PERSPECTIVES THAT DRIVE ENTERPRISE SUCCESS

JULY 28, 2021

Asset-Liability Study Phase 3 – Selecting an Asset Allocation

Tulare County Employees' Retirement Association

Verus

Introduction

— At the May 26th Board Meeting, we initiated a strategic portfolio review that began with an Asset-Liability Study.

  ▪ The primary outcome of the discussion was a Board commitment to moderately increase overall portfolio risk.

— At the June 23rd Board Meeting, we reviewed alternative methods by which risk could reasonably be increased (public equities, private markets strategies, and real assets strategies).

  ▪ Verus reviewed the liquidity implications of increasing allocations to private markets and real assets strategies.

  ▪ The Board requested additional options for consideration that include various levels of higher allocations to private market investments.

— **The focus of today's discussion is to continue to review the asset allocation question in light of these additional mixes.**

Additional mixes for discussion

		Heavy Public Markets	Hybrid Option	Heavy Private Markets	Heavy Real Assets	New Mixes for Discussion				"7% attempt"	2021 CMA's (10 Yr)			
	Policy	Mix 1	Mix 2	Mix 3	Mix 4	Mix 4.1	Mix 4.2	Mix 4.3	Mix 4.4	Mix 5	Return (g)	Return (a)	Standard Deviation	Sharpe Ratio (a)
US Large	19	24	23	20	20	20	23	21	18	12	5.1	6.3	15.7	0.38
US Small	6	8	7	6	6	6	5	4	4	3	5.2	7.3	21.4	0.33
Total Domestic Equity	**25**	**32**	**30**	**26**	**26**	**26**	**28**	**25**	**22**	**15**				
International Developed	12	15	13	13	13	13	13	13	12	10	5.2	6.7	17.9	0.36
Emerging Markets	3	5	4	3	3	3	3	4	4	5	5.4	8.3	25.5	0.32
Total Int'l Equity	**15**	**20**	**17**	**16**	**16**	**16**	**16**	**17**	**16**	**15**				
Global Equity	3	3	3	3	3	3	3	3	2	0	5.2	6.6	17.3	0.37
Total Equity	**43**	**55**	**50**	**45**	**45**	**45**	**47**	**45**	**40**	**30**				
Core Plus Fixed Income	17	15	15	15	15	17	15	15	15	15	2.2	2.3	4.0	0.50
Global Aggregate	5	0	0	0	0	0	0	0	0	0	1.1	1.3	6.1	0.17
Emerging Market Debt (Hard)	3	3	3	3	3	1.5	1.5	0		0	5.2	6.0	12.7	0.45
Emerging Market Debt (Local)	3	3	3	3	3	1.5	1.5	0		0	4.3	5.0	12.2	0.39
Total Fixed Income	**27**	**20**	**20**	**20**	**20**	**20**	**18**	**15**	**15**	**15**				
Real Estate Debt	5	5	5	4	4	3	3	4	4	0	5.3	6.3	15.0	0.41
Core Real Estate	10	5	5	6	6	3	3	4	5	5	5.8	6.5	12.6	0.50
Value Add Real Estate	5	5	5	3	6	4	3	4	5	5	7.8	9.1	17.1	0.52
Opportunistic Real Estate	0	0	0	2	5	4	3	4	6	10	9.8	11.8	21.6	0.54
Infrastructure	0	0	0	0	4	4	3	4	3	5	7.8	9.4	18.8	0.49
Total Real Assets	**20**	**15**	**15**	**15**	**25**	**18**	**15**	**20**	**23**	**25**				
Private Equity	5	5	10	12	5	12	15	15	15	20	9.3	12.1	28.1	0.46
Private Credit	5	5	5	8	5	5	5	5	7	10	4.6	5.2	11.2	0.45
Total Non-Public Investments	**10**	**10**	**15**	**20**	**10**	**17**	**20**	**20**	**22**	**30**				
Cash	0	0	0	0	0	0	0	0	0	0	0.2	0.2	1.2	-
Total Allocation	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**				

	Policy	Mix 1	Mix 2	Mix 3	Mix 4	Mix 4.1	Mix 4.2	Mix 4.3	Mix 4.4	Mix 5
Mean Variance Analysis										
Forecast 10 Year Return	*5.4*	*5.6*	*5.8*	*6.0*	*6.0*	*6.1*	*6.2*	*6.4*	*6.5*	*7.0*
Standard Deviation	10.7	12.3	12.3	12.2	12.0	12.5	13.0	13.0	12.7	13.2
Return/Std. Deviation	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*
1st percentile ret. 1 year	*-16.7*	*-19.2*	*-19.0*	*-18.7*	*-18.4*	*-19.1*	*-19.8*	*-19.6*	*-19.0*	*-19.5*
Sharpe Ratio	0.51	0.48	0.50	0.51	0.52	0.52	0.51	0.52	0.54	0.56

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Verus scenario analysis

	Mix 4.1	Mix 4.2	Mix 4.3	Mix 4.4
10 Year Return Forecast				
Stagflation	3.6	3.2	3.5	3.7
Weak	0.3	-0.1	0.1	0.3
Base CMA	*6.0*	*6.2*	*6.3*	*6.3*
Strong	12.6	13.2	13.4	13.2
Range of Scenario Forecast	*12.2*	*13.3*	*13.3*	*12.9*
Shock (1 year)	*-26.1*	*-28.3*	*-28.1*	*-26.4*
10 Year Real Return Forecast				
Stagflation	-2.5	-2.9	-2.6	-2.5
Weak	-0.8	-1.2	-1.0	-0.8
Base CMA	*3.9*	*4.1*	*4.2*	*4.2*
Strong	10.0	10.6	10.8	10.6
Range of Scenario Forecast	*12.5*	*13.5*	*13.4*	*13.0*

The scenario analysis dimensions return projections across different economic regimes.

Source: MPI, Verus

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Risk decomposition
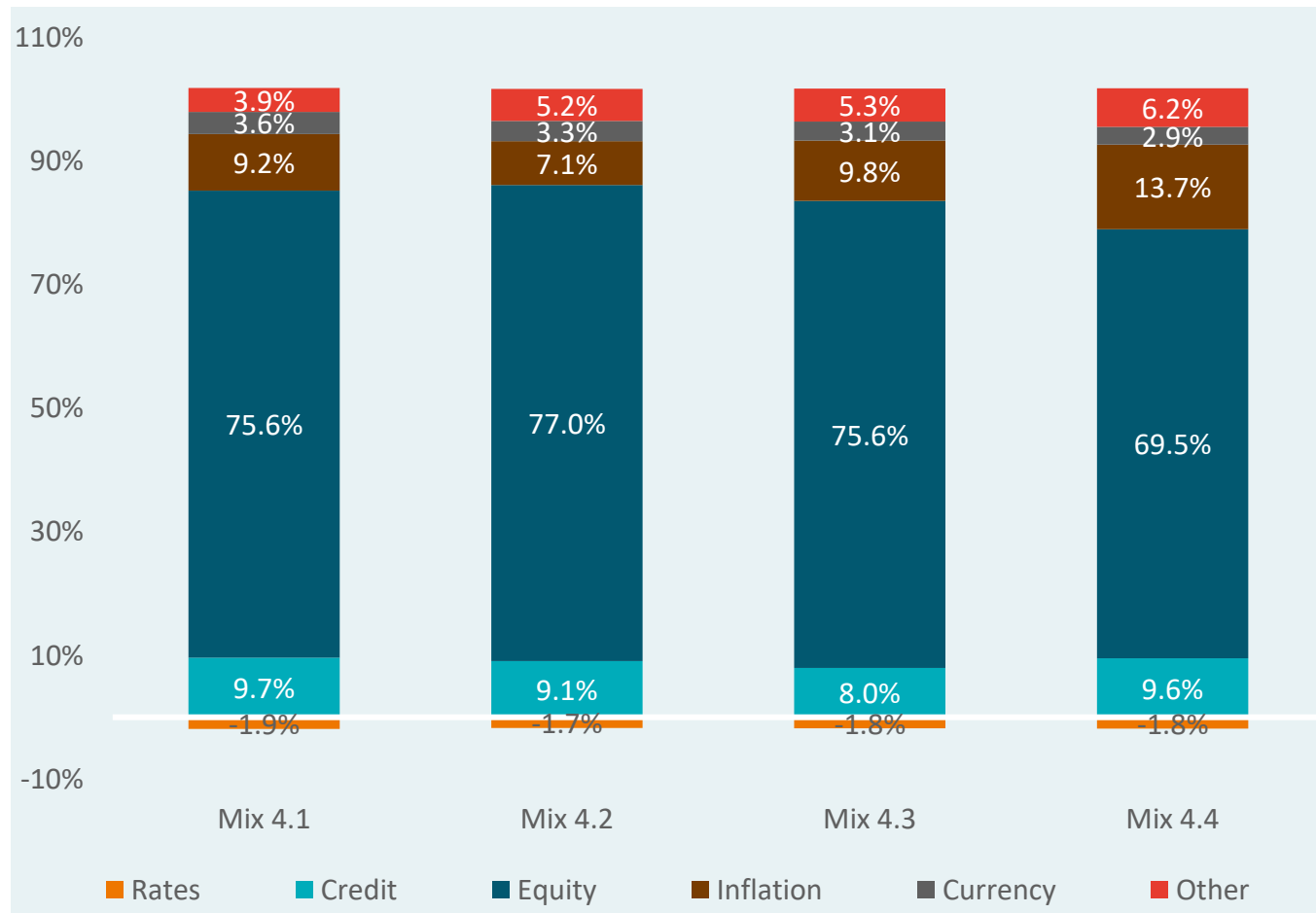
RISK CONTRIBUTION BY RISK FACTOR

Equity risk is the largest single risk factor for all mixes.

Credit risk is a function of fixed income.

