Callan Institute

2022 Capital Markets Assumptions

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Process Overview

How are Capital Market Projections Constructed?

Guiding objectives and process

Underlying beliefs guide the development of the projections:

- An initial bias toward long-run averages
- A conservative bias
- An awareness of risk premiums
- A presumption that markets are ultimately clear and rational

Reflect our beliefs that long-term equilibrium relationships between the capital markets and lasting trends in global economic growth are key drivers to setting capital market expectations

Long-term compensated risk premiums represent “beta”—exposure to each broad market, whether traditional or “exotic,” with limited dependence on successful realization of alpha

The projection process is built around several key building blocks:

- Advanced modeling at the individual asset class level (e.g., a detailed bond model, an equity model)
- A path for interest rates and inflation
- A cohesive economic outlook
- A framework that encompasses Callan beliefs about the long-term operation and efficiencies of the capital markets

2022 Risk and Returns

Summary of Callan's Long-Term Capital Market Assumptions (2022 – 2031)

		Projected Return			Projected Risk
Asset Class	**Index**	**1-Year Arithmetic**	**10-Year Geometric***	**Real**	**Standard Deviation**
Equities					
Broad U.S. Equity	Russell 3000	8.00%	6.60%	4.35%	17.95%
Large Cap U.S. Equity	S&P 500	7.85%	6.50%	4.25%	17.70%
Small/Mid Cap U.S. Equity	Russell 2500	8.75%	6.70%	4.45%	21.30%
Global ex-U.S. Equity	MSCI ACWI ex USA	8.70%	6.80%	4.55%	20.70%
Developed ex-U.S. Equity	MSCI World ex USA	8.25%	6.50%	4.25%	19.90%
Emerging Market Equity	MSCI Emerging Markets	9.80%	6.90%	4.65%	25.15%
Fixed Income					
Short Duration Gov't/Credit	Bloomberg 1-3 Yr G/C	1.50%	1.50%	-0.75%	2.00%
Core U.S. Fixed	Bloomberg Aggregate	1.80%	1.75%	-0.50%	3.75%
Long Government	Bloomberg Long Gov	1.85%	1.10%	-1.15%	12.50%
Long Credit	Bloomberg Long Cred	2.60%	2.10%	-0.15%	10.50%
Long Government/Credit	Bloomberg Long G/C	2.30%	1.80%	-0.45%	10.40%
TIPS	Bloomberg TIPS	1.35%	1.25%	-1.00%	5.05%
High Yield	Bloomberg High Yield	4.40%	3.90%	1.65%	10.75%
Global ex-U.S. Fixed	Bloomberg Gl Agg xUSD	1.20%	0.80%	-1.45%	9.20%
Emerging Market Sovereign Debt	EMBI Global Diversified	4.00%	3.60%	1.35%	9.50%
Alternatives					
Core Real Estate	NCREIF ODCE	6.60%	5.75%	3.50%	14.20%
Private Infrastructure	MSCI Glb Infra/FTSE Dev Core 50/50	7.10%	6.10%	3.85%	15.45%
Private Equity	Cambridge Private Equity	11.45%	8.00%	5.75%	27.60%
Private Credit	N/A	6.40%	5.50%	3.25%	14.60%
Hedge Funds	Callan Hedge FOF Database	4.35%	4.10%	1.85%	8.20%
Commodities	Bloomberg Commodity	4.05%	2.50%	0.25%	18.00%
Cash Equivalents	90-Day T-Bill	1.20%	1.20%	-1.05%	0.90%
Inflation	CPI-U		2.25%		1.60%

* Geometric returns are derived from arithmetic returns and the associated risk (standard deviation).

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Current Market Conditions

Resurgent U.S. Equity Market in 4Q21

Strong performance across both growth and value strategies during 2021

- 2021 returns for U.S. equity markets are eye-popping:
  - S&P 500: +28.7%
  - U.S. Small Cap: +14.8%
  - Non-U.S. equity markets lagged:
  - MSCI World ex USA: +12.6%
  - Emerging Markets: -2.5%
- Economic data recovered in 4Q after softening in 3Q. Tight labor market and mismatch between jobs and job seekers is vexing employers.
- Inflation spiked and recorded 7% for the first time in decades.
- 4Q GDP hit a robust 6.8% (estimate), after dropping in 3Q. Growth for the year is 5.7% (estimate). The economic recovery is still solid. Supply chain issues and sentiment surrounding the end of fiscal stimulus, the Omicron variant, and the Fed taper vex investors as we head into 2022.

Returns for Periods ended 12/31/21

	1 Quarter	1 Year	5 Years	10 Years	25 Years
U.S. Equity					
Russell 3000	9.28	25.66	17.97	16.30	9.81
S&P 500	11.03	28.71	18.47	16.55	9.76
Russell 2000	2.14	14.82	12.02	13.23	8.99
Global ex-U.S. Equity					
MSCI World ex USA	3.14	12.62	9.63	7.84	5.39
MSCI Emerging Markets	-1.31	-2.54	9.88	5.49	--
MSCI ACWI ex USA Small Cap	0.62	12.93	11.21	9.46	6.93
Fixed Income					
Bloomberg Aggregate	0.01	-1.54	3.57	2.90	4.94
90-day T-Bill	0.01	0.05	1.14	0.63	2.06
Bloomberg Long Gov/Credit	2.15	-2.52	7.39	5.72	7.31
Bloomberg Global Agg ex-US	-1.18	-7.05	3.07	0.82	3.40
Real Estate					
NCREIF Property	5.23	16.67	7.57	9.23	9.34
FTSE Nareit Equity	16.31	43.24	10.75	11.38	9.89
Alternatives					
CS Hedge Fund	0.94	8.23	5.47	4.90	6.74
Cambridge Private Equity*	4.81	49.51	21.16	17.17	15.72
Bloomberg Commodity	-1.56	27.11	3.66	-2.85	1.13
Gold Spot Price	4.08	-3.51	9.69	1.56	6.61
Inflation - CPI-U	1.64	7.04	2.92	2.14	2.28

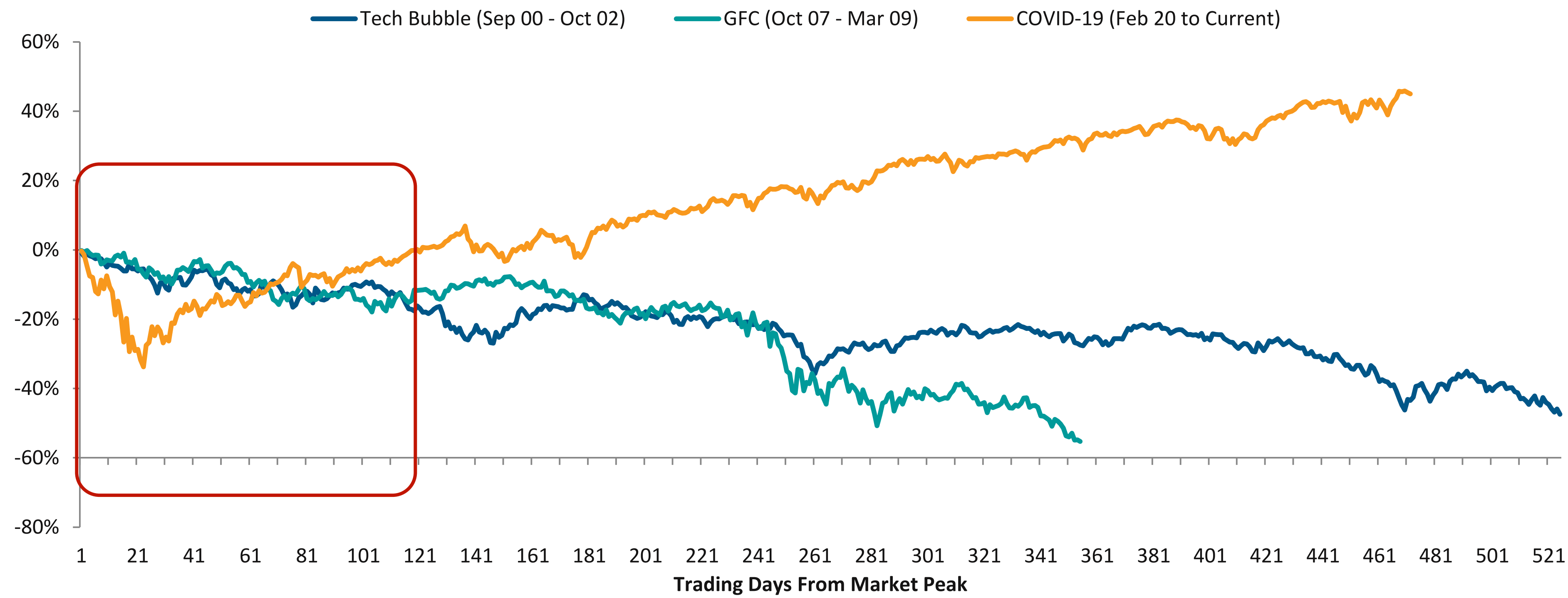
*Cambridge PE preliminary data through 09/30/21.
Sources: Bloomberg, Callan, Cambridge, Credit Suisse, FTSE Russell, MSCI, NCREIF, S&P Dow Jones Indices

Unprecedented Shock to Global Capital Markets—But It Was Over in a Flash!

V-shaped recovery in equity—back in black by mid-August 2020, up 119% from market bottom!

