



# Common Investment Meeting (TRS)

<b>Schedule</b>	Wednesday, April 18, 2018, 09:00 AM — 02:00 PM EDT
<b>Venue</b>	Office of the New York City Comptroller, 1 Centre Street, 10th Floor (Room 1005) - Northside, New York, NY 10007
<b>Organizer</b>	Kim Boston

## Public Agenda

PUBLIC SESSION		1
9:00 AM	Welcome and Opening	
9:05 AM	Risk Update	2
	 CIM_Presentation Slides_RISK UPDATE_041818.pdf	3
9:50 AM	Asset Allocation Discussion	30
	 CIM_Presentation Slides_ASSET ALLOCATION UPDATE_041818.pdf	31

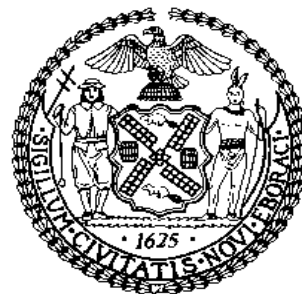
**PUBLIC SESSION**

# Risk Update

# RISK UPDATE



# Update on MSCI and Risk Reporting



THE CITY OF NEW YORK  
OFFICE OF THE COMPTROLLER

4/18/2018

# Agenda

1. MSCI Implementation
2. Sample Risk Reports



# MSCI Implementation Update

- Risk Reports
  - Public Markets: To be distributed at least quarterly
    - Public Equities
    - Public Fixed Income (including High Yield and Bank Loan)
    - Hedge Funds (Police and Fire)
  - Private Markets: Implementation started Q2 2018
    - OFI
    - Private Equity
    - Private Real Estate
    - Infrastructure
  - ETI: Implementation started Q2 2018
- Performance attribution: implementation to start in Q3 2018



# MSCI's Reporting Package

- MSCI recently commenced production of public market risk reports
- BAM's goal is to distribute public market risk reports at least quarterly
- Reporting of total plan risk – including private market investments – will be distributed on a quarterly basis. Note that:
  - Private market investments are only marked quarterly
  - BAM's review of risk reports detailing private market investments is more involved





# Monthly Cycle

## Monthly cycle of the generation and distribution of the reports

Deadline	Action	Responsibility
10 <sup>th</sup> business day	BAM queries latest portfolio company from Burgiss and sends to MSCI	BAM
13 <sup>th</sup> business day	BAM delivers updates to account structure and commingled ownership ratios	BAM
16 <sup>th</sup> business day	SSB completes monthly audit cycle of investment accounts	State Street
17 <sup>th</sup> business day	MSCI loads data and performs validation process	MSCI
23 <sup>rd</sup> business day	MSCI posts updated Standard Board reports	MSCI
25 <sup>th</sup> business day	BAM reviews Standard Board reports for completeness and accuracy	BAM
25 <sup>th</sup> business day	BAM distributes reports	BAM



# Sample Risk Reports

- Today we will discuss risk reports detailing a portfolio:
  - consisting of public markets investments totaling \$10B
    - Public Equities (US, Developed Markets, EM)
    - Public Fixed Income (excluding OFI)
  - based on actual NYCRS holdings as of February 28, 2018
- We will focus on Total Plan risk but reports detailing risk at the Asset Group level and Asset Class level are available
- BAM will be contacting the trustees to see if there is interest in a more detailed teach in



# Total Plan Summary

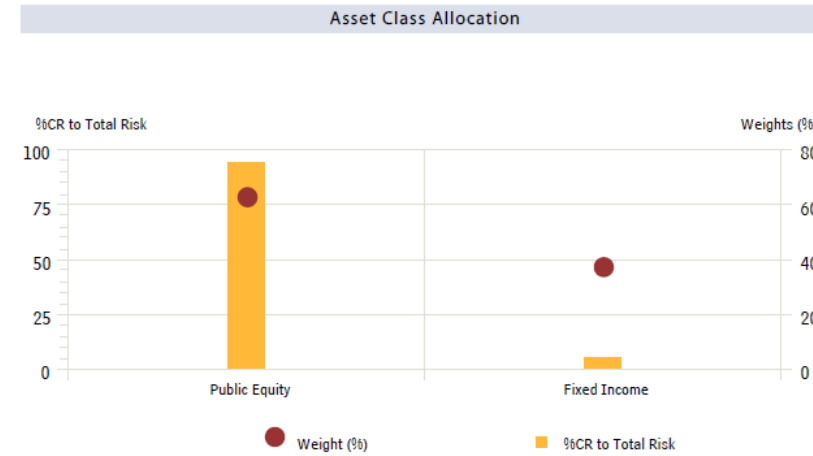
## BarraOne Total Plan Summary

COMPANY: Sample Total Plan  
 PORTFOLIO: Sample Total Plan  
 BENCHMARK: Sample Total Plan Policy  
 POSITIONS: 29,679

CURRENCY: USD  
 ANALYSIS DATE: February 28, 2018  
 MARKET VALUE: 10,000,000,000  
 ACCEPTED: 29,402

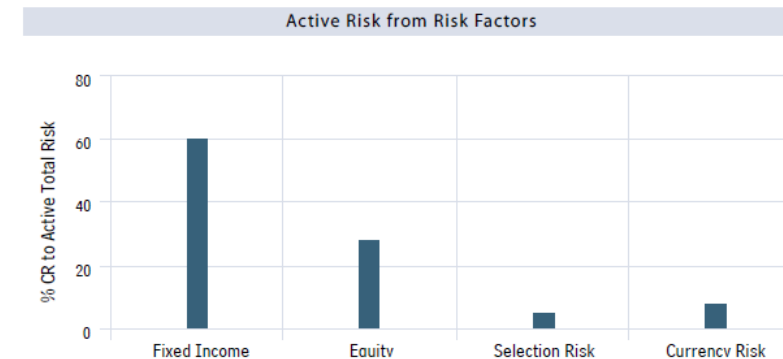
### Total Plan Summary

Risk Summary		Asset Class Contribution to Risk					
Statistic	Value	Asset Class	Mkt Value	Weight (%)	Total Risk	Risk Contribution	%CR to TR
Total Risk	6.66	<b>Total</b>	<b>10,000,000,000</b>	<b>100.00</b>	<b>6.66</b>	<b>6.66</b>	<b>100.00</b>
Benchmark Risk	6.72	Public Equity	6,298,741,145	62.99	10.16	6.31	94.71
Active Risk	0.94	Fixed Income	3,701,258,855	37.01	3.06	0.35	5.29
Portfolio Beta	0.98						
Effective Duration	2.20						



### Risk Factor Breakdown

Risk Decomposition						
Risk Source	Portfolio			Active		
	Risk Contribution	% Risk	Correlation	Risk Contribution	% Risk	Correlation
<b>Total Risk</b>	<b>6.66</b>	<b>100.00</b>	<b>1.00</b>	<b>0.94</b>	<b>100.00</b>	<b>1.00</b>
Local Market Risk	5.89	88.43	0.98	0.86	92.20	0.94
Common Factor Risk	5.87	88.04	0.98	0.82	87.71	0.92
Equity	5.57	83.62	0.95	0.26	27.52	0.42
Fixed Income	0.29	4.41	0.26	0.56	60.19	0.74
Selection Risk	0.03	0.39	0.06	0.04	4.49	0.21
Currency Risk	0.77	11.57	0.54	0.07	7.80	0.23



Source: MSCI



# Total Plan Summary

- Total Risk is 6.66%
  - Ex-ante annualized volatility of return
  - Ex-ante volatility is a function of individual asset exposures, volatilities and correlations
- Benchmark Risk is 6.72%
- Active Risk is 0.94%
  - Ex-ante volatility of excess return or tracking error

Risk Summary	
Statistic	Value
Total Risk	6.66
Benchmark Risk	6.72
Active Risk	0.94
Portfolio Beta	0.98
Effective Duration	2.20

## BarraOne Total Plan Summary

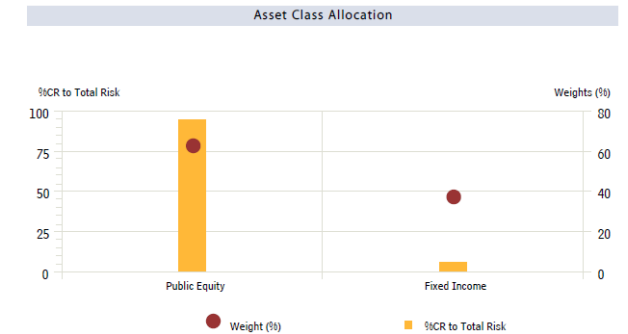
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Asset Class Contribution to Risk					
Asset Class	Mkt Value	Weight (%)	Total Risk	Risk Contribution	%CR to TR
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Fixed Income	3,701,258,855	37.01	3.06	0.35	5.29

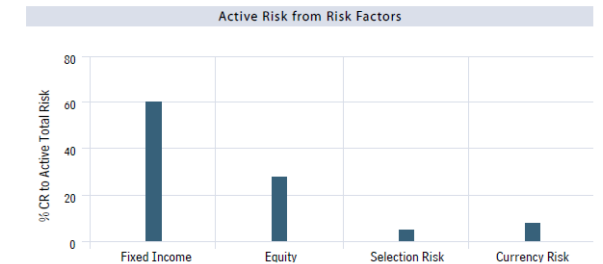
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# Total Plan Summary

- Total Risk of 6.66% is composed of:
  - The Equity portfolio contributes 6.31%, or 94.71% of Total Risk
  - The Fixed Income portfolio which contributes 0.35% or 5.29% of Total Risk

## BarraOne Total Plan Summary

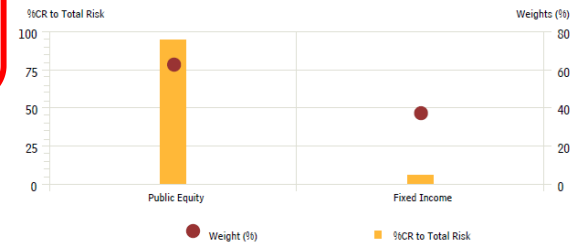
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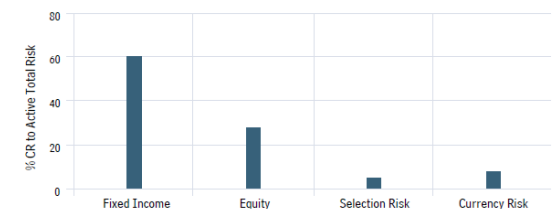
### Asset Class Allocation



### Risk Factor Breakdown

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### Active Risk from Risk Factors



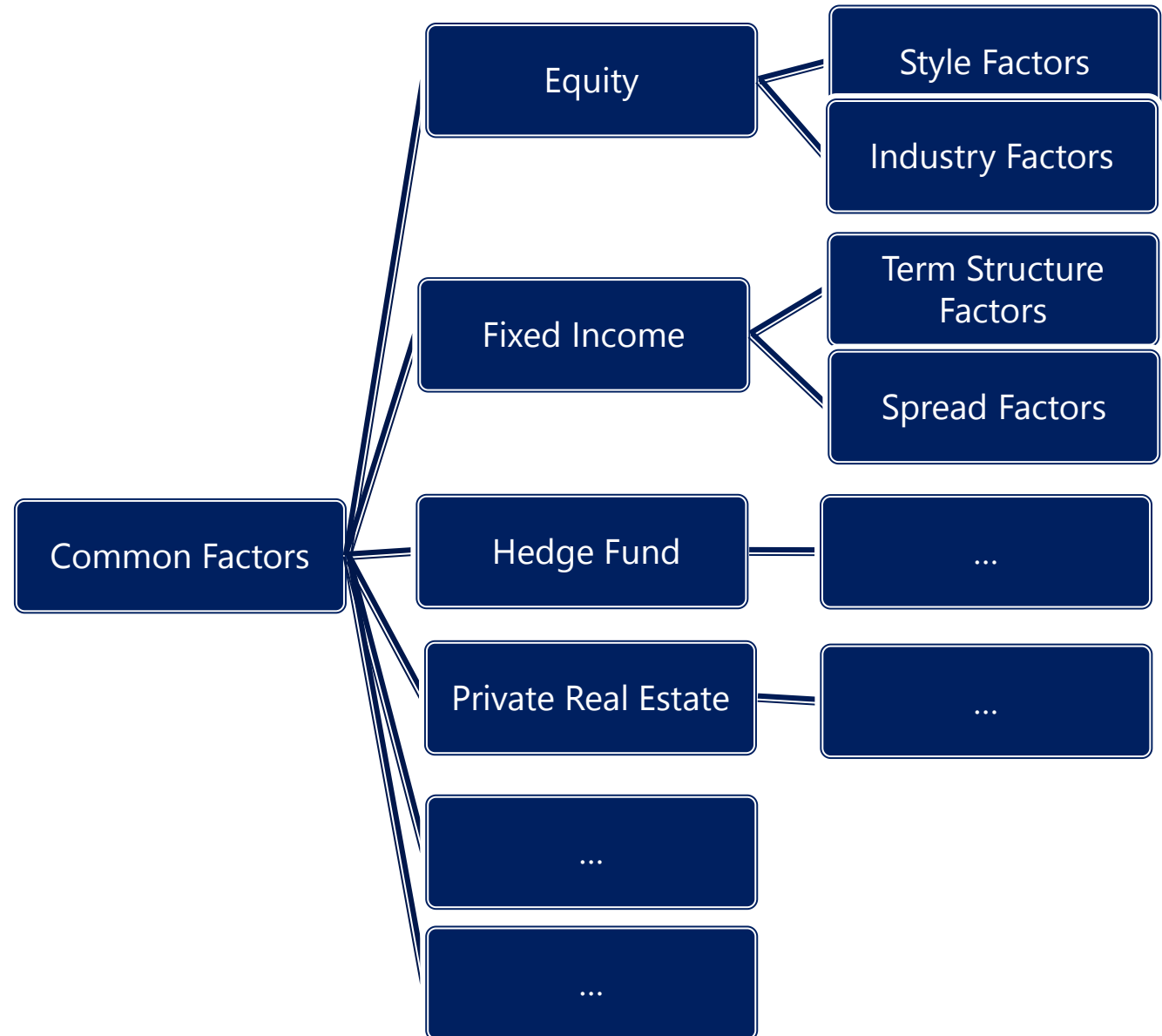
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- Factor based investment analysis
  - Assets are thought of as bundles of risk factors – that both explain and produce an asset's return
  - Assets embed different combinations of risk factors
  - Factors can explain risk of both generic assets (indexed strategies) and more complex strategies (private asset classes)
  - Since factors can explain the risk of any asset they provide a means of aggregating exposures across an entire investment portfolio



