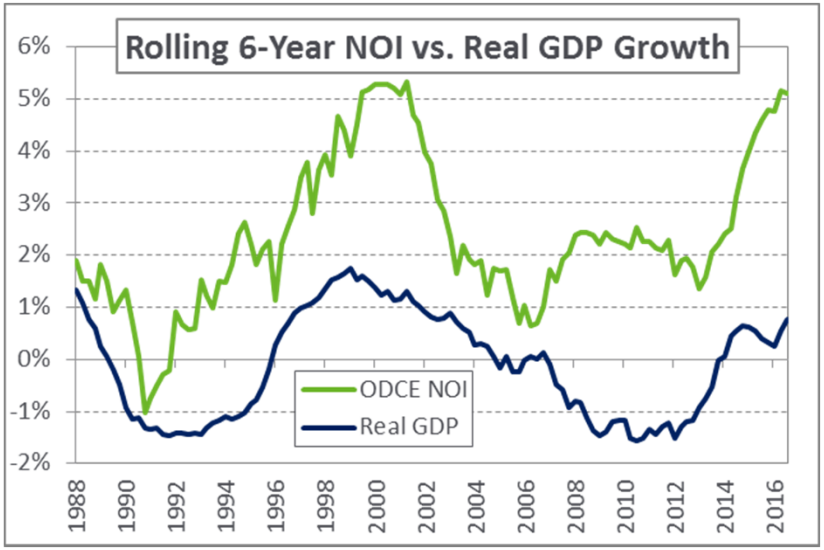
Notably, MLP yields have increased relative to last year in combination with generally stronger balance sheets and a double-digit price decline

Real Estate: Real income growth is a function of Net Operating Income (NOI) growth

Rolling 6-year NOI growth exhibits cyclically economic pattern and appears to be at or near its peak

Commodities: Real income is represented by collateral return

A cash proxy is used to represent the collateral and as such, it represents the return on cash over the investment horizon



Real Asset Yields	11/30/16	11/30/17
MLPs	7.4%	8.1%
Core Real Estate	4.7%	4.6%
US REITs	4.6%	4.0%
Global REITs	4.2%	3.6%
Global Infrastructure Equities	4.1%	3.9%
Natural Resource Equities	3.0%	3.3%
US 10-Yr Breakeven Inflation	2.0%	1.9%
Commodity Index Roll Yield	-6.5%	-1.4%

Source: (Top) NCREIF, Bloomberg, NEPC
Source: (Bottom) NCREIF, Alerian, NAREIT, S&P, Bloomberg

REAL ASSETS: VALUATION

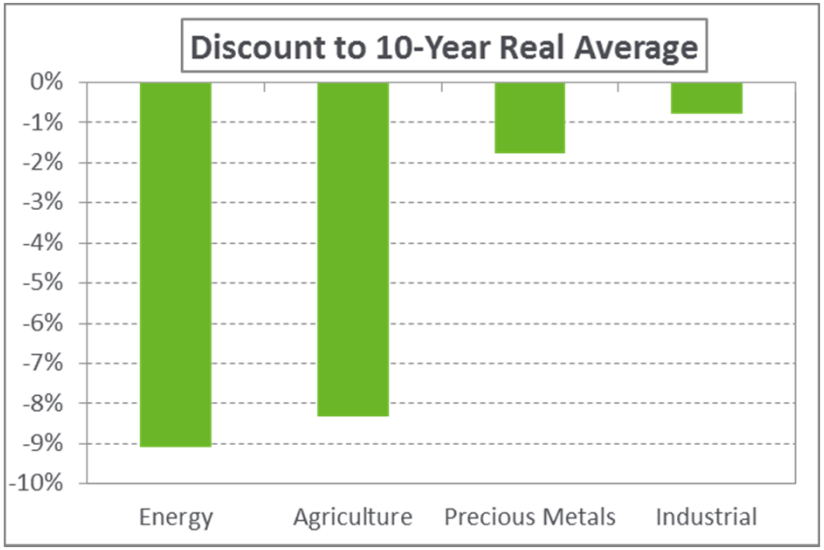
Change in commodity valuations can be attributed to both roll yield and change in spot price

