MEKETA | 45 YEARS
CELEBRATING A MILESTONE

San Jose Federated City Employees' Retirement System

May 18, 2023

Asset Allocation Analysis

Introduction

→ This document reviews updated capital market expectations, evaluates the current asset allocation policy, and presents alternative asset allocation options for the Retirement System.

→ When we last considered changes to asset allocation one year ago, the market environment was characterized by historically high equity valuations, but interest rates were much lower than current levels. Given the much higher interest rates and lower asset class valuations at this time, expectations for asset class returns have increased significantly. Meketa Investment Group expects that the Retirement System's long-term (20-year) expected return remains well above the actuarial assumed rate of return of 6.625%, and the standard deviation, as calculated by risk advisor Verus, remains near the 12% threshold defined as the upper limit in the Retirement System's Investment Policy Statement.

→ The asset allocation review process highlights the natural tension between long term goals and short term risks, and should allow the System's decision-makers to make more informed decisions regarding portfolio positioning. Meketa Investment Group first worked with San Jose Staff to develop and analyze a wide variety of potential alternative asset allocation policies. This document provides three alternative asset allocation options for your information.

→ Throughout the following slides, we provide various approaches to assessing risk in order to provide a "mosaic" of the risks faced by the System, including mean-variance analysis using Meketa's capital markets expectations, historical scenario analysis, and forward-looking stress testing and Economic Regime Management® analysis. The goal of this review is not to declare one portfolio the "right" choice or the only prudent choice, but to highlight the risk and return tradeoffs of different policy portfolios.

San Jose Federated Investment Policy Statement Asset Allocation Policy

→ According to the Retirement System's Investment Policy Statement:

"The Board recognizes that establishing an appropriate strategic asset allocation ("SAA") portfolio is critical to the long-term success of the investment program, as asset allocation is the single biggest determinant of the expected risk and return of the System."

→ The IPS also includes the following process:

"The (asset allocation) will be re-evaluated annually following the results of the annual actuarial study. (It) shall be established and modified based on the results of formal asset allocation studies performed approximately every three years or when a significant market correction occurs. The capital market assumptions ("CMAs") used in such studies shall be reviewed and updated annually or when the S&P 500 experiences a decrease of more than 20% from peak. The Board shall consult with the general investment consultant in connection with such asset allocation studies and CMA reviews."

Meketa's Capital Market Expectations

→ We update our capital markets expectations each year in January.

- Changes are driven by many factors, including interest rates, credit spreads, cap rates, and equity prices.

→ 2022 was a difficult year, with losses experienced for most asset classes, as interest rates increased, spreads widened, and most risk assets declined in value.

- However, there is a notable silver lining to this story – increased return assumptions.

→ Bond yields increased by the largest amount since the 1990s, driving up future returns for fixed income assets.

→ Despite lower growth projections globally, the price decline experienced by equities and many other risk assets has improved their forward-looking returns.

→ The net result is the largest increase in return assumptions in our 20+ year history of creating capital market expectations ("CMEs").

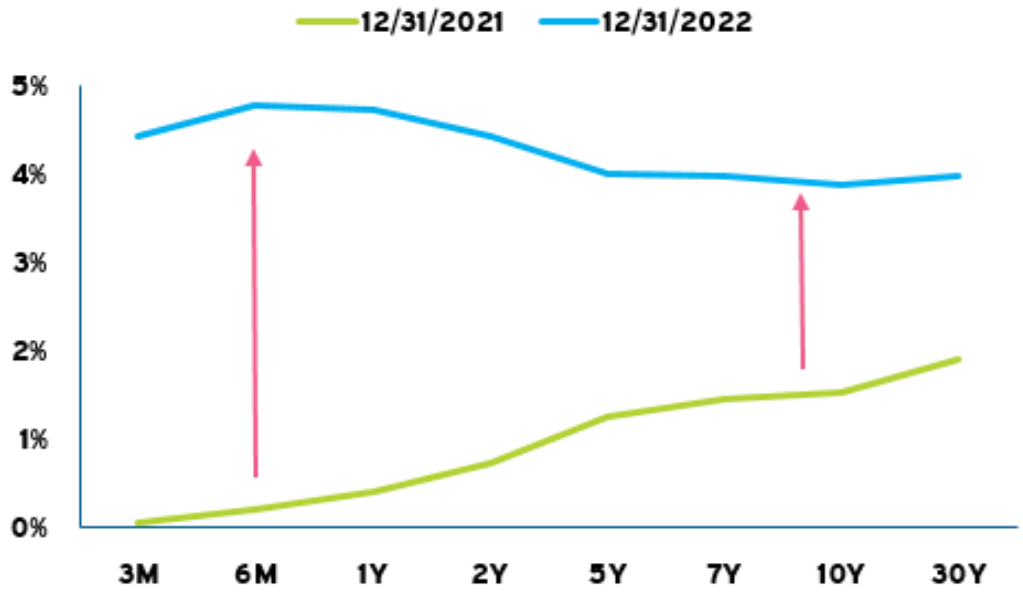
→ While our 10-year CMEs continue to be lower than many of our 20-year CMEs, this is no longer true across the board, especially in fixed income.

Rising Interest Rates

→ The US Treasury yield curve moved upward and flattened during 2022, even inverting in some portions of the curve.

→ The increase was particularly sharp for short-term rates, driven by the Federal Reserve's actions that were intended to battle inflation.

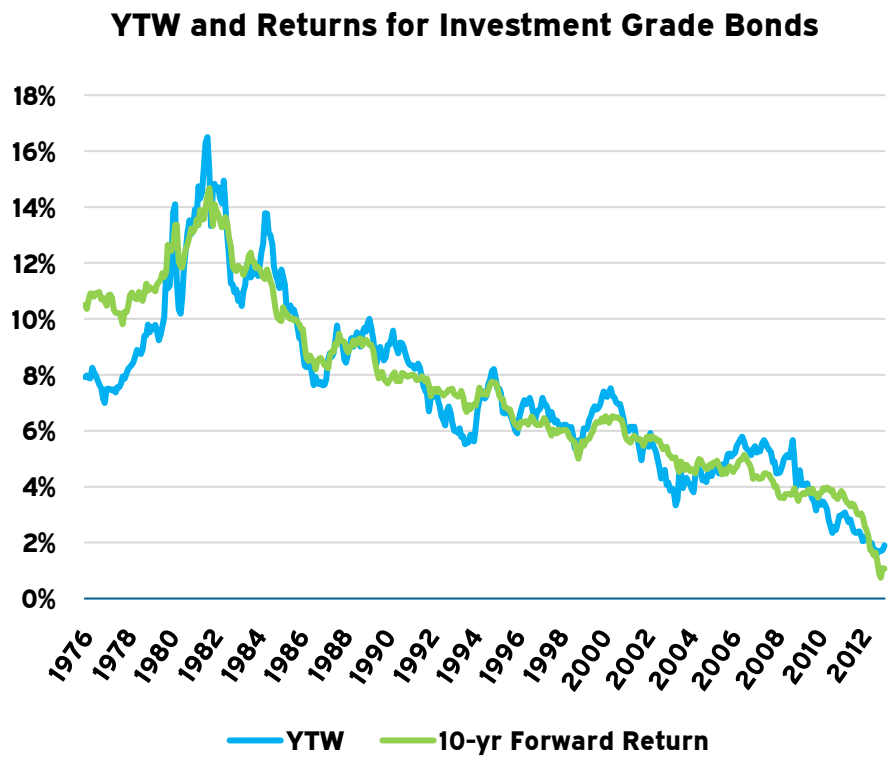
US Yield Curve[1]

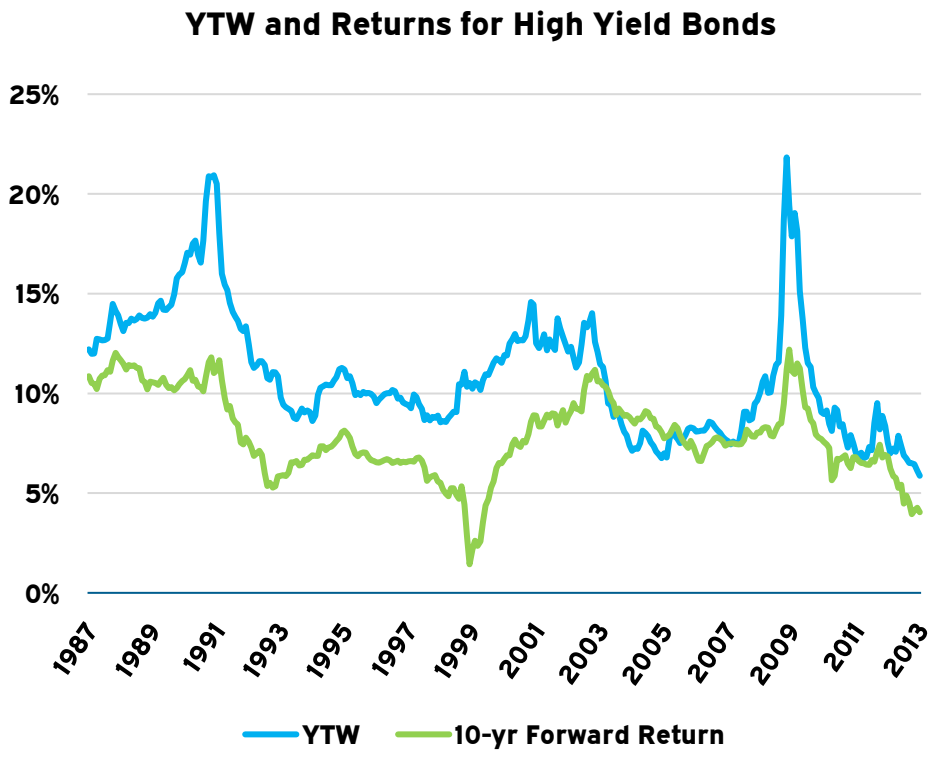


[1] Source: Bloomberg. Data is as of December 31, 2022.