S&P 500 Cumulative Returns

Market Peak-to-Trough for Recent Corrections vs. Current Path of COVID-19 Correction Through 12/31/21



Sharpest and fastest equity market decline ever: 16 trading days to reach bear market; -34% after just 23 days

- S&P 500 recovered all its pandemic-related losses by Aug. 10, 2020, only 97 days from the bottom.
- S&P 500 up 28.7% in 2021.

Fun fact: As of Dec. 31, 2021, or 472 trading days, the S&P is up over 45% from the previous market peak on 2/19/20. In contrast, during the GFC the market was still down 31% from the previous market peak after 472 trading days (Aug. 24, 2009).

Sources: Callan, S&P Dow Jones Indices

Economic Outlook

Role of economic variables

GDP and inflation

- GDP forecasts provide a very rough estimate of future earnings growth
- Inflation forecasts provide an approximate path for short-term yields
- Inflation is added to the real return forecasts for equity and fixed income

GDP forecasts

- 2% to 2.5% for the U.S.
- 1.5% to 2.0% for developed ex-U.S. markets
- 4% to 5% for emerging markets
- All forecasts are below long-term averages
- Path to longer-term growth will include cycles with recessions

Inflation forecasts

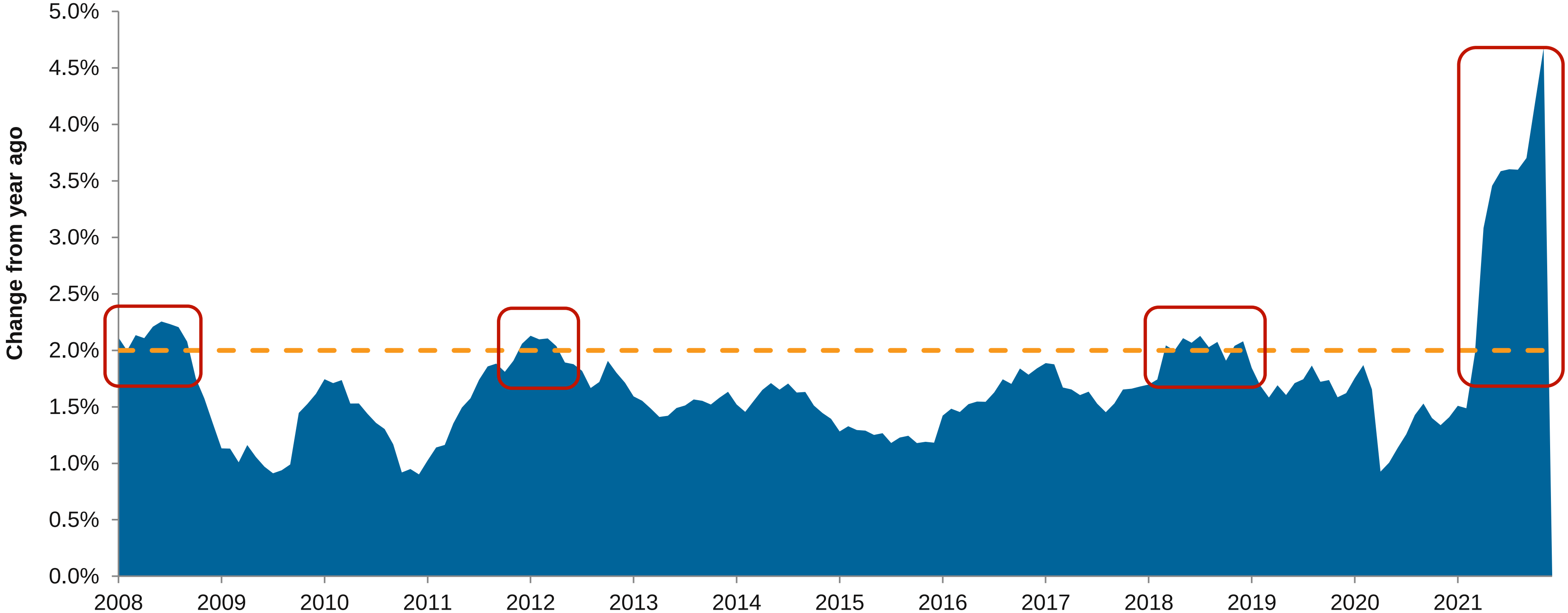
- 2.0% to 2.5% for the U.S.
- 1.75% to 2.25% for developed ex-U.S. markets
- 2.40% to 2.90% for emerging markets

Detour: Special Focus on Inflation

The Fed's New Inflation Framework

Targeting core Personal Consumption Expenditures Index

Personal Consumption Expenditures Excluding Food and Energy (Chain-Type Price Index)

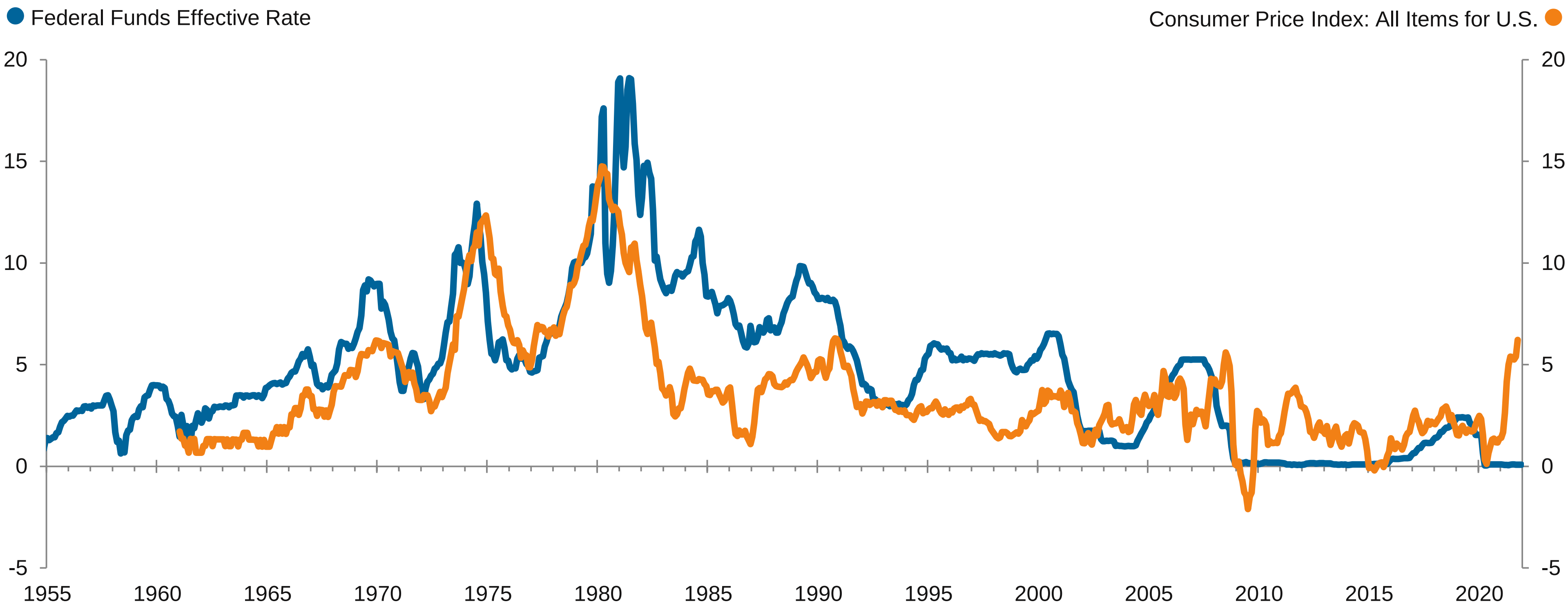


– Inflation worries are in the headlines, and the data are clearly signaling a sharp rise in the short term.
– Inflation had consistently undershot the Fed's 2% target, prompting the Fed to change its inflation framework.
– Fed's aim is to achieve an average of 2% inflation over the medium term, which is not specifically defined.
– PCE is the Fed's target, different from and typically lower than CPI-U, which had a year-over-year gain of 7.0% in December 2021.

Sources: Federal Reserve Bank of St. Louis, U.S. Bureau of Economic Analysis

Inflation versus Interest Rates Over the Long Term

Federal Funds vs. Consumer Price Index



We are a long way from the inflation and interest rate spike of 1980–1981, and even the last rise in inflation from 2005–2008.

