



PERSPECTIVES THAT DRIVE ENTERPRISE SUCCESS



JUNE 6, 2018

Asset Liability Study: Phase 5

Fresno County Employees' Retirement Association

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Executive summary

At the May meeting, the Board of Trustees narrowed down potential asset allocation alternatives and requested Verus come back with a few more granular mixes. The following presentation reviews the risk and return characteristics of several mixes along with next steps for implementation.

Relative to the current policy, each alternative mix is incrementally more aggressive. This is driven by lower allocations to fixed income in favor of public equities.

- Increasing equity exposure increases both expected return and expected volatility.
- More aggressive portfolios increase the range of possible outcomes and the magnitude of worst case scenarios.
- Each alternative mix adds incremental tracking error relative to the current policy but reduces tracking error relative to peers.

The goal of today's discussion is to adopt the go-forward asset allocation mix and determine the appropriate implementation strategy.

Asset allocation alternatives

Asset allocation

	Mix 1 (Current Policy)	Mix 2	Mix 3	Mix 4	Mix 5
Domestic Large Cap Equity	14%	19%	20%	20%	21%
Domestic Small Cap Equity	3%	5%	5%	5%	5%
International Developed Equity	9%	14%	14%	15%	15%
International Small Cap Equity	3%	3%	3%	3%	3%
Emerging Markets Equity	7%	6%	6%	6%	6%
Global Equity					
Total Public Equity	36%	47%	48%	49%	50%
US Credit Fixed Income	5%	4%	4%	4%	4%
High Yield Fixed Income	5%	3%	3%	3%	3%
Bank Loans	5%	5%	4%	3%	3%
Global Sovereign	7%	7%	7%	7%	6%
Emerging Markets Debt	5%	3%	3%	3%	3%
TIPS	4%	3%	3%	3%	3%
Total Fixed Income	31%	25%	24%	23%	22%
Private Equity	6%	6%	6%	6%	6%
Private Credit	8%	8%	8%	8%	8%
Commodities	3%				
Real Estate	5%	5%	5%	5%	5%
Infrastructure	3%	3%	3%	3%	3%
Hedge Funds	8%	6%	6%	6%	6%
Total Alternatives/Real Assets	33%	28%	28%	28%	28%
Total Portfolio	100%	100%	100%	100%	100%
Mean Variance Analysis					
Forecast 10 Year Return	6.0	6.1	6.1	6.2	6.2
Risk (StdDev Rtn), %	11.8	12.7	12.7	12.8	13.0
Sharpe Ratio	0.36	0.36	0.36	0.36	0.36
Equity Tail Risk	-34%	-37%	-37%	-37%	-38%

At the last meeting, the Board expressed comfort with a larger equity allocation (between 47% and 50%).

Asset allocation changes explained

Changes relative to the current policy

Mix 2:

- Adds 11% to global public equity, funded 2% from hedge funds, 6% from fixed income, and removing the 3% commodities allocation.

Mix 3:

- Adds 12% to global public equity, funded 2% from hedge funds, 7% from fixed income, and removing the 3% commodities allocation.

Mix 4:

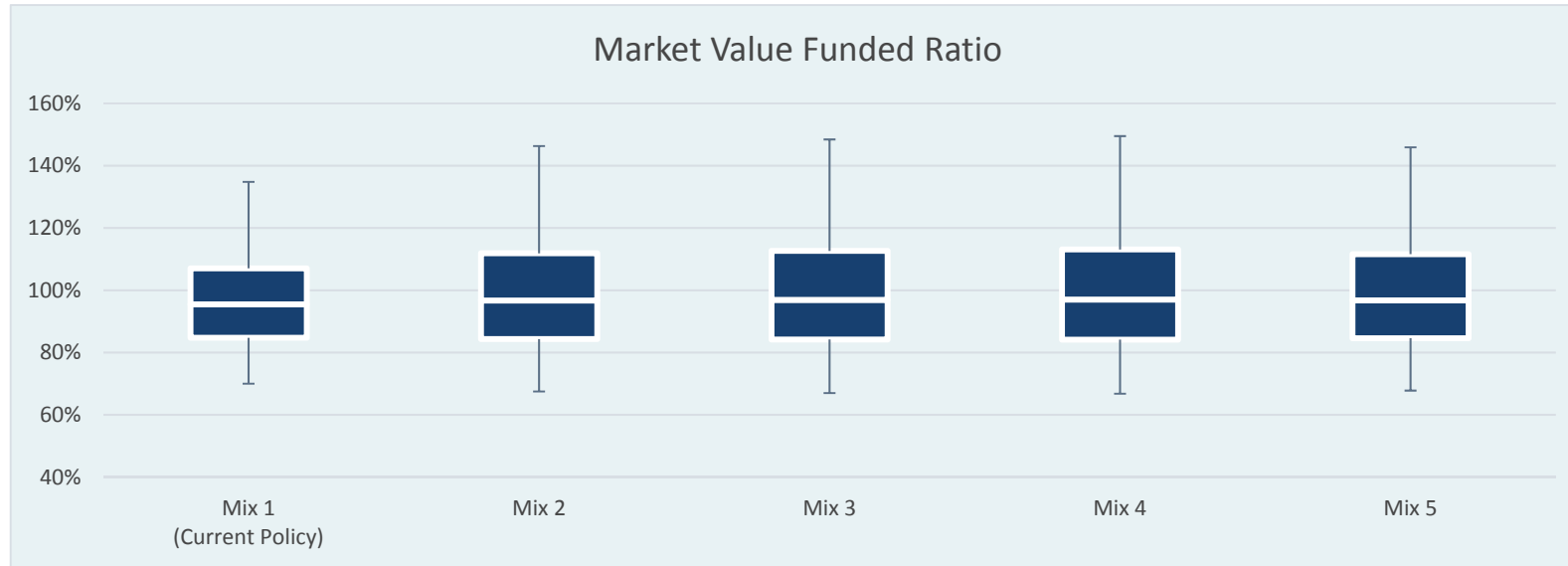
- Adds 13% to global public equity, funded 2% from hedge funds, 8% from fixed income, and removing the 3% commodities allocation.

Mix 5:

- Adds 14% to global public equity, funded 2% from hedge funds, 9% from fixed income, and removing the 3% commodities allocation.

In general, the more volatile fixed income sectors were scaled back first.

Stochastic projections – funded status



Relative to the current policy, the alternative mixes increase the range of possible outcomes.

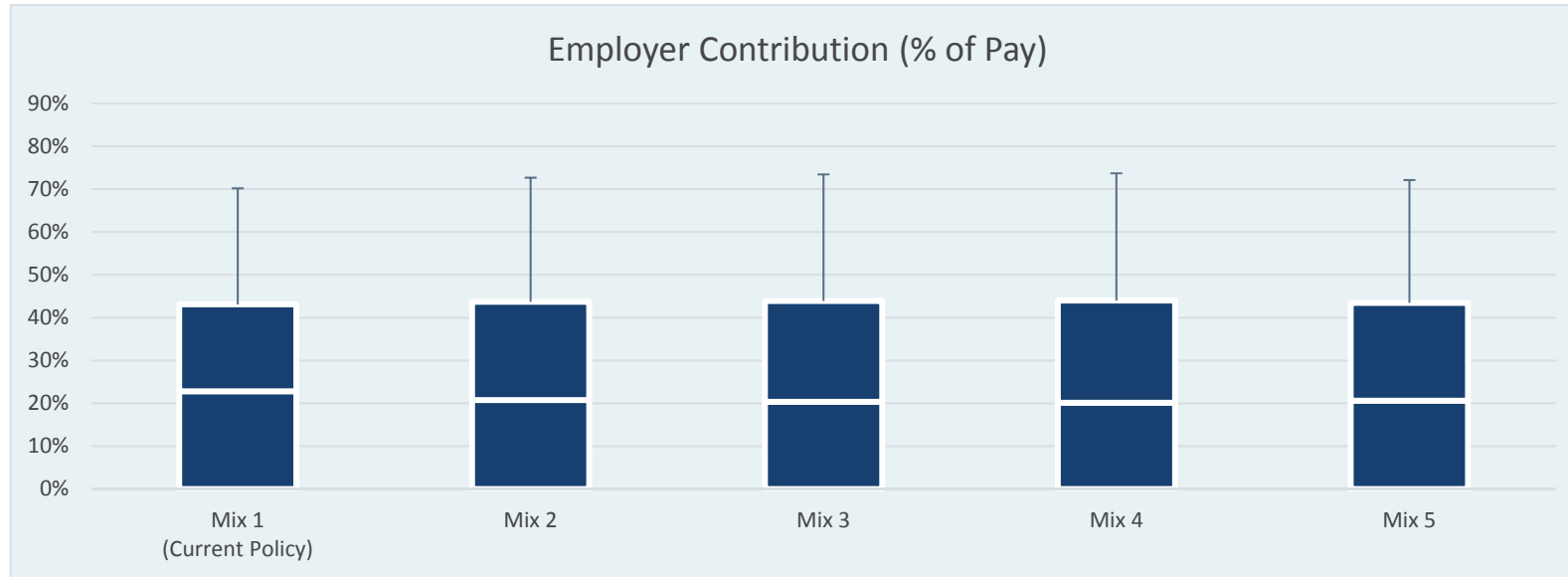
Each alternative mix offers a similar set of projected outcomes.