Higher Yields Means Higher Future Returns

→ This increase in interest rates matters because yields are a very good predictor of future returns for bonds,[1] at least over a 10-year horizon.





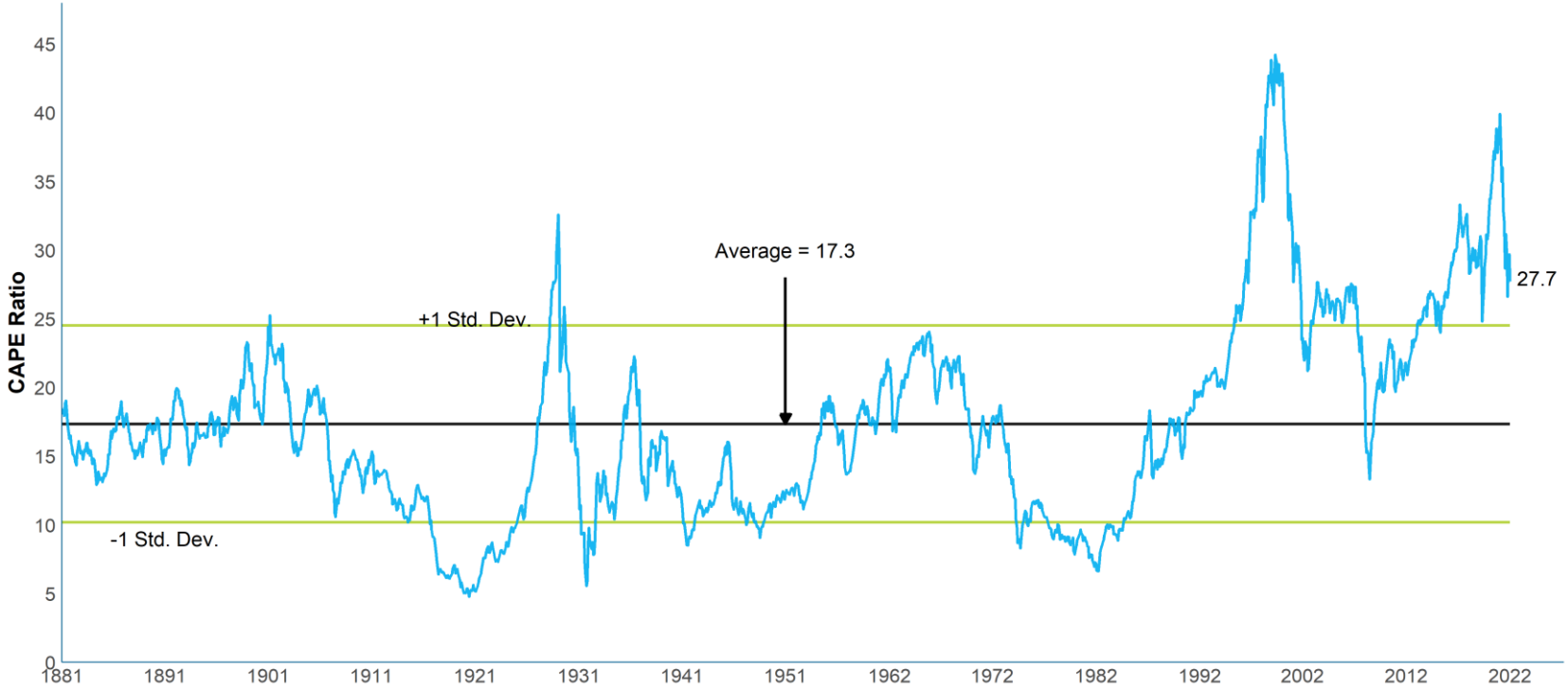
[1] When predicting returns for bonds, default risk should also be taken into account. For example, defaults are why the return for high yield bonds have generally been below the starting yield.
Source: Bloomberg Aggregate and Bloomberg High yield indices. Data is as of December 31, 2022.

Lower Prices for Equities

→ US stocks had a rough year, with the S&P 500 index experiencing an 18.1% loss.

→ Valuations remain elevated relative to their long-term history but are much nearer their average for the past 30 years.

US Equity Cyclically Adjusted P/E[1]



[1] Source: Robert Shiller, Yale University, and Meketa Investment Group. Data is as of December 31, 2022 for the on S&P 500 Index.

Lower Prices in Non-US Equities, too

→ EAFE equities declined 14.5% in USD terms in 2022, though the loss was only 7.0% in local currency.

→ EAFE valuations are now relatively close to their historical average.

Developed International Equity Cyclically Adjusted P/E[1]

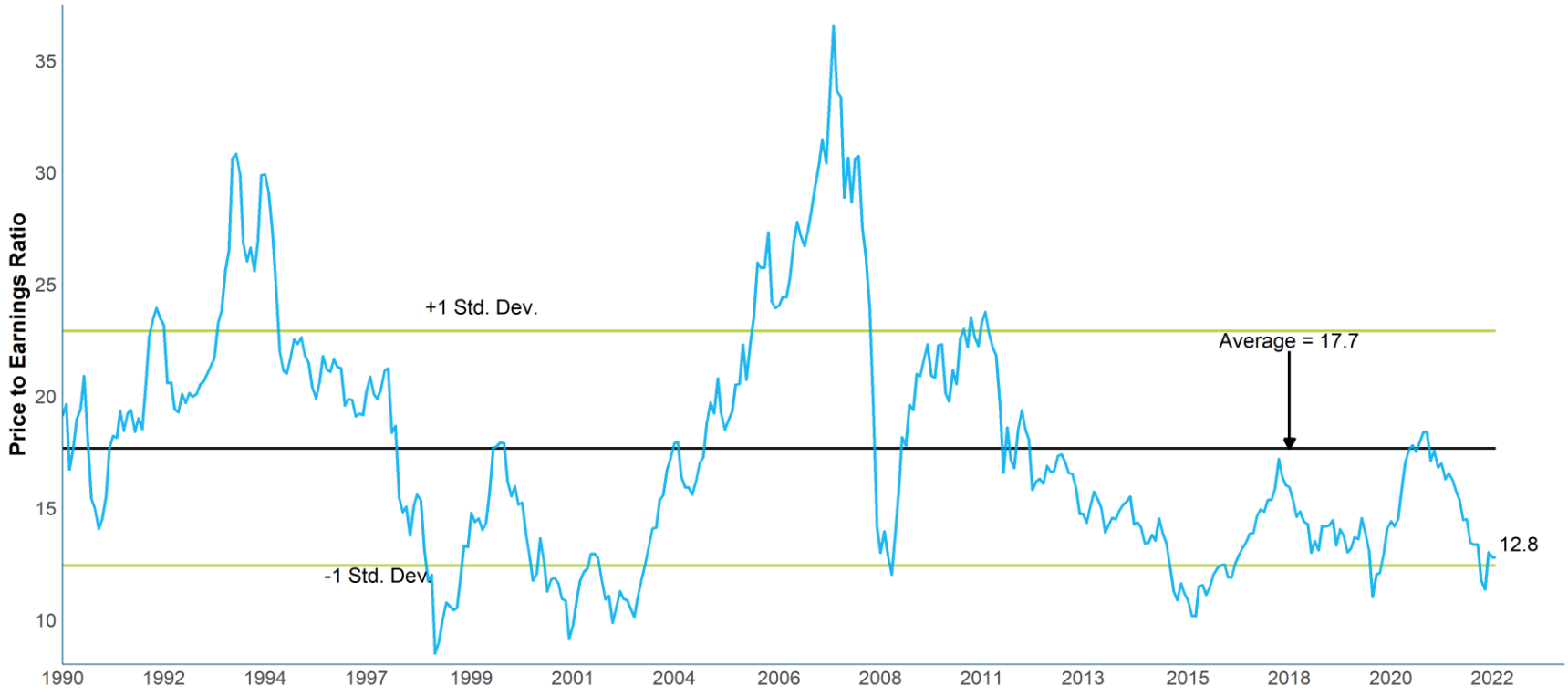
[1] Source: MSCI and Bloomberg. Earnings figures represent the average of monthly "as reported" earnings over the previous ten years. Data is as of December 31, 2022.

And Lower Prices in Emerging Market Equities

→ Driven by a substantial downturn in Chinese equities (-21.9%), emerging market equities finished the year down 20.1%.

→ As a result, valuations are well below their long-term average.