Source: Federal Reserve Bank of St. Louis

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Fixed Income

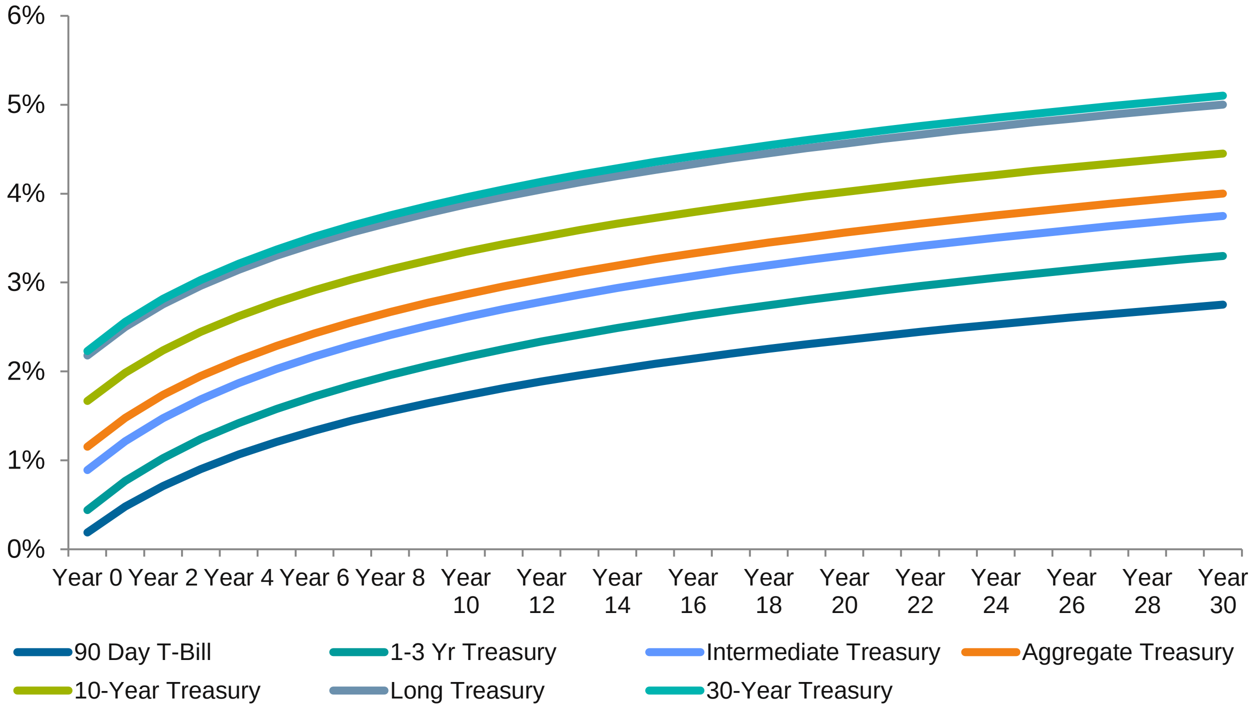
10-Year Expected Returns

10-Year Projections

	Income Return	+	Capital Gain/Loss	+	Credit Default	+	Roll Return	=	2022 Expected Return	2021 Expected Return	Change
Cash	**1.20%**		**0.00%**		**0.00%**		**0.00%**		**1.20%**	**1.00%**	**0.20%**
Short Duration 1-3 Year G/C	**1.65%**		**-0.40%**		**0.00%**		**0.25%**		**1.50%**	**1.50%**	**0.00%**
1-3 Year Government	1.55%		-0.40%		0.00%		0.25%		1.40%		
1-3 Year Credit	2.15%		-0.50%		-0.10%		0.25%		1.80%		
Intermediate G/C	**2.35%**		**-0.80%**		**-0.10%**		**0.25%**		**1.70%**	**1.50%**	**0.20%**
Intermediate Government	2.05%		-0.80%		0.00%		0.25%		1.50%		
Intermediate Credit	2.95%		-1.00%		-0.20%		0.25%		2.00%		
Aggregate	**2.90%**		**-1.30%**		**-0.10%**		**0.25%**		**1.75%**	**1.75%**	**0.00%**
Government	2.25%		-1.20%		0.00%		0.25%		1.30%		
Securitized	2.55%		-0.90%		0.00%		0.25%		1.90%		
Credit	3.85%		-1.80%		-0.30%		0.25%		2.00%		
Long Duration G/C	**4.25%**		**-2.85%**		**-0.20%**		**0.60%**		**1.80%**	**1.80%**	**0.00%**
Long Government	3.30%		-2.80%		0.00%		0.60%		1.10%		
Long Credit	4.70%		-2.90%		-0.30%		0.60%		2.10%		
TIPS	**2.50%**		**-1.50%**		**0.00%**		**0.25%**		**1.25%**	**1.70%**	**-0.45%**
Non-U.S. Fixed (unhedged)	**2.15%**		**-1.50%**		**-0.10%**		**0.25%**		**0.80%**	**0.75%**	**0.05%**
High Yield	**6.95%**		**-1.30%**		**-2.00%**		**0.25%**		**3.90%**	**4.35%**	**-0.45%**
Emerging Market Debt	**6.05%**		**-1.40%**		**-1.30%**		**0.25%**		**3.60%**	**3.50%**	**0.10%**
Bank Loans	**6.50%**		**-0.30%**		**-1.60%**		**0.00%**		**4.60%**	**4.30%**	**0.30%**

Yield Curve Path

Smoothed Yield Curve Paths



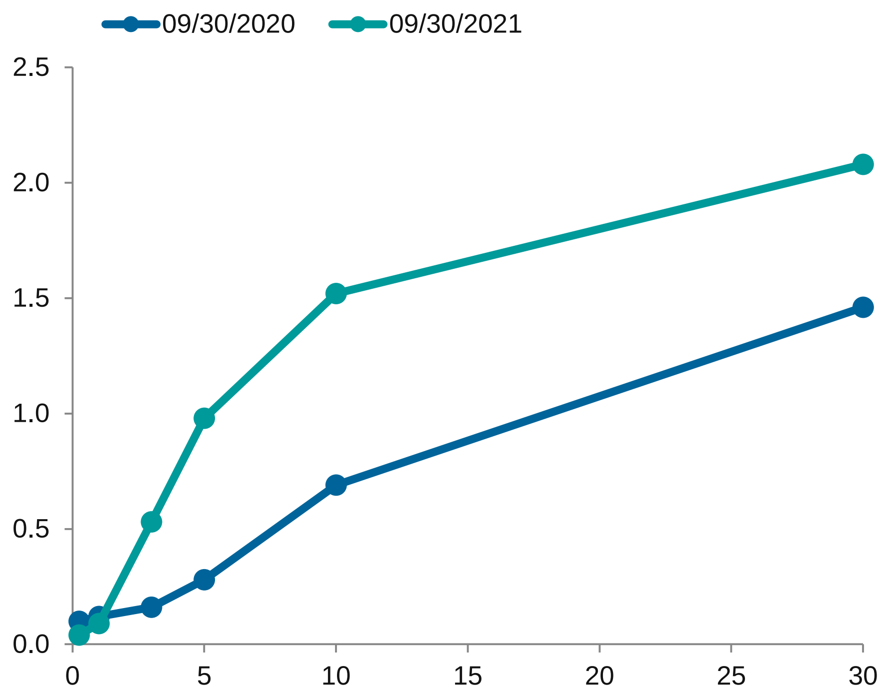
	Long Term Premium	Final Yield	Premium Over
Inflation	0.00%	2.25%	N/A
90 Day T-Bill	0.50%	2.75%	Inflation
TIPS	1.50%	4.25%	
1-3 Year Treasury	0.55%	3.30%	
Intermediate Treasury	1.00%	3.75%	
Aggregate Treasury	1.25%	4.00%	Cash
10-Year Treasury	1.70%	4.45%	
Long Treasury	2.25%	5.00%	
30-Year Treasury	2.35%	5.10%	

- We updated the bond model this year to extend our yield forecast horizon over 30 years.
  - Allows for a longer-term view on reversion to equilibrium rates, durations, convexity, and spreads.
  - We used a smoothing approach where yields rise faster early in the horizon and reach equilibrium at year 30.
- Cash at the end of the 30-year horizon is 2.75%.
  - Reflects a 50 basis point premium over projected inflation, which is consistent with long-term U.S. interest rate history.
- Term premiums are consistent with long-term historical medians.
  - For example, in Year 30 the 10-Year Treasury yield is 4.45%, or 1.70% above cash.

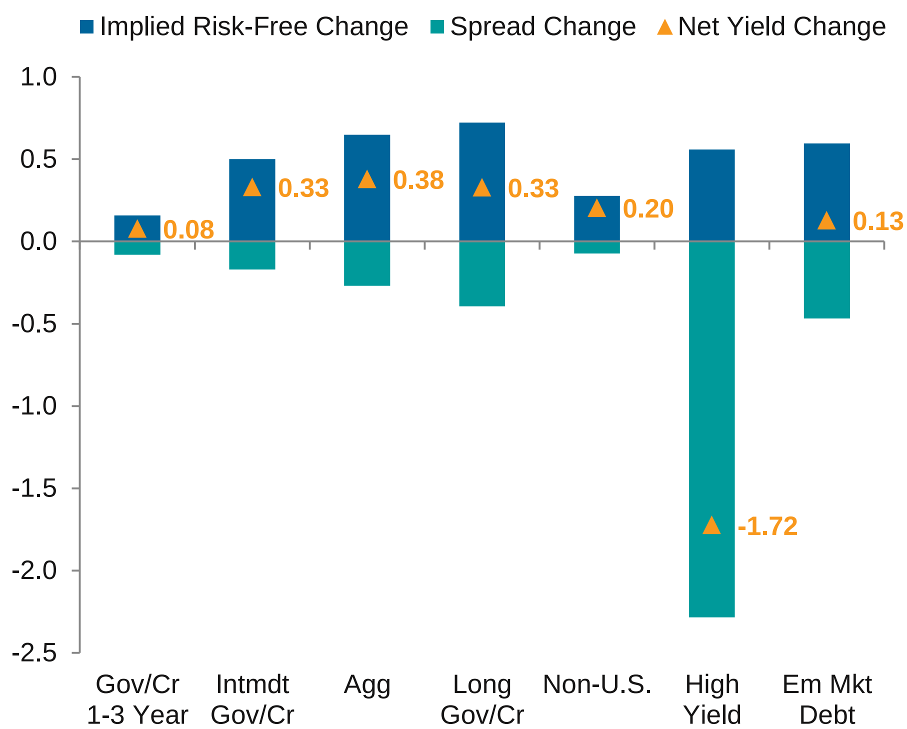
Rate Movement in the Last Year

(9/30/20 to 9/30/21)