# Total Plan Summary

- Currency Risk contributes 0.77% or 11.57% of Total Risk
  - Currency Risk, or exchange rate risk, results from the fact that currencies change in value relative to one another
  - The Currency Risk of the sample portfolio results from investments in international equity

## BarraOne Total Plan Summary

### Total Plan Summary

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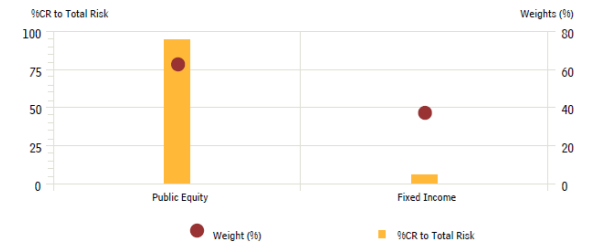
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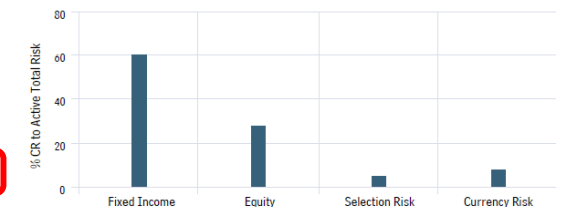
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### Asset Class Allocation



### Active Risk from Risk Factors



# Total Plan Summary

- Common Factor Risk is 5.87% or 88.04% of Total Risk
- The main components of Common Factor Risk are:
  - Equity Factor Risk - 5.57% or 83.62% of Total Risk
  - Fixed Income Factor Risk - 0.29% or 4.41% of Total Risk

## BarraOne Total Plan Summary

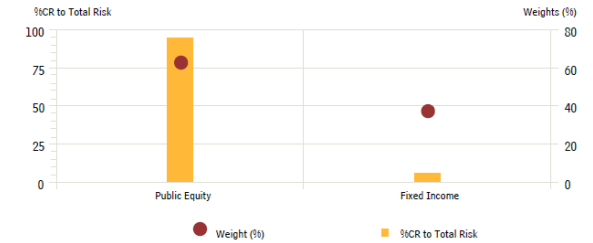
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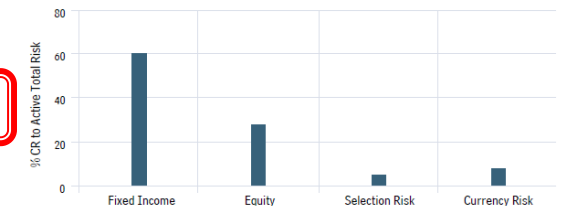
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### Active Risk from Risk Factors



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# Total Plan Summary

- Active Common Factor Risk is 82 bps
- The largely passive Equity asset class contributed only 26 bps (27.52%) to the Active Risk of the portfolio
- Fixed Income portfolio, which makes much greater use of active management, contributed 56 bps (60.19%) to the Active Risk of the portfolio

## BarraOne Total Plan Summary

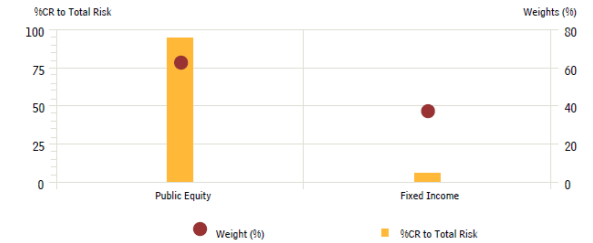
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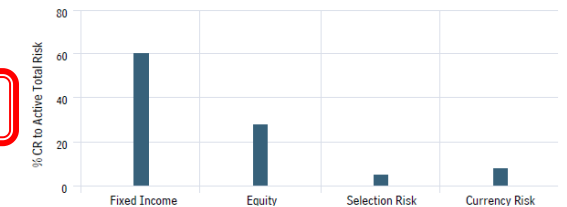
### Asset Class Allocation



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### Active Risk from Risk Factors



# Total Plan Summary

- Active risk can be decomposed into contributions from each asset class (down) and contributions from broad factors (across).
- The Fixed Income asset class contributes to both Fixed Income factor risk (29bps) and Equity factor risk (6bps) - due to investments in high yield and convertibles.

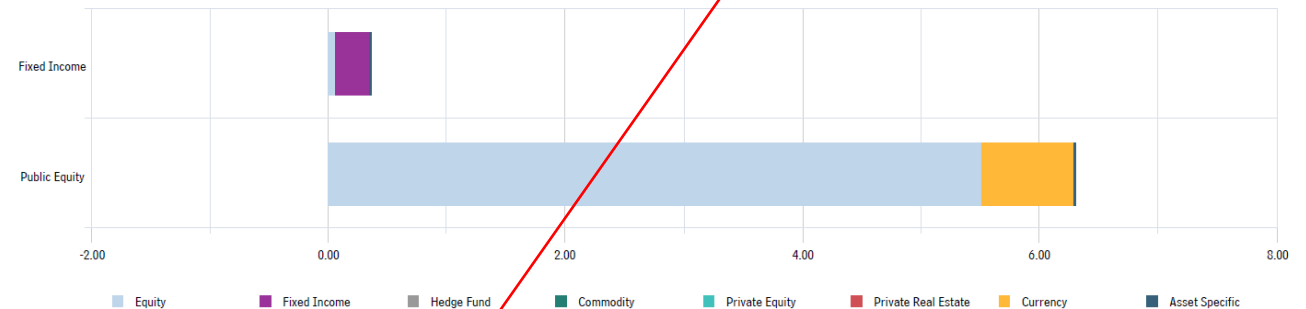
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### Risk Contribution Breakdown by Risk Type

Asset Name	Mkt Value	Weight (%)	Eff Weight (%)	Total Risk	%CR to Total Risk	Port Risk Contribution	Equity	Fixed Income	Hedge Fund	Commodity	Private Real Estate	Private Equity	Currency	Asset Specific
<b>Total</b>	<b>10,000,000,000</b>	<b>100.00</b>	<b>100.00</b>	<b>6.66</b>	<b>100.00</b>	<b>6.66</b>	<b>5.57</b>	<b>0.29</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.00</b>	<b>0.77</b>	<b>0.03</b>
Fixed Income	3,701,258,855	37.01	37.01	3.06	5.29	0.35	0.06	0.29	0.00	0.00	0.00	0.00	0.00	0.00
Public Equity	6,298,741,145	62.99	62.99	10.16	94.71	6.31	5.51	-0.00	0.00	0.00	0.00	0.00	0.77	0.03



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Source: MSCI

# Total Plan Summary

- Active risk can also be decomposed into Allocation Risk and Selection Risk
- Selection Risk refers to the risk arising from the managers' choice of specific securities

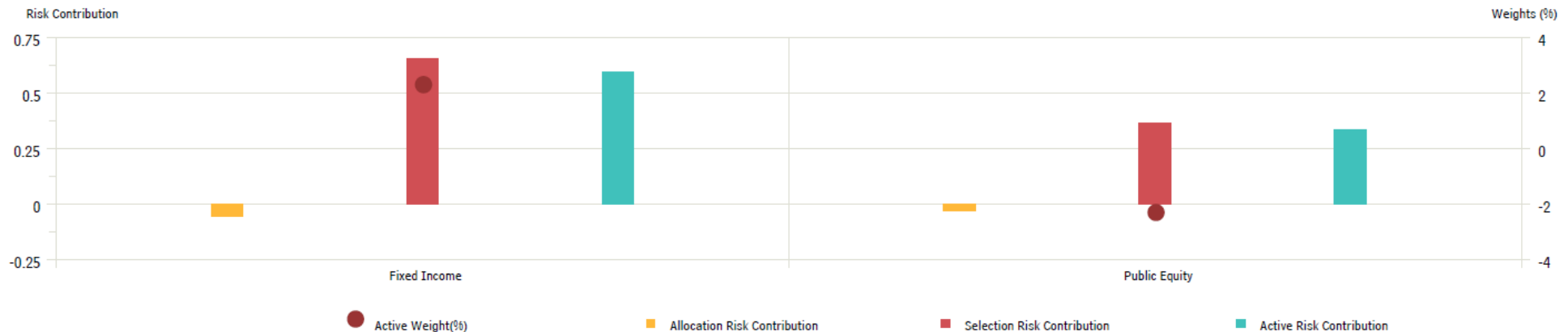
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### Allocation Selection

Asset Class	Active Weight(%)	Allocation			Selection			Active
		Volatility	Correlation	Risk Contribution	Volatility	Correlation	Risk Contribution	
<b>Active Total Risk</b>				<b>-0.03</b>			<b>1.02</b>	<b>0.94</b>
Fixed Income	2.35	7.58	-0.31	-0.06	2.41	0.73	0.65	0.60
Public Equity	-2.35	4.02	0.31	-0.03	0.95	0.62	0.37	0.34



Source: MSCI



# Total Plan Summary

- The Total Plan Risk Reports also break down Total and Active Risk by:
  - Region
  - Country
  - Currency
  - GICS Sector
  - Bond Sector
  - Bond Rating



# Stress Scenarios

## Top 10 Worst Scenarios

Scenario	Portfolio P&L	Benchmark P&L
2007-2009 Subprime and Credit Crisis	-38.51	-40.21
2008 - 2009 Global Financial Crisis	-32.03	-33.45
2007-2008 Equity Slow Grind	-11.54	-12.07
1987 Market Crash (Aug. to Nov.)	-10.89	-10.75
\$200 per Barrel - Oil Supply Shock	-10.76	-10.96
1998 Russian Financial Crisis	-9.72	-9.17
2001 Sept 11	-8.49	-8.86
2006 Emerging Market Crash	-8.34	-8.64
1990 Reunification of Germany	-7.64	-7.19
1994 US Rate Hike	-3.19	-5.29

Scenario	Portfolio P&L	Benchmark P&L
1994 US Rate Hike	-3.19	-5.29

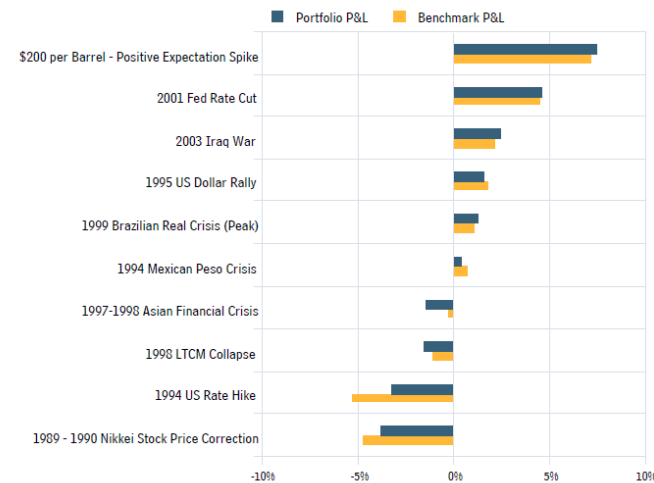
## BarraOne Total Plan Summary

COMPANY: Sample Total Plan  
 PORTFOLIO: Sample Total Plan  
 BENCHMARK: Sample Total Plan Policy  
 POSITIONS: 29,679  
 MODEL: BIM303L