Emerging Market Equity Cyclically Adjusted P/E[1]

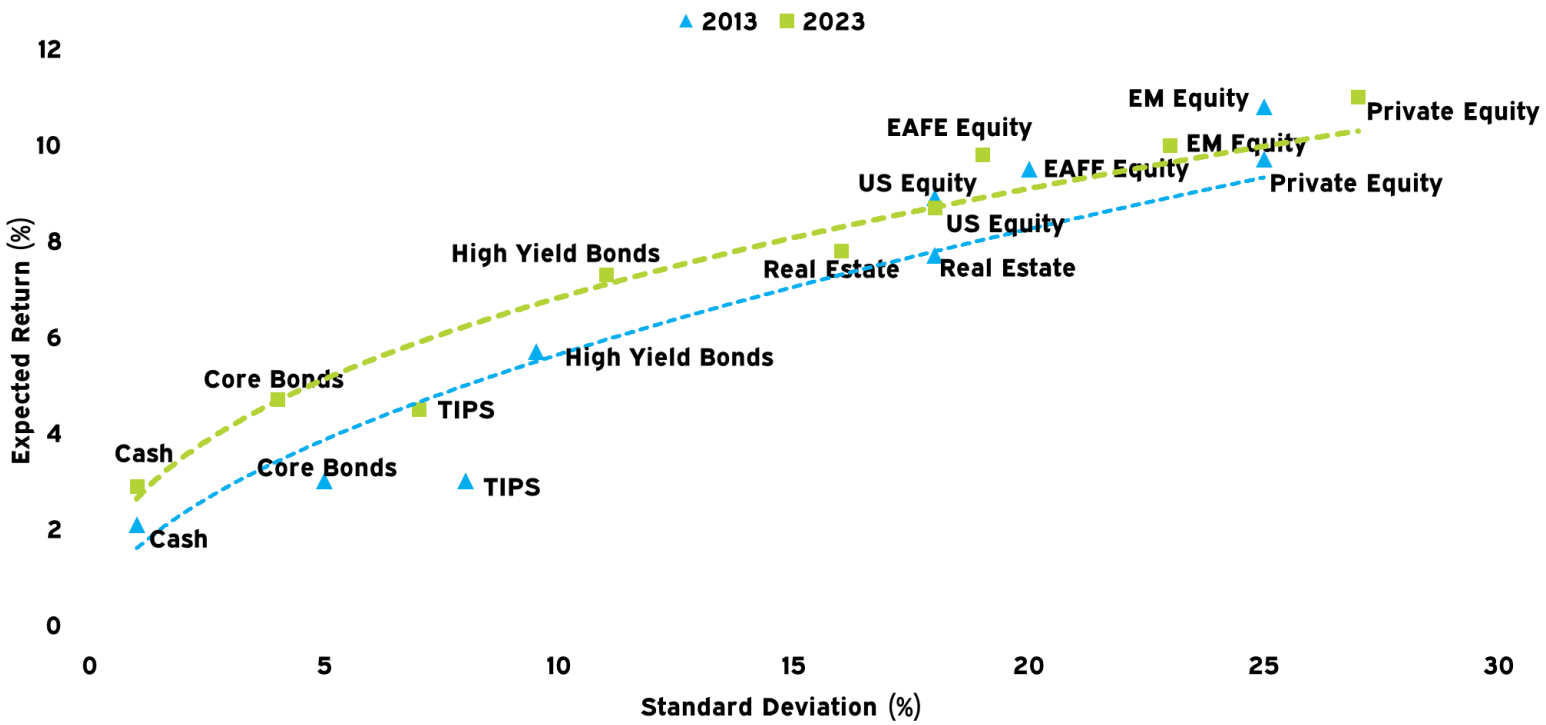


[1] Source: MSCI and Bloomberg. Earnings figures represent the average of monthly "as reported" earnings over the previous ten years. Data is as of December 31, 2022.

The Big Picture: Higher Return for the ~Same Risk[1]

→ The relationship between long-term return expectations and the level of risk accepted is not static.

→ We anticipate many investors can take on less risk than they have over the past decade if they want to achieve their target returns.



[1] Expected return and standard deviation are based upon Meketa Investment Group's 2013 and 2023 20-year capital market expectations.

Mean Variance Optimization ("MVO")

→ MVO is the traditional starting point for determining asset allocation.

→ MVO mathematically determines an "efficient frontier" of policy portfolios with the highest risk-adjusted returns.

→ All asset classes exhibit only three characteristics, which serve as inputs to the model:

- Expected return
- Expected volatility
- Expected covariance with all other assets

→ The model assumes:

- Normal return distribution
- Stable volatility and covariances over time
- Returns are not serially correlated

→ The MVO model tends to underestimate the risks of large negative events.

Asset Allocation Policy Comparison[1]

	Fed Current (%)	Mix A (%)	Mix B (%)	Mix C (%)
Split between Growth/Income & Diversification[2]	*75/25*	*75/25*	*74/26*	*71/29*
Growth	**75**	**75**	**74**	**71**
US Equity	25	22	22	24
Dev. Market Equity (non-US)	12	15	15	12
Emerging Market Equity	12	12	12	10
Global Equity	NA	NA	NA	NA
Buyouts	8	8	8	8
Venture Capital	4	4	3	3
Private Debt	3	3	3	3
Private Real Estate	3	3	3	3
REITs	0	0	0	0
Private Real Assets	3	3	3	3
Public Real Assets	0	0	0	0
Emerging Market Bonds	3	3	3	3
High Yield Bonds	2	2	2	2
Low Beta	**8**	**8**	**9**	**8**
Absolute Return	3	3	4	3
Cash Equivalents (Immunized CFs)	5	5	5	5
Other	**17**	**17**	**17**	**21**
Core Real Estate	5	5	5	5
TIPS	2	2	2	4
Investment Grade Bonds	8	8	8	8
Long-term Govt Bonds	2	2	2	4
Meketa Expected Return (10 years)	*8.3*	*8.4*	*8.3*	*8.1*
Meketa Expected Return (20 years)	*8.8*	*8.9*	*8.8*	*8.6*
Verus Standard Deviation	*12.1*	*12.1*	*11.9*	*11.4*

[1] Expected return and standard deviation are based upon Meketa Investment Group's 2023 Annual Asset Study. Throughout this document, returns for periods longer than one year are annualized.
[2] Growth includes all asset classes listed under "Growth" except emerging markets bonds and high yield bonds, plus core real estate.

Review of Proposed Asset Allocation Policies

→ San Jose Staff and Meketa Investment Group discussed several alternative policies.

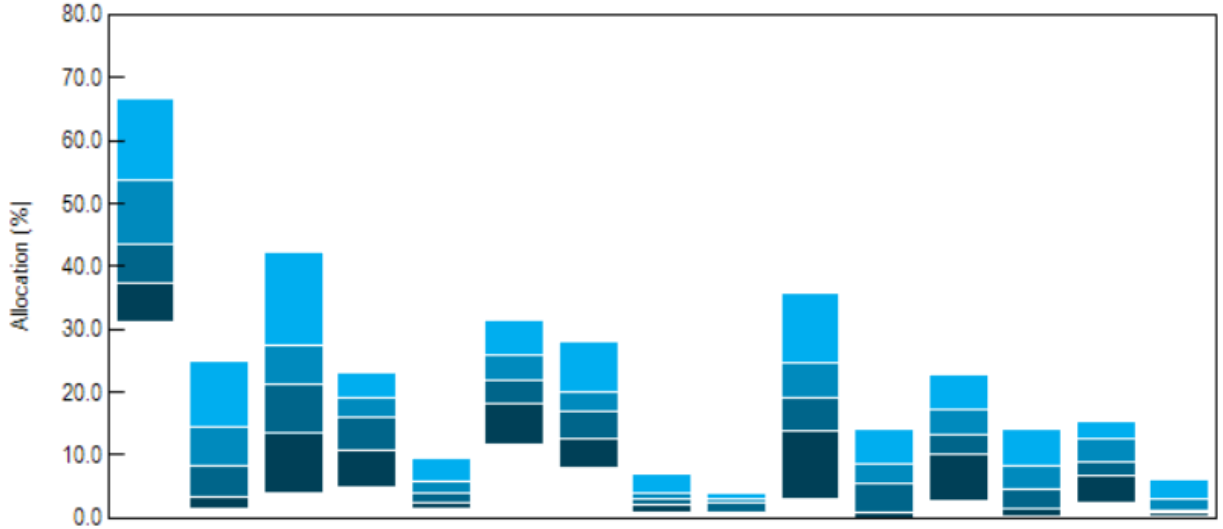
→ We show the following allocations:

- The Federated Current Policy.
- Then we show three alternative options:
  - Mix A shifts some US Equity to outside the US (Developed Market Equity – non-US).
  - Mix B shifts the same amount of US Equity to outside the US as Mix A, and also shifts 1% of assets from Venture Capital to Absolute Return (hedge funds).
  - Mix C shifts 4% from Growth (1% US Equity, 2% Emerging Markets Equity, 1% Venture Capital) to Income (2% TIPS, 2% Long-term Gov't Bonds), resulting in a lower expected standard deviation.

Peer Information - InvestorForce Public DB > $1B Net Peer Universe

Total Plan Allocation vs. InvMetrics Public DB > $1B Net

As of December 31, 2022



	Allocation (Rank)															
5th Percentile	66	24	42	23	9.	31	27	6.	4.	35	14	22	14	15	6.	--
25th Percentile	53	14	27	18	5.	25	20	4.	3.	24	8.	17	8.	12	3.	--
Median	43	8.	21	15	3.	22	17	3.	2.	19	5.	13	4.	9.	1.	--
75th Percentile	37	3.	13	10	2.	18	12	2.	1.	13	1.	10	1.	6.	0.	--
95th Percentile	31	1.	4.	4.	1.	11	8.	0.	0.	3.	0.	2.	0.	2.	0.	--
# of Portfolios	59	22	51	57	35	59	49	28	11	55	36	47	38	52	59	--

MVO-Based Risk Analysis

Scenario	Current Fed Mix (%)	Mix A (%)	Mix B (%)	Mix C (%)
Worst Case Returns				
One Year	-19.1	-19.1	-18.8	-17.9
Three Years (annualized)	-8.3	-8.3	-8.2	-7.6
Five Years (annualized)	-4.7	-4.7	-4.6	-4.2
Ten Years (annualized)	-1.0	-0.9	-0.9	-0.6
Twenty Years (annualized)	1.8	1.8	1.9	2.0
Probability of Experiencing Negative Returns				
One Year	25.4	25.4	25.3	24.7
Three Years	12.6	12.6	12.4	11.8
Five Years	7.0	6.9	6.8	6.3
Ten Years	1.8	1.8	1.8	1.5
Twenty Years	0.2	0.2	0.1	0.1
Probability of Achieving at least a 6.625% Return				
One Year	56.2	56.3	56.2	56.0
Three Years	60.7	60.8	60.6	60.3
Five Years	63.7	63.9	63.6	63.2
Ten Years	69.0	69.2	68.9	68.3
Twenty Years	75.8	76.1	75.7	75.0