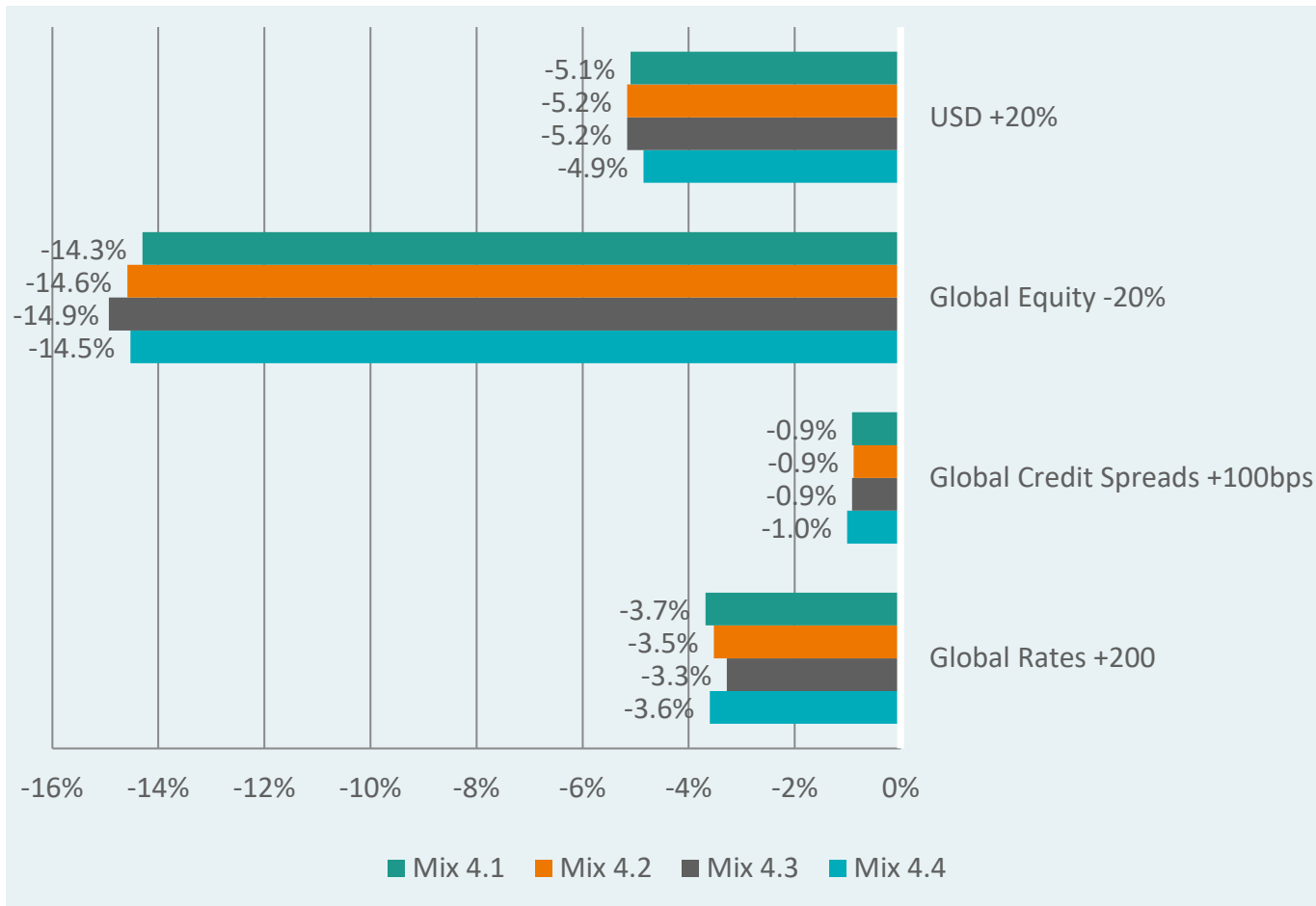Currency risk is a function of international investments.

Inflation risk is a function of real assets.

"Other" are risks inherent within private markets.
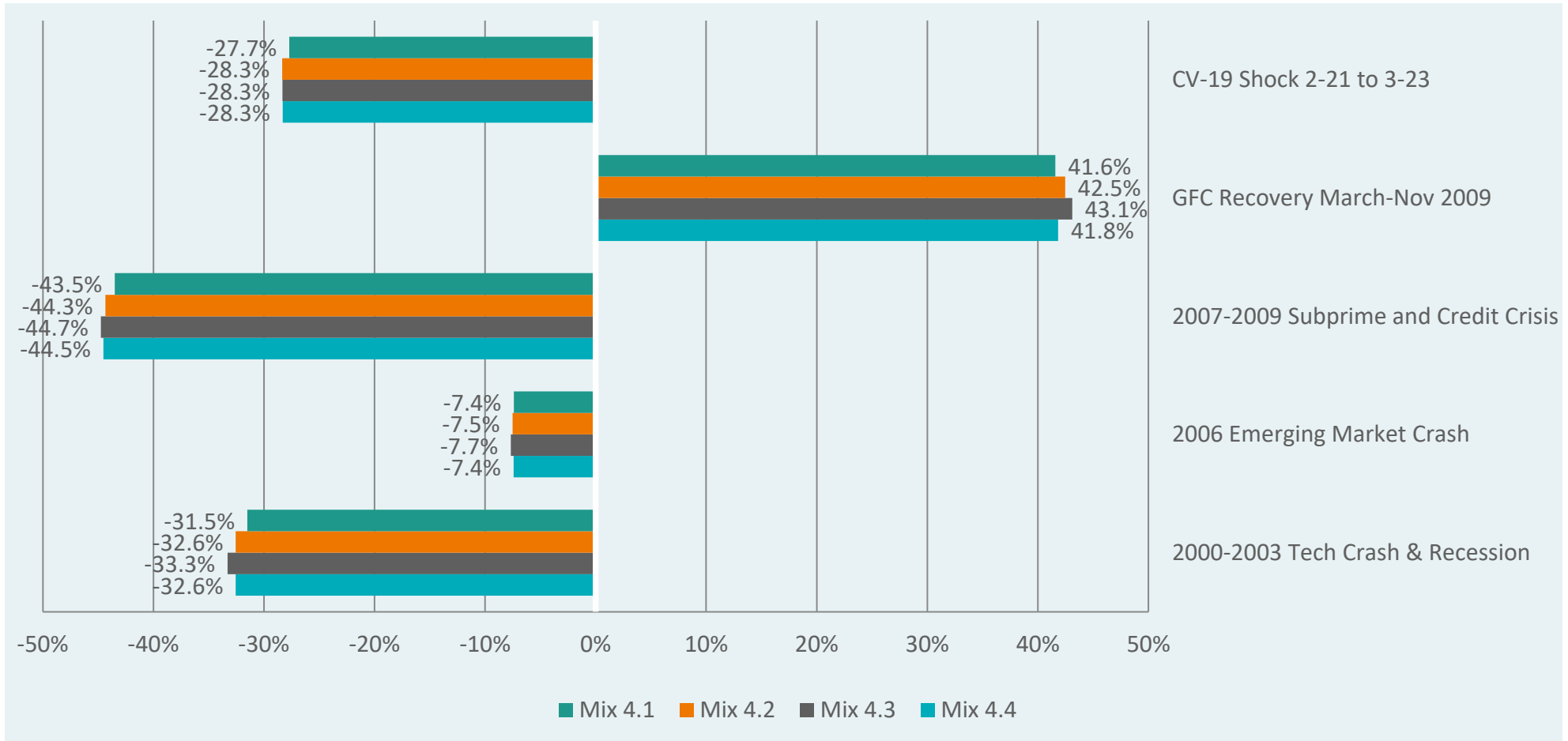
Source: Barra, Ex-Ante Volatility

Stress tests

This analysis is based on how the risk factors inherent in the current index holdings react in those environments.

Source: Barra

Scenario analysis

CV-19 Shock 2-21 to 3-23
- -27.7%
- -28.3%
- -28.3%
- -28.3%

GFC Recovery March-Nov 2009
- 41.6%
- 42.5%
- 43.1%
- 41.8%

2007-2009 Subprime and Credit Crisis
- -43.5%
- -44.3%
- -44.7%
- -44.5%

2006 Emerging Market Crash
- -7.4%
- -7.5%
- -7.7%
- -7.4%

2000-2003 Tech Crash & Recession
- -31.5%
- -32.6%
- -33.3%
- -32.6%

Legend: Mix 4.1, Mix 4.2, Mix 4.3, Mix 4.4

Source: Barra

Allocations to illiquid strategies
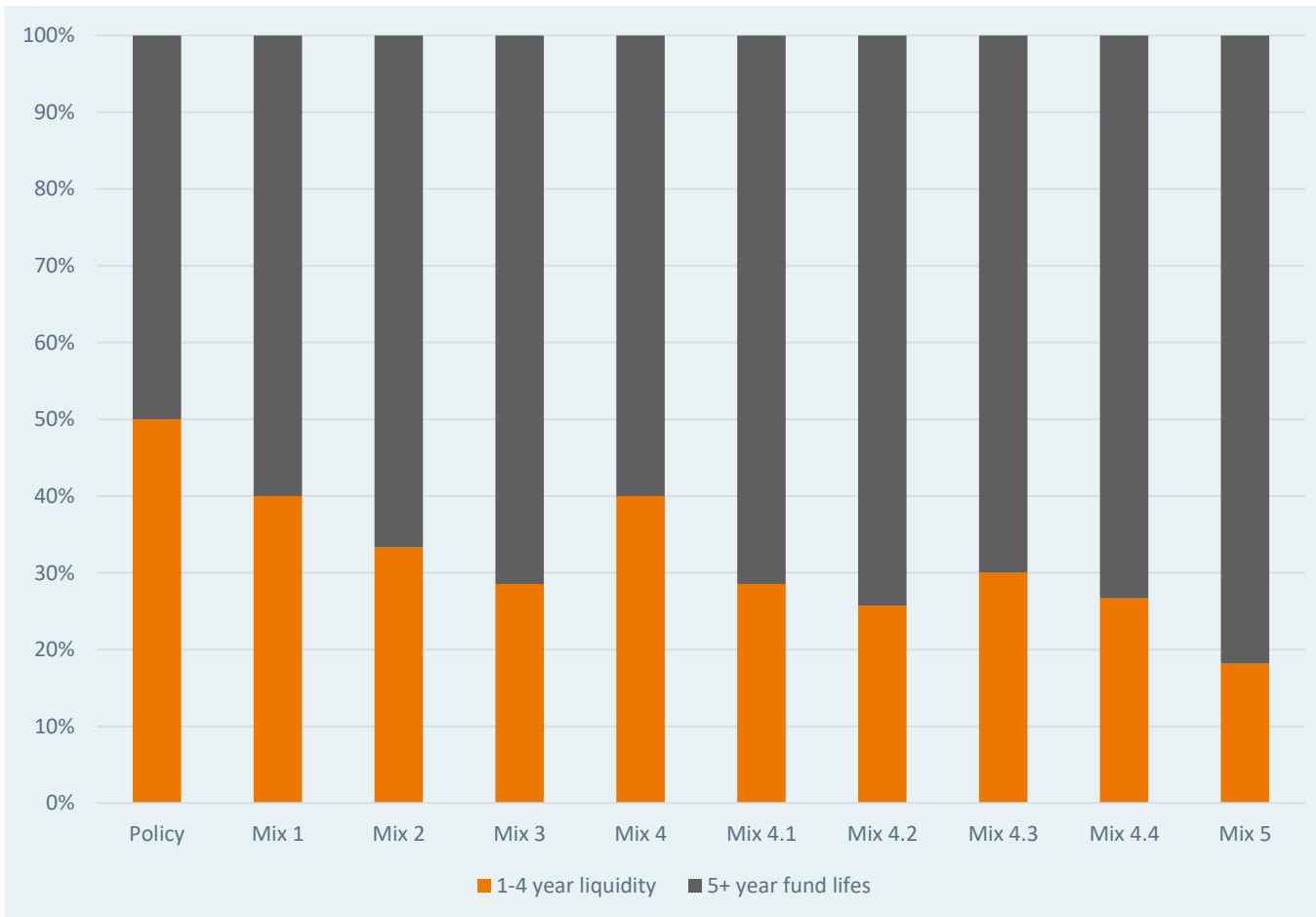
ALLOCATIONS TO ILLIQUID ASSETS BY TYPE

Mixes 3 through 5 have significant allocations to illiquid investments.