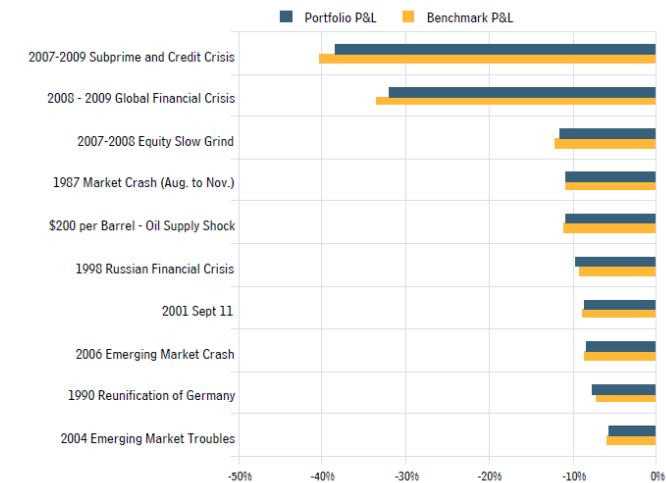
CURRENCY: USD  
 ANALYSIS DATE: February 28, 2018  
 MARKET VALUE: 10,000,000,000  
 ACCEPTED: 29,402

### Stress Scenarios

Top 10 Best Scenarios			
Scenario	Portfolio P&L	Benchmark P&L	Market Change (\$)
\$200 per Barrel - Positive Expectation S	7.49	7.14	749,052,202
2001 Fed Rate Cut	4.58	4.46	457,506,355
2003 Iraq War	2.43	2.18	242,695,000
1995 US Dollar Rally	1.53	1.72	152,841,188
1999 Brazilian Real Crisis (Peak)	1.24	1.06	123,894,237
1994 Mexican Peso Crisis	0.36	0.65	36,361,074
1997-1998 Asian Financial Crisis	-1.47	-0.32	-147,492,771
1998 LTCM Collapse	-1.54	-1.05	-154,374,834
1994 US Rate Hike	-3.19	-5.29	-318,745,127
1989 - 1990 Nikkei Stock Price Correctio	-3.83	-4.74	-382,742,021



Top 10 Worst Scenarios			
Scenario	Portfolio P&L	Benchmark P&L	Market Change (\$)
2007-2009 Subprime and Credit Crisis	-38.51	-40.21	-3,851,035,261
2008 - 2009 Global Financial Crisis	-32.03	-33.45	-3,202,785,444
2007-2008 Equity Slow Grind	-11.54	-12.07	-1,154,074,143
1987 Market Crash (Aug. to Nov.)	-10.89	-10.75	-1,088,646,477
\$200 per Barrel - Oil Supply Shock	-10.76	-10.96	-1,075,955,836
1998 Russian Financial Crisis	-9.72	-9.17	-971,881,864
2001 Sept 11	-8.49	-8.86	-849,463,402
2006 Emerging Market Crash	-8.34	-8.64	-834,465,404
1990 Reunification of Germany	-7.64	-7.19	-764,185,760
2004 Emerging Market Troubles	-5.55	-5.92	-554,745,268



Source: MSCI

# Q & A

# Appendix

# Equity Summary

- Equity Total Risk is 10.16%, while Benchmark Risk is 10.11%
- Active Risk (Tracking Error) is 0.95%
- The above suggests a significant allocation to passive strategies

## BarraOne Equity Summary

### Total Plan Summary

Risk Summary	
Statistic	Value
Total Risk	10.16
Benchmark Risk	10.11
Active Risk	0.95
Portfolio Beta	1.00

### Risk Factor Breakdown

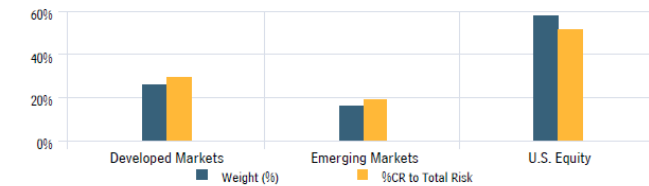
Risk Source	Portfolio			Active		
	Risk Contribution	% Risk	Correlation	Risk Contribution	% Risk	Correlation
<b>Total Risk</b>	<b>10.16</b>	<b>100.00</b>	<b>1.00</b>	<b>0.95</b>	<b>100.00</b>	<b>1.00</b>
Local Market Risk	9.02	88.81	0.98	0.79	82.45	0.86
Common Factor Risk	8.98	88.40	0.98	0.69	72.64	0.81
Equity	8.98	88.40	0.98	0.69	72.63	0.81
Style	0.29	2.86	0.68	0.15	16.27	0.43
Industry	8.69	85.54	0.97	0.54	56.37	0.68
Selection Risk	0.04	0.41	0.06	0.09	9.02	0.31
Currency Risk	1.14	11.19	0.51	0.17	17.55	0.34

Asset Class Contribution to Risk					
Asset Class	Mkt Value	Weight (%)	Total Risk	Risk Contribution	%CR to TR
<b>Total</b>	<b>6,298,741,145</b>	<b>100.00</b>	<b>10.16</b>	<b>10.16</b>	<b>100.00</b>
Developed Markets	1,649,386,079	26.19	12.31	2.97	29.27
Emerging Markets	1,000,622,619	15.89	14.75	1.97	19.35
U.S. Equity	3,648,732,447	57.93	9.64	5.22	51.37

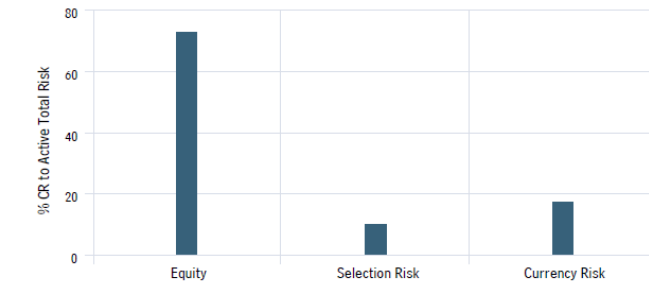
COMPANY: Sample Total Plan  
PORTFOLIO: Public Equity  
BENCHMARK: Public Equity Policy  
POSITIONS: 20,351  
MODEL: BIM303L

CURRENCY: USD  
ANALYSIS DATE: February 28, 2018  
MARKET VALUE: 6,298,741,145  
ACCEPTED: 20,235

### Asset Class Allocation



### Active Risk from Risk Factors



### Risk Summary

Statistic	Value
Total Risk	10.16
Benchmark Risk	10.11
Active Risk	0.95
Portfolio Beta	1.00

Source: MSCI



# Equity Summary

- Factors explain 72.64% of Total Active Risk
- The Style Factor contributes 16.27% of Total Active Risk
- The Industry Factor contributes 56.37% of Total Active Risk

## BarraOne Equity Summary

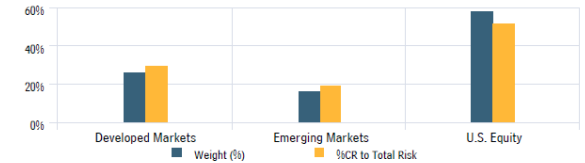
COMPANY: Sample Total Plan  
PORTFOLIO: Public Equity  
BENCHMARK: Public Equity Policy  
POSITIONS: 20,351  
MODEL: BIM303L

CURRENCY: USD  
ANALYSIS DATE: February 28, 2018  
MARKET VALUE: 6,298,741,145  
ACCEPTED: 20,235

### Total Plan Summary

Risk Summary		Asset Class Contribution to Risk					
Statistic	Value	Asset Class	Mkt Value	Weight (%)	Total Risk	Risk Contribution	%CR to TR
Total Risk	10.16	<b>Total</b>	<b>6,298,741,145</b>	<b>100.00</b>	<b>10.16</b>	<b>10.16</b>	<b>100.00</b>
Benchmark Risk	10.11	Developed Markets	1,649,386,079	26.19	12.31	2.97	29.27
Active Risk	0.95	Emerging Markets	1,000,622,619	15.89	14.75	1.97	19.35
Portfolio Beta	1.00	U.S. Equity	3,648,732,447	57.93	9.64	5.22	51.37

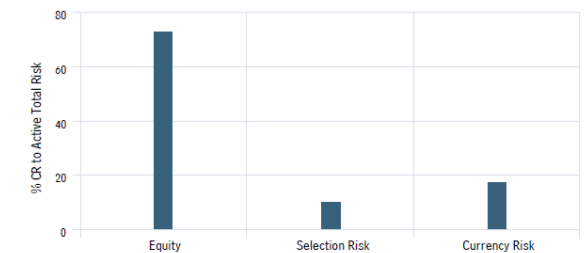
### Asset Class Allocation



### Risk Factor Breakdown

Risk Source	Portfolio			Active		
	Risk Contribution	% Risk	Correlation	Risk Contribution	% Risk	Correlation
<b>Total Risk</b>	<b>10.16</b>	<b>100.00</b>	<b>1.00</b>	<b>0.95</b>	<b>100.00</b>	<b>1.00</b>
Local Market Risk	9.02	88.81	0.98	0.79	82.45	0.86
Common Factor Risk	8.98	88.40	0.98	0.69	72.64	0.81
Equity	8.98	88.40	0.98	0.69	72.63	0.81
Style	0.29	2.86	0.68	0.15	16.27	0.43
Industry	8.69	85.54	0.97	0.54	56.37	0.68
Selection Risk	0.04	0.41	0.06	0.09	9.82	0.31
Currency Risk	1.14	11.19	0.51	0.17	17.55	0.34

### Active Risk from Risk Factors



### Risk Decomposition

Risk Source	Portfolio			Active		
	Risk Contribution	% Risk	Correlation	Risk Contribution	% Risk	Correlation
<b>Total Risk</b>	<b>10.16</b>	<b>100.00</b>	<b>1.00</b>	<b>0.95</b>	<b>100.00</b>	<b>1.00</b>
Local Market Risk	9.02	88.81	0.98	0.79	82.45	0.86
Common Factor Risk	8.98	88.40	0.98	0.69	72.64	0.81
Equity	8.98	88.40	0.98	0.69	72.63	0.81
Style	0.29	2.86	0.68	0.15	16.27	0.43
Industry	8.69	85.54	0.97	0.54	56.37	0.68
Selection Risk	0.04	0.41	0.06	0.09	9.82	0.31
Currency Risk	1.14	11.19	0.51	0.17	17.55	0.34

Source: MSCI

# Fixed Income Summary

- Fixed Income Total Risk is 3.06%
- Active Risk is 2.41%

## Risk Summary

Statistic	Value
Total Risk	3.06
Benchmark Risk	5.06
Active Risk	2.41
Portfolio Beta	0.57
Cont. to Eff. Duration	5.93
Convexity	0.62
Yield to Worst (%)	3.17
OAS to Swap (bp)	98.42

## BarraOne Fixed Income Summary

### Total Plan Summary

Risk Summary	
Statistic	Value
Total Risk	3.06
Benchmark Risk	5.06
Active Risk	2.41
Portfolio Beta	0.57
Cont. to Eff. Duration	5.93
Convexity	0.62
Yield to Worst (%)	3.17
OAS to Swap (bp)	98.42

Asset Class Contribution to Risk						
Asset Class	Mkt Value	Weight (%)	Total Risk	Risk Contribution	%CR to TR	
Total	3,701,258,855	100.00	3.06	3.06	100.00	
Bank Loans	212,269,305	5.74	4.00	0.03	1.02	
Convertible Bonds	137,617,160	3.72	5.40	0.04	1.43	
Core-Core Plus	96,876,101	2.62	3.79	0.09	3.11	
Credit	595,042,672	16.08	3.63	0.56	18.36	
High Yield	481,714,205	13.01	6.22	0.32	10.55	
Mortgages	317,801,558	8.59	5.90	0.42	13.78	
ST Treasury	556,887,466	15.05	0.83	0.07	2.42	
TIPS	477,852,094	12.91	3.70	0.40	13.23	
Treasury-Agency	824,469,568	22.28	6.20	1.10	36.10	

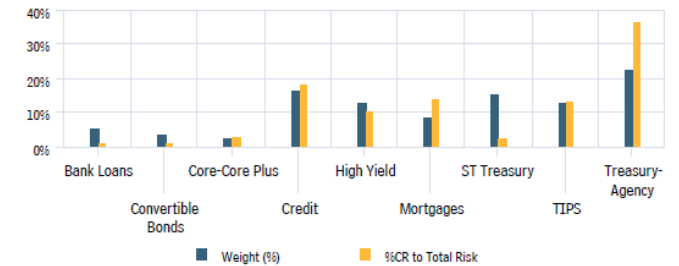
### Risk Factor Breakdown

Risk Decomposition						
Risk Source	Portfolio			Active		
	Risk Contribution	% Risk	Correlation	Risk Contribution	% Risk	Correlation
Total Risk	3.06	100.00	1.00	2.41	100.00	1.00
Local Market Risk	3.06	99.99	1.00	2.41	99.99	1.00
Common Factor Risk	3.05	99.68	1.00	2.40	99.57	1.00
Equity	0.01	0.23	0.04	0.06	2.53	0.35
Style	-0.00	-0.06	-0.04	0.02	0.62	0.36
Industry	0.01	0.29	0.06	0.05	1.90	0.32
Fixed Income	3.04	99.45	1.00	2.34	97.04	1.00
Nominal Rates	2.20	71.91	0.80	2.35	97.71	0.99
Real Rates	0.41	13.27	0.85	0.08	3.20	0.64
Credit	0.44	14.28	0.27	-0.09	-3.86	-0.50
Selection Risk	0.01	0.31	0.06	0.01	0.42	0.07