Historical Negative Scenario Analysis[1]
(*Cumulative* Return)

Scenario	Current Fed Mix (%)	Mix A (%)	Mix B (%)	Mix C (%)
COVID-19 Market Shock (Feb 2020 - Mar 2020)	-19.1	-19.0	-19.1	-17.9
Taper Tantrum (May - Aug 2013)	-0.5	-0.7	-0.7	-0.8
Global Financial Crisis (Oct 2007 - Mar 2009)	-29.3	-29.5	-29.5	-27.0
Popping of the TMT Bubble (Apr 2000 - Sep 2002)	-19.6	-19.7	-19.1	-16.2
LTCM (Jul - Aug 1998)	-10.1	-10.0	-10.0	-9.3
Rate spike (1994 Calendar Year)	2.3	2.5	2.3	1.9
Crash of 1987 (Sep - Nov 1987)	-12.5	-12.1	-12.1	-11.6
Strong dollar (Jan 1981 - Sep 1982)	2.4	1.9	1.8	3.5
Volcker Recession (Jan - Mar 1980)	-3.8	-3.9	-3.9	-4.1
Stagflation (Jan 1973 - Sep 1974)	-23.1	-22.9	-22.8	-21.5

[1] See the Appendix for our scenario inputs. In periods where the ideal benchmark was not yet available we used the next closest benchmark(s) as a proxy.

Historical Positive Scenario Analysis[1]
(*Cumulative* Return)

Scenario	Current Fed Mix (%)	Mix A (%)	Mix B (%)	Mix C (%)
Covid Recovery (Apr 2020 – Dec 2021)	54.8	53.7	52.8	51.8
Global Financial Crisis Recovery (Mar 2009 - Nov 2009)	37.6	37.9	38.0	35.5
Best of Great Moderation (Apr 2003 - Feb 2004)	32.5	33.1	33.3	30.8
Peak of the TMT Bubble (Oct 1998 - Mar 2000)	61.6	61.7	57.7	54.6
Plummeting Dollar (Jan 1986 - Aug 1987)	58.5	60.8	60.9	55.7
Volcker Recovery (Aug 1982 - Apr 1983)	32.7	31.8	31.8	31.9
Bretton Wood Recovery (Oct 1974 - Jun 1975)	30.6	30.0	29.9	29.1

[1] See the Appendix for our scenario inputs. In periods where the ideal benchmark was not yet available we used the next closest benchmark(s) as a proxy.

Stress Testing: Impact of Market Movements (Expected Return under Stressed Conditions)[1]

Scenario	Current Fed Mix (%)	Mix A (%)	Mix B (%)	Mix C (%)
10-year Treasury Bond rates rise 100 bps	5.0	5.1	5.0	4.4
10-year Treasury Bond rates rise 200 bps	-0.9	-0.9	-0.9	-1.5
10-year Treasury Bond rates rise 300 bps	-2.3	-2.5	-2.5	-3.0
Baa Spreads widen by 50 bps, High Yield by 200 bps	0.4	0.4	0.4	0.6
Baa Spreads widen by 300 bps, High Yield by 1000 bps	-23.2	-23.3	-23.2	-21.8
Trade Weighted Dollar gains 10%	-4.3	-4.6	-4.7	-4.0
Trade Weighted Dollar gains 20%	-2.4	-2.7	-2.8	-1.9
US Equities decline 10%	-6.5	-6.5	-6.4	-6.0
US Equities decline 25%	-18.5	-18.4	-18.3	-17.3
US Equities decline 40%	-28.4	-28.3	-28.3	-26.9

[1] Assumes that assets not directly exposed to the factor are affected nonetheless. See the Appendix for further details.

Stress Testing: Impact of Positive Market Movements (Expected Return under Stressed Conditions)[1]

Scenario	Current Fed Mix (%)	Mix A (%)	Mix B (%)	Mix C (%)
10-year Treasury Bond rates drop 100 bps	2.0	1.9	1.9	2.3
10-year Treasury Bond rates drop 200 bps	10.9	11.0	11.0	11.2
Baa Spreads narrow by 30 bps, High Yield by 100 bps	7.9	7.9	7.8	7.6
Baa Spreads narrow by 100 bps, High Yield by 300 bps	14.2	14.2	14.3	13.5
Trade Weighted Dollar drops 10%	8.4	8.6	8.6	8.0
Trade Weighted Dollar drops 20%	23.4	24.1	24.1	22.8
US Equities rise 10%	7.4	7.3	7.2	7.0
US Equities rise 30%	17.8	17.4	17.4	16.9

[1] Assumes that assets not directly exposed to the factor are affected nonetheless. See the Appendix for further details.

Economic Regime Management®

→ The Economic Regime Management® ("ERM") approach focuses on understanding the dynamics of the most important macro level forces that drive returns across asset classes.

→ We find the most important factors to be:

- Interest Rate Surprise – Unexpected changes in the 10 year interest rate (related to Duration).
- Inflation Surprise – Unexpected changes in the CPI growth rate.
- Growth Surprise – Unexpected changes in the Real GDP growth rate.
- Systemic Risk – "System-wide" risk that propagates through all asset classes (e.g., 2008).

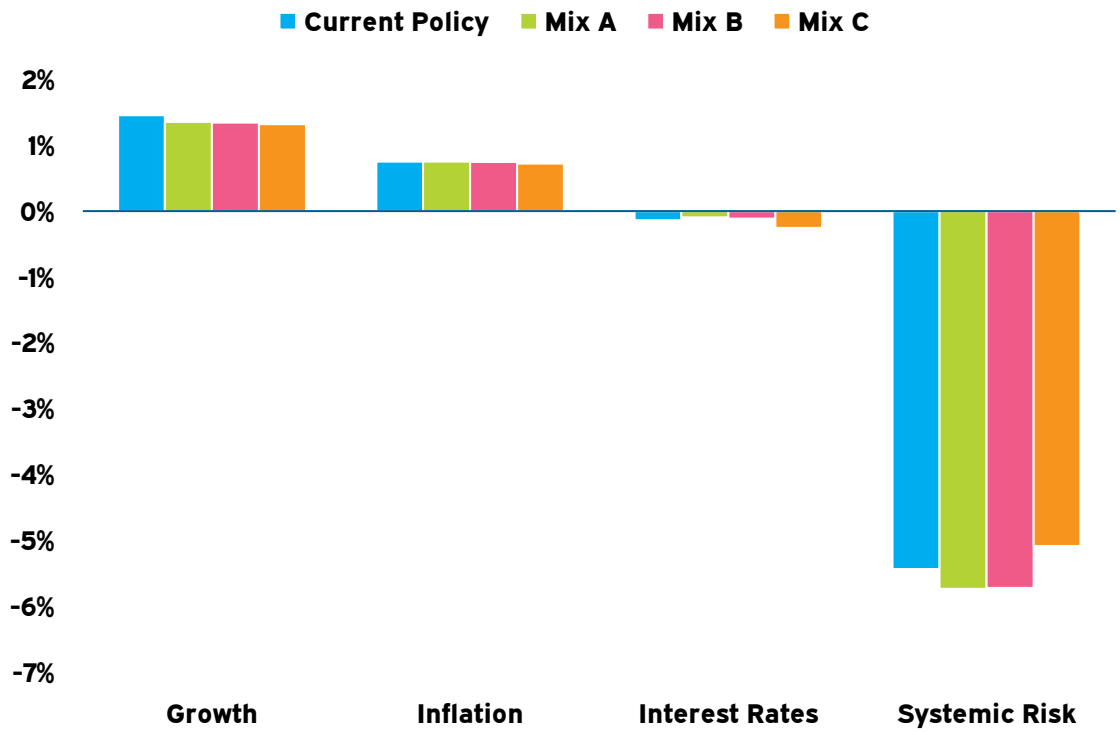
→ We focus on surprises because expectations matter.

- What was considered "low" inflation in the 1970s would be considered "high" today.

→ These factors explain the majority of volatility across asset classes.

→ Understanding these dynamics explain the "why" not just the "what."

Portfolio Sensitivity Comparison



→ The chart above shows the resulting change in portfolio return given a one standard deviation event in the respective risk factor.

→ There is more concentration in Growth and Systematic Risk because these sources of risk tend to pay better (have higher expected returns) than the other risk factors.

Summary

→ Meketa Investment Group believes that the current System allocation, adopted in early 2020 and confirmed in early 2021 and early 2022, remains reasonable. The Investment Committee could also consider the other mixes presented.

→ If a new asset allocation mix is selected for the Retirement System, we recommend that Investment Committee also consider an updated asset allocation for the Health Care Trust, to make sure that the overall strategy of the two plans remains aligned.

→ We also look forward to discussing this analysis with the members of the Investment Committee.