FUNDED STATUS – STOCHASTIC OUTCOMES IN 10 YEARS

	Mix 1 (Current Policy)	Mix 2	Mix 3	Mix 4	Mix 5
Best Case (95%)	134.8%	146.5%	148.4%	149.5%	145.9%
Median Outcome (50%)	95.5%	96.9%	96.9%	97.0%	96.8%
Worst Case (5%)	70.0%	67.6%	67.0%	66.8%	67.8%
CVAR (5%)	51.2%	49.2%	48.6%	48.4%	49.6%
Range (Best-Worst Case)	64.8%	78.9%	81.4%	82.7%	78.1%

Source: ProVal, Verus

Stochastic projections – employer contributions



Relative to the current policy, the alternative mixes increase the magnitude of worst case scenarios.

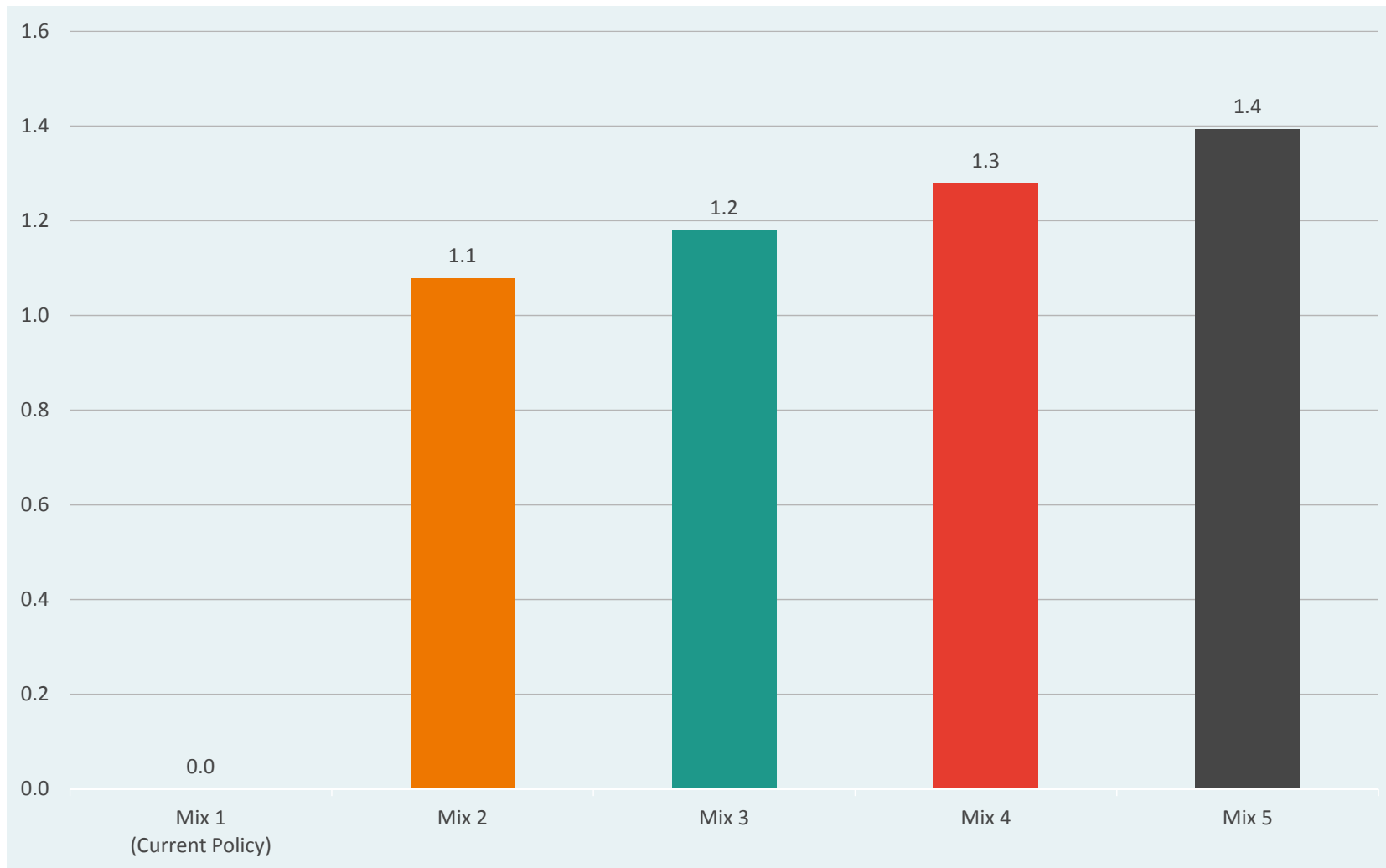
Each alternative mix offers a similar set of projected outcomes.

EMPLOYER CONTRIBUTIONS – STOCHASTIC OUTCOMES IN 10 YEARS

	Mix 1 (Current Policy)	Mix 2	Mix 3	Mix 4	Mix 5
Best Case (95%)	0.0%	0.0%	0.0%	0.0%	0.0%
Median Outcome (50%)	22.8%	20.5%	20.4%	20.1%	20.6%
Worst Case (5%)	70.2%	72.6%	73.4%	73.7%	72.1%
CVAR (5%)	80.8%	83.6%	84.4%	84.8%	83.1%