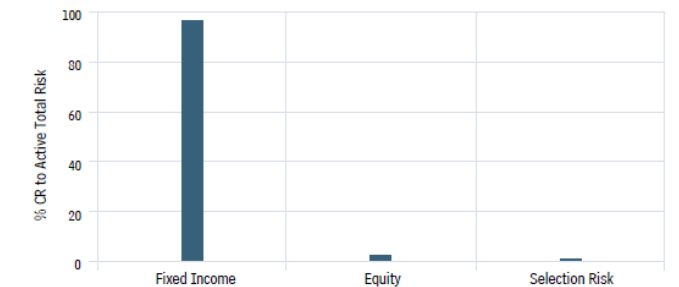
COMPANY: Sample Total Plan  
PORTFOLIO: Fixed Income  
BENCHMARK: Fixed Income Policy  
POSITIONS: 9,328  
MODEL: BIM303L

CURRENCY: USD  
ANALYSIS DATE: February 28, 2018  
MARKET VALUE: 3,701,258,855  
ACCEPTED: 9,167

### Asset Class Allocation



### Active Risk from Risk Factors



Source: MSCI

# Fixed Income Summary

- Factor Risk is 3.05%, which includes Equity Factor Risk of 0.01% and Fixed Income Factor Risk of 3.04%
- The Equity Factor Risk comes from holdings of High Yield bonds and convertibles

Risk Decomposition						
Risk Source	Portfolio			Active		
	Risk Contribution	% Risk	Correlation	Risk Contribution	% Risk	Correlation
<b>Total Risk</b>	<b>3.06</b>	<b>100.00</b>	<b>1.00</b>	<b>2.41</b>	<b>100.00</b>	<b>1.00</b>
Local Market Risk	3.06	99.99	1.00	2.41	99.99	1.00
Common Factor Risk	3.05	99.68	1.00	2.40	99.57	1.00
Equity	0.01	0.23	0.04	0.06	2.53	0.35
Style	-0.00	-0.06	-0.04	0.02	0.62	0.36
Industry	0.01	0.29	0.06	0.05	1.90	0.32
Fixed Income	3.04	99.45	1.00	2.34	97.04	1.00
Nominal Rates	2.20	71.91	0.80	2.35	97.71	0.99
Real Rates	0.41	13.27	0.85	0.08	3.20	0.64
Credit	0.44	14.28	0.27	-0.09	-3.86	-0.50
Selection Risk	0.01	0.31	0.06	0.01	0.42	0.07

## BarraOne Fixed Income Summary

### Total Plan Summary

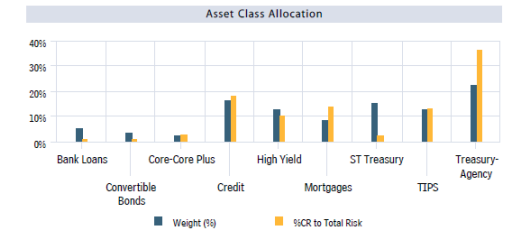
Risk Summary		Asset Class Contribution to Risk					
Statistic	Value	Asset Class	Mkt Value	Weight (%)	Total Risk	Risk Contribution	%CR to TR
Total Risk	3.06	Total	3,701,258,855	100.00	3.06	3.06	100.00
Benchmark Risk	5.06	Bank Loans	212,269,305	5.74	4.00	0.03	1.02
Active Risk	2.41	Convertible Bonds	137,617,160	3.72	5.40	0.04	1.43
Portfolio Beta	0.57	Core-Core Plus	96,876,101	2.62	3.79	0.09	3.11
Cont. to Eff. Duration	5.93	Credit	595,042,672	16.08	3.63	0.56	18.36
Convexity	0.62	High Yield	481,714,205	13.01	6.22	0.32	10.55
Yield to Worst (1s)	3.17	Mortgages	317,801,558	8.59	5.90	0.42	13.78
OAS to Swap (bp)	98.42	ST Treasury	556,887,466	15.05	0.83	0.07	2.42
		TIPS	477,852,094	12.91	3.70	0.40	13.23
		Treasury-Agency	824,469,568	22.28	6.20	1.10	36.10

### Risk Factor Breakdown

Risk Decomposition						
Risk Source	Portfolio			Active		
	Risk Contribution	% Risk	Correlation	Risk Contribution	% Risk	Correlation
<b>Total Risk</b>	<b>3.06</b>	<b>100.00</b>	<b>1.00</b>	<b>2.41</b>	<b>100.00</b>	<b>1.00</b>
Local Market Risk	3.06	99.99	1.00	2.41	99.99	1.00
Common Factor Risk	3.05	99.68	1.00	2.40	99.57	1.00
Equity	0.01	0.23	0.04	0.06	2.53	0.35
Style	-0.00	-0.06	-0.04	0.02	0.62	0.36
Industry	0.01	0.29	0.06	0.05	1.90	0.32
Fixed Income	3.04	99.45	1.00	2.34	97.04	1.00
Nominal Rates	2.20	71.91	0.80	2.35	97.71	0.99
Real Rates	0.41	13.27	0.85	0.08	3.20	0.64
Credit	0.44	14.28	0.27	-0.09	-3.86	-0.50
Selection Risk	0.01	0.31	0.06	0.01	0.42	0.07

COMPANY: Sample Total Plan  
PORTFOLIO: Fixed Income  
BENCHMARK: Fixed Income Policy  
POSITIONS: 9,328  
MODEL: BIM303L

CURRENCY: USD  
ANALYSIS DATE: February 28, 2018  
MARKET VALUE: 3,701,258,855  
ACCEPTED: 9,167



# Fixed Income Summary

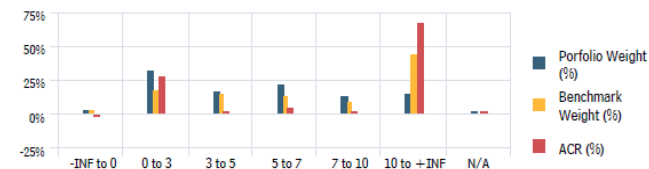
- Term Structure:
  - Shift: Parallel shift in the curve
  - Twist: Steepening of the curve
  - Butterfly: Curvature of the curve
- Key Rate Duration Table: changes in asset value given independent perturbations of 100 bps to each point of the yield curve

## BarraOne Fixed Income Summary

### Portfolio by Factor Breakdowns

Spread Factor	Top 10 Spread Factor						Contribution (Residual)		
	Volatility	Exposure (Residual)				Correlation Active Port	to TR	to AR	to AR%
		Portfolio	Benchmark	Active	MCAR				
US Energy CCC	10.26	0.01	0.00	0.01	0.03	0.33	0.01	0.03	1.38
US Swap Shift	0.18	2.64	2.07	0.57	0.00	0.25	-0.07	0.03	1.09
US Financials BBB	0.55	0.21	0.09	0.12	0.00	0.27	0.02	0.02	0.74
US Health Care CCC	2.46	0.01	-0.00	0.01	0.01	0.28	0.00	0.01	0.39
US Energy BBB	0.81	0.08	0.05	0.03	0.00	0.23	0.01	0.00	0.20
US Financials Real Estate BBB	0.52	0.04	0.02	0.03	0.00	0.28	0.00	0.00	0.16
US Consumer Staples CCC	1.96	0.01	0.00	0.01	0.01	0.34	0.00	0.00	0.16
US Materials CCC	3.71	0.00	-0.00	0.00	0.01	0.36	0.00	0.00	0.14
US Swap Twist	0.10	0.71	0.46	0.25	0.00	0.13	-0.01	0.00	0.14
US Materials BBB	0.59	0.04	0.02	0.02	0.00	0.27	0.00	0.00	0.14

### %CR to Active Risk by Duration Buckets



COMPANY: Sample Total Plan  
 PORTFOLIO: Fixed Income  
 BENCHMARK: Fixed Income Policy  
 POSITIONS: 9,328  
 MODEL: BIM303L

CURRENCY: USD  
 ANALYSIS DATE: February 28, 2018  
 MARKET VALUE: 3,701,258,855  
 ACCEPTED: 9,167

Top 10 Term Structure									
		Exposure (Residual)				Correlation	Contribution (Residual)		
Term Structure	Volatility	Portfolio	Benchmark	Active	MCAR	Active Port	to TR	to AR	to AR%
US Shift	0.50	4.94	8.51	-3.57	-0.00	-0.86	1.95	1.54	64.11
US Twist	0.21	1.72	6.42	-4.70	-0.00	-0.85	0.19	0.84	34.77
US Inflation-protected	0.51	0.98	1.24	-0.26	-0.00	-0.42	0.39	0.05	2.28
US Inflation-protected	0.36	0.31	0.45	-0.14	-0.00	-0.45	0.01	0.02	0.90
US Inflation-protected	0.17	-0.30	-0.31	0.01	0.00	0.19	0.01	0.00	0.02
CA Butterfly	0.11	-0.00	0.00	-0.00	0.00	0.42	0.00	-0.00	-0.00
CA Twist	0.18	0.00	0.00	0.00	-0.00	-0.49	0.00	-0.00	-0.00
US Municipal Butterfly	0.15	-0.00	0.00	-0.00	0.00	0.16	0.00	-0.00	-0.00
CA Shift	0.47	0.00	0.00	0.00	-0.00	-0.62	0.00	-0.00	-0.01
US Municipal Twist	0.26	0.01	0.00	0.01	-0.00	-0.42	0.00	-0.00	-0.04

### Key Rate Duration

	Cont. To Eff. Dur	Key Rate Duration									
		1 Yr	2 Yrs	5 Yrs	7 Yrs	10 Yrs	15 Yrs	20 Yrs	25 Yrs	30 Yrs	40 Yrs
Portfolio	5.93	0.11	0.27	0.71	1.08	0.96	0.37	0.45	0.91	0.61	0.01
Benchmark	9.74	0.08	0.15	0.60	0.82	0.93	0.80	1.29	2.95	1.76	0.01
Active	-3.81	0.04	0.12	0.11	0.26	0.03	-0.42	-0.83	-2.05	-1.15	0.01

Source: MSCI

# Fixed Income Summary

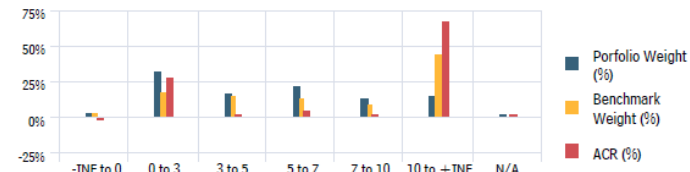
The factor exposure column represents the sensitivity of the portfolio to moves in term structure or spread factors

## BarraOne Fixed Income Summary

### Portfolio by Factor Breakdowns

Spread Factor	Top 10 Spread Factor								
	Exposure (Residual)					Correlation		Contribution (Residual)	
	Volatility	Portfolio	Benchmark	Active	MCAR	Active Port	to TR	to AR	to AR%
US Energy CCC	10.26	0.01	0.00	0.01	0.03	0.33	0.01	0.03	1.38
US Swap Shift	0.18	2.64	2.07	0.57	0.00	0.25	-0.07	0.03	1.09
US Financials BBB	0.55	0.21	0.09	0.12	0.00	0.27	0.02	0.02	0.74
US Health Care CCC	2.46	0.01	-0.00	0.01	0.01	0.28	0.00	0.01	0.39
US Energy BBB	0.81	0.08	0.05	0.03	0.00	0.23	0.01	0.00	0.20
US Financials Real Estate BBB	0.52	0.04	0.02	0.03	0.00	0.28	0.00	0.00	0.16
US Consumer Staples CCC	1.96	0.01	0.00	0.01	0.01	0.34	0.00	0.00	0.16
US Materials CCC	3.71	0.00	-0.00	0.00	0.01	0.36	0.00	0.00	0.14
US Swap Twist	0.10	0.71	0.46	0.25	0.00	0.13	-0.01	0.00	0.14
US Materials BBB	0.59	0.04	0.02	0.02	0.00	0.27	0.00	0.00	0.14

### %CR to Active Risk by Duration Buckets

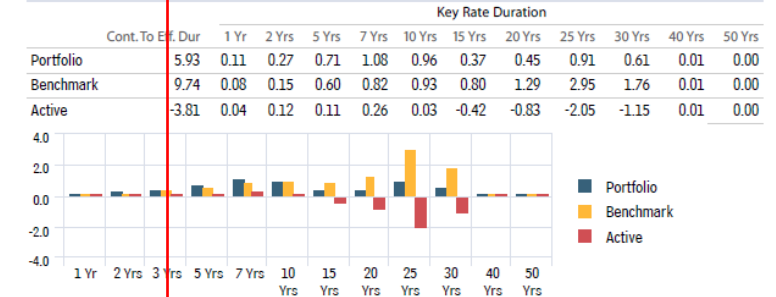


COMPANY: Sample Total Plan  
PORTFOLIO: Fixed Income  
BENCHMARK: Fixed Income Policy  
POSITIONS: 9,328  
MODEL: BIM303L