Appendix

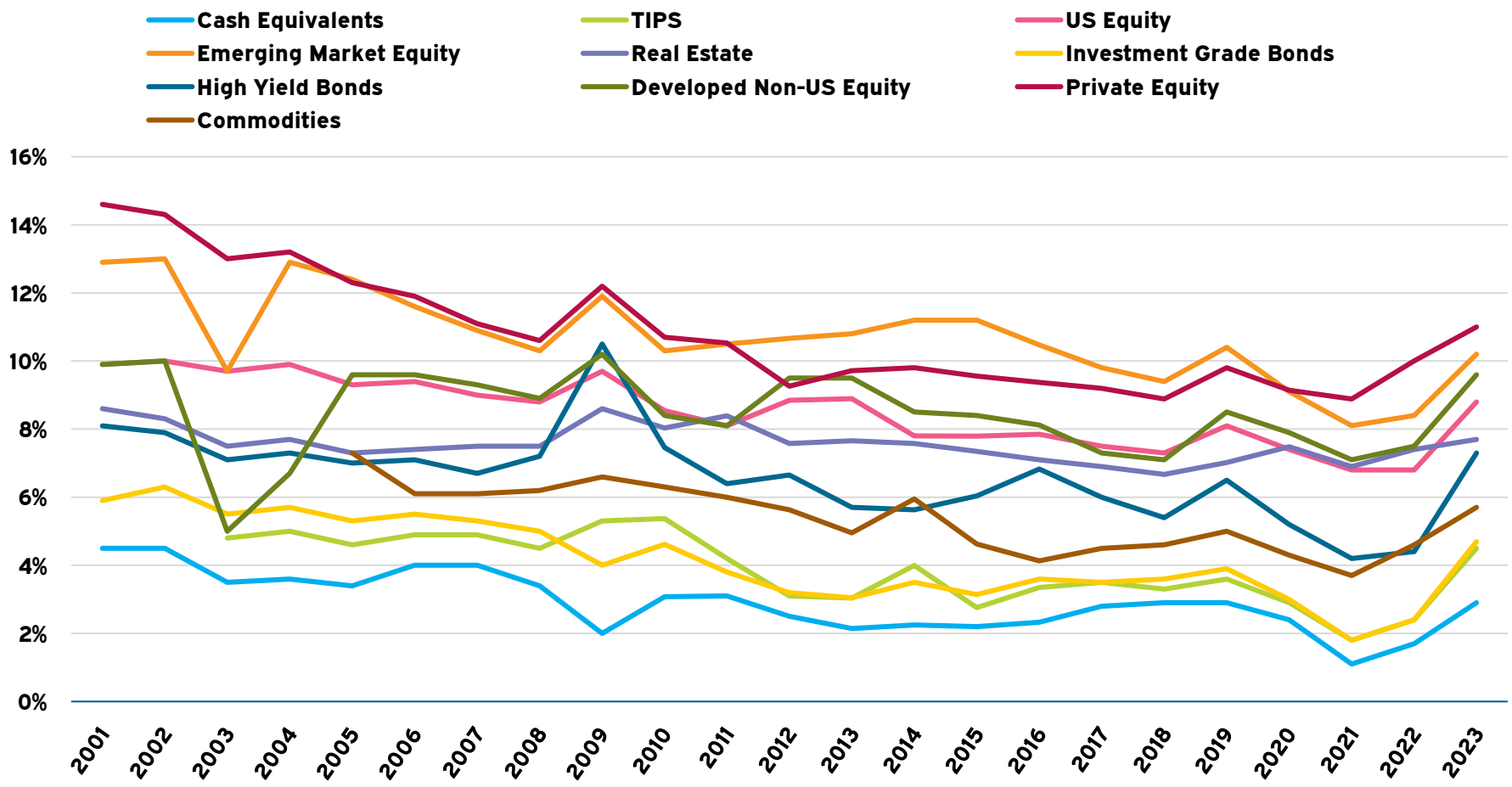
Notes and Disclaimers

1 The returns shown in the Policy Options and Risk Analysis sections rely on estimates of expected return, standard deviation, and correlation developed by Meketa Investment Group. To the extent that actual return patterns to the asset classes differ from our expectations, the results in the table will be incorrect. However, our inputs represent our best unbiased estimates of these simple parameters.

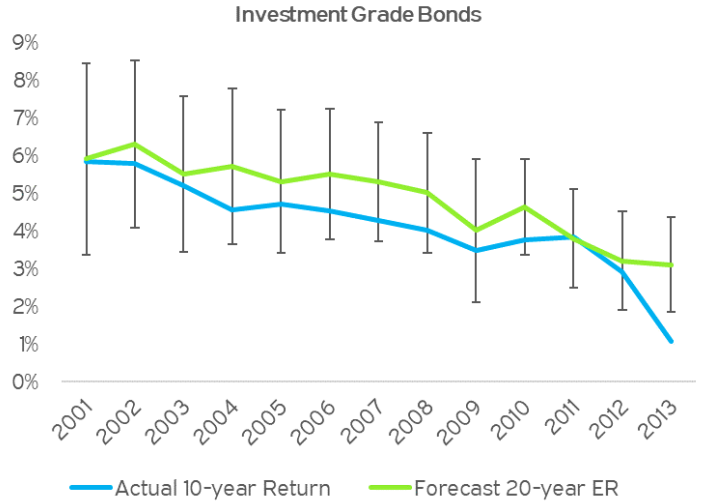
2 The returns shown in the Policy Options and Risk Analysis sections use a lognormal distribution, which may or may not be an accurate representation of each asset classes' future return distribution. To the extent that it is not accurate in whole or in part, the probabilities listed in the table will be incorrect. As an example, if some asset classes' actual distributions are even more right-skewed than the lognormal distribution (i.e., more frequent low returns and less frequent high returns), then the probability of the portfolio hitting a given annual return will be lower than that stated in the table.

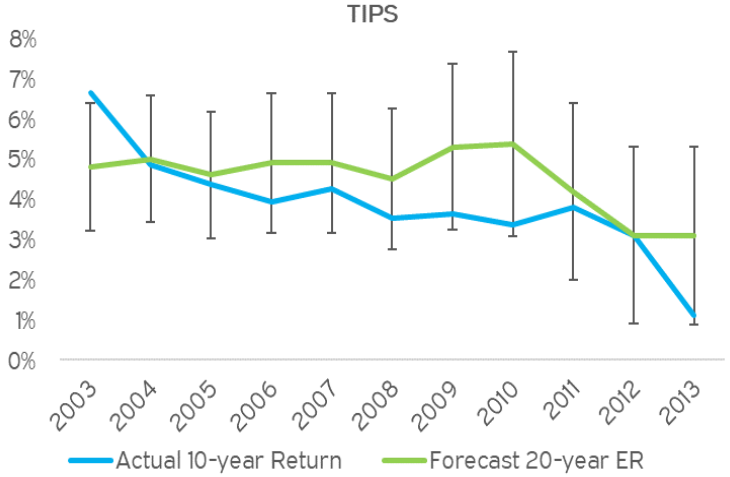
3 The standard deviation bars in the chart in the Risk Analysis section do not indicate the likelihood of a 1, 2, or 3 standard deviation event—they simply indicate the return we expect if such an event occurs. Since the likelihood of such an event is the same across allocations regardless of the underlying distribution, a relative comparison across policy choices remains valid.