Source: ProVal, Verus

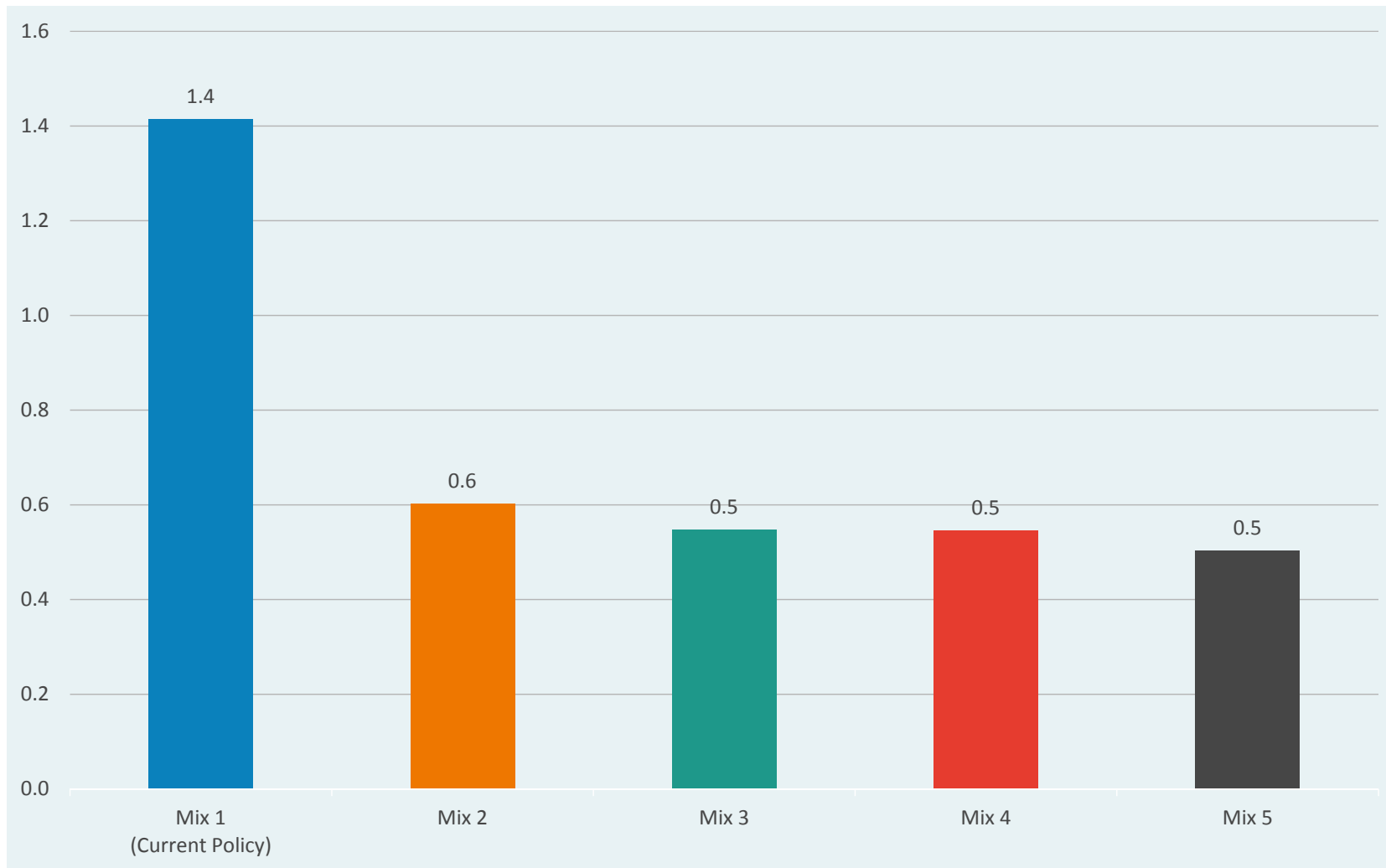
Active risk to current policy



Each mix incrementally adds tracking error relative to the current policy.

Source: Verus, BarraOne

Active risk to peers

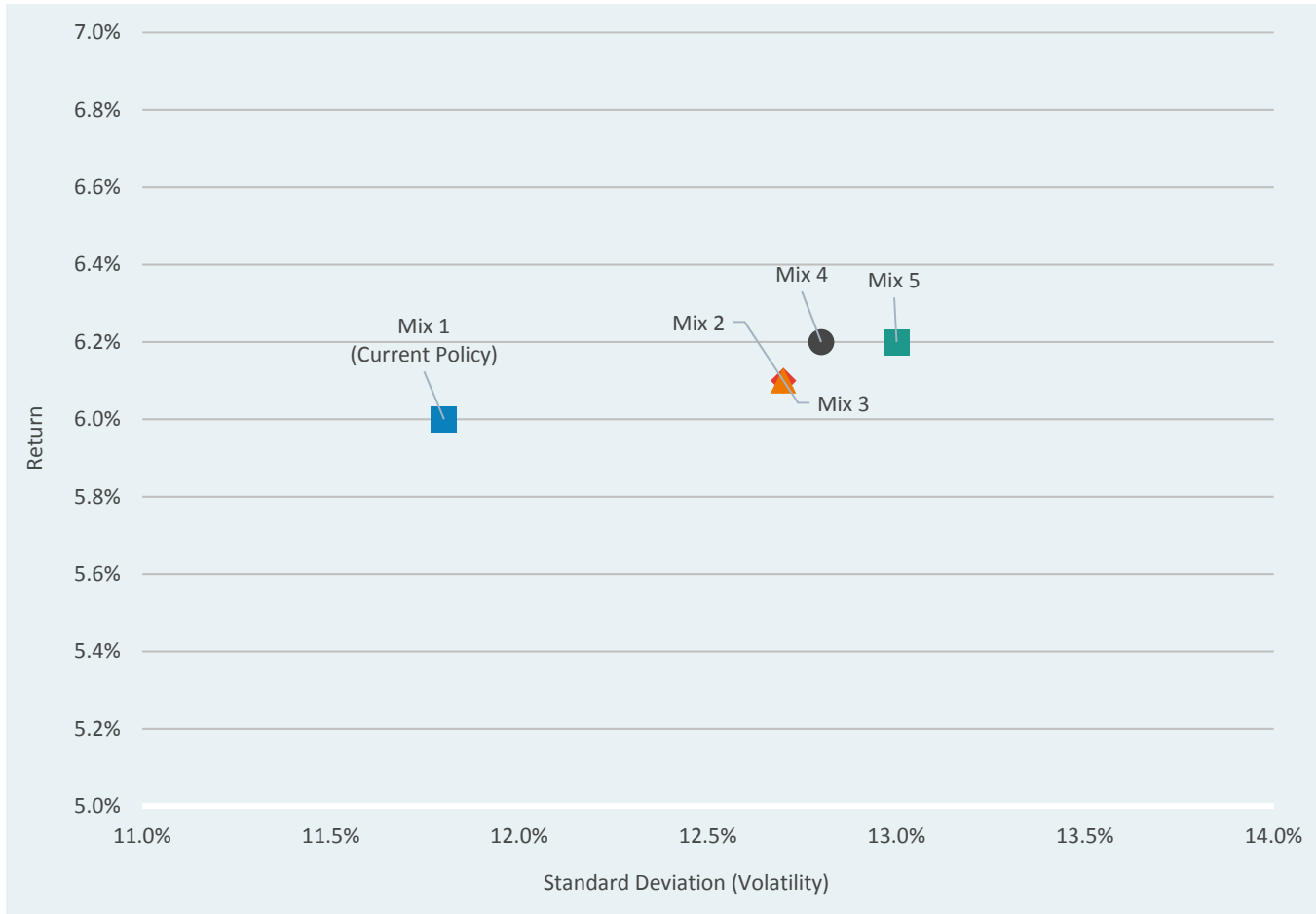


Each mix reduces tracking error relative to peers.