Treasury Yield Curve Change



Net Yield Changes After Spread Tightening



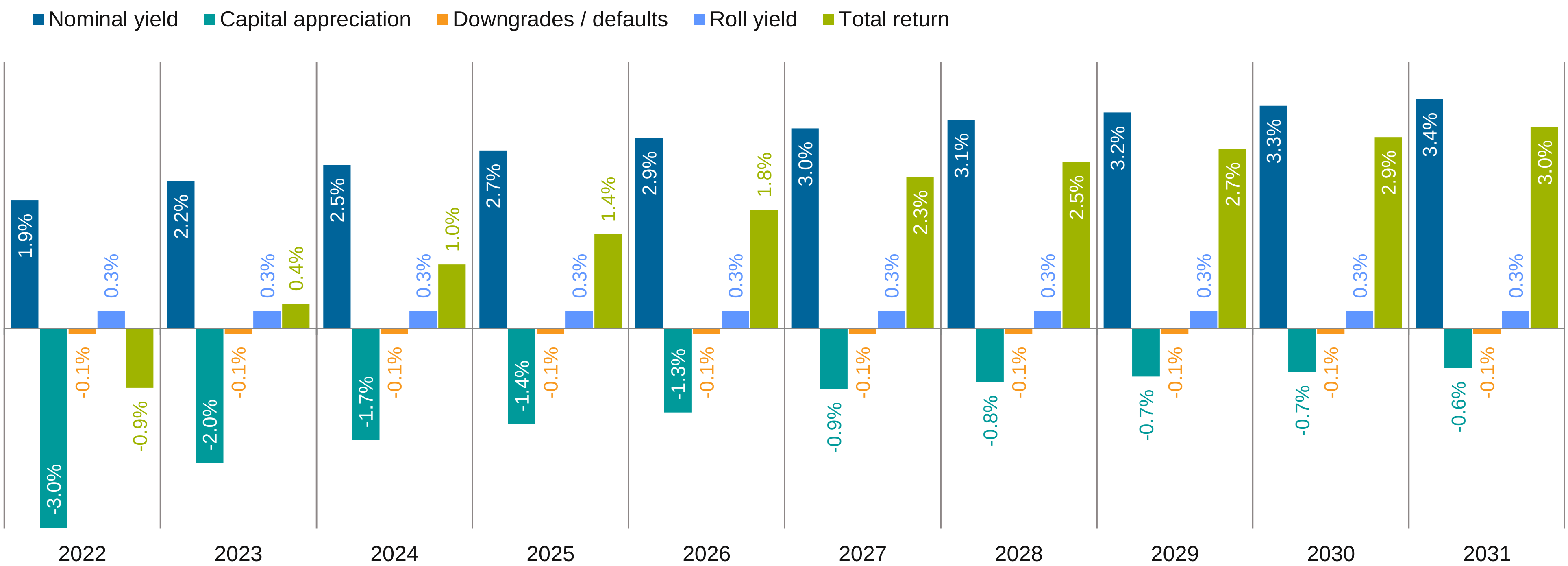
The Treasury yield curve rose meaningfully in the last year.

– However, spreads also tightened and absorbed some of the rise in rates.
– In the case of high yield, spreads tightened so much the overall yield on the sector dropped by over 1.7%.

Sources: Bloomberg, Federal Reserve

Core Fixed Income Return Components

Total Return Attribution



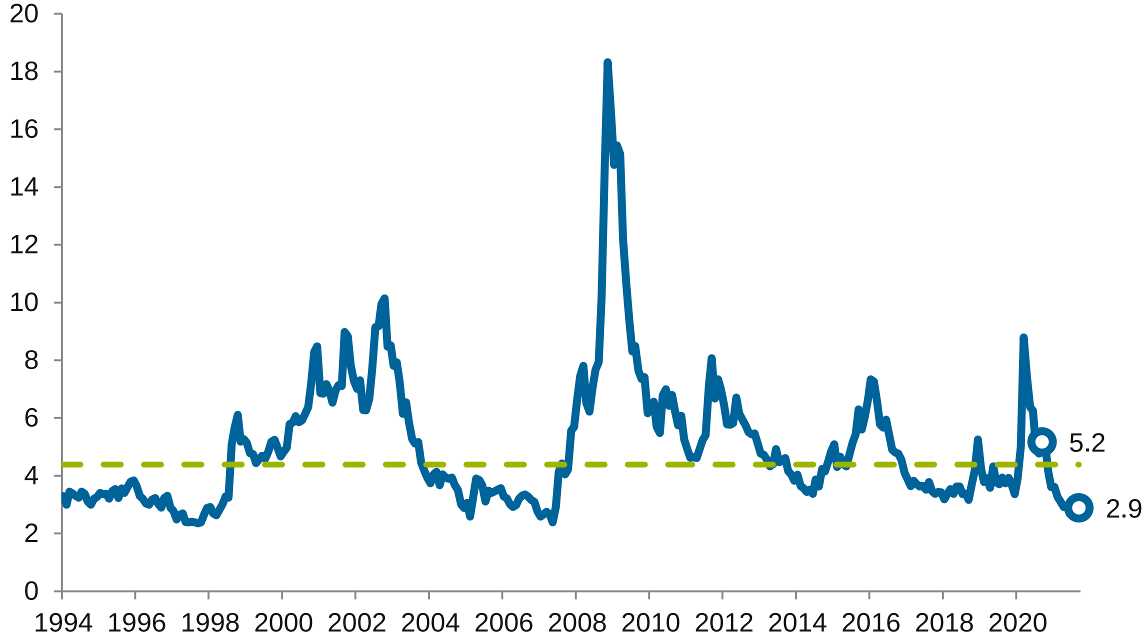
Higher yields relative to last year are offset by capital losses from our rising rate projection.

– We project rates to rise faster early in the forecast, leading to larger capital losses and lower total returns.

– As rates stabilize, the carry from yield outweighs capital losses, leading to positive total returns.

Key Assumption Changes for 2022: High Yield

Historical High Yield OAS



Data represents Jan 1994 to Sept 2021

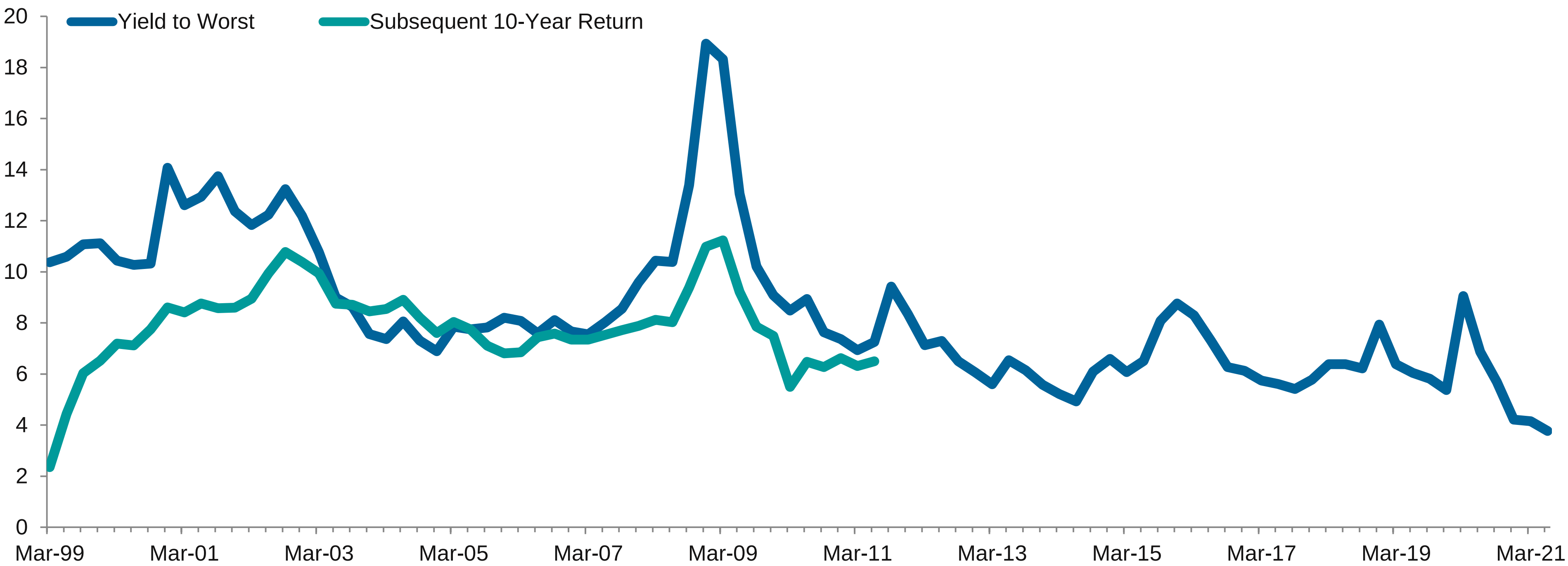
	High Yield OAS
Minimum	2.35
25th	3.38
50th	4.39
75th	6.08
Maximum	18.33
Average	4.99
Spread as of 9/30/20	5.17
Percentile as of 9/30/20	64%
Spread as of 9/30/21	2.89
Percentile as of 9/30/21	8%

- Last year spreads were above median at the time we prepared assumptions.
- This year spreads were in the bottom decile.
- Assuming spreads rise back to long-term medians, in addition to rising risk-free rates, will create a stronger headwind to performance.