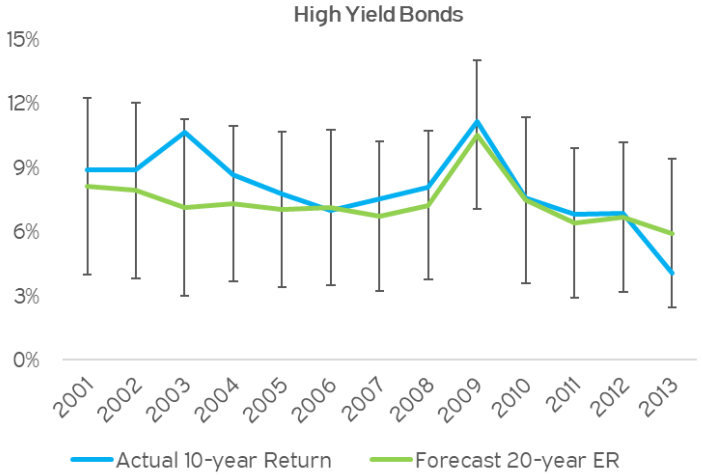
Meketa 20-year CMEs since 2000

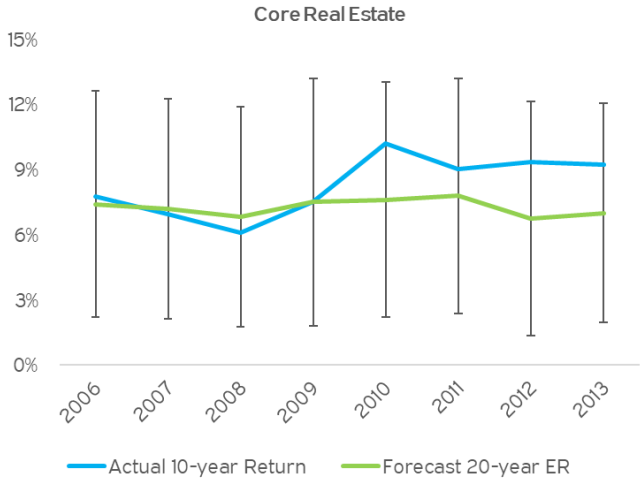


Meketa Track Record

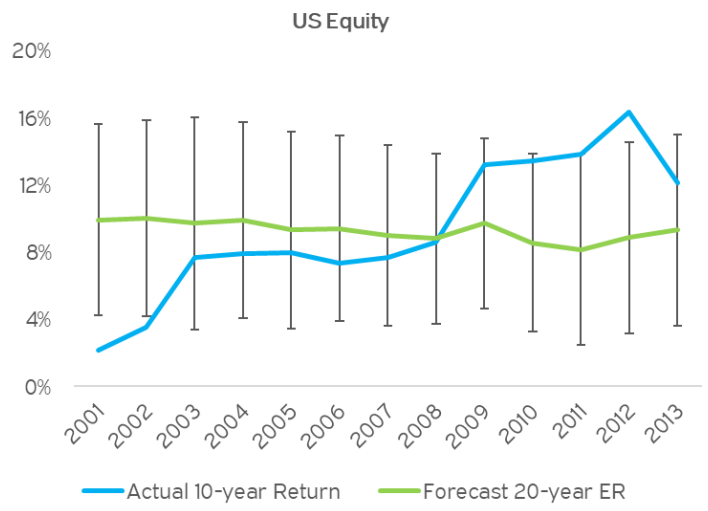


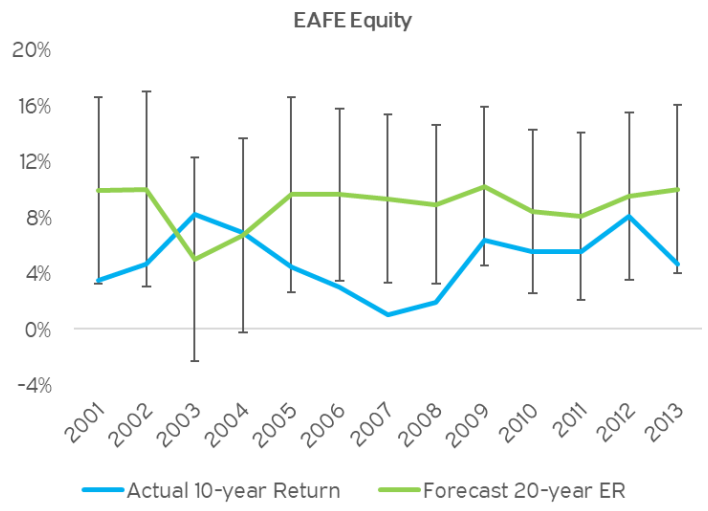


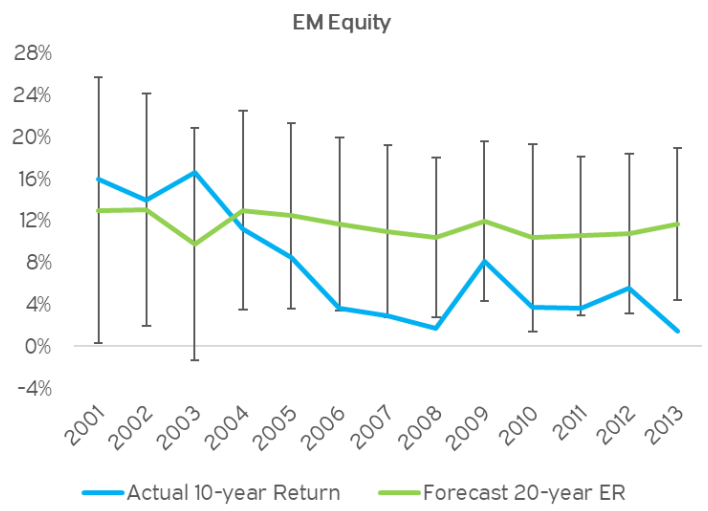


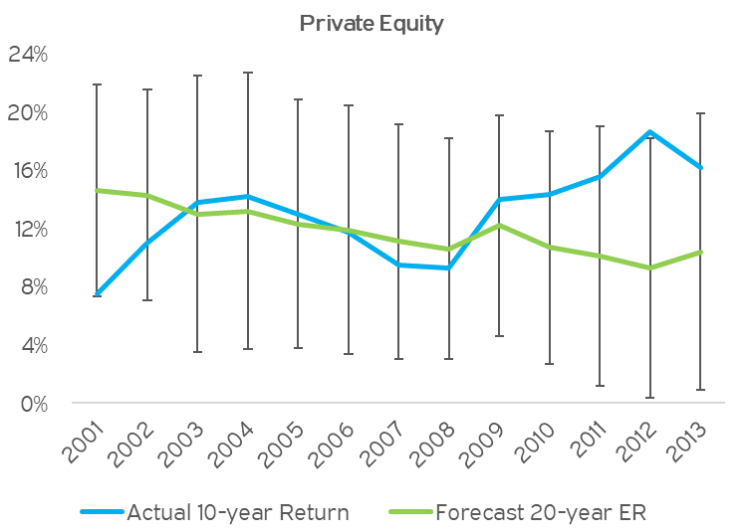


Meketa Track Record (continued)









Meketa Return and Risk Data

Asset Class	10-year Expected Return (%)	20-year Expected Return (%)	Standard Deviation (%)	11-20 year Risk Premia[1] (%)
Cash Equivalents	3.1	2.9	1.0	-1.5
Investment Grade Bonds	4.8	4.7	4.0	0.4
Long-term Government Bonds	4.3	5.0	12.0	1.5
TIPS	4.3	4.5	7.0	0.5
High Yield Bonds	8.0	7.3	11.0	2.5
Bank Loans	7.6	7.0	10.0	2.2
Emerging Market Debt (local)	6.4	6.0	12.0	1.5
Private Debt	9.4	9.0	15.0	4.6
US Equity	7.8	8.7	18.0	5.5
Developed Non-US Equity	10.1	9.8	19.0	5.4
Emerging Non-US Equity	10.3	10.0	23.0	5.6
Global Equity	8.8	9.2	18.0	5.5
Private Equity	9.7	11.0	27.0	8.0
Real Estate	5.9	7.8	16.0	5.5
Infrastructure	6.9	8.3	15.0	5.6
Commodities	6.3	5.7	17.0	1.0
Hedge Funds	5.4	6.1	7.0	2.6
Inflation	2.5	2.6	3.0	-1.5

[1] Risk Premia are calculated relative to the market's projection for the yield on the 10-year Treasury in ten years.

Meketa Correlation Data

	Inv. Grade Bonds	Long-term Gov't Bonds	TIPS	High Yield Bonds	US Equity	Dev. Non-US Equity	Em. Market Equity	Private Equity	Real Estate	Commod.	Infra.	Hedge Funds
Investment Grade Bonds	1.00											
Long-term Government Bonds	0.83	1.00										
TIPS	0.76	0.54	1.00									
High Yield Bonds	0.28	-0.17	0.46	1.00								
US Equity	0.10	-0.24	0.27	0.75	1.00							
Developed Non-US Equity	0.16	-0.22	0.30	0.77	0.89	1.00						
Emerging Market Equity	0.20	-0.18	0.36	0.76	0.77	0.87	1.00					
Private Equity	0.00	-0.10	0.05	0.70	0.85	0.80	0.75	1.00				
Real Estate	0.20	0.05	0.10	0.50	0.50	0.45	0.40	0.45	1.00			
Commodities	0.00	-0.28	0.31	0.54	0.52	0.59	0.63	0.30	0.15	1.00		
Infrastructure	0.29	0.09	0.31	0.64	0.63	0.65	0.58	0.50	0.57	0.41	1.00	
Hedge Funds	0.08	-0.30	0.30	0.78	0.86	0.87	0.84	0.60	0.45	0.67	0.65	1.00

2022 Peer Survey

→ Annually, Horizon Actuarial Services, LLC publishes a survey of capital market assumptions that they collect from various investment advisors.[1]

→ The Horizon survey is a useful tool to determine whether a consultant's expectations for returns (and risk) are reasonable.

Asset Class	Horizon 10-Year Average (%)	Meketa 10-Year (%)	Horizon 20-Year Average (%)	Meketa 20-Year (%)
Cash Equivalents	1.5	1.1	2.0	1.7
TIPS	2.0	1.6	2.6	2.4
US Core Bonds	2.6	1.7	3.5	2.4
US High Yield Bonds	4.0	3.3	5.0	4.4
Emerging Market Debt	4.6	4.3	5.3	4.4
Private Debt	6.9	6.7	7.1	7.3
US Equity (large cap)	5.9	5.4	6.5	6.8
Developed Non-US Equity	6.5	6.7	7.1	7.5
Emerging Non-US Equity	7.3	8.1	7.9	8.4
Private Equity	9.2	8.9	9.8	10.0
Real Estate	5.4	6.4	6.0	7.4
Infrastructure	6.4	7.1	6.9	7.7
Commodities	3.7	4.3	4.2	4.6
Hedge Funds	4.8	3.4	5.5	4.4
Inflation	2.5	2.6	2.4	2.2

[1] The 10-year horizon included all 40 respondents, and the 20-year horizon included 24 respondents. Figures are based on Meketa's 2022 CMEs.

Scenario Return Inputs

Asset Class	Benchmark Used
Investment Grade Bonds	Barclays Aggregate
TIPS	Barclays US TIPS
Intermediate-term Government Bonds	Barclays Treasury Intermediate
Long-term Government Bonds	Barclays Long US Treasury
EM Bonds (local)	JPM GBI-EM Global Diversified Composite
Bank Loans	CSFB Leveraged Loan
High Yield Bonds	Barclays High Yield
Direct Lending	Cliffwater Direct Lending Index
Mezzanine Debt	Preqin Associates Mezzanine
Distressed Debt	Preqin Distressed Debt Index
Core Real Estate	NCREIF Property
Value-Added RE	NCREIF Townsend Value Added
Opportunistic RE	NCREIF Townsend Opportunistic
REITs	NAREIT Equity
Infrastructure (private)	S&P Global Infrastructure
Natural Resources (private)	S&P Global Natural Resources
Timber	NCREIF Timberland
Commodities	Bloomberg Commodity Index
US Equity	Russell 3000
Public Foreign Equity (Developed)	MSCI EAFE
Public Foreign Equity (Emerging)	MSCI Emerging Markets
Private Equity	Preqin Private Equity Composite
Long-short Equity	HFRI Equity Hedge
Global Macro	HFRI Macro
Hedge Funds	HFRI Fund Weighted Composite
Private Debt	Weighted average of Distressed Debt, Mezzanine Debt and Direct Lending (2nd Lien)