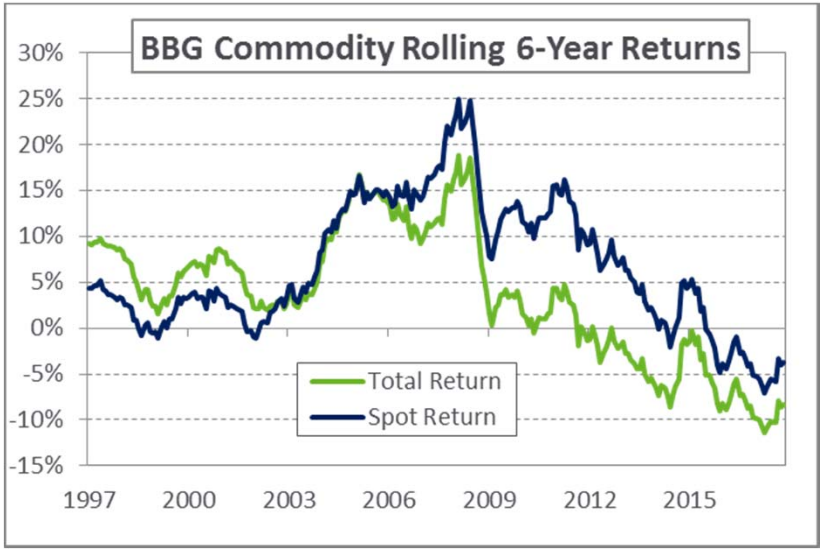
Commodity prices continue to trade below their long-term real averages, particularly in the energy and agriculture sectors

Roll yield continues to be a hurdle for investing in commodity futures

Post-2008, spot returns have had consistently higher returns than total return indices – demonstrating the impact of negative roll yield on overall investments

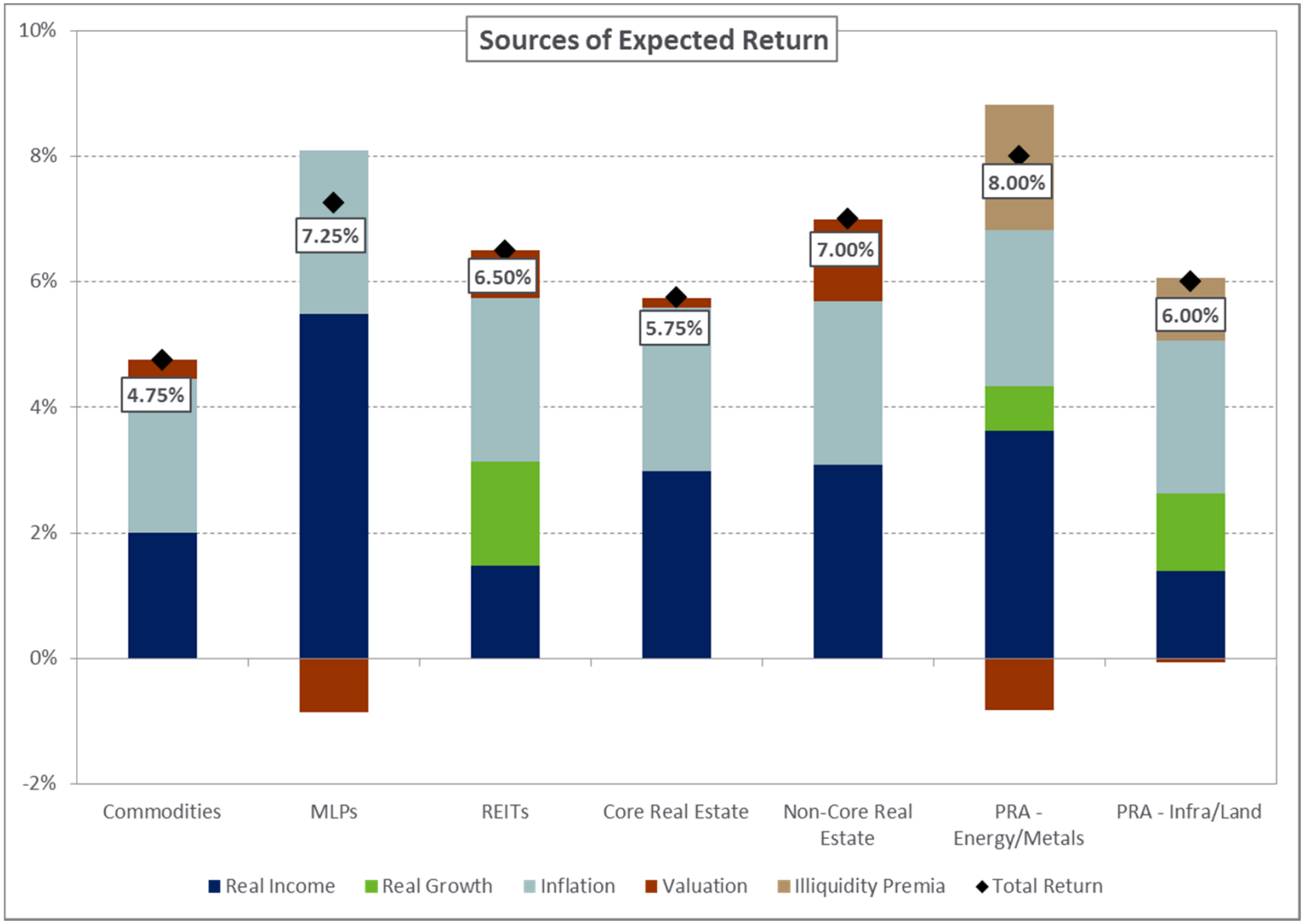
In the latter half of 2017, commodity prices rallied off mid-year lows, causing the negative roll yield to be much smaller relative to last year