Source: Bloomberg

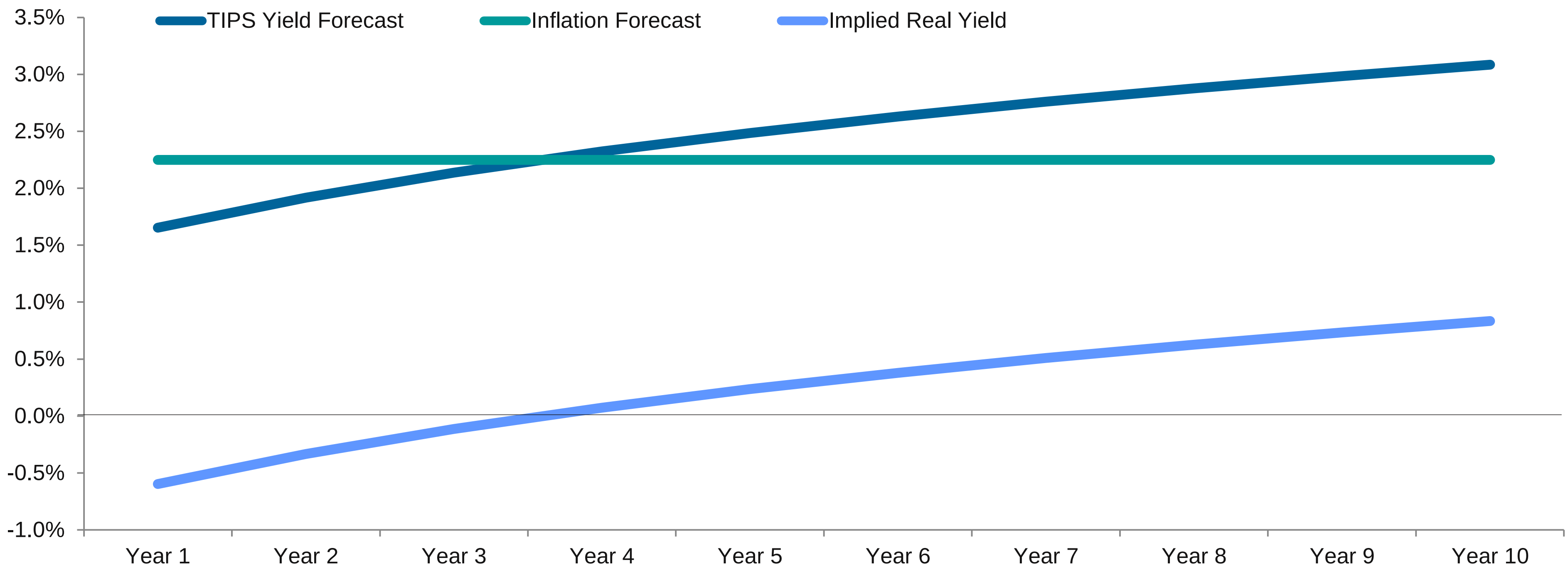
Key Assumption Changes for 2022: High Yield

High yield starting yield vs. forward 10-year return



- There have only been a few periods where the subsequent 10-year return beat the starting yield.
- The performance gap represents downgrade and default drag.
- Our high yield projection reflects this relationship, with the starting yield acting as a constraint on our return expectation.

Key Assumption Changes for 2022: TIPS



- This year we updated the model to use real duration for TIPS instead of nominal duration.
- Since our inflation assumption is flat, that implies our rising yield forecast equates to rising real yields.
- Median TIPS real duration is 7.8 historically vs. a median of 5.5 for nominal duration.
- The higher duration translates to higher capital losses compared to the 2021 forecast, more than offsetting the higher starting yield.

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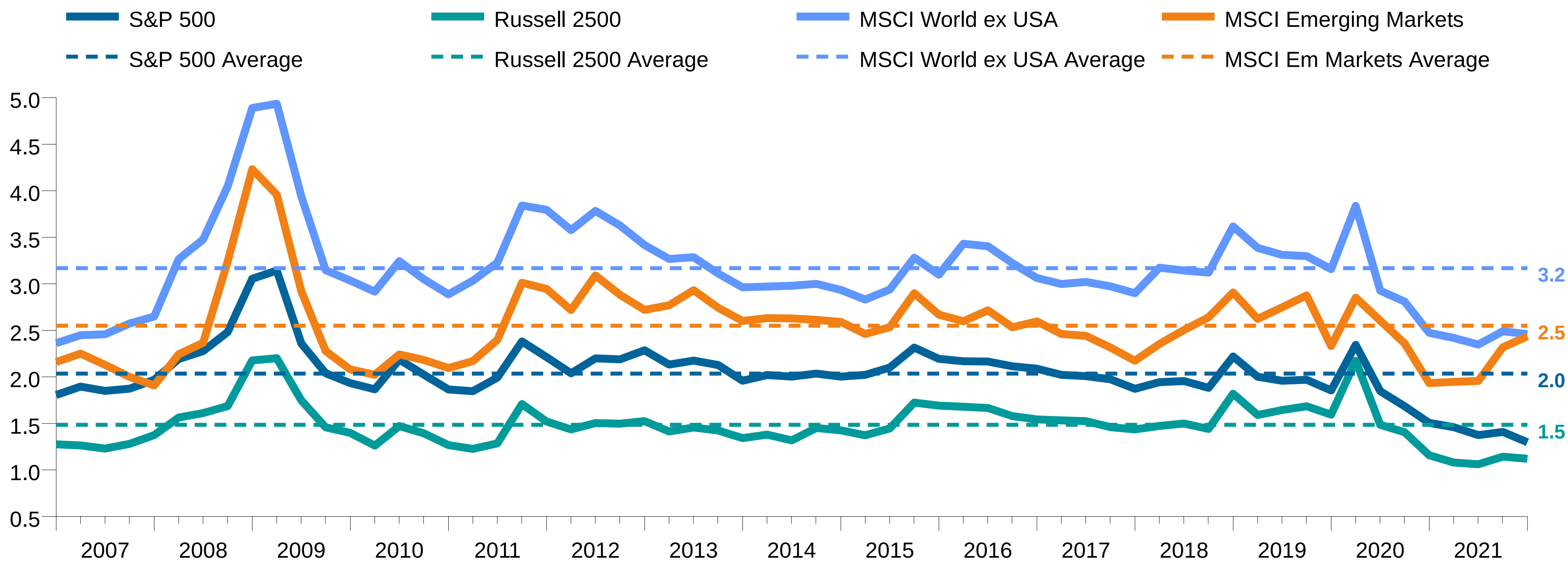
Equity

U.S. Equity Assumptions

Dividend yields

Dividend Yield for 15 Years Ended December 31, 2021

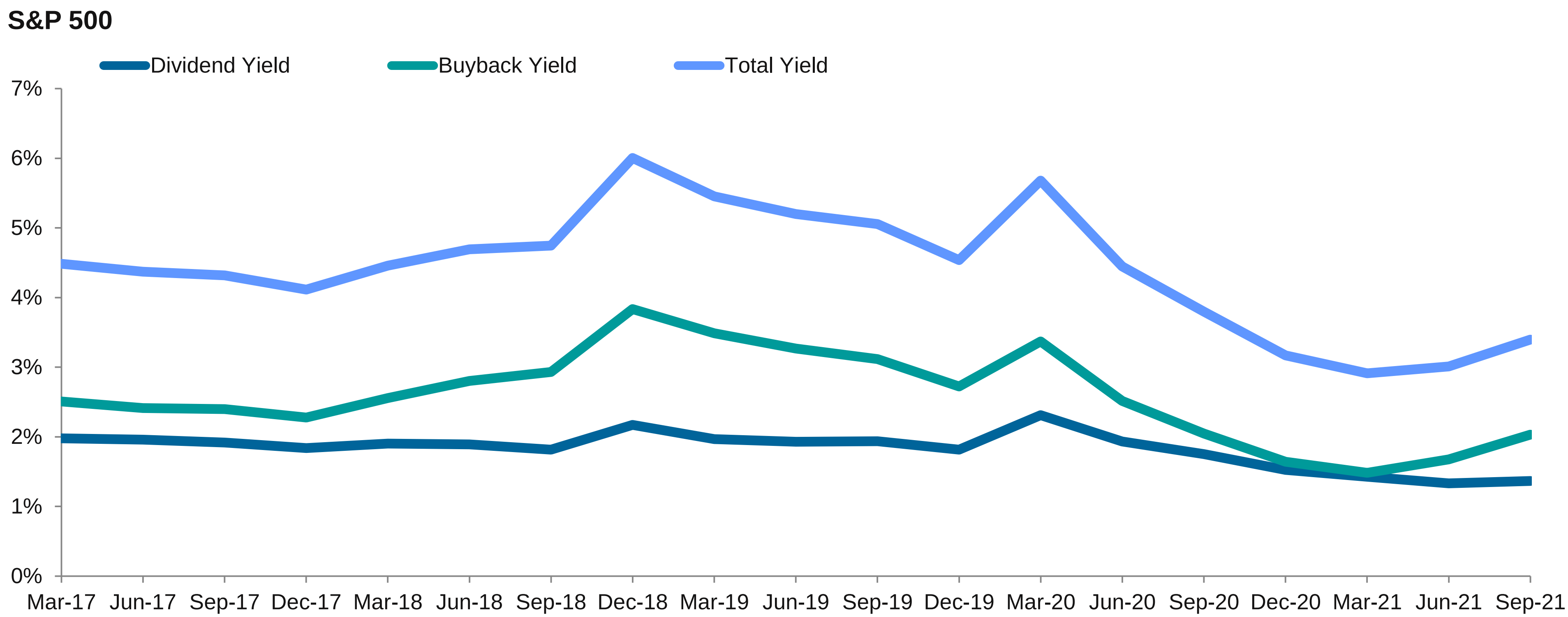


– COVID-19 caused a decline in yields around the world.
– Yields have turned up but have still not reached their pre-pandemic levels.
– Forecast yields are expected to return to approximately their longer-term averages.