It will take at least 5 years to fully implement these targets.
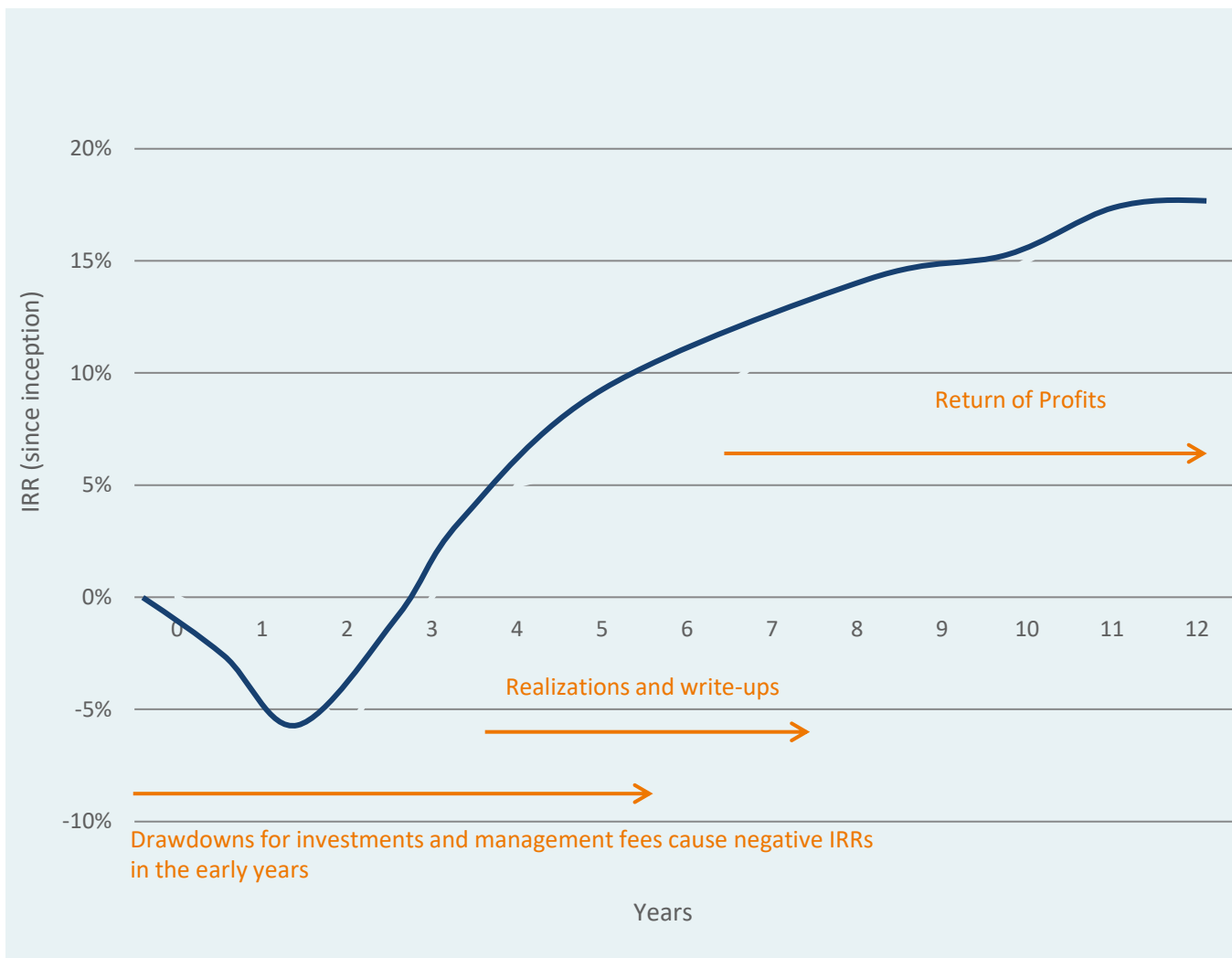
Framing illiquidity

COMPOSITION OF ILLIQUID ASSET CLASSES

"1-4 year liquidity" includes RE debt, core RE, and infrastructure. "5+ year fund lifes" includes private equity, private credit, value-add RE, and opp. RE.

The more aggressive mixes not only have larger illiquid allocations, but the duration of those lock-ups is generally longer.

Private equity: the "J-curve" effect

Private equity returns are generally negative during the first few years of an investment – primarily due to the realization of early losses and fee payments – though the degree varies by asset type.

As investments mature and are realized, returns become positive, resulting in the "J-Curve" Effect.

Chart labels:
- IRR (since inception) — vertical axis (20%, 15%, 10%, 5%, 0%, -5%, -10%)
- Years — horizontal axis (0 through 12)
- Return of Profits
- Realizations and write-ups
- Drawdowns for investments and management fees cause negative IRRs in the early years

Appendix: Phase II discussion materials

Introduction

Key takeaways from asset-liability study

— At the May 26th Board of Retirement meeting, Verus reviewed:

  ▪ Demographics, contribution rates, cash flows, credit ratings, & plan sponsor financial strength vs. peers

  ▪ Verus' Capital Market assumptions

  ▪ Stochastic & deterministic asset-liability projections for several preliminary asset allocations.

— As a result of that discussion, there appeared to be unanimous support for exploring adoption of a higher risk portfolio

The goal of today's discussion is to help the Board identify a go-forward asset allocation, recognizing there are different ways to increase risk, with different tradeoffs associated with each.

Which <u>overall</u> risks should an investor accept?

Accept greater volatility

Take on illiquidity risk, which may lead to forced selling

Tilt into assets with higher expected return, but forecasts may be wrong

TCERA has accepted or is contemplating

These philosophical considerations will ultimately impact success

Make portfolio timing "bets" which might fail to pay off

Rely on active managers who may fail to produce alpha

Over-diversify which might reduce return

Accept lower risk, but also weaker performance

Be truly different from peers

Add portfolio leverage, which can change risk profile

Not a strategy that TCERA is strongly considering at this point
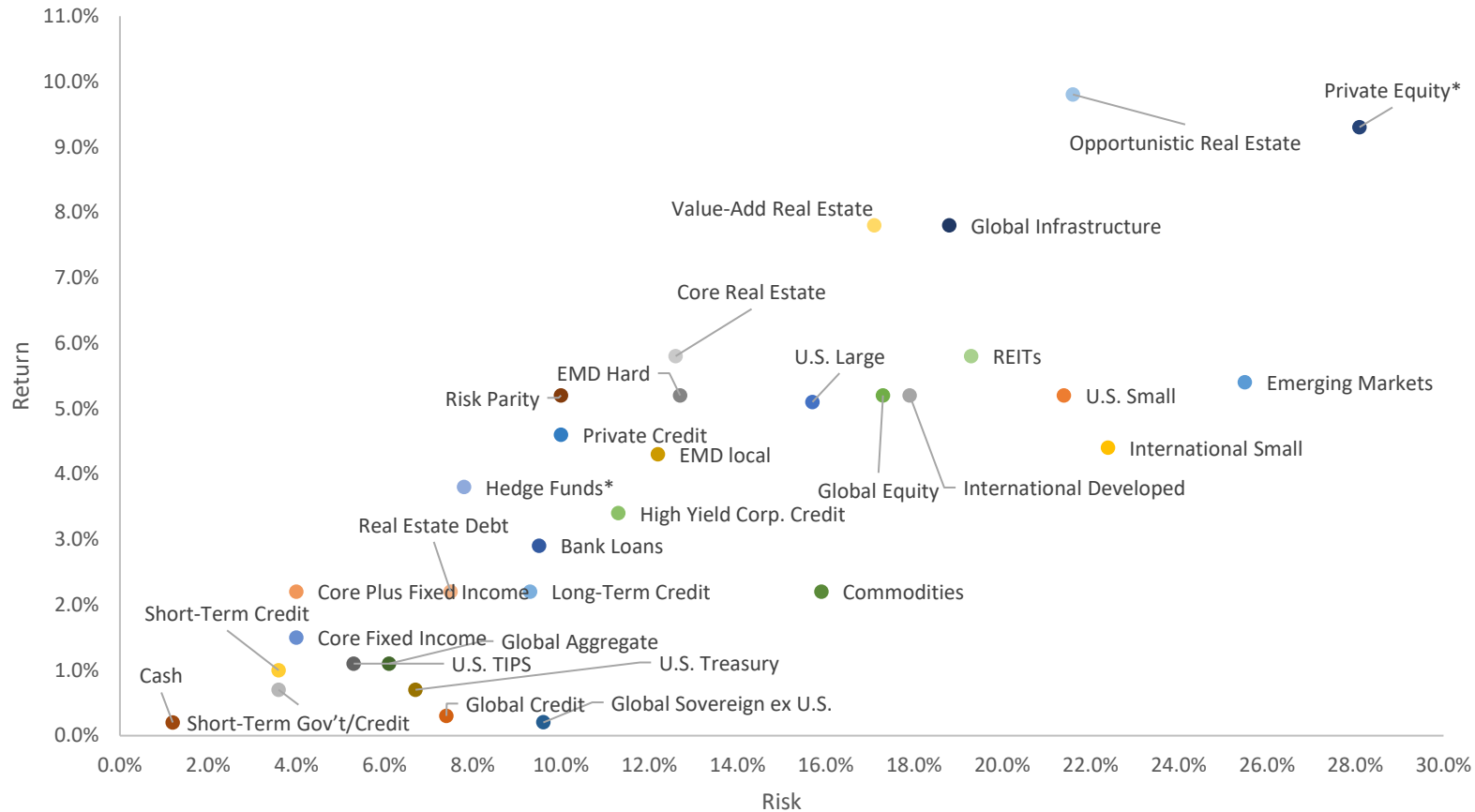
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Adding volatility & illiquidity

Increasing risk does not guarantee higher returns... but it's a starting point

Currently, the asset classes with the highest projected returns are illiquid strategies.

Based on the Verus 2021 Capital Market Assumptions (10 year, returns are geometric)

Ways to increase projected <u>volatility</u>

Method	Pros	Cons
More Public Equity ▪ *domestic, international, EM equity*	Easy to implement. Very liquid & low cost. Little peer risk.	Based on current projections, does not meaningfully increase <u>projected return</u>.
More Liquid Credit ▪ *bank loans, high yield, EMD*	Also easy to implement. Less volatility relative to adding equity.	Liquid fixed income typically serves a capital preservation role. Limited upside at current prices. Unlikely to meaningfully improve return.
More Private Markets ▪ *private equity, private credit*	Based on projections, most effective method of adding return.	Expensive and time-consuming to build out the exposure. Illiquid, very long lockups.
More Private Real Assets ▪ Value-add & opportunistic real estate, global infrastructure	Depending on strategies pursued, relative to traditional private markets, may offer: ▪ better downside protection ▪ real return (inflation-hedging) ▪ slightly better liquidity	Likely to offer less upside return relative to traditional private markets. Relative to public equity, expensive, time-consuming to build out, & illiquid (though less so than private markets)

While these options are not necessarily mutually exclusive, because of liquidity constraints it isn't practical to pursue all of them.