Negative Historical Scenario Returns - Sample Inputs

	COVID-19 Market Shock (Feb 2020-Mar 2020)	Taper Tantrum (May - Aug 2013)	Global Financial Crisis (Oct 2007 - Mar 2009)	Popping of the TMT Bubble (Apr 2000 - Sep 2002)	LTCM (Jul - Aug 1998)
Cash Equivalents	0.4	0.0	2.6	9.9	0.8
Short-term Investment Grade Bonds	0.4	-0.1	7.9	21.9	1.6
Investment Grade Bonds	-0.9	-3.7	8.5	28.6	1.8
Long-term Corporate Bonds	-18.4	-9.3	-10.3	26.9	-0.6
Long-term Government Bonds	12.7	-11.6	24.2	35.5	4.1
TIPS	-0.4	-8.5	8.2	37.4	0.7
Global ILBs	-6.5	-7.4	-3.9	39.7	0.7
High Yield Bonds	-20.8	-2.0	-22.8	-6.3	-5.0
Bank Loans	-20.3	0.8	-23.7	6.3	0.7
Direct Lending	-4.8	2.6	-3.3	-2.6	-2.3
Foreign Bonds	-4.5	-3.2	2.1	8.5	3.5
Mezzanine Debt	-4.8	4.6	-26.4	-2.0	-2.6
Distressed Debt	-12.2	4.6	-26.4	-2.0	-2.6
Emerging Market Bonds (major)	-15.3	-11.5	-5.0	6.3	-28.2
Emerging Market Bonds (local)	-13.9	-14.3	-7.9	7.2	-34.1
US Equity	-35.0	3.0	-45.8	-43.8	-15.4
Developed Market Equity (non-US)	-32.7	-2.2	-52.1	-46.7	-11.5
Emerging Market Equity	-31.2	-9.4	-51.2	-43.9	-26.7
Global Equity	-33.6	-0.7	-49.3	-46.7	-14.0
Private Equity/Debt	-7.8	5.7	-27.7	-23.4	-3.2
Private Equity	-7.4	5.8	-28.2	-26.0	-3.3
Private Debt Composite	-10.1	4.6	-22.3	-1.7	-2.3
REITs	-41.0	-13.3	-63.0	45.4	-15.3
Core Private Real Estate	0.7	3.6	-10.6	23.6	2.3
Value-Added Real Estate	-3.5	3.8	-20.2	177.0	1.8
Opportunistic Real Estate	-8.6	4.0	-25.7	21.4	1.5
Natural Resources (Private)	-22.1	2.5	-31.2	-3.9	-16.9
Timberland	0.1	1.3	20.7	-1.5	0.5
Farmland	-0.1	3.3	26.7	11.4	0.8
Commodities (naïve)	-18.9	-2.4	-36.9	18.5	-12.0
Core Infrastructure	-1.3	3.7	-0.8	24.8	-0.3
Hedge Funds	-9.1	-0.4	-17.8	-2.1	-9.4
Long-Short	-10.9	1.0	-26.4	-8.8	-8.3
Hedge Fund of Funds	-7.6	-0.5	-19.5	-0.4	-7.7

Negative Historical Scenario Returns - Sample Inputs (continued)

	Rate spike (1994 Calendar Year)	Crash of 1987 (Sep - Nov 1987)	Strong dollar (Jan 1981 - Sep 1982)	Volcker Recession (Jan - Mar 1980)	Stagflation (Jan 1973 - Sep 1974)
Cash Equivalents	3.9	1.4	24.4	2.9	13.5
Short-term Investment Grade Bonds	0.5	2.3	29.9	-2.6	4.3
Investment Grade Bonds	-2.9	2.2	29.9	-8.7	7.9
Long-term Corporate Bonds	-5.8	1.5	29.6	-14.1	-12.0
Long-term Government Bonds	-7.6	2.6	28.4	-13.6	-1.8
TIPS	-7.5	2.8	15.6	-7.8	4.3
Global ILBs	-7.9	2.9	16.5	-8.3	4.5
High Yield Bonds	-1.0	-3.6	6.9	-2.3	-15.5
Bank Loans	10.3	-1.7	3.3	-1.1	-7.5
Direct Lending	7.6	-2.3	3.2	-1.0	-7.2
Foreign Bonds	5.3	-0.3	34.8	-6.5	-1.4
Mezzanine Debt	7.6	-2.3	3.2	-1.0	-7.2
Distressed Debt	7.6	-2.3	3.2	-1.0	-7.2
Emerging Market Bonds (major)	-18.9	-9.2	-1.6	-2.6	-20.2
Emerging Market Bonds (local)	-22.8	-11.0	-2.0	-3.2	-23.9
US Equity	1.3	-29.5	-2.3	-4.1	-42.6
Developed Market Equity (non-US)	7.8	-14.5	-18.0	-7.0	-36.3
Emerging Market Equity	-7.3	-25.3	-12.1	-6.6	-44.2
Global Equity	5.0	-21.5	-11.2	-5.8	-39.3
Private Equity/Debt	13.2	-0.7	-2.7	-2.5	-18.2
Private Equity	14.2	-0.5	-3.9	-2.7	-20.1
Private Debt Composite	6.2	-1.8	3.0	-1.0	-6.9
REITs	-3.5	-19.5	2.5	-3.6	-33.9
Core Private Real Estate	6.4	2.5	23.9	5.5	-4.4
Value-Added Real Estate	11.2	4.3	44.2	9.6	-7.6
Opportunistic Real Estate	18.8	3.1	30.7	7.0	-5.6
Natural Resources (Private)	12.6	-9.9	-9.5	-9.1	19.3
Timberland	15.4	9.2	23.6	-7.4	5.5
Farmland	9.4	5.3	13.3	-4.2	3.1
Commodities (naïve)	16.6	1.8	-16.0	-9.6	139.5
Core Infrastructure	-11.5	-0.1	-0.2	-0.1	-0.5
Hedge Funds	4.1	-7.8	-3.8	-1.9	-15.7
Long-Short	2.6	-10.0	-4.9	-2.5	-19.8
Hedge Fund of Funds	-3.5	-5.7	-2.7	-1.4	-11.5

Positive Historical Scenario Returns - Sample Inputs

	Global Financial Crisis Recovery (Mar 2009 - Nov 2009)	Best of Great Moderation (Apr 2003 - Feb 2004)	Peak of the TMT Bubble (Oct 1998 - Mar 2000)	Plummeting Dollar (Jan 1986 - Aug 1987)	Volcker Recovery (Aug 1982 - Apr 1983)	Bretton Wood Recovery (Oct 1974 - Jun 1975)
Cash Equivalents	0.1	0.9	6.7	10.0	6.0	4.5
Short-term Investment Grade Bonds	4.3	2.8	5.3	13.2	15.4	5.0
Investment Grade Bonds	9.0	4.6	1.7	14.4	26.4	9.2
Long-term Corporate Bonds	28.8	11.3	-3.1	15.9	42.1	17.5
Long-term Government Bonds	2.0	4.9	-2.3	15.4	33.6	11.8
TIPS	14.3	9.1	6.3	10.2	11.5	4.1
Global ILBs	24.7	9.6	6.6	10.8	12.1	4.3
High Yield Bonds	49.1	21.8	2.1	24.9	23.3	19.3
Bank Loans	32.9	10.1	6.1	11.1	10.4	8.7
Direct Lending - First Lien	10.6	5.7	1.1	5.8	5.0	5.1
Direct Lending - Second Lien	14.3	7.7	1.4	7.8	6.7	6.8
Foreign Bonds	23.4	15.2	-7.0	44.5	32.3	17.9
Mezzanine Debt	30.8	23.7	26.8	5.4	8.2	8.3
Distressed Debt	30.8	23.7	26.8	5.4	8.2	8.3
Emerging Market Bonds (major)	27.0	20.6	49.0	38.9	21.6	21.0
Emerging Market Bonds (local)	37.5	25.2	61.0	48.4	26.5	25.7
US Equity	51.6	37.2	50.2	64.8	59.3	55.1
Developed Market Equity (non-US)	60.5	56.7	53.0	140.0	29.6	34.6
Emerging Market Equity	94.6	79.4	101.3	126.5	52.1	53.4
Global Equity	59.9	46.2	54.8	108.4	43.0	44.6
Private Equity/Debt	15.4	23.3	84.6	19.1	13.7	18.4
Private Equity	13.0	23.7	92.1	21.7	14.8	20.2
Private Debt Composite	27.5	20.4	21.4	5.9	7.9	8.0
REITs	82.5	44.6	-5.2	51.8	47.4	42.5
Core Private Real Estate	-16.4	9.0	18.1	13.1	6.8	4.5
Value-Added Real Estate	-32.7	11.4	19.6	23.6	11.9	7.8
Opportunistic Real Estate	-19.0	13.6	27.9	16.7	8.6	5.7
Natural Resources (Private)	57.8	36.1	22.2	78.3	30.2	14.8
Timberland	-3.3	8.5	20.5	28.6	20.0	8.7
Farmland	5.4	9.6	10.4	15.9	11.3	5.0
Commodities (naïve)	28.9	30.6	17.1	27.6	6.2	-20.2
Core Infrastructure	2.1	8.5	33.0	1.4	0.6	0.6
Hedge Funds	20.1	22.4	52.8	30.6	13.8	14.5
Long-Short	25.9	25.3	81.4	40.8	18.0	18.9
Hedge Fund of Funds	10.3	13.3	36.8	21.3	9.7	10.3

'Anti' Stress Test Return Assumptions - Sample Inputs[1]