Sources: MSCI, Russell, Standard & Poor's

U.S. Equity Assumptions

Return of cash



S&P 500 dividend and buyback yields declined in 2020.

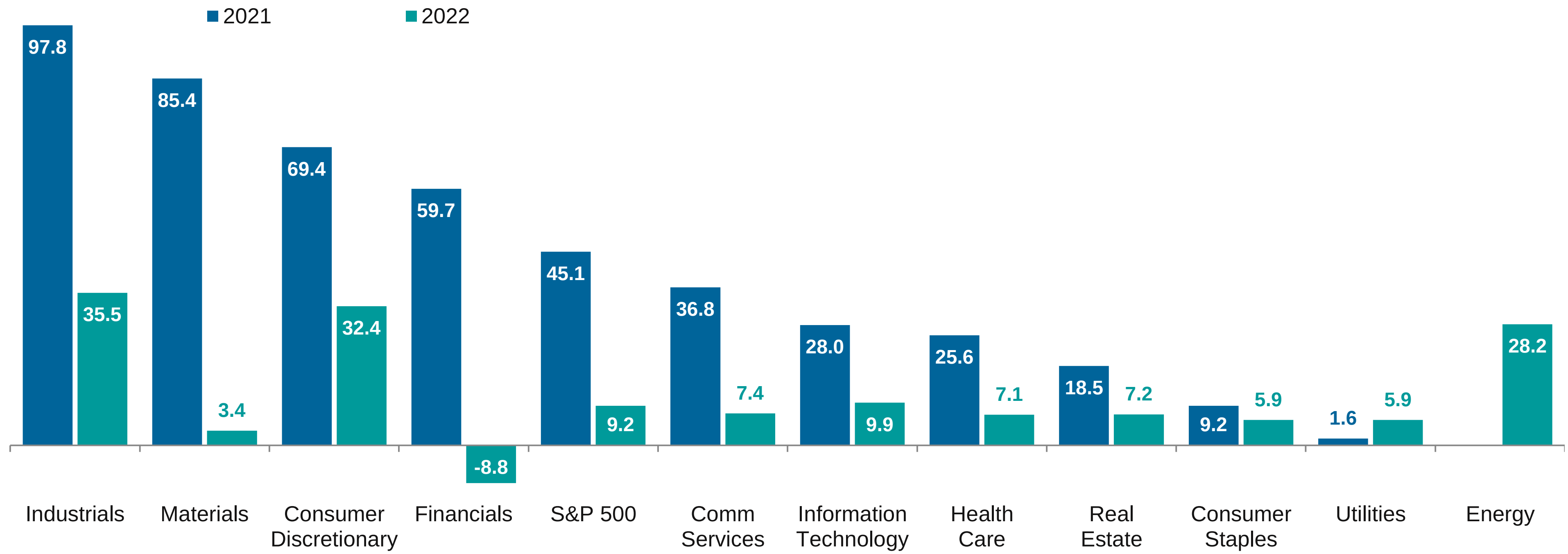
– Dollar value of dividends stalled.
– Dollar value of buybacks dropped significantly at the onset of the pandemic but recovered to near pre-pandemic levels.
– Price appreciation was the major cause of declines in yields.

Source: Standard & Poor's

U.S. Equity Assumptions

Current earnings growth

Percent S&P 500 Earnings Growth



- Projections are as of December 2021.
- Earnings growth for 2021 continues to surprise on the upside.
- The magnitude of that growth was due to poor earnings in 2020 as well as demand from the economy's reopening.
- Projected earnings growth for 2021 is likely to outpace return, which was 29% for 2021.
  - Keeps backward-looking P/E in line

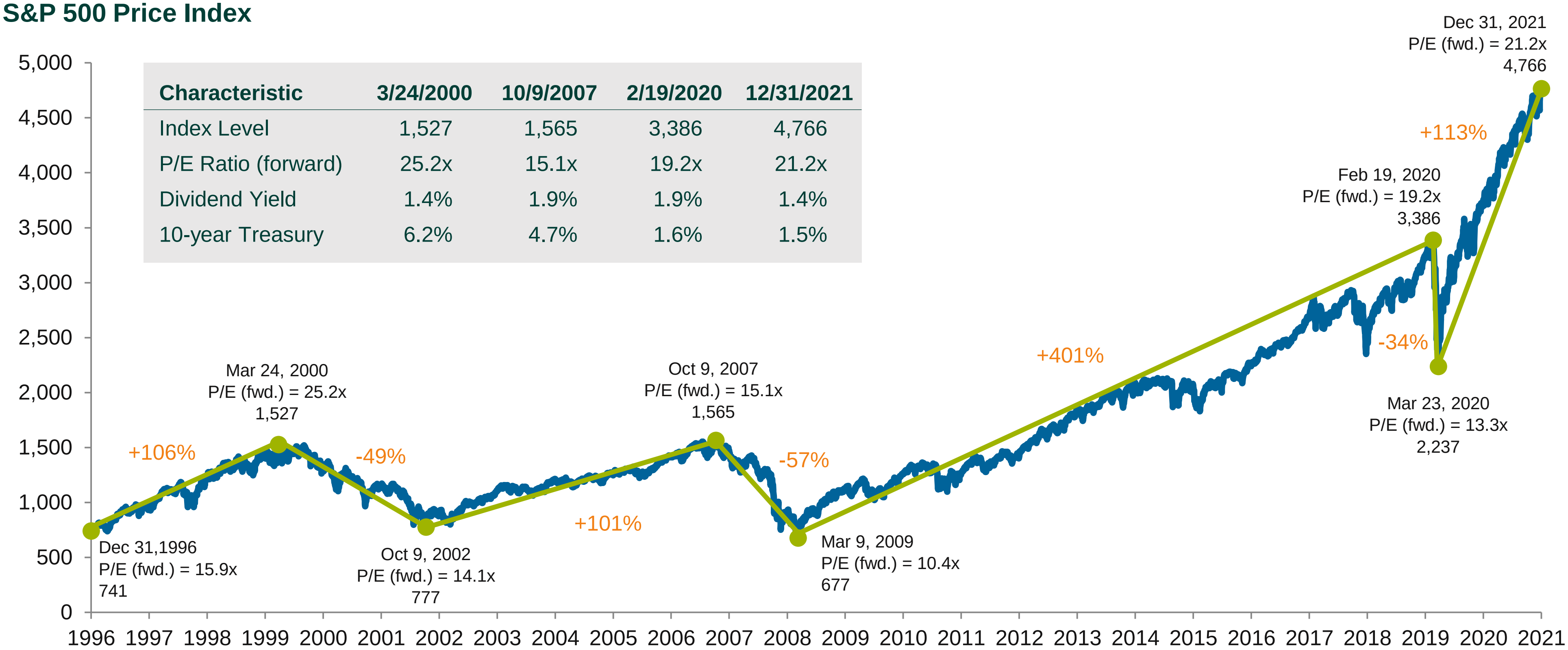
Source: Factset, Standard & Poors

U.S. Equity Assumptions

Price appreciation

S&P 500 Price Index

Characteristic	3/24/2000	10/9/2007	2/19/2020	12/31/2021
Index Level	1,527	1,565	3,386	4,766
P/E Ratio (forward)	25.2x	15.1x	19.2x	21.2x
Dividend Yield	1.4%	1.9%	1.9%	1.4%
10-year Treasury	6.2%	4.7%	1.6%	1.5%



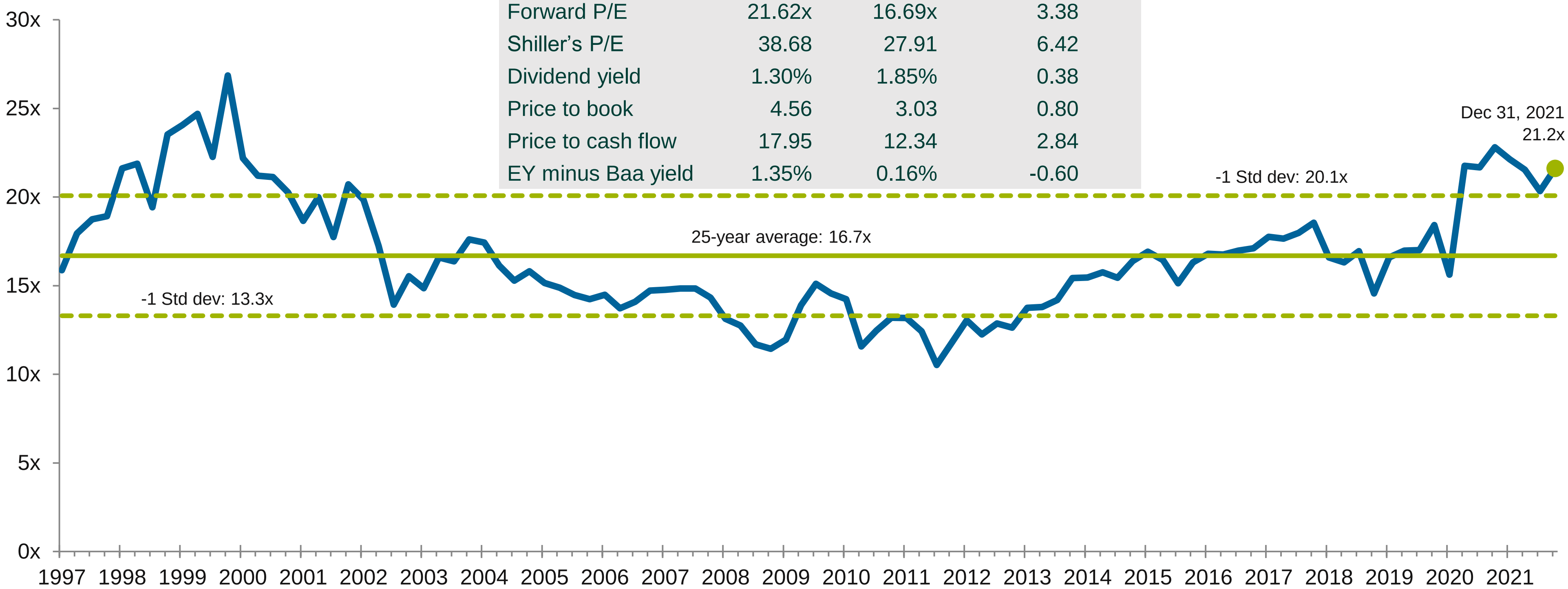
– The S&P has more than doubled since the pandemic low.
– Appreciation has outpaced forward earnings estimates and valuations have increased above pre-pandemic levels.