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Public equity: forward looking projections

|	U.S. Large	U.S. Small	EAFE	EM
Index	S&P 500	Russell 2000	MSCI EAFE Large	MSCI EM
Current Shiller P/E Ratio	30.8	43.1	17.0	11.2
Regular P/E Ratio	26.0	13,764**	34.6	20.1
2020 Shiller P/E Change	+6.2%	-4.4%	-2.9%	+6.7%
2020 Regular P/E Change	+33.3%	+33,571%	+207.1%	+51.1%
Current Shiller P/E Percentile Rank	86%	91%	32%	34%
Current Regular P/E Percentile Rank	94%	100%	97%	93%
Average of P/E Methods' Percentile Rank	90%	95%	64%	63%
2020 YTD Return	5.6%	-8.7%	-7.1%	-1.2%
Shiller PE History	1982	1988	1982	2005
Long-Term Average Shiller P/E	23.1	31.4	22.4	14.8
Verus Building Block Approach				
Current Dividend Yield	1.8%	1.3%	2.8%	2.3%
Long-Term Average Real Earnings Growth	2.4%	2.9%	1.8%	1.4%
Inflation on Earnings	2.0%	2.0%	0.8%	2.0%
Repricing Effect (Estimate)	-1.0%	-1.0%	-0.3%	-0.3%
Nominal Return	**5.1%**	**5.2%**	**5.2%**	**5.4%**

Data as of 9/30/20

*Average trailing P/E from previous 12 months is used

**Earnings have fallen to nearly zero, which is the cause of this extremely high figure (the denominator of the Price/Earnings equation is nearly zero)

NOTE: For all equities, we exclude data prior to 1972, which allows for a more appropriate comparison between data sets

Public equity: a historical perspective

ROLLING 10-YEAR RETURNS

Legend: S&P 500 · Russell 2000 · MSCI EAFE · MSCI Emerging Markets
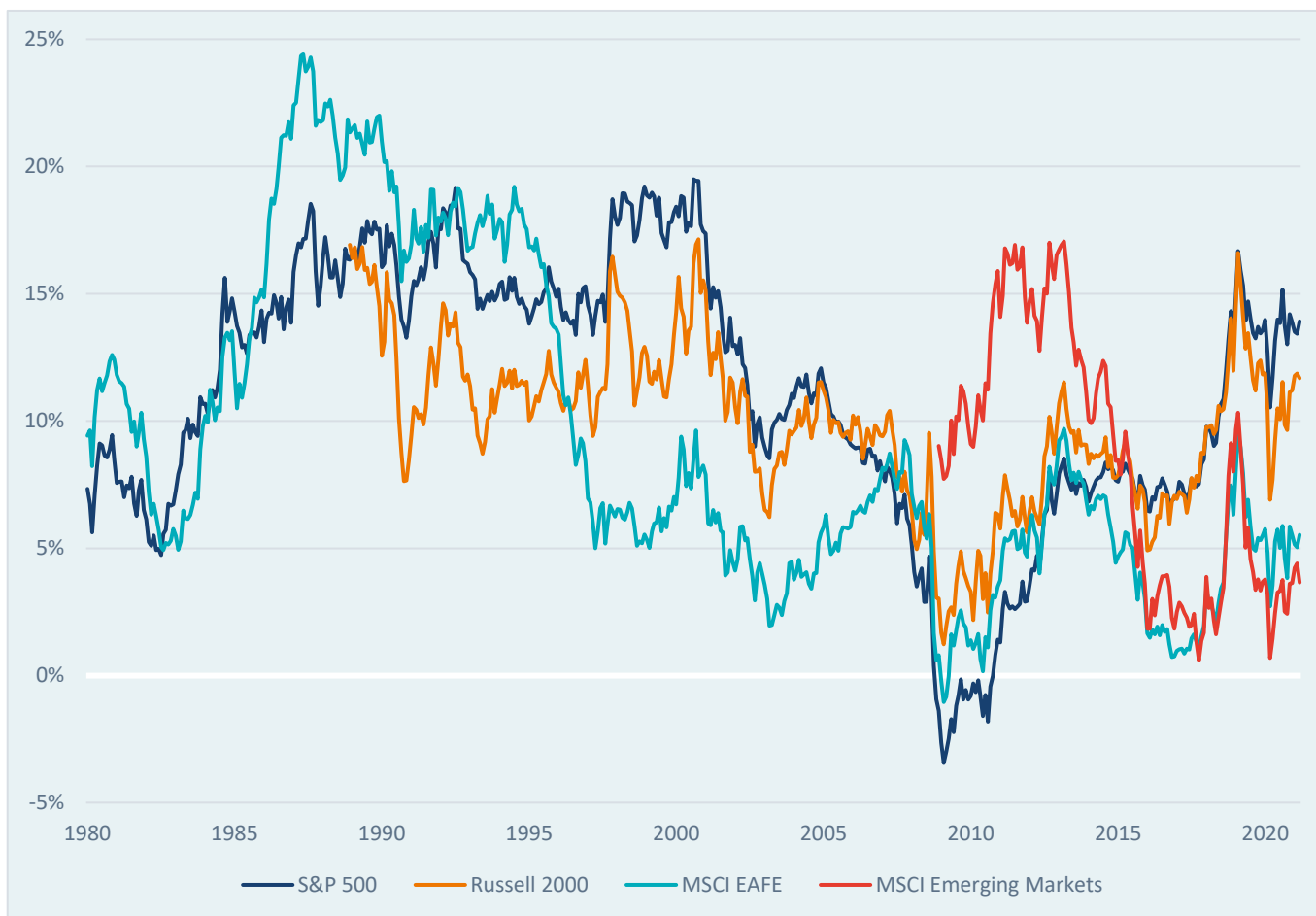
Source: eVestment. Monthly rolling 10-year intervals.
Note: Returns as of 3/31/2021

Past performance is not indicative of future returns….

We need to balance humility in forecasting with trying to mitigate natural behavioral biases

Percent of 10-year periods with returns below 5%	
S&P 500	11.1%
Russell 2000	7.2%
MSCI EAFE	24.0%
MSCI EM	37.8%

10-year return & risk assumptions

Asset Class	Index Proxy	Ten Year Return Forecast		Standard Deviation Forecast	Sharpe Ratio Forecast (g)	Sharpe Ratio Forecast (a)	10-Year Historical Sharpe Ratio (g)	10-Year Historical Sharpe Ratio (a)
		Geometric	Arithmetic					
Equities								
U.S. Large	S&P 500	5.1%	6.3%	15.7%	0.31	0.38	0.99	0.99
U.S. Small	Russell 2000	5.2%	7.3%	21.4%	0.23	0.33	0.51	0.58
International Developed	MSCI EAFE	5.2%	6.7%	17.9%	0.28	0.36	0.27	0.34
International Small	MSCI EAFE Small Cap	4.4%	6.7%	22.4%	0.19	0.29	0.43	0.49
Emerging Markets	MSCI EM	5.4%	8.3%	25.5%	0.20	0.32	0.11	0.19
Global Equity	MSCI ACWI	5.2%	6.6%	17.3%	0.29	0.37	0.58	0.62
Private Equity*	Cambridge Private Equity	9.3%	12.1%	25.7%	0.35	0.46	-	-
Fixed Income								
Cash	30 Day T-Bills	0.2%	0.2%	1.2%	-	-	-	-
U.S. TIPS	BBgBarc U.S. TIPS 5-10	1.1%	1.2%	5.3%	0.15	0.18	0.66	0.67
U.S. Treasury	BBgBarc Treasury 7-10 Year	0.7%	0.9%	6.7%	0.07	0.10	0.67	0.68
Global Sovereign ex U.S.	BBgBarc Global Treasury ex U.S.	0.2%	0.6%	9.6%	-0.01	0.04	0.09	0.12
Global Aggregate	BBgBarc Global Aggregate	1.1%	1.3%	6.1%	0.14	0.17	0.38	0.39
Core Fixed Income	BBgBarc U.S. Aggregate Bond	1.5%	1.6%	4.0%	0.31	0.36	1.02	1.01
Core Plus Fixed Income	BBgBarc U.S. Universal	2.2%	2.3%	4.0%	0.49	0.50	1.13	1.12
Short-Term Gov't/Credit	BBgBarc U.S. Gov't/Credit 1-3 Year	0.7%	0.8%	3.6%	0.14	0.16	1.23	1.22
Short-Term Credit	BBgBarc Credit 1-3 Year	1.0%	1.1%	3.6%	0.21	0.23	1.23	1.22
Long-Term Credit	BBgBarc Long U.S. Corporate	2.2%	2.6%	9.3%	0.21	0.25	0.76	0.77
High Yield Corp. Credit	BBgBarc U.S. Corporate High Yield	3.4%	4.0%	11.3%	0.28	0.34	0.82	0.83
Bank Loans	S&P/LSTA Leveraged Loan	2.9%	3.2%	9.5%	0.28	0.32	0.66	0.67
Global Credit	BBgBarc Global Credit	0.3%	0.6%	7.4%	0.01	0.05	0.63	0.64
Emerging Markets Debt (Hard)	JPM EMBI Global Diversified	5.2%	6.0%	12.7%	0.39	0.45	0.60	0.63
Emerging Markets Debt (Local)	JPM GBI-EM Global Diversified	4.3%	5.0%	12.2%	0.33	0.39	-0.01	0.05
Private Credit	Bank Loans + 175bps	4.6%	5.2%	11.2%	0.39	0.45	-	-
Other								
Commodities	Bloomberg Commodity	2.2%	3.4%	15.9%	0.13	0.20	-0.47	-0.41
Hedge Funds*	HFRI Fund Weighted Composite	3.8%	4.1%	7.8%	0.46	0.49	0.47	0.49
Real Estate Debt	BBgBarc CMBS IG	2.2%	2.5%	7.5%	0.26	0.30	1.18	1.17
Core Real Estate	NCREIF Property	5.8%	6.5%	12.6%	0.44	0.50	2.06	1.99
Value-Add Real Estate	NCREIF Property + 200bps	7.8%	9.1%	17.1%	0.44	0.52	-	-
Opportunistic Real Estate	NCREIF Property + 400bps	9.8%	11.8%	21.6%	0.44	0.54	-	-
REITs	Wilshire REIT	5.8%	7.5%	19.3%	0.29	0.38	0.46	0.52
Global Infrastructure	S&P Global Infrastructure	7.8%	9.4%	18.8%	0.40	0.49	0.28	0.35
Risk Parity	Risk Parity	5.2%	5.9%	10.0%	0.50	0.56	-	-
Currency Beta	MSCI Currency Factor Index	1.2%	1.3%	3.5%	0.28	0.30	0.15	0.16
Inflation		2.0%	-	-	-	-	-	-

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.