Source: Verus, BarraOne

Risk and return

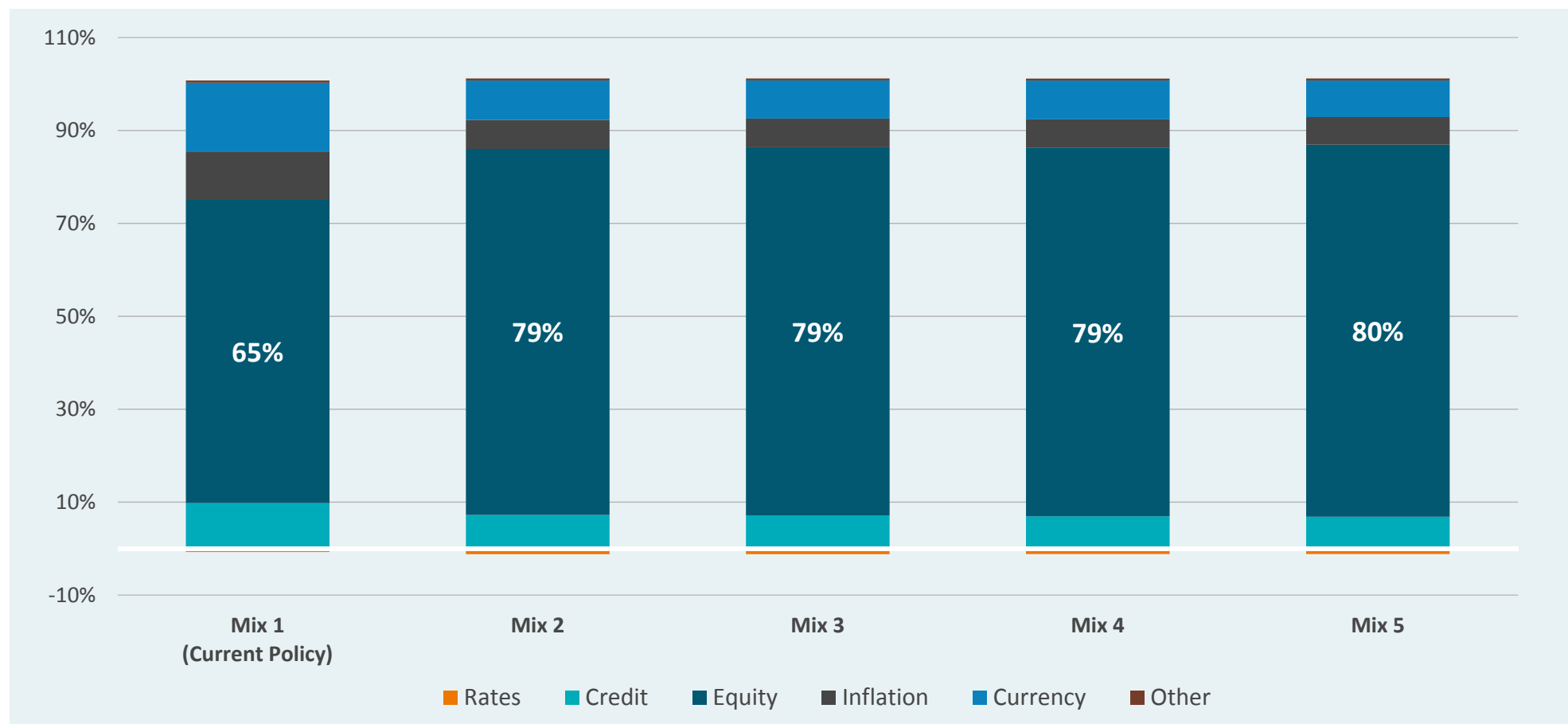
EXPECTED RETURN VS EXPECTED STANDARD DEVIATION



Increasing equity exposure incrementally increases both expected return and expected volatility.