CURRENCY: USD  
ANALYSIS DATE: February 28, 2018  
MARKET VALUE: 3,701,258,855  
ACCEPTED: 9,167

Term Structure	Top 10 Term Structure								
	Exposure (Residual)					Correlation		Contribution (Residual)	
	Volatility	Portfolio	Benchmark	Active	MCAR	Active Port	to TR	to AR	to AR%
US Shift	0.50	4.94	8.51	-3.57	-0.00	-0.86	1.95	1.54	64.11
US Twist	0.21	1.72	6.42	-4.70	-0.00	-0.85	0.19	0.84	34.77
US Inflation-protected	0.51	0.98	1.24	-0.26	-0.00	-0.42	0.39	0.05	2.28
US Inflation-protected	0.36	0.31	0.45	-0.14	-0.00	-0.45	0.01	0.02	0.90
US Inflation-protected	0.17	-0.30	-0.31	0.01	0.00	0.19	0.01	0.00	0.02
CA Butterfly	0.11	-0.00	0.00	-0.00	0.00	0.42	0.00	-0.00	-0.00
CA Twist	0.18	0.00	0.00	0.00	-0.00	-0.49	0.00	-0.00	-0.00
US Municipal Butterfly	0.15	-0.00	0.00	-0.00	0.00	0.16	0.00	-0.00	-0.00
CA Shift	0.47	0.00	0.00	0.00	-0.00	-0.62	0.00	-0.00	-0.01
US Municipal Twist	0.26	0.01	0.00	0.01	-0.00	-0.42	0.00	-0.00	-0.04

### Key Rate Duration



Term Structure	Volatility	Exposure Portfolio
US Shift	0.50	4.94
US Twist	0.21	1.72
US Inflation-protected	0.51	0.98
US Inflation-protected	0.36	0.31
US Inflation-protected	0.17	-0.30
CA Butterfly	0.11	-0.00
CA Twist	0.18	0.00
US Municipal Butterfly	0.15	-0.00
CA Shift	0.47	0.00
US Municipal Twist	0.26	0.01

Source: MSCI

**QUESTIONS?**

## Asset Allocation Discussion

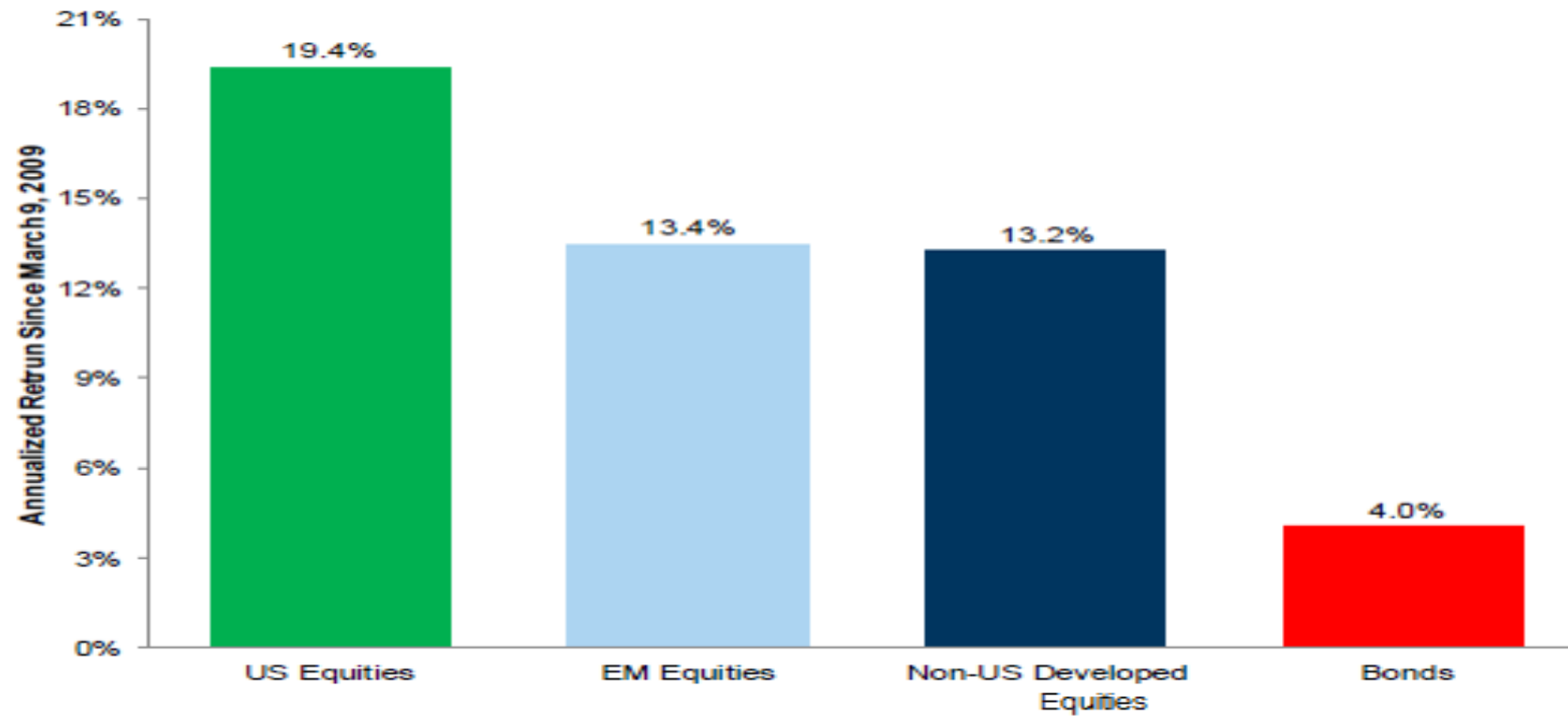
# ASSET ALLOCATION UPDATE



# Asset Allocation Review - Global Macro Update

- Annualized Asset Class Returns

## 2. Annualized Asset Class Returns Since March 9, 2009



Source: Goldman Sachs



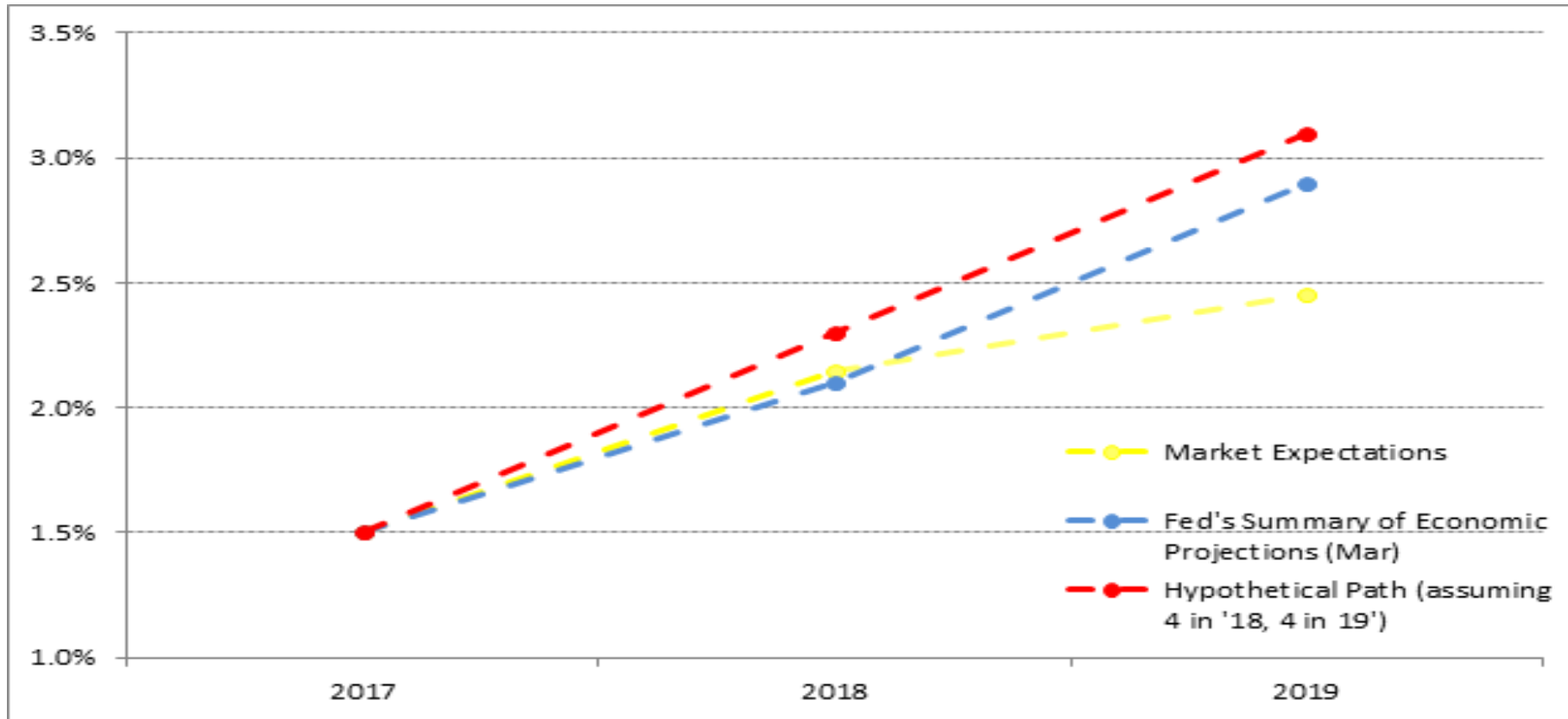
# Asset Allocation Review - Global Macro Update

- Global QE continues to slow
- Policy Rate increases (US, Canada, and UK)
- Increased fiscal stimulus (Tax Cut and Job Act, Dec. '17 and Bipartisan Budget Act, Jan. '18)
- Valuations



# Asset Allocation Review - Global Macro Update

- Probable FOMC rate increases not priced into markets



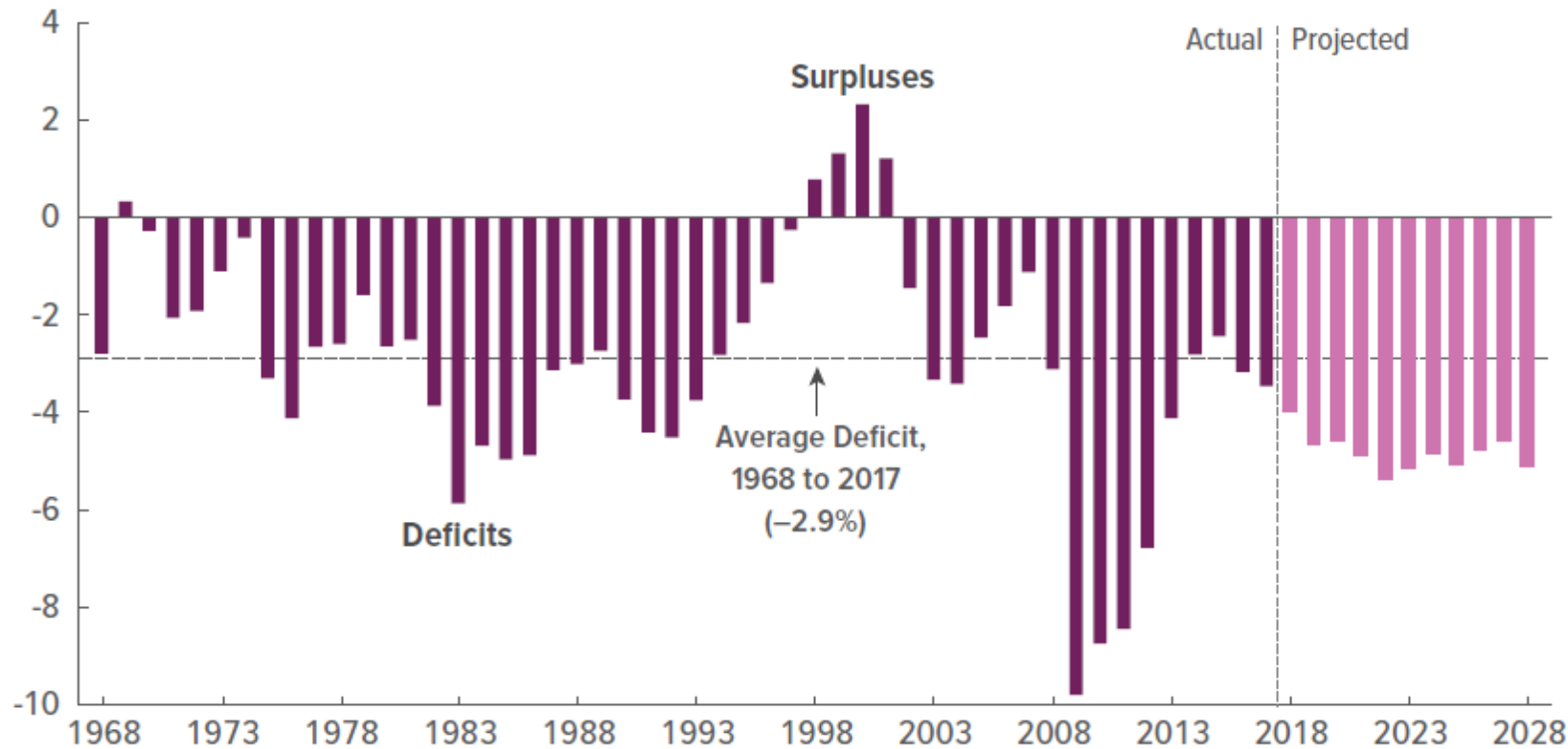
Source: Morgan Stanley



# Asset Allocation Review - Global Macro Update

- Total deficits or surpluses

Percentage of Gross Domestic Product



Deficits as a percentage of gross domestic product are projected to increase over the next few years and then largely stabilize. They exceed their 50-year average throughout the 2018–2028 period.