Source: Federal Reserve, Standard & Poor's

Large cap valuations

S&P 500 Index: Forward P/E Ratio

Valuation Measure	Latest	25-year Average	Std Dev Over- / Under-valued
Forward P/E	21.62x	16.69x	3.38
Shiller's P/E	38.68	27.91	6.42
Dividend yield	1.30%	1.85%	0.38
Price to book	4.56	3.03	0.80
Price to cash flow	17.95	12.34	2.84
EY minus Baa yield	1.35%	0.16%	-0.60



– All valuation measures in excess of one standard deviation above 25-year averages.
– Forward P/E has stalled even with exceptional forecast returns for 2022.
– Return to more normal earnings growth in future years limits price appreciation without further valuation expansion.

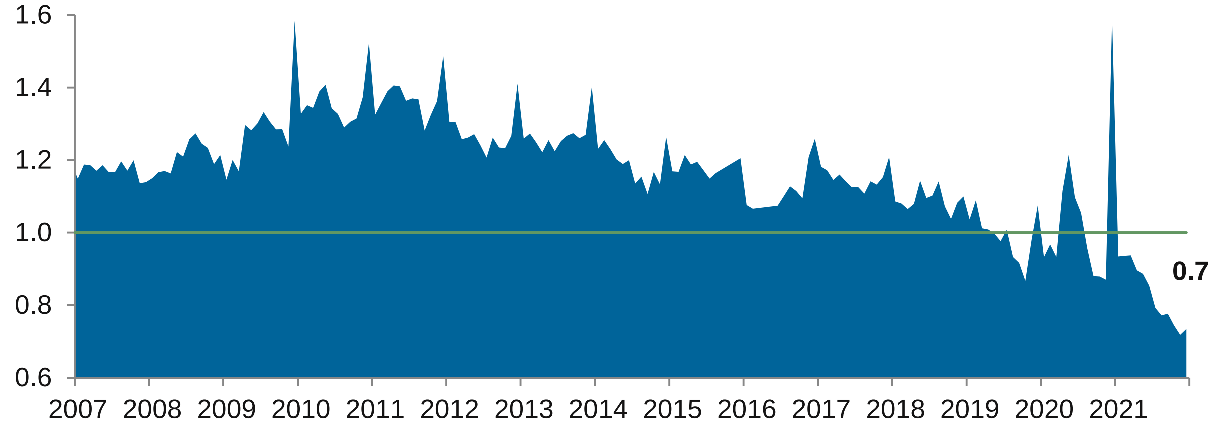
Source: FactSet, FRB, Robert Shiller, Standard & Poor's, Thomson Reuters, J.P. Morgan Asset Management

U.S. Equity Assumptions

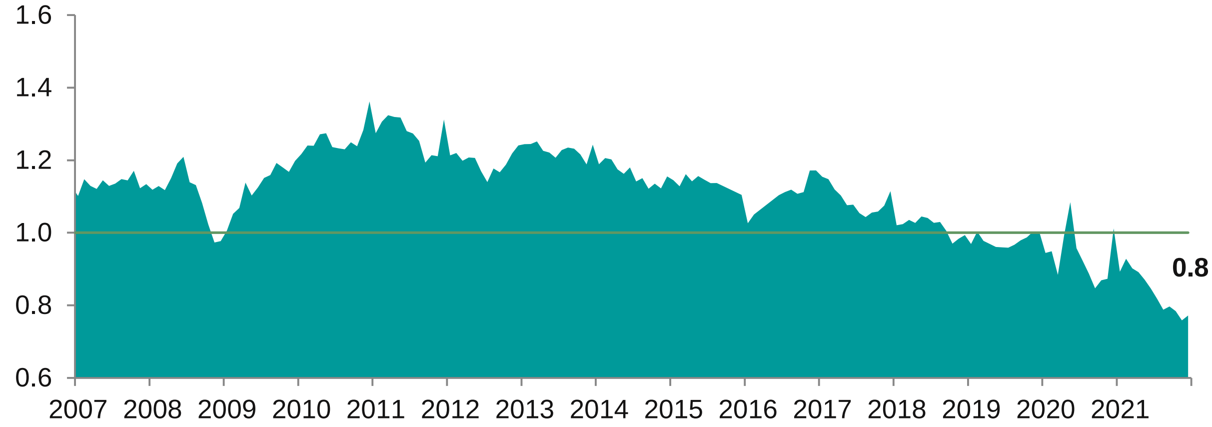
Mid and small cap relative valuations

- Large capitalization stocks have relatively high valuations.
- Historically, smaller cap stocks have had higher valuations than large caps.
  - Investors buying future rather than historical earnings
- The small cap S&P 600 P/E is only 69% of the S&P 500 P/E.
- The mid cap S&P 400 P/E is only 76% of the S&P 500 P/E.
- Lower valuations improve the potential for higher returns relative to large cap going forward.

S&P 600/S&P 500 Relative Forward P/E Ratios



S&P 400/S&P 500 Relative Forward P/E Ratios

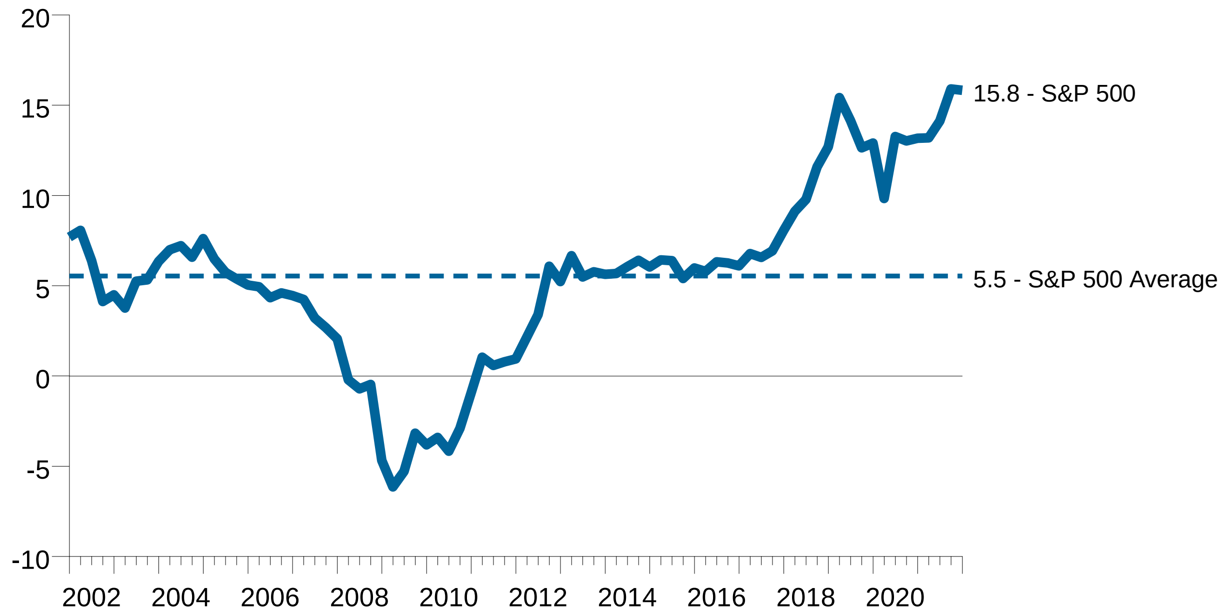


Source: Standard & Poor's

Risk premium

- Over the very long term, the equity risk premium (ERP) vs. cash is around 6%.
- Callan equity projection is at T-bills + 5.3%, consistent with long-term history.
  - Over the past 20 years ERP vs. cash has been 5.4%.
- Cash at 1.2%, ERP at 5.3% = Equity Return of 6.50%

Rolling 40 Quarter Relative Returns Relative To 3 Month T-Bill for 20 Years Ended December 31, 2021