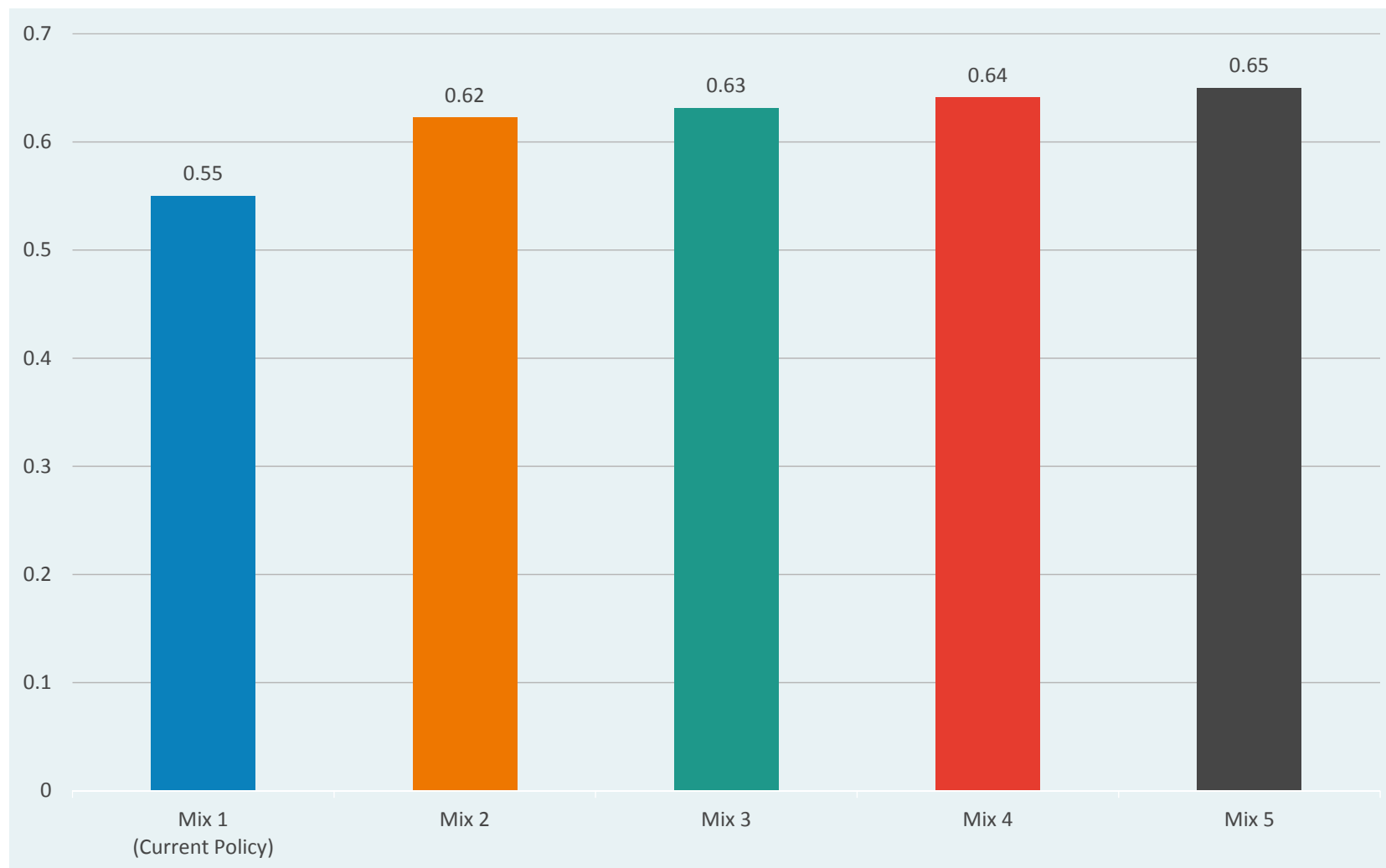
Source: Verus, MPI

Risk decomposition



Source: Verus, BarraOne

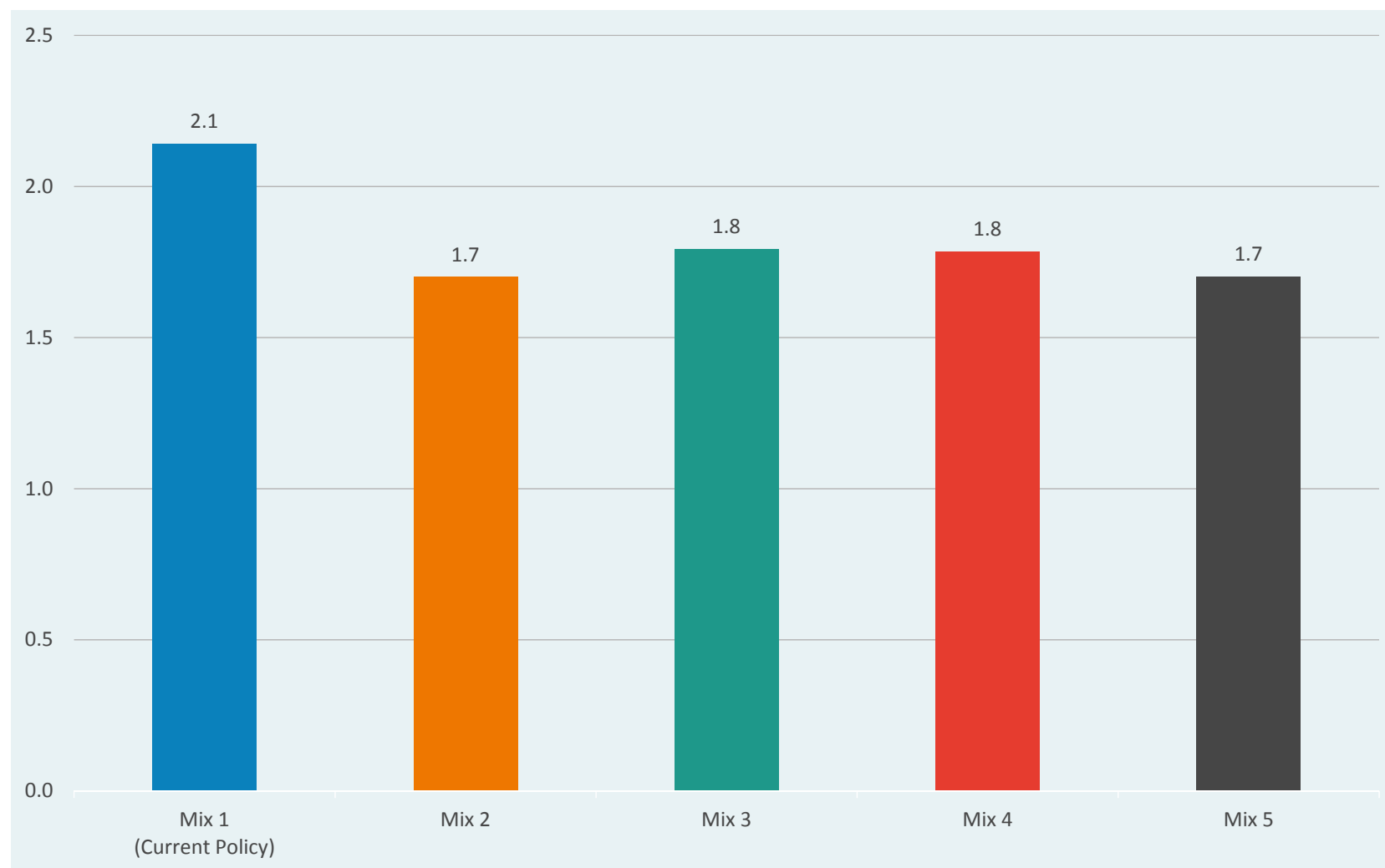
Equity beta



The greater the equity allocation the higher the equity beta.

Source: Verus, BarraOne

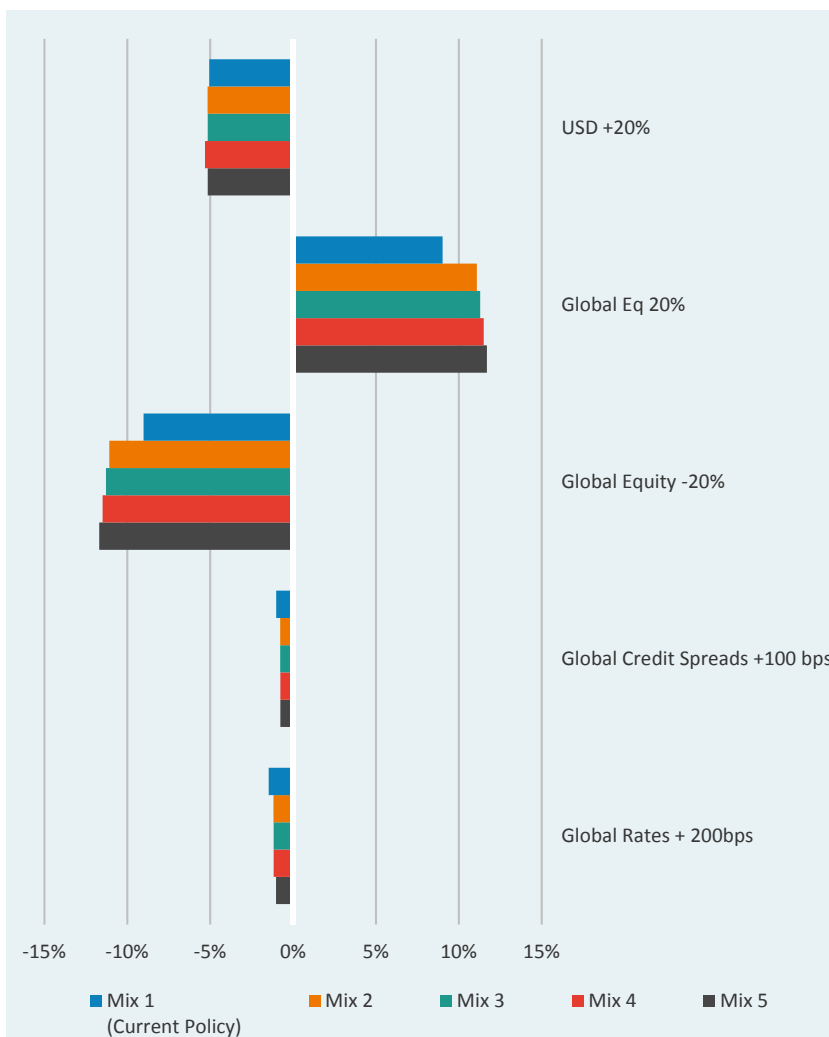
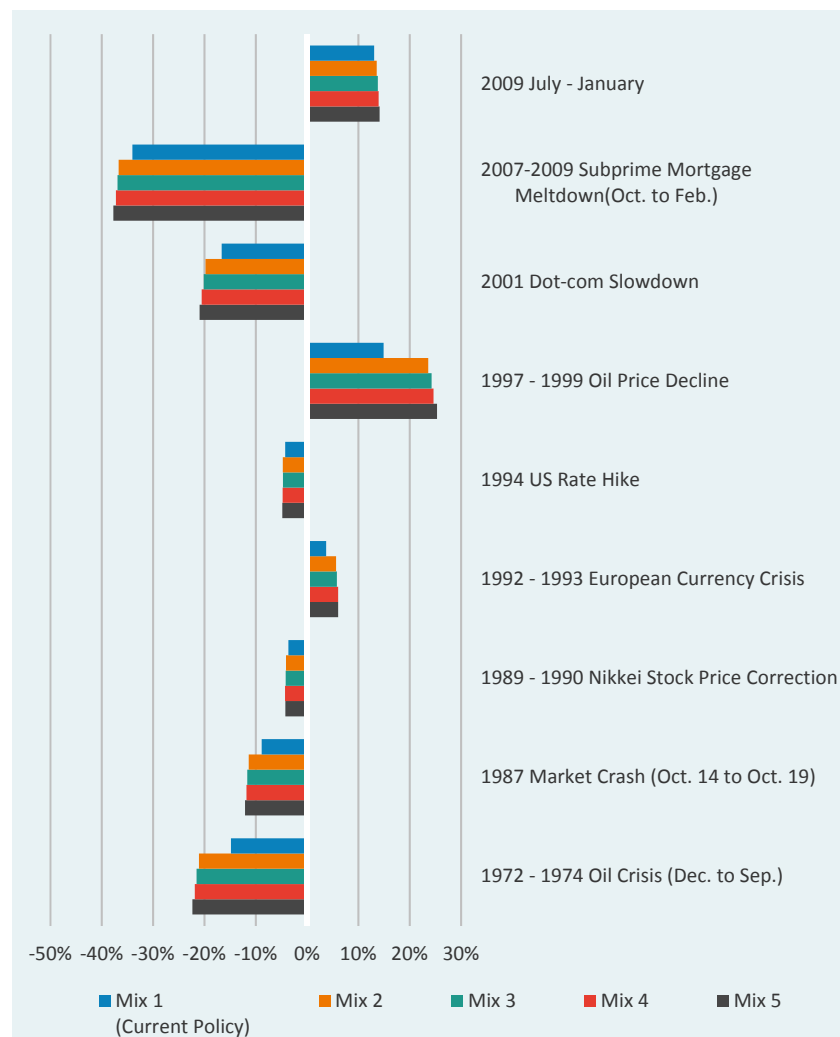
Effective duration



Lower allocations to fixed income decrease the duration of each alternative mix relative to the current policy.