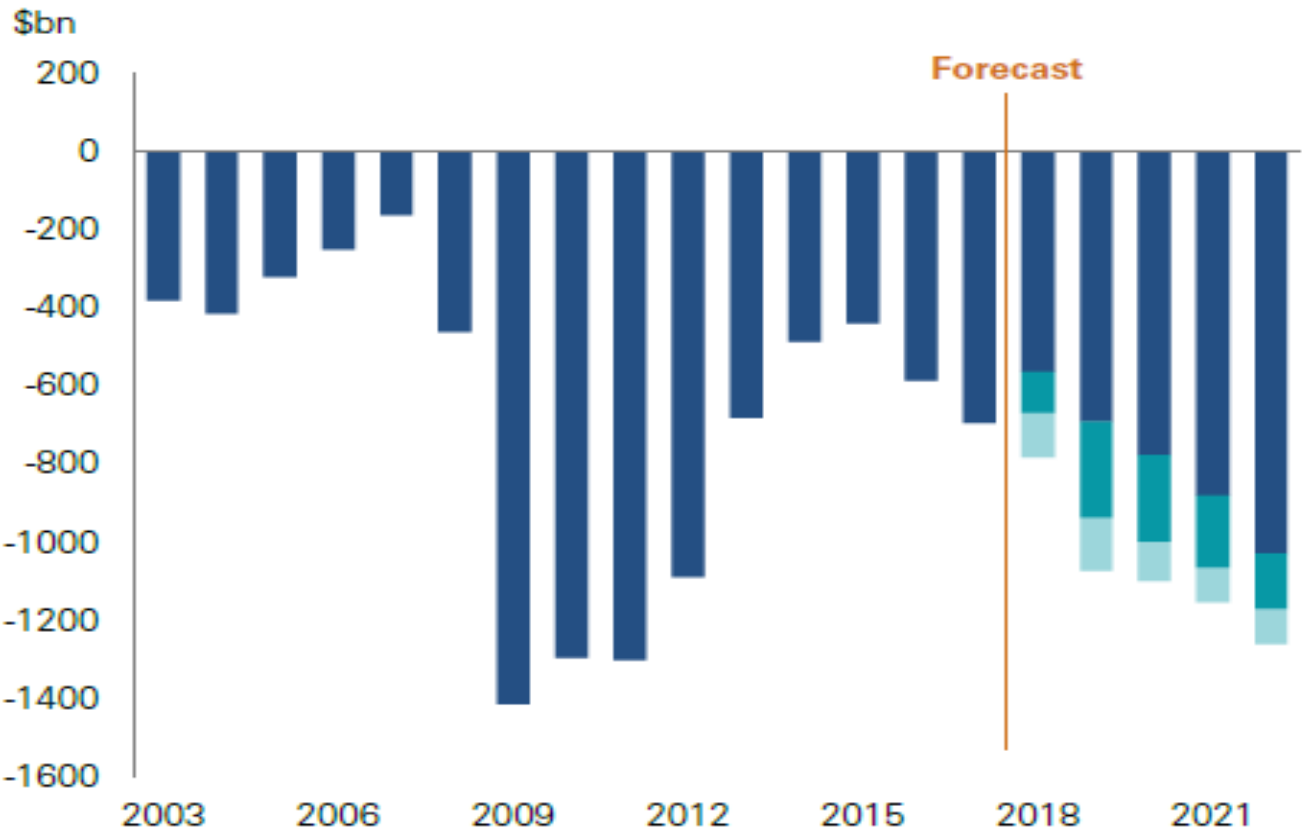
Source: Congressional Budget Office



# Asset Allocation Review - Global Macro Update

## Fiscal Deficit: Further Deterioration

Impact on US Fiscal Deficit From Tax Reform and Budget Act



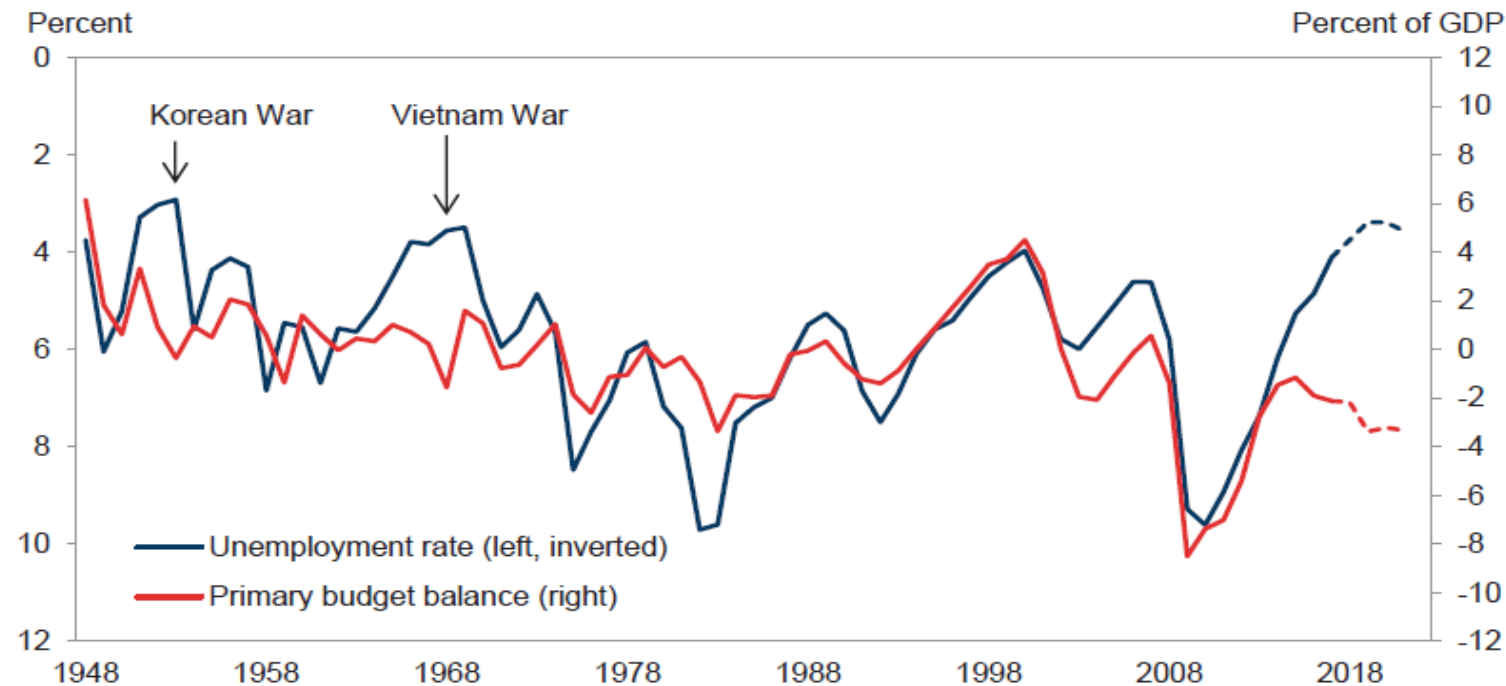
Source: CBO via Haver. Data as of February 2018.

	Increase in spending caps
	Tax reform (JCT)
	CBO Baseline (June 2017)



# Asset Allocation Review - Global Macro Update

- Unprecedented late-cycle fiscal stimulus.



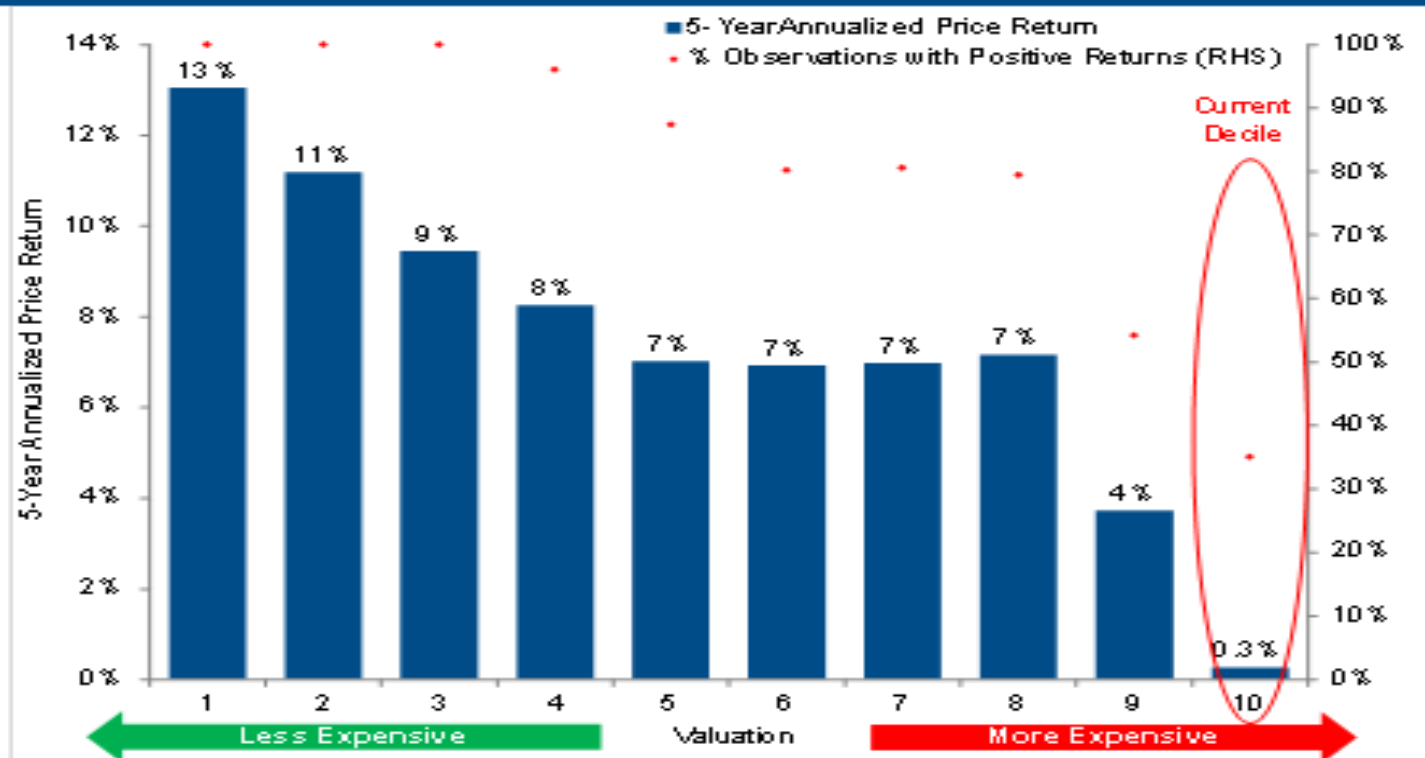
Source: Department of Labor, Office of Management and Budget, Goldman Sachs Global Investment Research



# Asset Allocation Review - Global Macro Update

## • US Equity Valuations

2. US Equity Price Returns from Each Valuation Decile<sup>2</sup> – February 2018



Valuation model (over the last 70 years) uses five inputs:

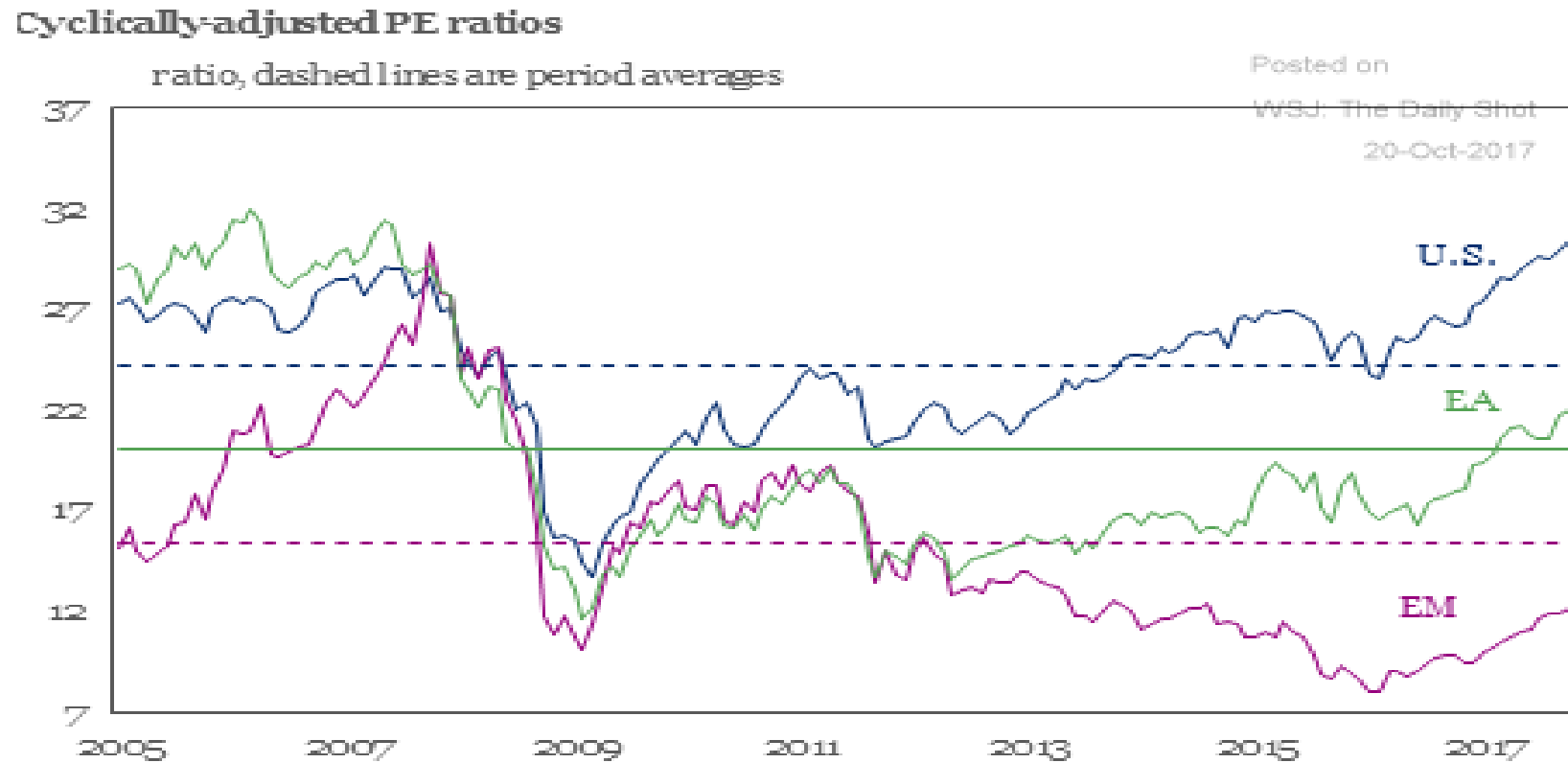
1. Price/trend earnings
2. Price/peak earnings
3. Price/trailing 12-mo earnings
4. Schiller CAPE ratio
5. Price/10-yr average earnings.