*Return expectations differ depending on method of implementation

Mean-variance analysis

	Policy	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5	Return (g)	Return (a)	Standard Deviation	Sharpe Ratio (a)
US Large	19.0	24.0	23.0	20.0	20.0	12.0	5.1	6.3	15.7	0.38
US Small	6.0	8.0	7.0	6.0	6.0	3.0	5.2	7.3	21.4	0.33
Total Domestic Equity	*25*	*32*	*30*	*26*	*26*	*15*				
International Developed	12.0	15.0	13.0	13.0	13.0	10.0	5.2	6.7	17.9	0.36
Emerging Markets	3.0	5.0	4.0	3.0	3.0	5.0	5.4	8.3	25.5	0.32
Total Int'l Equity	*15*	*20*	*17*	*16*	*16*	*15*				
Global Equity	3.0	3.0	3.0	3.0	3.0	0.0	5.2	6.6	17.3	0.37
Total Equity	*43*	*55*	*50*	*45*	*45*	*30*				
Core Plus Fixed Income	17.0	15.0	15.0	15.0	15.0	15.0	2.2	2.3	4.0	0.50
Global Aggregate	5.0	0.0	0.0	0.0	0.0	0.0	1.1	1.3	6.1	0.17
Emerging Market Debt (Hard)	2.5	2.5	2.5	2.5	2.5	0.0	5.2	6.0	12.7	0.45
Emerging Market Debt (Local)	2.5	2.5	2.5	2.5	2.5	0.0	4.3	5.0	12.2	0.39
Total Fixed Income	*27*	*20*	*20*	*20*	*20*	*15*				
Real Estate Debt	5.0	5.0	5.0	4.0	4.0	0.0	5.3	6.3	15.0	0.41
Core Real Estate	10.0	5.0	5.0	6.0	6.0	5.0	5.8	6.5	12.6	0.50
Value Add Real Estate	5.0	5.0	5.0	3.0	6.0	5.0	7.8	9.1	17.1	0.52
Opportunistic Real Estate	0.0	0.0	0.0	2.0	5.0	10.0	9.8	11.8	21.6	0.54
Infrastructure	0.0	0.0	0.0	0.0	4.0	5.0	7.8	9.4	18.8	0.49
Total Real Assets	*20*	*15*	*15*	*15*	*25*	*25*				
Private Equity	5.0	5.0	10.0	12.0	5.0	20.0	9.3	12.1	28.1	0.46
Private Credit	5.0	5.0	5.0	8.0	5.0	10.0	4.6	5.2	11.2	0.45
Total Non-Public Investments	*10*	*10*	*15*	*20*	*10*	*30*				
Cash	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	1.2	-
Total Allocation	**100**	**100**	**100**	**100**	**100**	**100**				

	Policy	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
Mean Variance Analysis						
Forecast 10 Year Return	***5.4***	***5.6***	***5.8***	***6.0***	***6.0***	***7.0***
Standard Deviation	10.7	12.3	12.3	12.2	12.0	13.2
Return/Std. Deviation	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*
1st percentile ret. 1 year	*-16.7*	*-19.2*	*-19.0*	*-18.7*	*-18.4*	*-19.5*
Sharpe Ratio	0.51	0.48	0.50	0.51	0.52	0.56

Source: MPI, Verus

Projected returns increase from 5.4% to 7%, depending on the mix.

Projected standard deviation increase from 10.7% to 13.2%.

Verus scenario analysis

	Policy	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
10 Year Return Forecast						
Stagflation	3.7	3.3	3.5	3.3	4.4	3.6
Weak	0.7	0.1	0.3	0.3	1.0	0.4
Base CMA	**5.5**	**5.7**	**6.0**	**6.1**	**5.9**	**6.6**
Strong	11.1	12.3	12.6	12.6	11.7	13.6
Range of Scenario Forecast	*10.3*	*12.2*	*12.3*	*12.4*	*10.7*	*13.2*
Shock (1 year)	*-21.4*	*-25.9*	*-26.7*	*-25.9*	*-22.4*	*-25.9*
10 Year <u>Real</u> Return Forecast						
Stagflation	-2.4	-2.8	-2.6	-2.8	-1.7	-2.5
Weak	-0.4	-1.0	-0.8	-0.8	-0.1	-0.7
Base CMA	*3.4*	*3.6*	*3.9*	*4.0*	*3.8*	*4.5*
Strong	8.5	9.7	10.0	10.0	9.1	11.0
Range of Scenario Forecast	*10.8*	*12.5*	*12.5*	*12.8*	*10.8*	*13.6*

The scenario analysis dimensions return projections across different economic regimes.

Source: MPI & Verus

Asset mixes for consideration

HIGH-LEVEL ASSET ALLOCATION

All mixes increase projected risk & return, but in different ways.
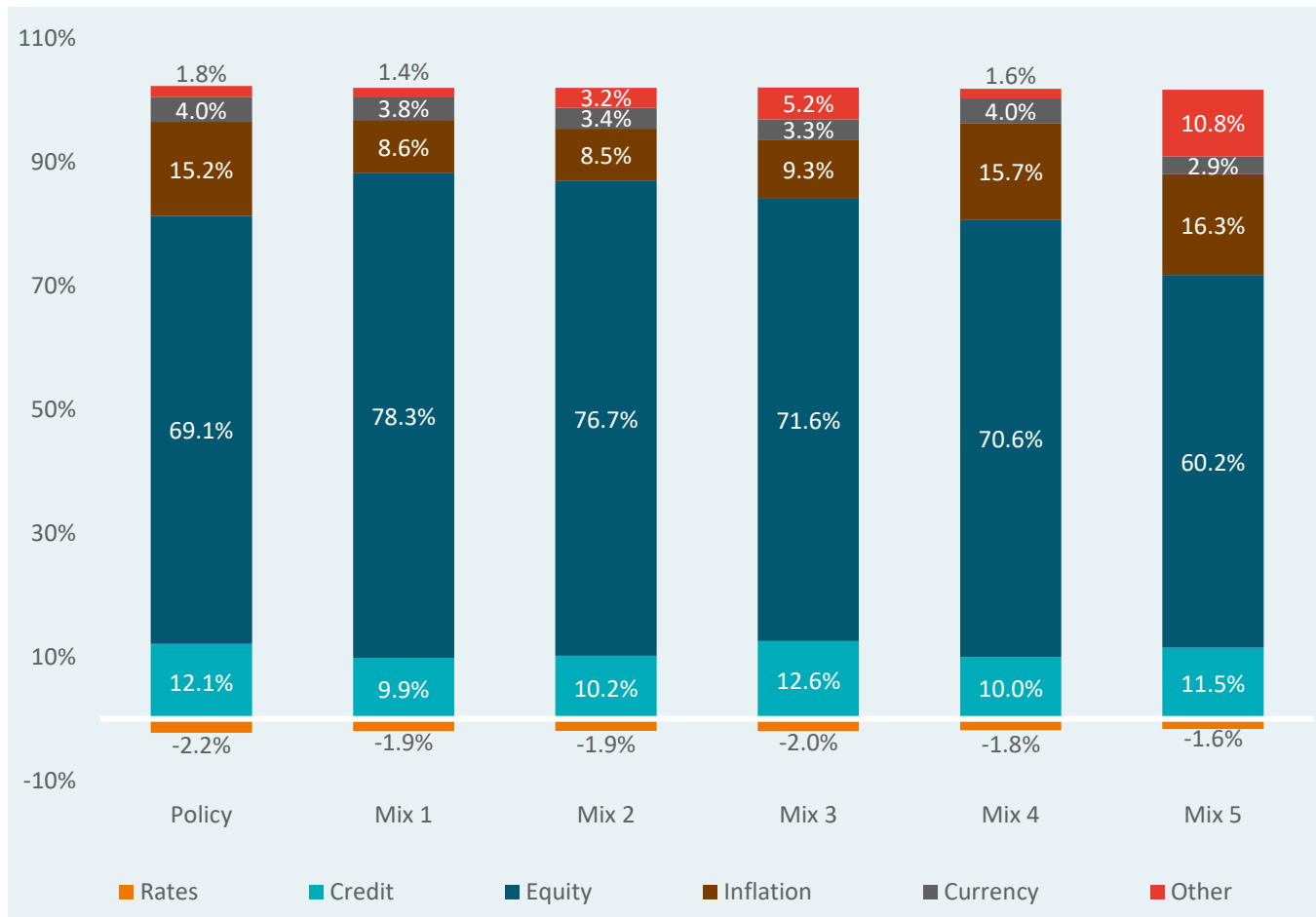
	Policy	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
Private markets	10	10	15	20	10	30
Real Assets	20	15	15	15	25	25
Fixed Income	27	20	20	20	20	15
Public Equity	43	55	50	45	45	30

Method of increasing risk:	more public equity	hybrid option	more private markets	more real assets	more privates & real assets

Risk decomposition

RISK CONTRIBUTION BY RISK FACTOR

	Policy	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
Other	1.8%	1.4%	3.2%	5.2%	1.6%	10.8%
Currency	4.0%	3.8%	3.4%	3.3%	4.0%	2.9%
Inflation	15.2%	8.6%	8.5%	9.3%	15.7%	16.3%
Equity	69.1%	78.3%	76.7%	71.6%	70.6%	60.2%
Credit	12.1%	9.9%	10.2%	12.6%	10.0%	11.5%
Rates	-2.2%	-1.9%	-1.9%	-2.0%	-1.8%	-1.6%

Legend: Rates, Credit, Equity, Inflation, Currency, Other

Equity risk is the largest single risk factor for all mixes.

Credit risk is a function of fixed income.
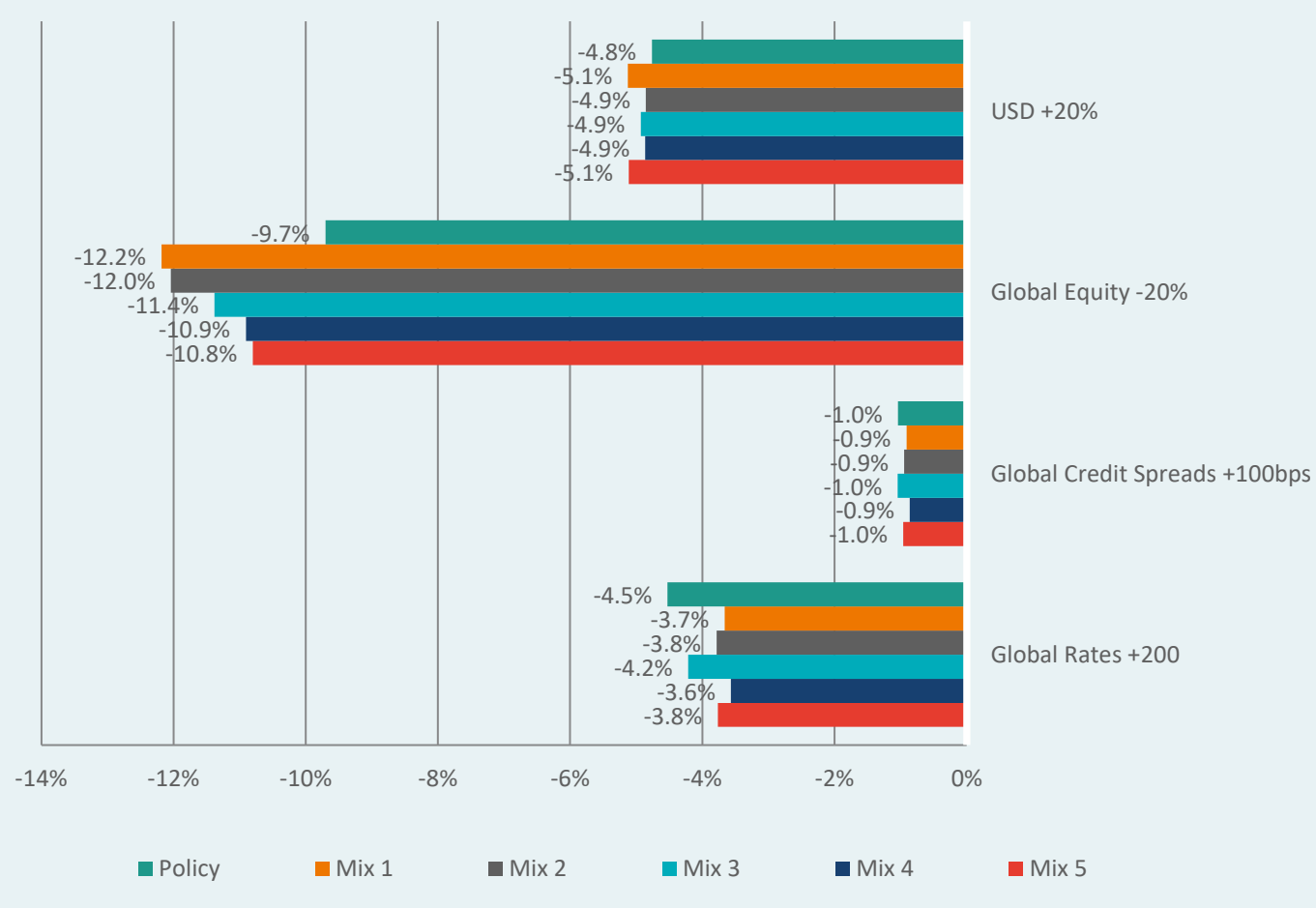
Currency risk a function of international investments.