Source: Verus, BarraOne

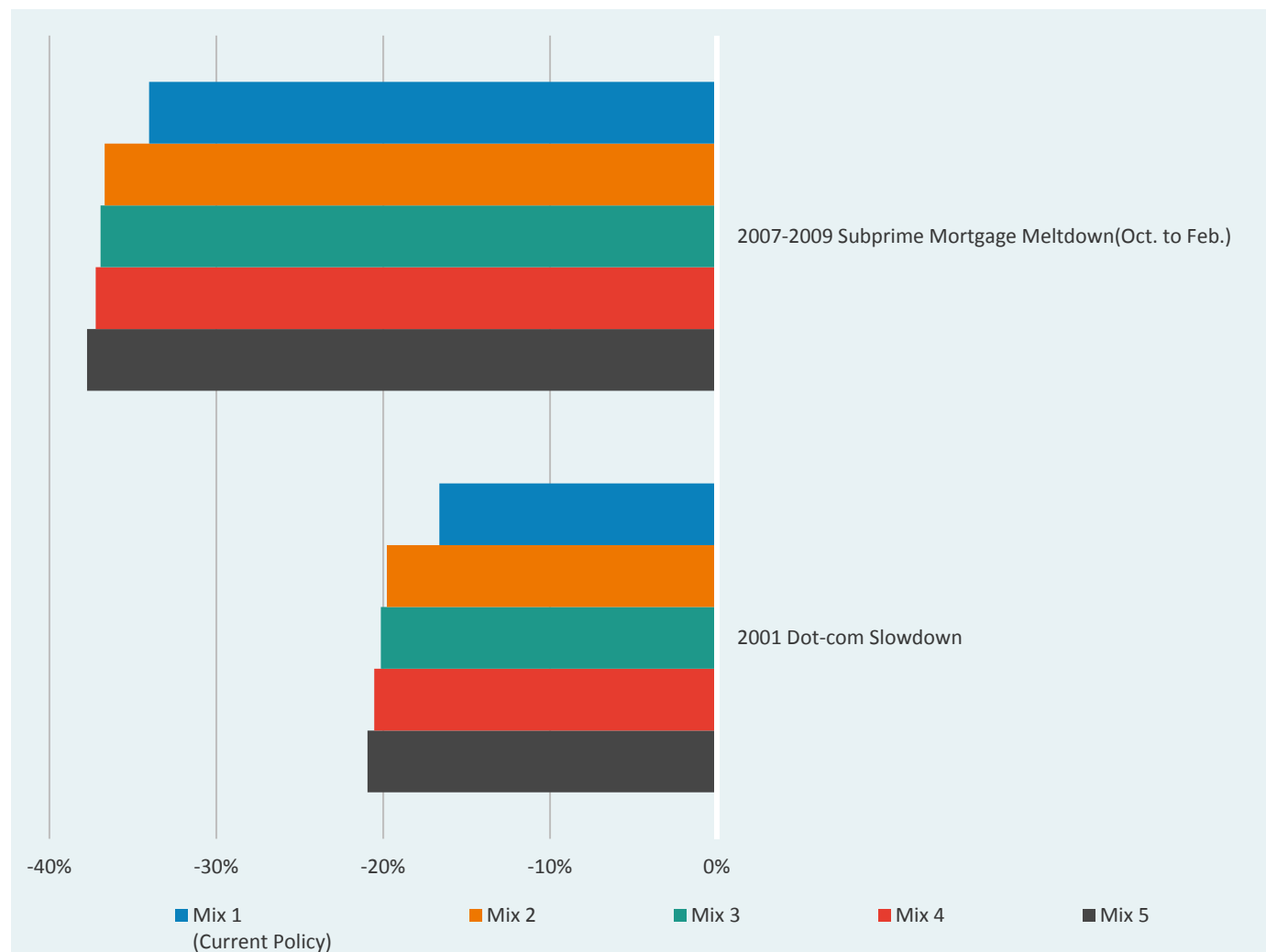
Scenario analysis



Tail risk increases materially in some scenarios, while only modestly in others.

Source: Verus, BarraOne

Equity tail risk



Source: Verus, BarraOne

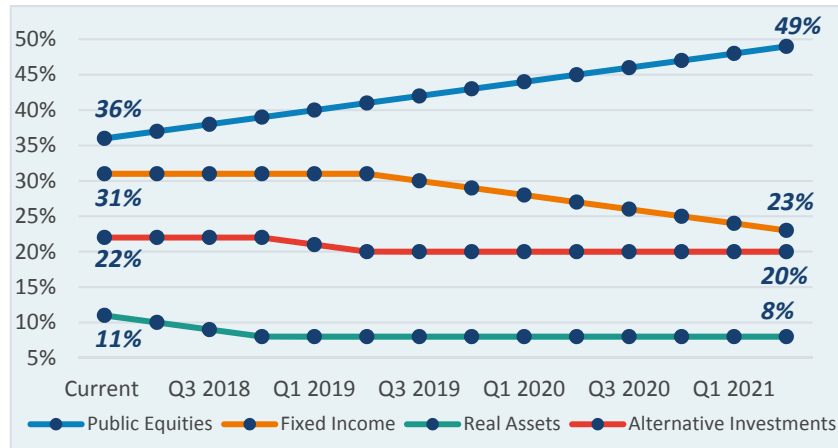
Higher equity allocations increase portfolio exposure to equity market shocks.

Implementation

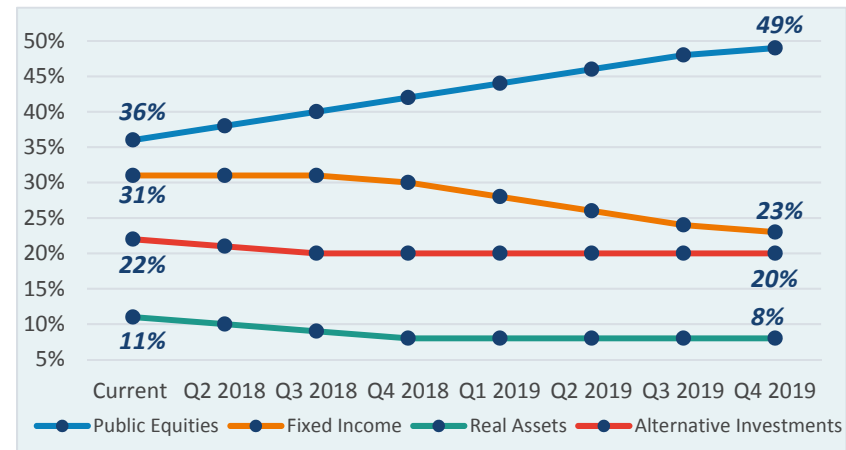
Rebalancing glidepath

- Rebalancing 1% of the portfolio each quarter, it would take roughly 3 years to reach the new target allocations.
- Rebalancing 2% of the portfolio each quarter, it would take roughly 1.5 years to reach the new target allocations.
- Rebalancing 3% of the portfolio each quarter, it would take roughly 1 year to reach the new target allocations.

SCENARIO 1: REBALANCING 1% EACH QUARTER

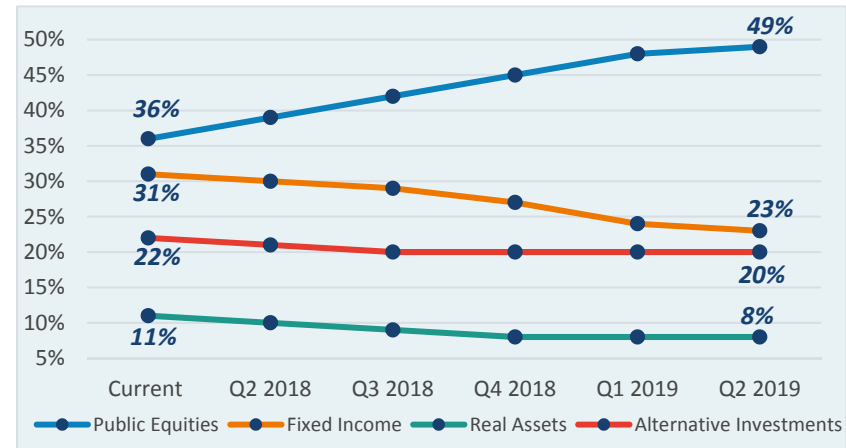


SCENARIO 2: REBALANCING 2% EACH QUARTER



Each scenario assumes an ending allocation of 49% to public equities.

SCENARIO 3: REBALANCING 3% EACH QUARTER



RBC Access Capital Community Investing

	Bloomberg Barclays US Securitized Index	Citigroup WGBI
Yield to Maturity	2.9%	1.3%
Effective Duration	4.6yrs	7.9yrs
Volatility (3yr Std. Deviation)	1.8%	5.8%

The \$45 million would be sourced from the Brandywine Global Investment-Grade Sovereign Fixed Income fund.

- At the April Board meeting, the Board of Trustees approved an investment in the RBC Access Capital Community Investing fund. Verus advocates funding this investment with \$45 million (roughly 1% of the portfolio), carved out from the global sovereign fixed income allocation.
- While the portfolio will be investing in projects that seek to positively impact the residents and communities of Fresno County, it will be benchmarked against the Bloomberg Barclays US Securitized Index.
- Relative the Citigroup WGBI index, the Bloomberg Barclays US Securitized Index offers a higher yield with lower volatility and a lower duration.