Source: (Top) Bloomberg, NEPC
Source: (Bottom) Bloomberg, NEPC

REAL ASSETS: BUILDING BLOCKS



Source: NEPC

MULTI-ASSET & DERIVED COMPOSITES

Multi-asset assumptions are the result of the sum of equity, credit, and real asset building blocks

Global 60/40: 60% global equity and 40% global bonds

US 60/40: 60% US equity and 40% core bonds

Risk Parity 10% Vol: Average of 3 common risk parity exposures

GAA Strategies: Average of 3 common GAA exposures

Global Equity: Market weighted blend of MSCI ACWI IMI (US, Non-US Developed, Emerging)

Core Bonds: Market weighted blend of Bloomberg Barclays US Aggregate Bond Index (Treasuries, IG Credit, MBS)

Real Assets (Liquid): Weighted blend of TIPS, global equities, REITs, and commodities

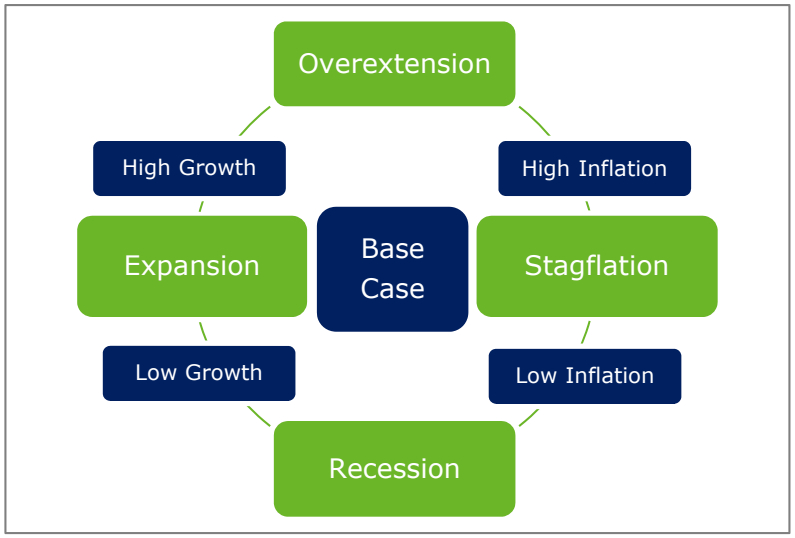
Hedge Funds: Weighted blend of 40% HF equity, 40% HF credit , and 20% HF macro

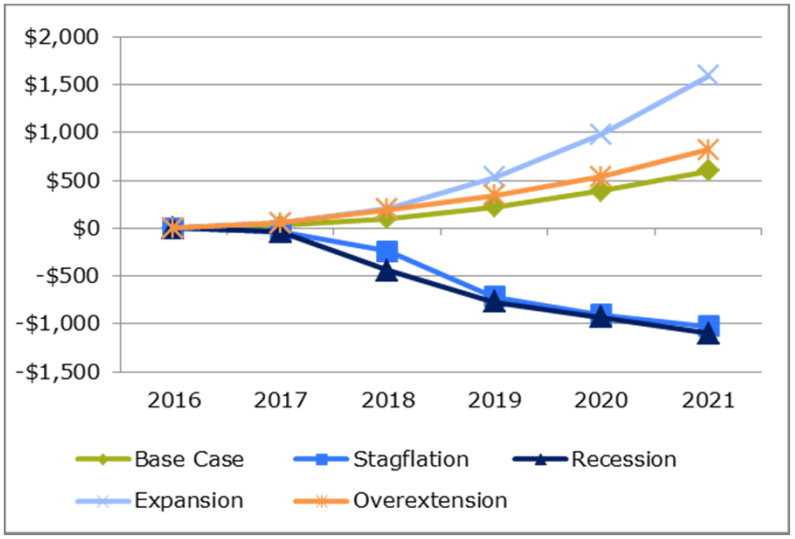
Asset Class	5-7 Year Return	Change 2018-2017
Global 60/40	4.91%	-.13%
US 60/40	4.54%	-.24%
Risk Parity 10% Vol	5.11%	+.04%
GAA Strategies	5.44%	-.11%
Hedge Funds – Macro Strategies	6.25%	-
Global Equity	6.88%	-.33%
Core Bonds	2.75%	+.10%
Real Assets (Liquid)	5.87%	-.05%
Hedge Funds	*5.83%*	*-.12%*