Inflation risk is a function of real assets.

"Other" are risks inherent within private markets.

Source: Barra, Ex-Ante Volatility

Verus

Stress tests

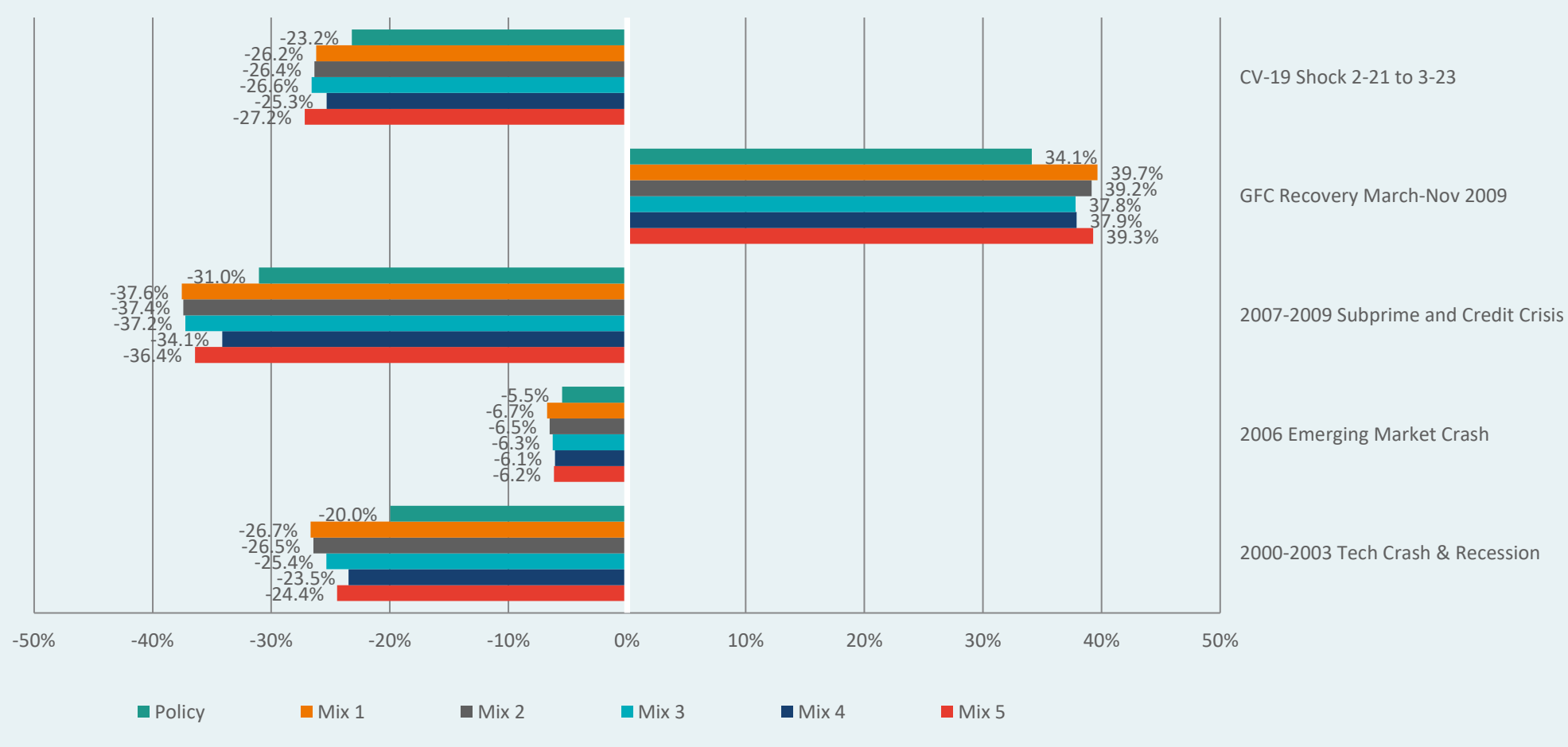This analysis is based on how the risk factors inherent in the current index holdings react in those environments.
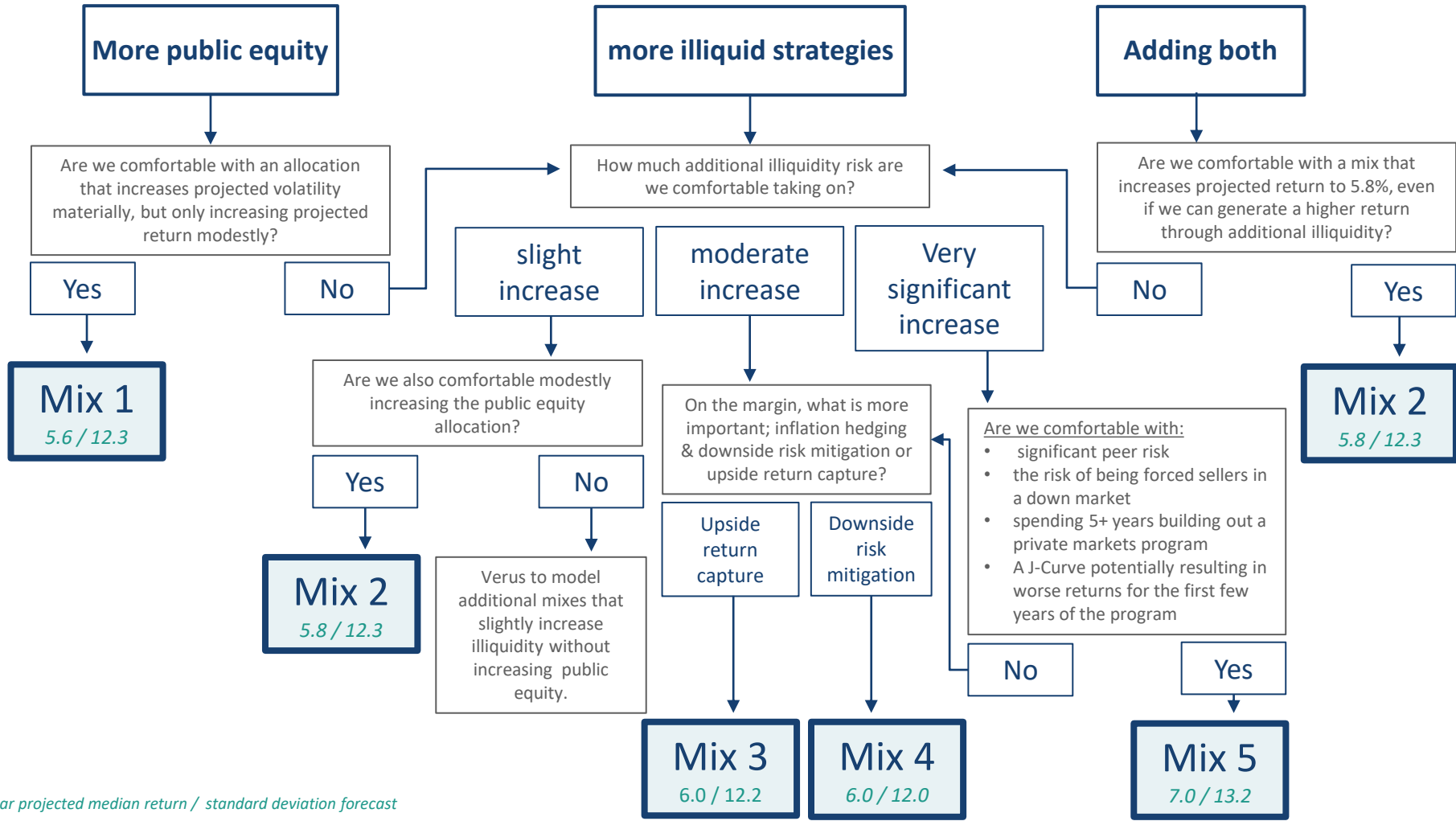
USD +20%
- -4.8% (Policy)
- -5.1% (Mix 1)
- -4.9% (Mix 2)
- -4.9% (Mix 3)
- -4.9% (Mix 4)
- -5.1% (Mix 5)

Global Equity -20%
- -9.7% (Policy)
- -12.2% (Mix 1)
- -12.0% (Mix 2)
- -11.4% (Mix 3)
- -10.9% (Mix 4)
- -10.8% (Mix 5)

Global Credit Spreads +100bps
- -1.0% (Policy)
- -0.9% (Mix 1)
- -0.9% (Mix 2)
- -1.0% (Mix 3)
- -0.9% (Mix 4)
- -1.0% (Mix 5)

Global Rates +200
- -4.5% (Policy)
- -3.7% (Mix 1)
- -3.8% (Mix 2)
- -4.2% (Mix 3)
- -3.6% (Mix 4)
- -3.8% (Mix 5)

Legend: Policy, Mix 1, Mix 2, Mix 3, Mix 4, Mix 5

Source: Barra

Verus

Scenario analysis

TAIL RISK – SCENARIO ANALYSIS

	Policy	Mix 1	Mix 2	Mix 3	Mix 4	Mix 5
CV-19 Shock 2-21 to 3-23	-23.2%	-26.2%	-26.4%	-26.6%	-25.3%	-27.2%
GFC Recovery March-Nov 2009	34.1%	39.7%	39.2%	37.8%	37.9%	39.3%
2007-2009 Subprime and Credit Crisis	-31.0%	-37.6%	-37.4%	-37.2%	-34.1%	-36.4%
2006 Emerging Market Crash	-5.5%	-6.7%	-6.5%	-6.3%	-6.1%	-6.2%
2000-2003 Tech Crash & Recession	-20.0%	-26.7%	-26.5%	-25.4%	-23.5%	-24.4%

Source: Barra

Verus

Decision framework

How are we, as Trustees, most comfortable adding risk in pursuit of higher returns?

More public equity

Are we comfortable with an allocation that increases projected volatility materially, but only increasing projected return modestly?

Yes

No

Mix 1
5.6 / 12.3

more illiquid strategies

How much additional illiquidity risk are we comfortable taking on?

slight increase

moderate increase

Very significant increase

Are we also comfortable modestly increasing the public equity allocation?

Yes

No

Mix 2
5.8 / 12.3

Verus to model additional mixes that slightly increase illiquidity without increasing public equity.

On the margin, what is more important; inflation hedging & downside risk mitigation or upside return capture?

Upside return capture

Downside risk mitigation

Are we comfortable with:
- significant peer risk
- the risk of being forced sellers in a down market
- spending 5+ years building out a private markets program
- A J-Curve potentially resulting in worse returns for the first few years of the program

No

Yes

Adding both

Are we comfortable with a mix that increases projected return to 5.8%, even if we can generate a higher return through additional illiquidity?