Source: Goldman Sachs



# Asset Allocation Review - Global Macro Update

- Global Equity Valuations



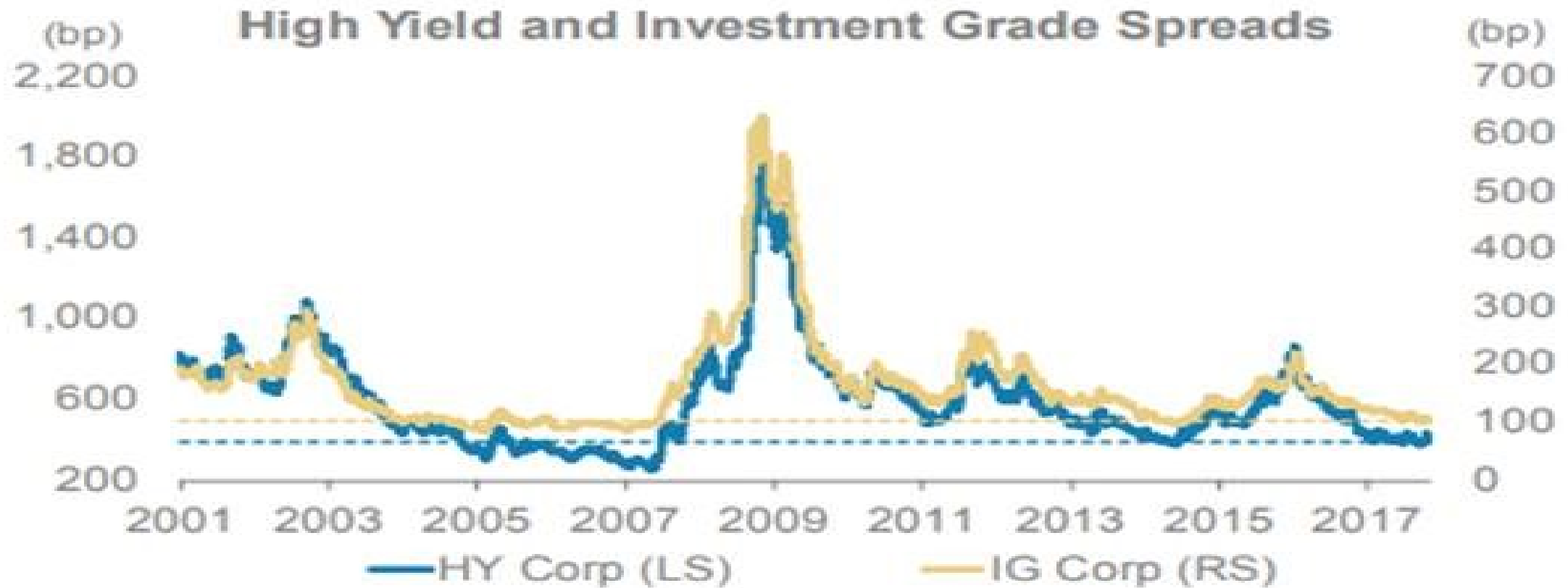
Source: Wall Street Journal





# Asset Allocation Review - Global Macro Update

- Credit Valuations

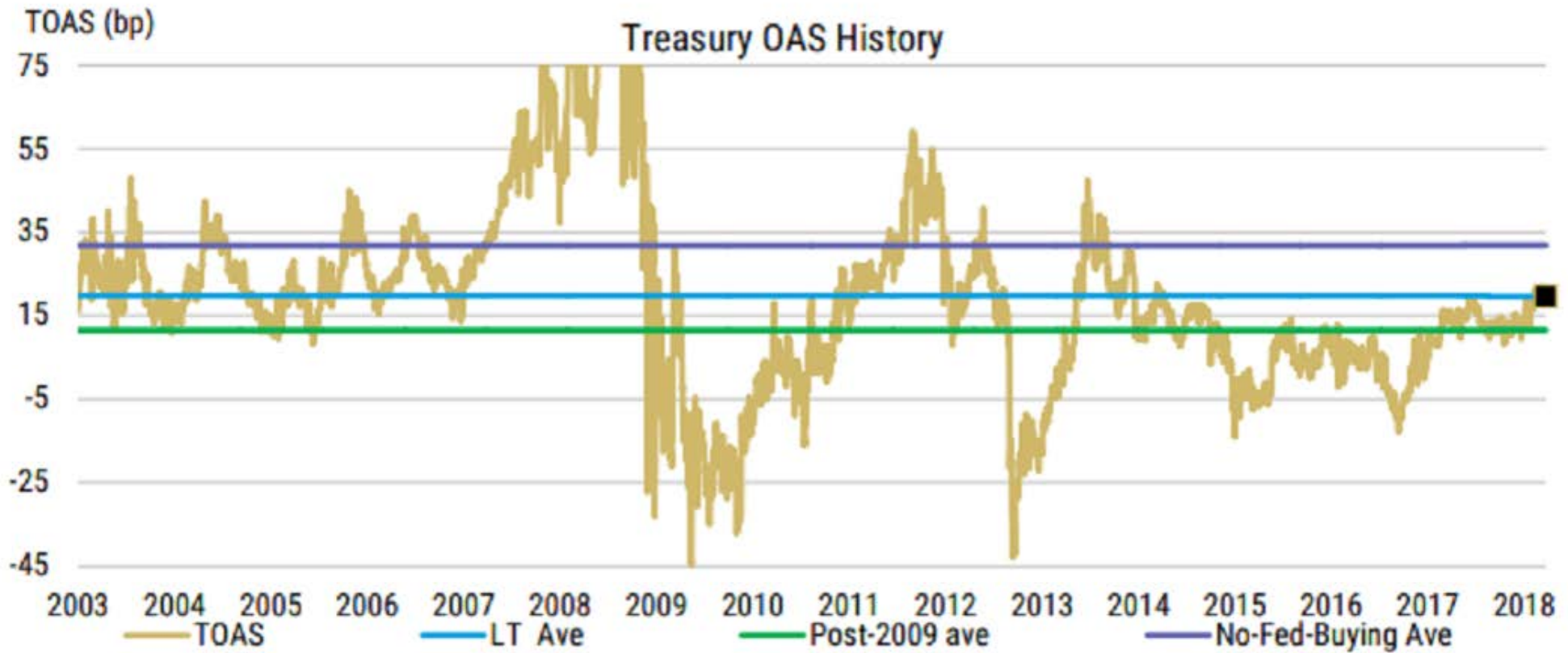


Source: Morgan Stanley, Citigroup Index LLC



# Asset Allocation Review - Global Macro Update

- MBS Valuations



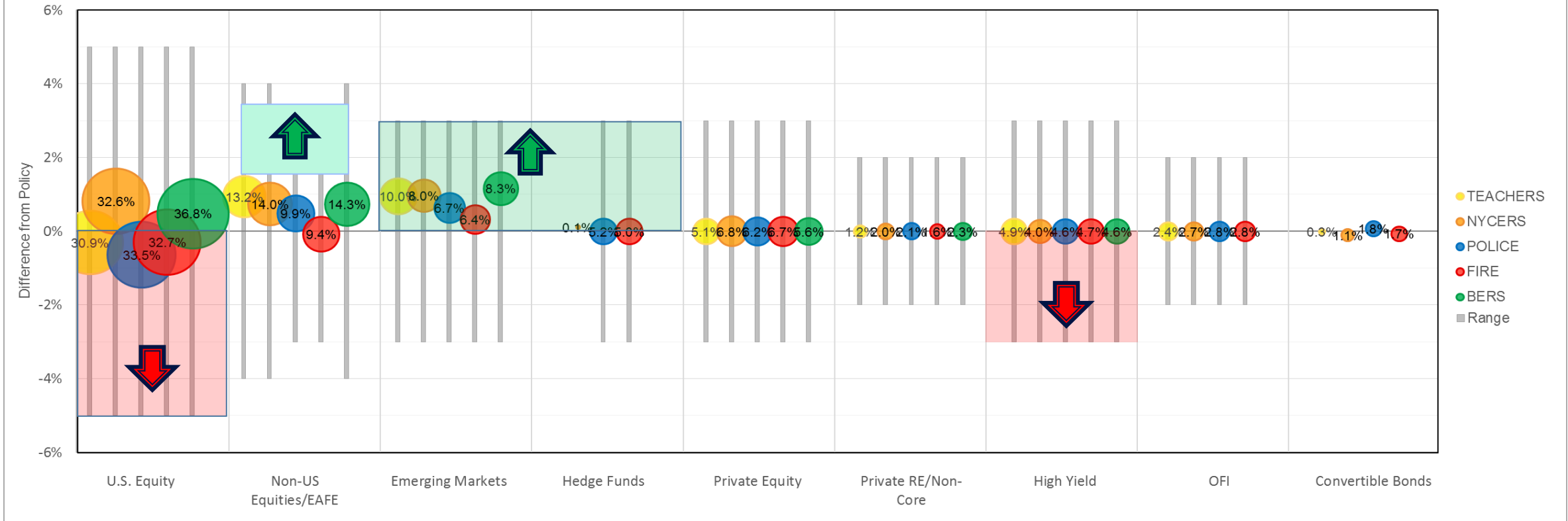
Source: Morgan Stanley



# Asset Allocation Review – Growth Assets

## Relative Mix to Adjusted New Policy Weights (12-31-2017)

Policy vs Actual Asset Allocation - Growth

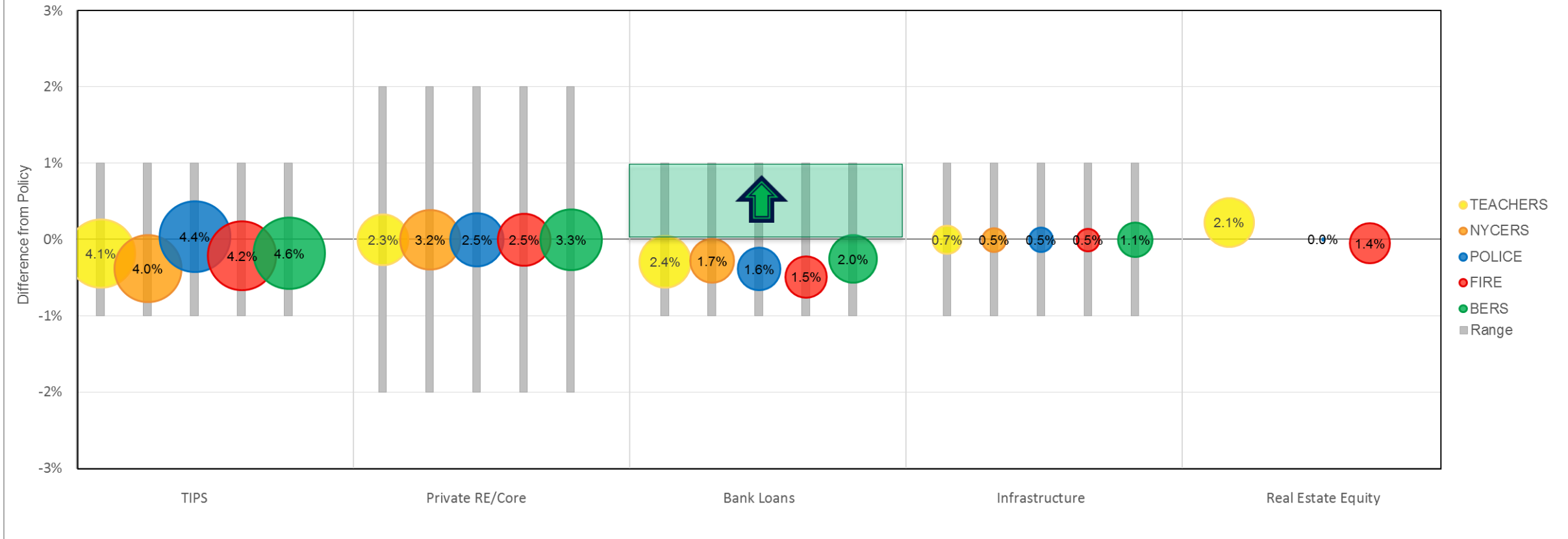


Source: State Street

# Asset Allocation Review – Inflation Protection Assets

## Relative Mix to Adjusted New Policy Weights (12-31-2017)

Policy vs Actual Asset Allocation - Inflation Protection

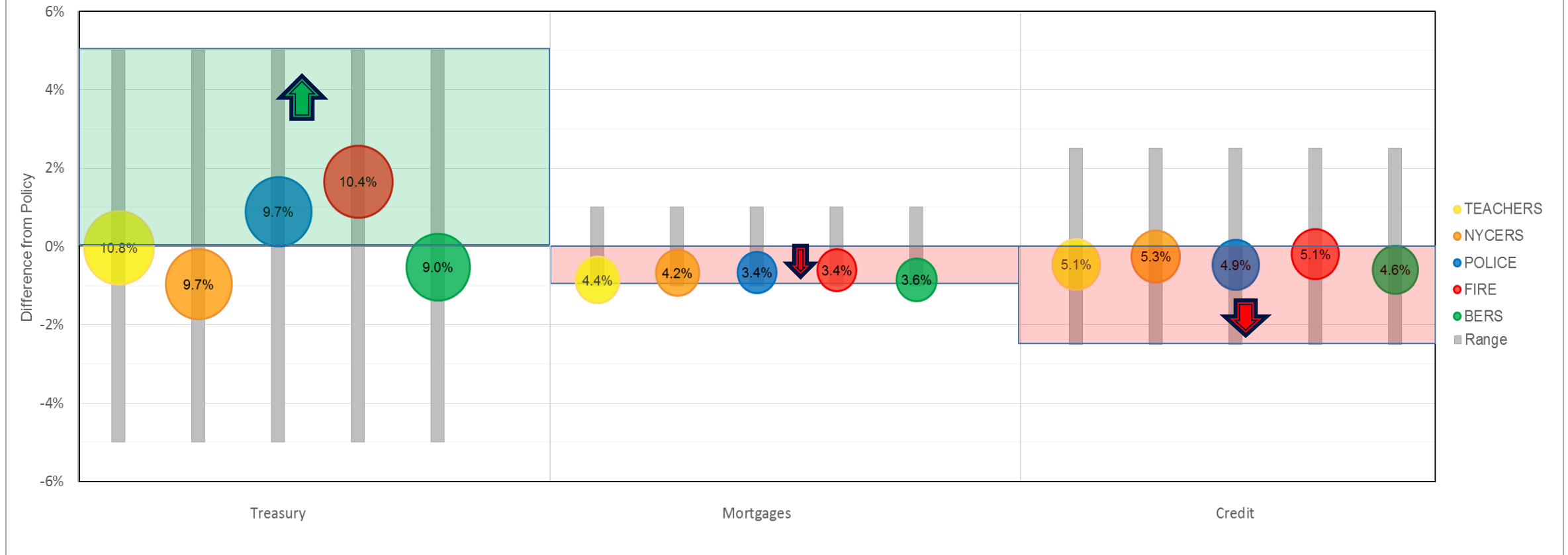


Source: State Street

# Asset Allocation Review - Deflation Protection Assets

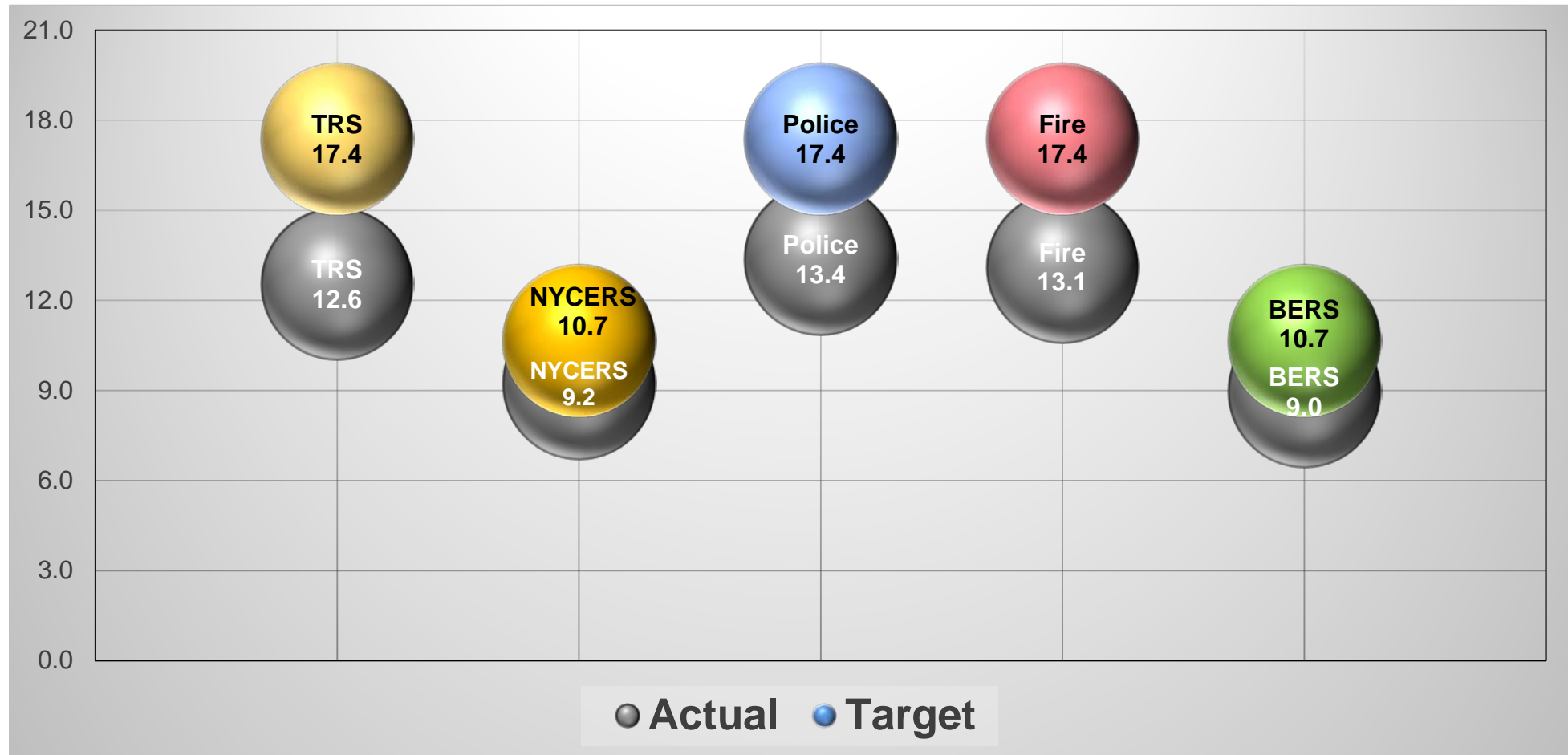
## Relative Mix to Adjusted New Policy Weights (12-31-2017)

Policy vs Actual Asset Allocation - Deflation Protection



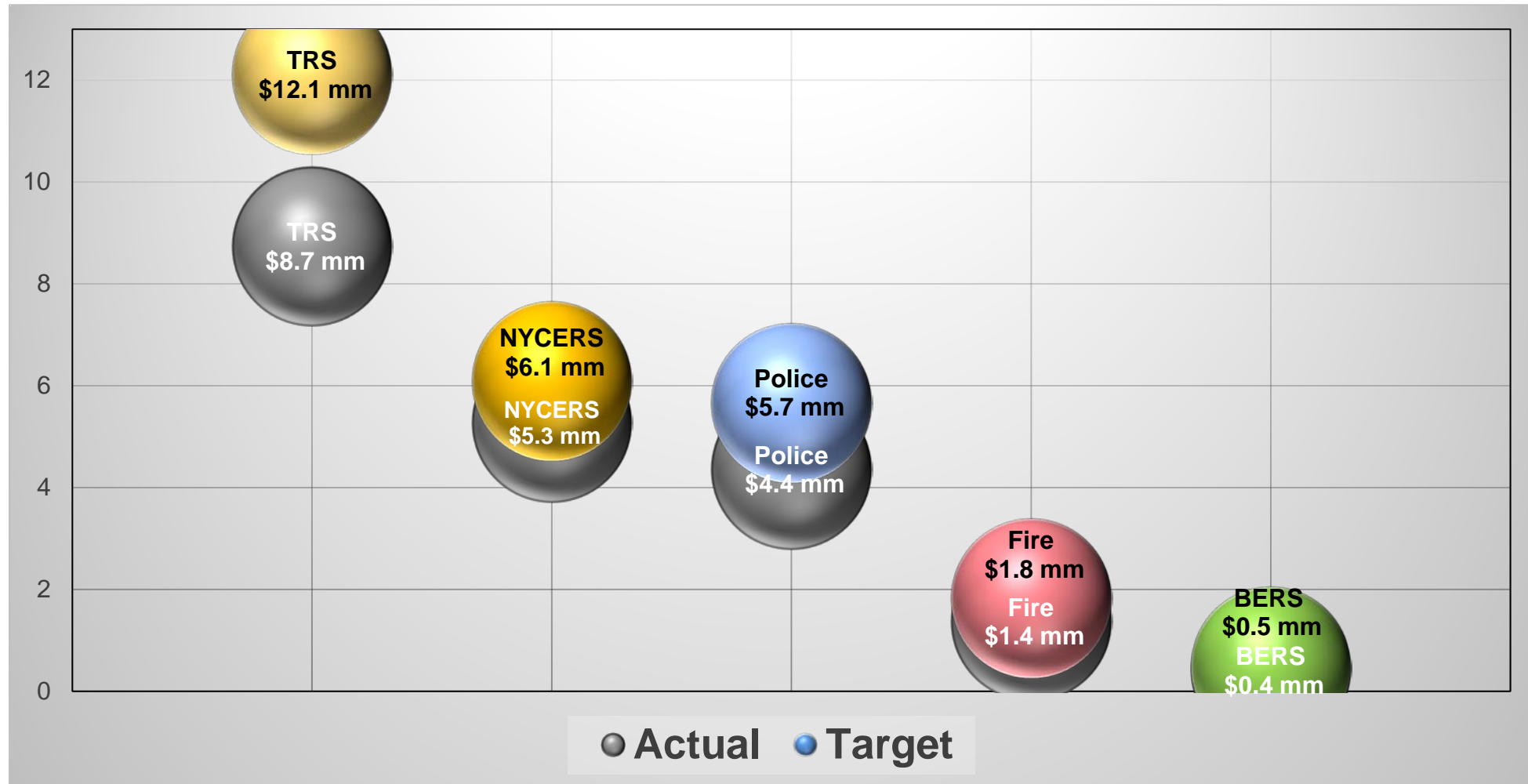
Source: State Street

# Asset Allocation Review – Current UST Duration as compared to target (12-31-2017)



Source: State Street

# Asset Allocation Review – Current UST Portfolio (dollar value/basis point) as compared to target as of 12/31/17



Source: State Street

# STRATEGIC ASSET ALLOCATION PROGRESS REPORT