Source: RBC GAM, Brandywine. Data as of 12/31/17.

Next steps

- Decide whether a change in asset allocation is warranted, and if so, identify the most suitable mix.
- Assuming a change is approved:
 - The Board must determine the appropriate rebalancing glidepath.
 - Rebalancing changes would be made in 1%, 2%, or 3% increments per quarter.
 - Verus will draft a revised investment policy statement for approval at the next meeting.
 - The updated IPS will reflect the new long-term asset allocation targets as well as the more granular rebalancing glidepath.
 - Verus and FCERA Staff will begin rebalancing the portfolio.
 - Increasing exposure to domestic large cap equities, domestic small/mid cap equities, and international developed equities.
 - Reducing exposure to emerging market equities, fixed income assets, and hedge funds.
 - Terminating the Invesco Commodities mandate.
 - Funding the RBC Access Capital Community Investing fund.

Appendix

2018 Asset-liability study timeline

Timeframe	Action	Description
December 6, 2017 Board Meeting	Board Meeting	Segal to review the finalized 6.30.17 actuarial valuation with the Board. Verus to review risk tolerance survey results.
December 15, 2017	Verus receives raw data from Segal	Segal to provide Verus with data used in 2017 actuarial valuation
+ 6 weeks	Liability Model Development	Verus partners with an outside firm in order to build a replication valuation using the information provided by Segal. The purpose of this is so that we can integrate the liability characteristics with asset characteristics.
+ 3 weeks	Verification of Liability Model accuracy	Once Verus receives replication valuation from outside vendor we verify the baseline forecasts align with Segal's valuation and projections.
January 30, 2017	Verus finalizes 2018 Capital Market Assumptions	Verus' strategic research team finalizes the asset-level projections using market data as of 12/31/17.
February 7, 2018 Board Meeting	Phase 1 of ALS	Review of Enterprise Risk Tolerance. Review of FCERA AA relative to current SACRS universe. Review fiscal health of sponsor
+ 3 weeks	Comparison Portfolio Development	Verus to develop comparison portfolios used for discussion purposes. These portfolios will have significant overall risk and allocation differences and will serve as the "goal posts" of the ALS.



2018 Asset-liability study timeline (cont.)

Timeframe	Action	Description
March 7, 2018 Board Meeting	Phase 2 of ALS	Verus to review the current portfolio relative to the comparison portfolios and generate asset-only modeling for each portfolio, focused on risk, return, scenario analysis, shock analyses, and risk decomposition
+ 3 weeks	Asset-Liability Integration	Verus to load comparison portfolios into liability model framework, prepare deterministic and stochastic modeling.
April 4, 2018 Board Meeting	Phase 3 of ALS	Verus to review results of asset-liability modeling using the comparison portfolios. <i>*Milestone #1: Narrow down which comparison portfolio offers the most attractive set of trade-offs relative to liabilities.</i>
+ 3 weeks	Further refinement of selected comparison portfolio	Once the Board gains comfort with the broad set of risk/return characteristics of a comparison portfolio, Verus to conduct further asset-only modeling to determine several similar alternatives
May 2, 2018 Board Meeting	Phase 4 of ALS	Verus will review the similar alternatives relative to the comparison portfolio that was selected for further consideration at April meeting. <i>*Milestone #2: Identify the new asset allocation mix to be implemented.</i>
June 6, 2018 Board Meeting	Phase 5 of ALS	Verus will review next steps for implementing the new asset allocation. Revise IPS, manager searches, transitions, etc.



10-year return & risk assumptions

Asset Class	Index Proxy	Ten Year Return Forecast		Standard Deviation	Sharpe Ratio	Sharpe Ratio	10-Year Historical	10-Year Historical
		Geometric	Arithmetic					
Equities								
U.S. Large	S&P 500	4.5%	5.6%	15.7%	0.15	0.22	0.50	0.56
U.S. Small	Russell 2000	4.4%	6.5%	21.5%	0.10	0.20	0.36	0.44
International Developed	MSCI EAFE	8.6%	10.1%	18.1%	0.35	0.44	0.11	0.2
International Developed Hedged	MSCI EAFE Hedged	8.6%	9.8%	16.2%	0.40	0.47	0.21	0.28
International Small	MSCI EAFE Small Cap	7.9%	10.2%	22.7%	0.25	0.35	0.24	0.33
International Small Hedged	MSCI EAFE Small Cap Hedged	7.9%	9.7%	20.1%	0.28	0.37	0.36	0.43
Emerging Markets	MSCI EM	7.3%	10.4%	26.6%	0.19	0.31	0.17	0.28
Global Equity	MSCI ACWI	6.3%	7.7%	17.5%	0.23	0.31	0.27	0.35
Private Equity	Cambridge Private Equity	6.4%	9.3%	25.8%	0.16	0.28	0.93	0.92
Fixed Income								
Cash	30 Day T-Bills	2.2%	2.2%	1.2%	-	-	-	-
U.S. TIPS	BBgBarc U.S. TIPS 5 - 10	2.6%	2.7%	5.5%	0.07	0.09	0.57	0.59
U.S. Treasury	BBgBarc Treasury 7-10 Year	2.4%	2.6%	6.8%	0.03	0.06	0.68	0.70
Global Sovereign ex U.S.	BBgBarc Global Treasury ex U.S.	2.7%	3.2%	9.9%	0.05	0.10	0.30	0.33
Global Sovereign ex U.S. Hedged	BBgBarc Global Treasury ex U.S. Hedged	2.7%	2.8%	3.3%	0.15	0.18	1.23	1.22
Core Fixed Income	BBgBarc U.S. Aggregate Bond	2.9%	3.1%	6.4%	0.11	0.14	1.09	1.08
Core Plus Fixed Income	BBgBarc U.S. Corporate IG	3.3%	3.6%	8.4%	0.13	0.17	0.81	0.81
Short-Term Gov't/Credit	BBgBarc U.S. Gov't/Credit 1 - 3 year	2.5%	2.6%	3.7%	0.08	0.11	1.36	1.34
Short-Term Credit	BBgBarc Credit 1-3 Year	2.4%	2.5%	3.7%	0.05	0.08	1.05	1.05
Long-Term Credit	BBgBarc Long U.S. Corporate	3.5%	3.9%	9.4%	0.14	0.18	0.64	0.67
High Yield Corp. Credit	BBgBarc U.S. Corporate High Yield	3.7%	4.3%	11.6%	0.13	0.18	0.64	0.67
Bank Loans	S&P/LSTA	4.9%	5.4%	10.5%	0.26	0.30	0.48	0.51
Global Credit	BBgBarc Global Credit	1.7%	2.0%	7.6%	-0.07	-0.03	0.59	0.61
Global Credit Hedged	BBgBarc Global Credit Hedged	1.7%	1.8%	5.0%	-0.10	-0.08	1.01	1.00
Emerging Markets Debt (Hard)	JPM EMBI Global Diversified	5.1%	5.9%	12.8%	0.23	0.29	0.74	0.76
Emerging Markets Debt (Local)	JPM GBI EM Global Diversified	5.8%	6.5%	12.1%	0.30	0.36	0.31	0.37
Private Credit	Bank Loans + 200 bps	6.9%	7.5%	10.5%	0.45	0.50	-	-
Other								
Commodities	Bloomberg Commodity	4.3%	5.5%	15.9%	0.13	0.21	-0.33	-0.25
Hedge Funds	HFRI Fund of Funds	4.0%	4.8%	7.9%	0.23	0.33	0.21	0.23
Hedge Fund of Funds	HFRI Fund of Funds	3.0%	3.8%	7.9%	0.10	0.20	0.21	0.23
Hedge Funds - Equity Hedge	HFRI Equity Hedge	4.2%	5.5%	11.1%	0.18	0.30	0.36	0.39
Hedge Funds - Event Driven	HFRI Event Driven	4.5%	5.6%	9.9%	0.22	0.34	0.55	0.57
Hedge Funds - Relative Value	HFRI Relative Value	3.9%	4.5%	6.8%	0.25	0.34	0.89	0.89
Hedge Funds - Macro	HFRI Macro	3.3%	4.7%	8.5%	0.12	0.29	0.43	0.44
Core Real Estate	NCREIF Property	6.0%	6.7%	12.7%	0.30	0.35	0.77	0.75
Value-Add Real Estate	NCREIF Property + 200bps	8.0%	9.7%	19.5%	0.30	0.38	-	-
Opportunistic Real Estate	NCREIF Property + 400bps	10.0%	12.9%	26.0%	0.30	0.41	-	-
REITs	Wilshire REIT	6.0%	7.7%	19.5%	0.19	0.28	0.16	0.28
Infrastructure	S&P Global Infrastructure	7.1%	8.7%	18.9%	0.26	0.34	0.27	0.34
Risk Parity	Risk Parity	7.2%	7.7%	10.0%	0.50	0.55	-	-
Currency Beta	Russell Conscious Currency	2.2%	2.3%	4.4%	0.00	0.02	0.23	0.24
Inflation		2.1%	-	-	-	-	-	-