No

Yes

Mix 2
5.8 / 12.3

Mix 3
6.0 / 12.2

Mix 4
6.0 / 12.0

Mix 5
7.0 / 13.2

10 year projected median return / standard deviation forecast

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Contextualizing liquidity

"NORMAL MARKET" LIQUIDITY BUCKETING
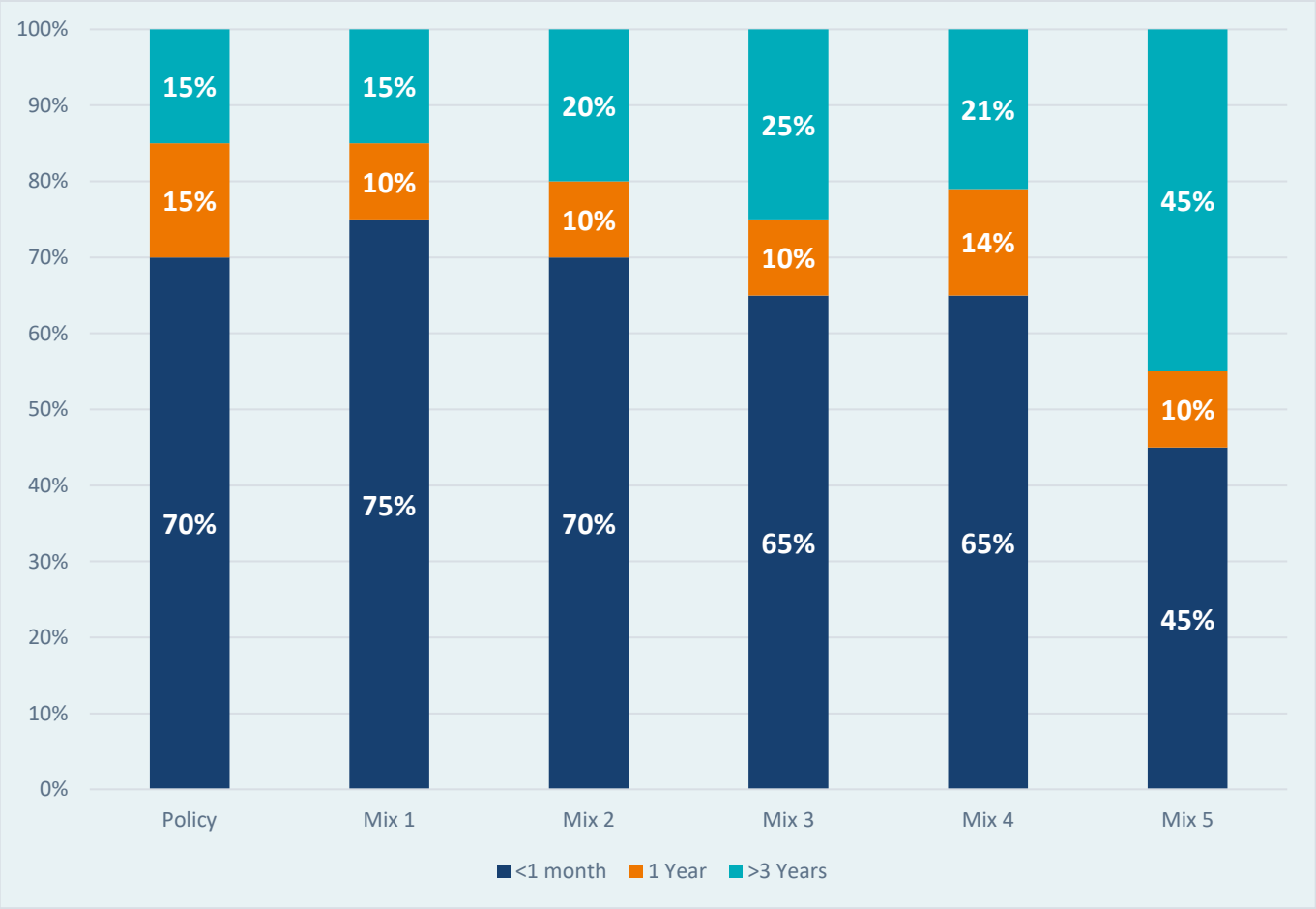
Liquidity refers to how quickly an asset can be converted to cash.

In distressed markets, assets' liquidity can become impaired.

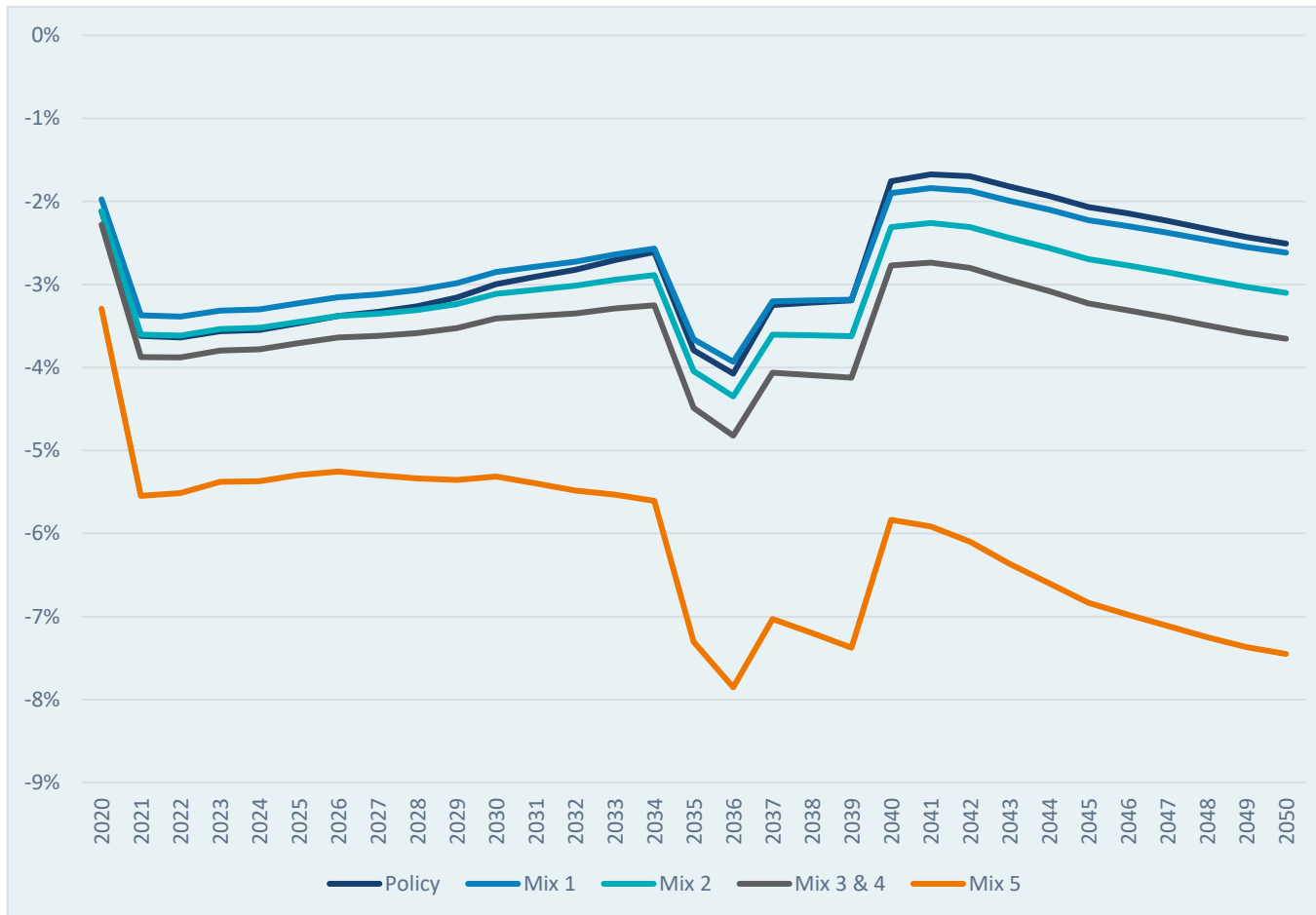A distressed liquidity estimate:*

"<1 month" → 1-3 months

"1 Year" → 1-3 years

">3 years" → ???

Liquidity is in some cases a subjective estimate.

Paying benefit payments: baseline

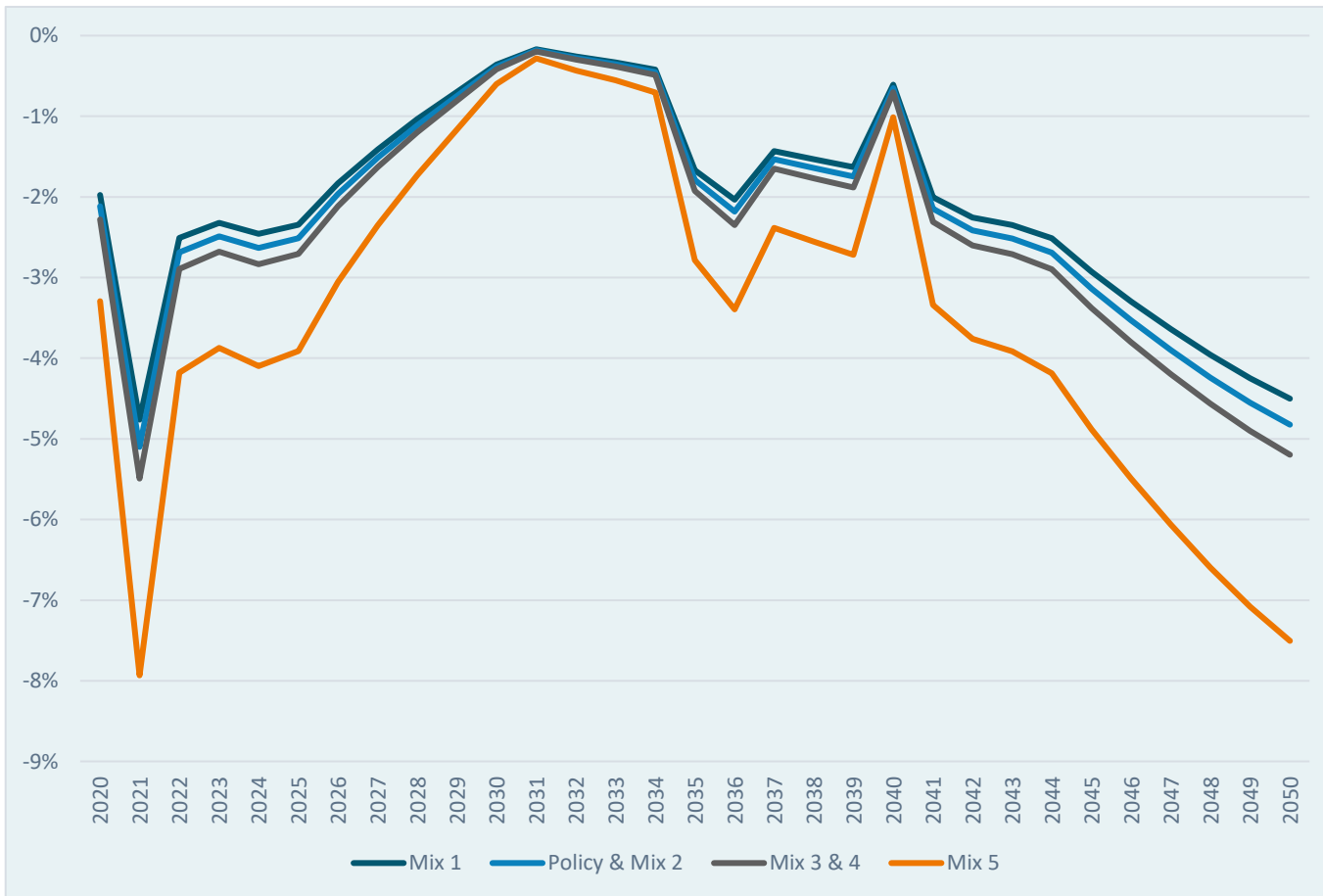**NET OPERATIONAL CASH OUTFLOWS AS A PERCENTAGE OF LIQUID ASSETS: BASELINE**

How much liquid assets
will TCERA retain to fund
benefit payments?