PROPRIETARY TOOLS

PROPRIETARY MODELING TOOLS: SCENARIO ANALYSIS

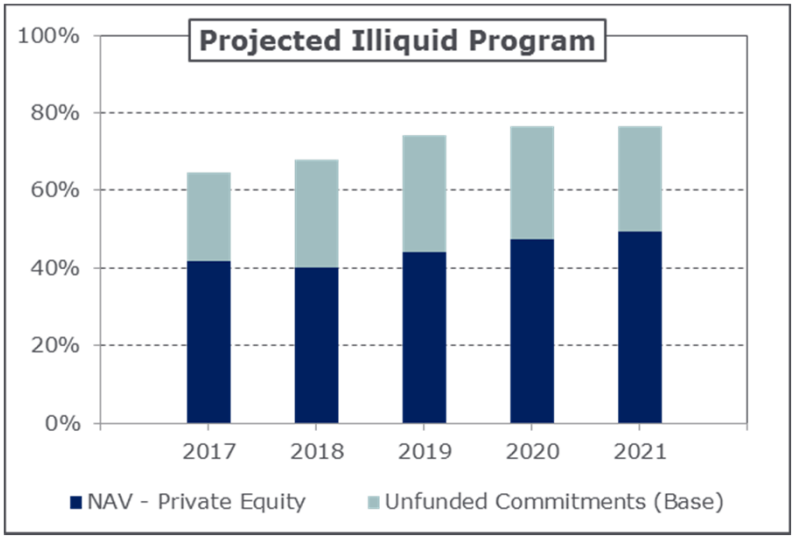
- **Scenario analysis tests the viability of asset mixes under multiple economic scenarios**
- **This risk tolerance exercise considers multi-standard deviation events over longer time frames (3-5 years)**
  - Often ignored/underappreciated in traditional mean-variance analysis
- **Scenario analysis and stress testing focuses investors' attention on outcomes that depart significantly from "expectations"**
  - Discards baseline return and risk and forces consideration of alternative outcomes

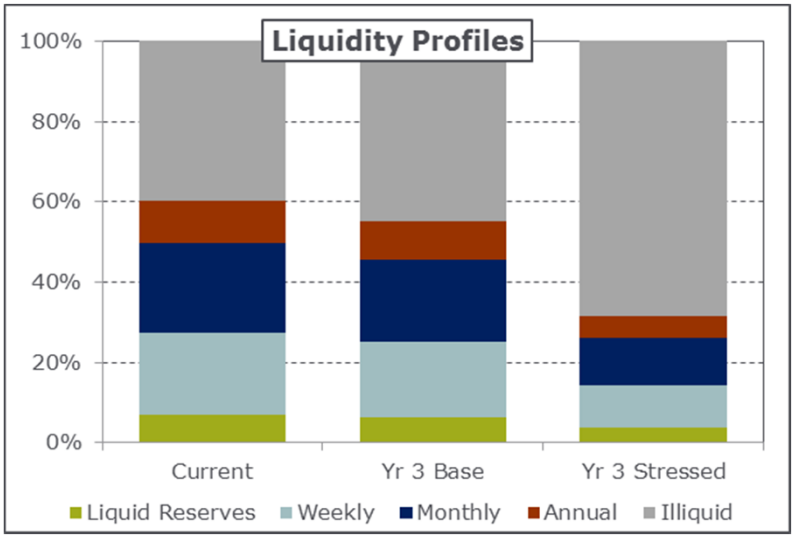




PROPRIETARY MODELING TOOLS: LIQUIDITY ANALYSIS

- **Improves perspective on illiquidity, a risk not captured in many traditional portfolio tools**
  - Illiquid exposure can magnify adverse events under stressed market conditions
- **Liquidity analysis highlights portfolio impact of changing cash flow demands**
  - Must consider the interplay of multiple factors across various market environments
    - Investment returns
    - Benefit payments
    - Contributions
    - Unfunded capital commitments
- **Customized stress test can help frame the nature and magnitude of any potential liquidity issues**
  - Provides guidance on the appropriate size of illiquid program





INFORMATION DISCLAIMER

Past performance is no guarantee of future results.

The goal of this report is to provide a basis for substantiating asset allocation recommendations. The opinions presented herein represent the good faith views of NEPC as of the date of this report and are subject to change at any time.

Information on market indices was provided by sources external to NEPC. While NEPC has exercised reasonable professional care in preparing this report, we cannot guarantee the accuracy of all source information contained within.

All investments carry some level of risk. Diversification and other asset allocation techniques do not ensure profit or protect against losses.

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