Investors wishing to produce expected geometric return forecasts for their portfolios should use the arithmetic return forecasts provided here as inputs into that calculation, rather than the single-asset-class geometric return forecasts. This is the industry standard approach, but requires a complex explanation only a heavy quant could love, so we have chosen not to provide further details in this document – we will happily provide those details to any readers of this who are interested.

Correlation assumptions

	Cash	US Large	US Small	Intl Large	Intl Large Hdg	Intl Small	Intl Small Hdg	EM	Global Equity	PE	US TIPS	US Treasury	Global Sovereign ex US	Global Sovereign ex US Hdg	US Core	US Core Plus	ST Govt/Credit	Short-Term Credit	Long-Term Credit	US HY	Bank Loans	Global Credit	Global Credit Hdg	EMD USD	EMD Local	Commodities	Hedge Funds	Real Estate	REITs	Infrastructure	Risk Parity	Currency Beta	Inflation
Cash	1.0																																
US Large	-0.3	1.0																															
US Small	-0.2	0.9	1.0																														
Intl Large	-0.3	0.9	0.8	1.0																													
Intl Large Hdg	-0.4	0.9	0.8	0.9	1.0																												
Intl Small	-0.3	0.9	0.8	1.0	0.9	1.0																											
Intl Small Hdg	-0.4	0.8	0.8	0.9	1.0	0.9	1.0																										
EM	-0.3	0.8	0.7	0.9	0.8	0.9	0.8	1.0																									
Global Equity	-0.3	1.0	0.9	1.0	0.9	0.9	0.9	0.9	1.0																								
PE	-0.2	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.7	1.0																							
US TIPS	0.0	0.2	0.1	0.3	0.1	0.3	0.2	0.4	0.3	0.1	1.0																						
US Treasury	0.1	-0.3	-0.3	-0.2	-0.3	-0.2	-0.3	-0.2	-0.2	-0.2	0.6	1.0																					
Global Sovereign ex US	0.1	0.3	0.1	0.4	0.1	0.4	0.1	0.4	0.4	0.0	0.6	0.5	1.0																				
Global Sovereign ex US Hdg	0.1	-0.2	-0.2	-0.2	-0.2	-0.2	-0.2	-0.1	-0.2	-0.1	0.4	0.8	0.4	1.0																			
US Core	0.0	0.0	-0.1	0.2	0.0	0.2	0.0	0.2	0.1	-0.1	0.8	0.9	0.6	0.7	1.0																		
US Core Plus	-0.2	0.4	0.3	0.5	0.4	0.5	0.4	0.5	0.5	0.1	0.7	0.5	0.5	0.4	0.8	1.0																	
ST Govt/Credit	0.3	-0.1	-0.1	0.1	-0.1	0.1	-0.1	0.1	0.0	-0.1	0.6	0.6	0.6	0.5	0.7	0.6	1.0																
Short-Term Credit	-0.1	0.3	0.3	0.5	0.4	0.5	0.4	0.5	0.4	0.1	0.6	0.2	0.4	0.2	0.5	0.8	0.7	1.0															
Long-Term Credit	-0.2	0.3	0.2	0.4	0.3	0.4	0.4	0.4	0.4	0.0	0.6	0.5	0.5	0.5	0.8	1.0	0.5	0.6	1.0														
US HY	-0.3	0.7	0.7	0.8	0.7	0.8	0.8	0.8	0.8	0.4	0.5	-0.2	0.3	-0.2	0.2	0.6	0.2	0.6	0.5	1.0													
Bank Loans	-0.4	0.6	0.6	0.6	0.6	0.6	0.7	0.6	0.6	0.4	0.3	-0.4	0.0	-0.3	0.0	0.4	-0.1	0.5	0.3	0.9	1.0												
Global Credit	-0.2	0.6	0.5	0.8	0.6	0.8	0.6	0.8	0.7	0.2	0.7	0.2	0.7	0.2	0.6	0.8	0.5	0.7	0.8	0.8	0.5	1.0											
Global Credit Hdg	-0.2	0.5	0.4	0.6	0.6	0.6	0.6	0.7	0.6	0.2	0.7	0.3	0.5	0.4	0.7	1.0	0.5	0.8	0.9	0.8	0.6	0.9	1.0										
EMD USD	-0.2	0.6	0.5	0.7	0.6	0.7	0.6	0.7	0.7	0.3	0.7	0.3	0.5	0.2	0.6	0.8	0.4	0.7	0.7	0.8	0.6	0.9	0.9	1.0									
EMD Local	0.0	0.6	0.6	0.7	0.6	0.7	0.6	0.8	0.7	0.3	0.6	0.2	0.7	0.1	0.5	0.6	0.4	0.5	0.6	0.7	0.4	0.8	0.7	0.8	1.0								
Commodities	-0.1	0.5	0.4	0.6	0.4	0.6	0.4	0.7	0.6	0.3	0.4	-0.2	0.4	-0.3	0.1	0.3	0.2	0.4	0.2	0.5	0.5	0.6	0.4	0.5	0.6	1.0							
Hedge Funds	-0.4	0.7	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.5	0.3	-0.3	0.1	-0.2	0.0	0.4	-0.1	0.5	0.3	0.7	0.7	0.6	0.5	0.5	0.6	1.0							
Real Estate	-0.1	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.5	0.4	0.1	-0.1	0.1	0.0	0.0	0.2	0.0	0.1	0.1	0.3	0.3	0.3	0.2	0.3	0.3	0.2	0.4	1.0					
REITs	-0.1	0.7	0.7	0.7	0.6	0.7	0.6	0.6	0.7	0.4	0.3	0.0	0.4	0.1	0.3	0.5	0.1	0.3	0.4	0.7	0.5	0.6	0.6	0.6	0.6	0.3	0.4	0.6	1.0				
Infrastructure	-0.3	0.8	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.2	0.4	-0.1	0.5	-0.1	0.2	0.5	0.1	0.5	0.5	0.7	0.5	0.8	0.7	0.7	0.7	0.6	0.6	0.6	0.6	1.0			
Risk Parity	-0.1	0.5	0.4	0.6	0.4	0.6	0.5	0.6	0.6	0.3	0.7	0.3	0.6	0.3	0.6	0.7	0.5	0.6	0.6	0.6	0.3	0.8	0.7	0.7	0.7	0.6	0.5	-0.1	0.5	0.7	1.0		
Currency Beta	-0.1	0.1	0.2	0.1	0.1	0.0	0.1	0.1	0.1	0.2	-0.2	-0.2	-0.1	0.0	-0.1	-0.1	-0.1	0.0	-0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	-0.1	0.0	0.1	0.0	1.0	
Inflation	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.2	0.1	-0.3	0.0	-0.3	-0.2	-0.1	-0.2	0.0	-0.2	0.3	0.4	0.1	0.0	0.1	0.1	0.3	0.2	0.1	0.1	0.1	0.1	-0.1	1.0

Note: Correlation assumptions are based on the last ten years. Private Equity and Real Estate correlations are especially difficult to model – we have therefore used BarraOne correlation data to strengthen these correlation estimates.

Range of likely 10 year outcomes

10 YEAR RETURN 90% CONFIDENCE INTERVAL