Assumes starting value of $1.8B, current TCERA contribution funding policy, Verus annual return projections for each mix, as well as each mix's allocation to liquid assets (defined as liquidity greater than 1 month). Because Mix 3 & Mix 4 have the same overall allocation to liquid assets, and the same return projection, their outcomes are identical in this projection.

Paying benefit payments: drawdown

NET OPERATIONAL CASH OUTFLOWS AS A PERCENTAGE OF LIQUID ASSETS: 25% DRAWDOWN

Paradoxically, in a significant drawdown event, the higher employer contribution rates offset the loss in liquidity caused by a drawdown.

Assumes starting value of $1.8B, current TCERA contribution funding policy, as well as each mix's allocation to liquid assets (defined as liquidity greater than 1 month). For this scenario, all mixes assume a 25% drawdown in year 1 followed by a 7% return each year thereafter. Because Policy & Mix 2 both have a 70% liquid allocation, the projections are identical here. Likewise, because Mix 3 & Mix 4 both have a 65% liquid allocation, their projections are identical here.

Verus

Paying benefit payments: drawdown v2

NET OPERATIONAL CASH OUTFLOWS AS A PERCENTAGE OF LIQUID ASSETS: 25% DRAWDOWN, ER CONTRIBUTIONS LOCKED AT PRE-DRAWDOWN LEVELS
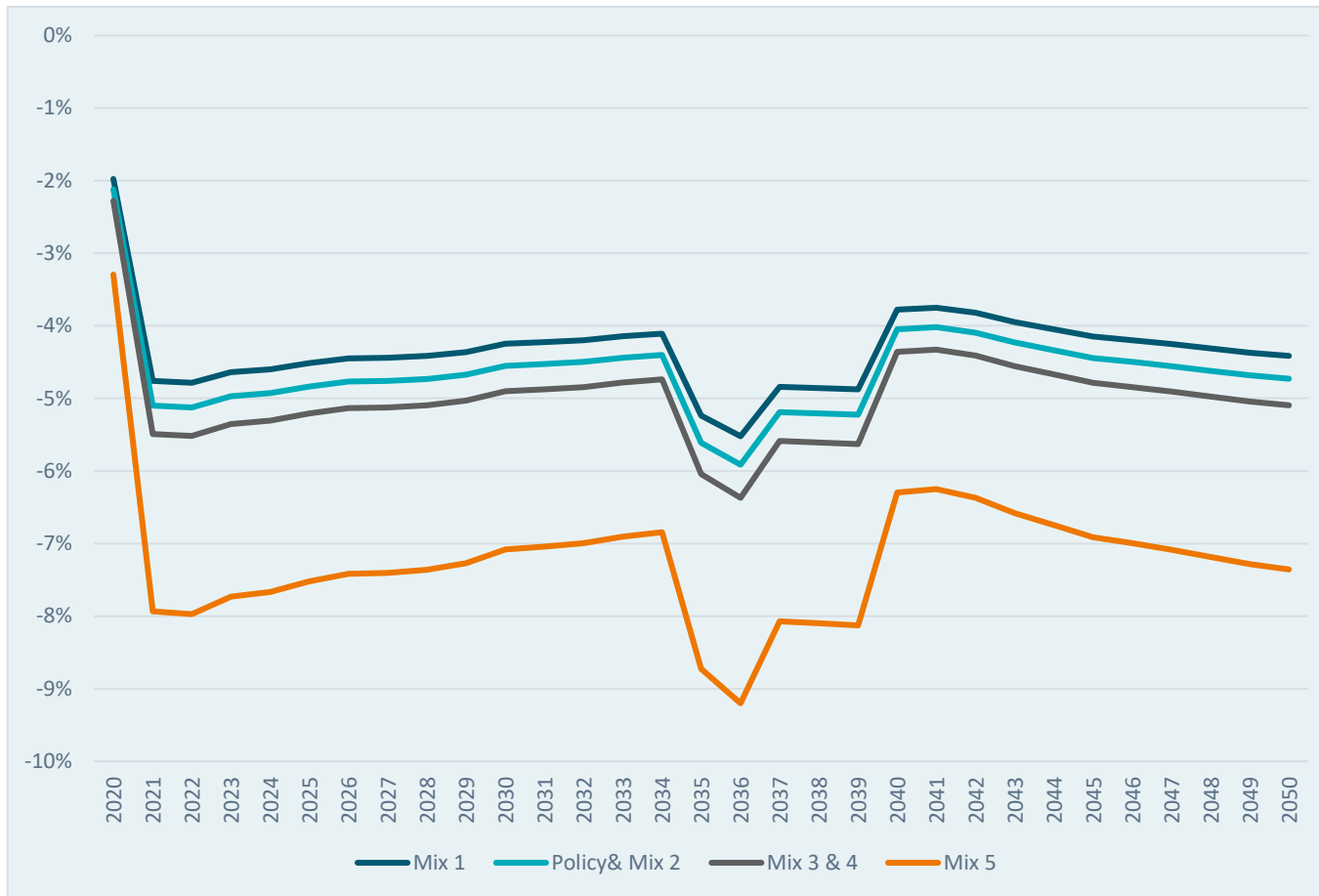

If we hold employer contributions static at the current projection levels, liquidity becomes a more significant issue during a drawdown.

Assumes starting value of $1.8B, current TCERA contribution funding policy, as well as each mix's allocation to liquid assets (defined as liquidity greater than 1 month). For this scenario, all mixes assume a 25% drawdown in year 1 followed by a 7% return each year thereafter. Because Policy & Mix 2 both have a 70% liquid allocation, the projections are identical here. Likewise, because Mix 3 & Mix 4 both have a 65% liquid allocation, their projections are identical here.

Paying benefit payments: drawdown v3

NET OPERATIONAL CASH OUTFLOWS AS A PERCENTAGE OF <u>FIXED INCOME ASSETS</u>: 25% DRAWDOWN, ER CONTRIBUTIONS LOCKED AT PRE-DRAWDOWN LEVELS
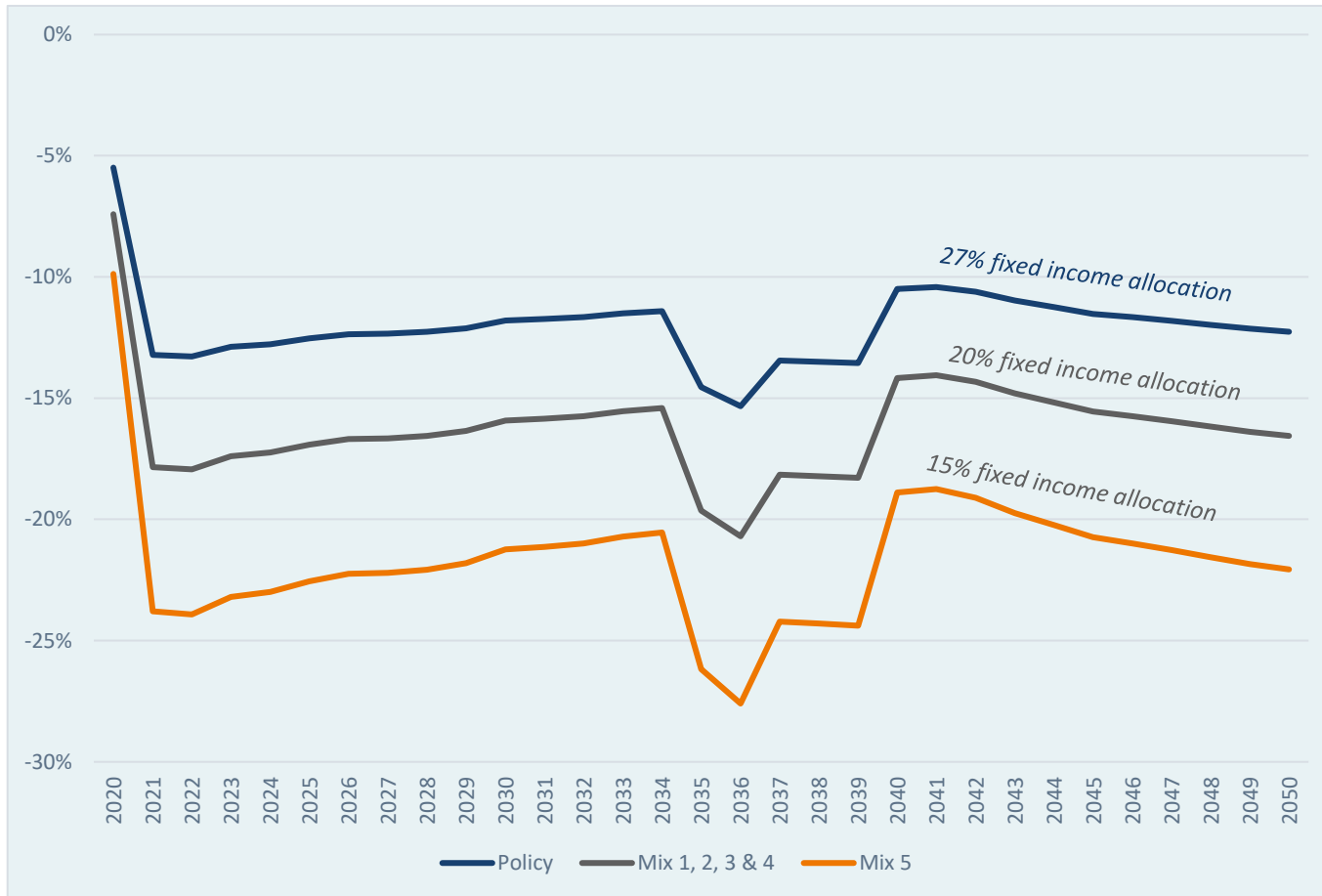
In a drawdown scenario, it is disadvantageous to be a forced seller of risk assets.

This analysis looks at liquidity needs, focusing just on how large the System's liquidity needs are relative to fixed income assets.

Assumes starting value of $1.8B, current TCERA contribution funding policy, as well as each mix's allocation to fixed income. For this scenario, all mixes assume a 25% drawdown in year 1 followed by a 7% return each year thereafter. This scenario applies the same static employer contribution assumption as the prior slide. Because Mix 1,2,3, & 4 all have a 20% fixed income allocation, their outcome under this analysis is identical.