	10-year Treasury Bond rates drop 100 bps	10-year Treasury Bond rates drop 200 bps	Baa Spreads narrow by 30 bps, High Yield by 100 bps	Baa Spreads narrow by 100 bps, High Yield by 300 bps	Trade Weighted Dollar drops 10%	Trade Weighted Dollar drops 20%	US Equities rise 10%	US Equities rise 30%
Cash Equivalents	0.2	0.4	0.6	0.2	2.0	4.5	2.3	3.1
Short-term Investment Grade Bonds	1.3	2.6	0.5	2.0	1.4	3.3	0.8	1.6
Investment Grade Bonds	4.5	9.3	1.3	3.9	2.5	9.4	1.8	3.8
Long-term Corporate Bonds	10.5	23.4	3.9	14.5	5.5	15.8	3.6	7.7
Long-term Government Bonds	13.3	28.8	0.6	-0.6	1.7	22.2	3.6	5.7
TIPS	5.2	10.9	1.2	5.9	3.7	7.8	1.5	2.2
Global ILBs	3.0	6.4	2.1	7.4	5.9	8.4	1.7	3.2
High Yield Bonds	2.8	8.9	7.0	25.7	7.6	8.6	4.8	10.6
Bank Loans	-0.2	2.2	4.0	16.4	4.2	0.6	2.2	4.5
Direct Lending	-0.4	0.2	4.9	5.6	1.7	3.8	1.8	3.4
Foreign Bonds	5.7	11.3	1.6	7.4	9.8	21.3	2.3	6.8
Mezzanine Debt	1.5	2.2	9.0	16.8	6.7	6.2	6.0	7.7
Distressed Debt	1.2	2.9	9.4	17.1	6.9	7.8	6.2	9.7
Emerging Market Bonds (major)	3.1	7.4	5.5	15.5	7.3	15.4	5.5	11.1
Emerging Market Bonds (local)	3.7	9.9	5.5	17.6	10.4	19.4	6.1	13.2
US Equity	3.4	15.3	11.4	18.8	7.9	24.9	10.6	31.7
Developed Market Equity (non-US)	-2.4	16.4	9.4	18.3	13.3	47.6	6.4	18.8
Emerging Market Equity	0.5	17.8	9.5	34.3	19.8	47.9	9.3	28.9
Global Equity	0.7	15.2	9.6	19.6	11.2	35.9	8.6	25.7
Private Equity/Debt	2.4	4.4	10.4	9.5	7.5	16.7	10.5	13.6
Private Equity	2.5	4.3	10.5	8.3	7.4	17.3	11.1	14.2
Private Debt Composite	0.8	1.8	7.7	12.8	5.0	5.9	4.6	6.5
REITs	2.6	14.5	9.7	27.1	6.3	25.5	10.0	24.1
Core Private Real Estate	1.0	1.6	4.6	-3.5	1.3	5.5	3.0	3.5
Value-Added Real Estate	2.7	6.4	5.5	-9.4	1.0	12.6	6.0	7.5
Opportunistic Real Estate	0.1	3.9	5.8	-5.5	-0.3	11.4	4.7	6.3
Natural Resources (Private)	-1.1	11.3	10.2	31.0	16.8	27.2	8.8	19.0
Timberland	6.5	9.2	4.9	-0.6	3.8	12.9	6.2	5.3
Farmland	3.2	4.2	6.6	3.8	3.4	7.8	5.2	4.0
Commodities (naïve)	-2.6	-3.2	3.1	9.8	13.5	-2.5	3.1	4.0
Core Infrastructure	0.8	-4.3	7.0	4.8	3.5	-2.3	2.0	2.9
Hedge Funds	3.3	4.8	5.8	11.3	6.0	9.3	5.6	9.8
Long-Short	3.3	5.8	6.9	12.3	7.8	15.2	7.0	13.3
Hedge Fund of Funds	2.5	3.9	4.9	10.2	5.0	8.3	4.7	8.8

[1] Assumptions are based on performance for each asset class during historical periods that resembled these situations.

Stress Test Return Assumptions - Sample Inputs[1]

	10-year Treasury Bond rates rise 100 bps	10-year Treasury Bond rates rise 200 bps	10-year Treasury Bond rates rise 300 bps	Baa Spreads widen by 50 bps, High Yield by 200 bps	Baa Spreads widen by 300 bps, High Yield by 1000 bps	Trade Weighted Dollar gains 10%	Trade Weighted Dollar gains 20%	US Equities decline 10%	US Equities decline 25%	US Equities decline 40%
Cash Equivalents	-0.2	-0.4	-0.5	2.8	1.1	4.0	1.3	3.1	2.3	0.4
Short-term Investment Grade Bonds	-1.2	-2.5	-3.7	2.2	1.5	1.2	1.4	1.3	0.7	0.8
Investment Grade Bonds	-4.3	-8.3	-11.9	3.9	-0.4	1.7	4.2	2.4	0.7	-1.0
Long-term Corporate Bonds	-8.9	-16.2	-20.9	2.6	-13.4	0.8	8.1	0.5	-8.3	-12.3
Long-term Government Bonds	-10.6	-18.8	-23.6	7.8	7.3	3.7	12.8	3.0	2.6	2.4
TIPS	-4.9	-9.8	-13.7	2.8	-6.1	-2.1	-0.2	2.6	-2.3	-8.7
Global ILBs	-1.6	-7.9	-11.9	2.4	-11.1	-3.1	-4.8	2.8	-5.4	-16.3
High Yield Bonds	2.7	-3.4	-3.6	-1.8	-23.0	-3.5	-0.6	-4.9	-15.5	-21.2
Bank Loans	1.4	-0.8	-5.1	-2.8	-20.8	-3.2	-0.6	-3.7	-13.2	-17.4
Direct Lending	0.0	-3.7	-6.3	-1.8	-9.1	-4.3	-0.6	-4.1	-7.6	-5.7
Foreign Bonds	-4.6	-9.8	-15.7	6.6	-2.9	-3.3	-8.8	1.8	-4.6	-9.2
Mezzanine Debt	3.8	-0.9	-6.1	-1.9	-19.4	-2.8	-6.4	-4.9	-15.6	-20.4
Distressed Debt	4.4	-1.1	-6.4	-2.2	-21.4	-3.5	-9.0	-5.4	-17.3	-21.8
Emerging Market Bonds (major)	1.0	-4.9	-3.6	-0.1	-14.7	-1.4	-4.2	-3.3	-12.5	-15.4
Emerging Market Bonds (local)	1.8	-5.1	-3.0	0.1	-12.8	-1.4	-12.2	-2.8	-13.3	-20.5
US Equity	7.2	0.9	2.8	-1.2	-32.0	-2.5	1.6	-10.6	-26.5	-42.4
Developed Market Equity (non-US)	9.2	3.1	-5.6	0.3	-35.1	-12.9	-9.0	-8.7	-23.4	-41.4
Emerging Market Equity	10.3	5.5	0.1	-1.1	-42.8	-15.1	-15.7	-11.9	-30.8	-46.9
Global Equity	7.8	2.1	-0.5	-0.7	-33.6	-8.3	-5.9	-9.8	-25.3	-41.5
Private Equity/Debt	6.4	0.9	-5.5	-0.2	-22.5	-4.3	-7.2	-10.1	-22.5	-25.3
Private Equity	6.8	1.0	-5.3	0.0	-22.8	-4.1	-6.4	-10.9	-23.3	-25.7
Private Debt Composite	2.5	-2.0	-6.2	-1.8	-15.8	-3.5	-4.3	-4.6	-12.8	-15.0
REITs	4.1	-3.5	1.2	-3.8	-37.3	-1.0	12.4	-6.5	-32.8	-55.7
Core Private Real Estate	2.4	2.7	5.0	2.0	-7.1	1.2	9.7	-0.2	-8.5	-14.0
Value-Added Real Estate	4.8	7.4	14.1	7.2	-13.5	13.8	6.4	1.3	-13.6	-23.1
Opportunistic Real Estate	4.1	6.5	9.9	1.1	-20.6	0.8	15.6	-1.5	-17.1	-26.3
Natural Resources (Private)	13.1	5.8	-3.5	-0.9	-27.5	-6.5	-21.5	-5.4	-20.9	-35.9
Timberland	1.4	1.6	-9.9	5.0	6.9	2.5	8.6	0.1	2.7	3.9
Farmland	2.4	-0.1	-9.2	3.9	10.1	0.8	8.0	0.6	4.9	10.3
Commodities (naïve)	9.6	5.3	-6.6	-4.3	-25.0	-5.6	-24.0	4.8	-11.1	-37.8
Core Infrastructure	0.3	-6.4	-6.1	1.2	0.1	-1.8	3.6	-1.1	-5.0	-7.8
Hedge Funds	3.0	-1.4	-5.1	-0.6	-14.5	-2.1	-1.7	-4.3	-12.2	-15.7
Long-Short	5.3	-0.7	-4.2	-0.1	-21.0	-3.0	-4.3	-7.3	-17.7	-23.5
Hedge Fund of Funds	2.2	-2.1	-5.7	-1.3	-14.8	-2.7	-2.4	-4.9	-12.5	-16.0

[1] Assumptions are based on performance for each asset class during historical periods that resembled these situations.

Meketa Investment Group 2023 Annual Asset Study
Twenty-Year Annualized Return and Volatility Expectations for Major Asset Classes

Asset Class	20-year Expected Return (%)	Standard Deviation (%)
Cash Equivalents	2.9	1.0
Investment Grade Bonds	4.7	4.0
Long-term Government Bonds	5.0	12.0
TIPS	4.5	7.0
High Yield Bonds	7.3	11.0
Bank Loans	7.0	10.0
Emerging Market Debt (local)	6.0	12.0
Private Debt	9.0	15.0
US Equity	8.7	18.0
Developed Non-US Equity	9.8	19.0
Emerging Non-US Equity	10.0	23.0
Global Equity	9.2	18.0
Private Equity	11.0	27.0
Real Estate	7.8	16.0
Infrastructure	8.3	15.0
Commodities	5.7	17.0
Hedge Funds	6.1	7.0
Inflation	*2.6*	*3.0*

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