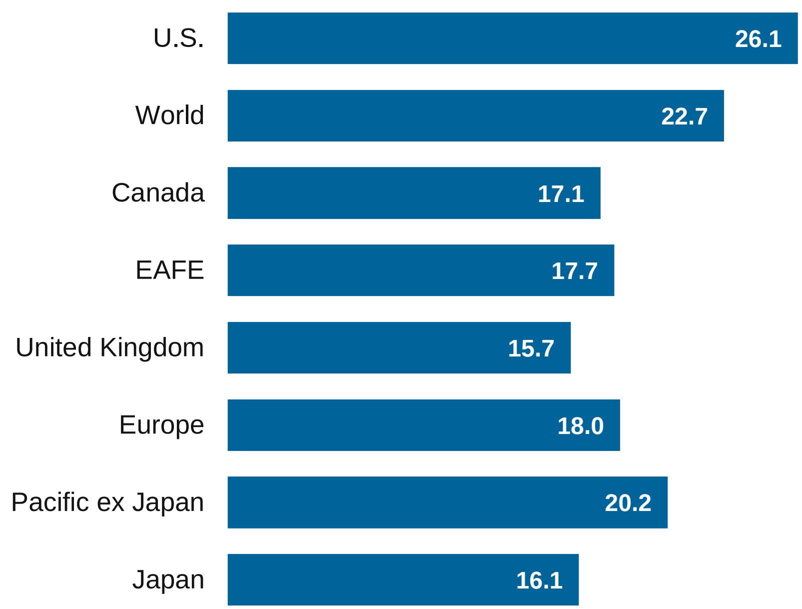


Source: Standard & Poor's

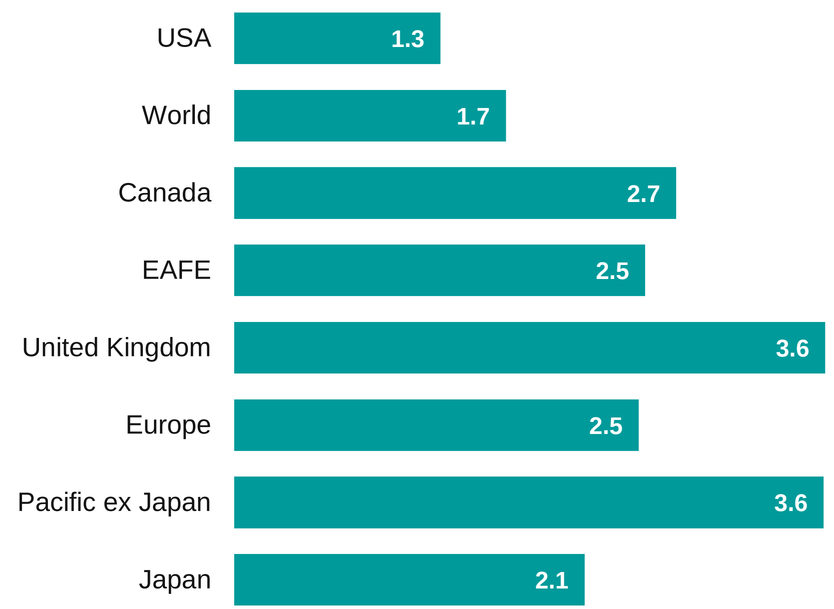
Global ex-U.S. Equity Assumptions

Developed markets valuations and dividend yield

Price Earnings Ratio



Dividend Yield



Valuations are generally high in developed markets.

- Valuations have changed only modestly over the past year.
- U.S. continues to have the highest valuations.

Low dividend yields have a direct impact on returns.

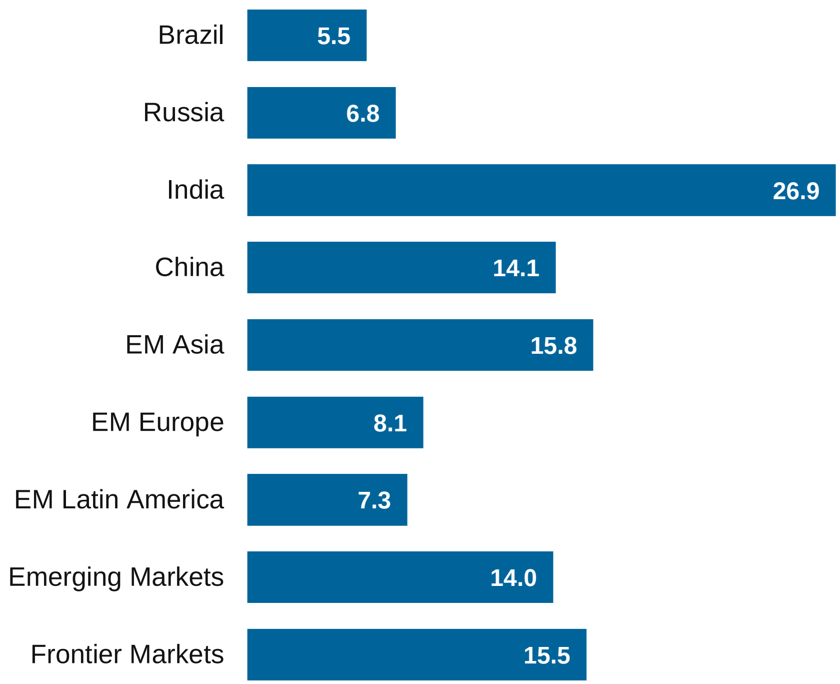
- Dividend yields have generally stayed the same or fallen since last year.

Source: MSCI (Dec. 31, 2021)

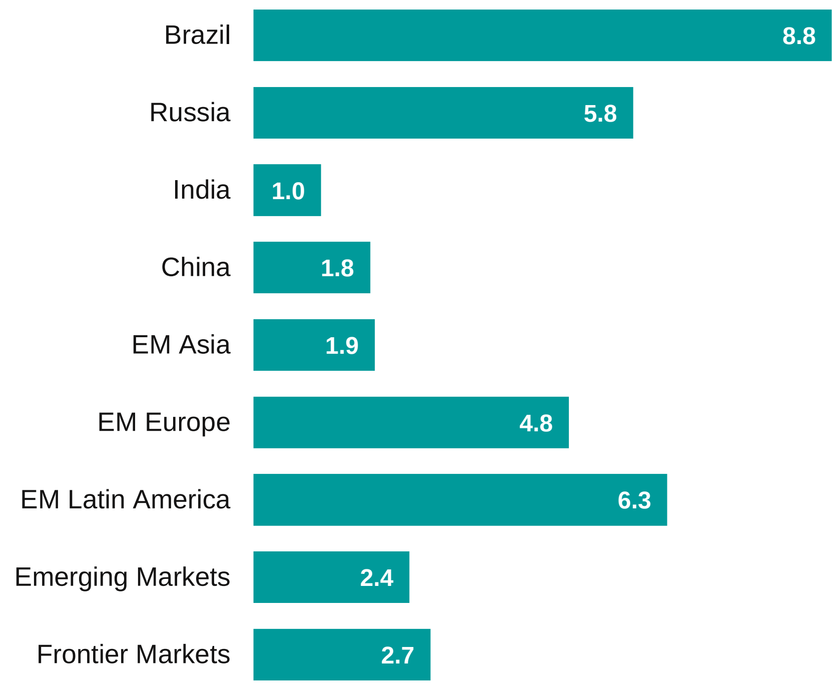
Global ex-U.S. Equity Assumptions

Emerging markets valuations and dividend yield

Price Earnings Ratio



Dividend Yield



Emerging markets also have elevated valuations.

- Among the BRICs, India has the highest valuation metrics while Brazil has fallen dramatically.
- Asia has the highest regional valuations, Latin America the lowest.

Significant dilution is realized as growing companies issue more shares.

Source: MSCI (Dec. 31, 2021)

Public Equity Assumptions

Index	Current Dividend Yield*	Forecasts Dividend Yield	Net Buyback Yield	Inflation	Real Earnings Growth**	Valuation Adjustment	Total Geometric Return	2021 Return	Change
S&P 500	1.35%	1.75%	0.50%	2.25%	2.25%	-0.25%	6.50%	6.50%	0.00%
Russell 2500	1.17%	1.50%	0.00%	2.25%	2.95%	0.00%	6.70%	6.70%	0.00%
Russell 3000	1.24%	1.70%	0.45%	2.25%	2.35%	-0.20%	6.55%	6.60%	-0.05%
MSCI World ex USA	2.53%	2.75%	0.00%	2.00%	1.75%	0.00%	6.50%	6.50%	0.00%
MSCI Emerging Markets	2.38%	2.10%	-2.10%	2.65%	4.25%	0.00%	6.90%	6.90%	0.00%
Aggregate							1.75%	1.75%	0.00%
Cash							1.20%	1.00%	0.20%

Index	Forecast ERP Cash^	Historical ERP Cash	Delta ERP Cash	Forecast ERP Aggregate	Historical ERP Aggregate^^	Delta ERP Aggregate
S&P 500	5.30%	7.62%	-2.32%	4.75%	4.80%	-0.05%
Russell 2500	5.50%	8.04%	-2.54%	4.95%	5.21%	-0.26%

No changes in public equity projections

- Change in Russell 3000 projection due to a difference in rounding
- 25 bps increase in inflation is offset by a 25 bps decrease in dividend yields

* Index yields as of December 31, 2021
** S&P 500 real earnings growth is forecast real GDP growth. R 2500 real earnings growth is an 70 bps spread over S&P 500. Developed and emerging markets earnings growth in line with their respective GDP assumptions.
^ Assumes cash return of 1.2%.
^^ Assumes Aggregate forecast is 1.75%.

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Alternatives

Private Equity

Background

The private equity market in aggregate is driven by many of the same economic factors as public equity markets. Buyout valuations appear reasonable while venture/growth equity valuations are high.

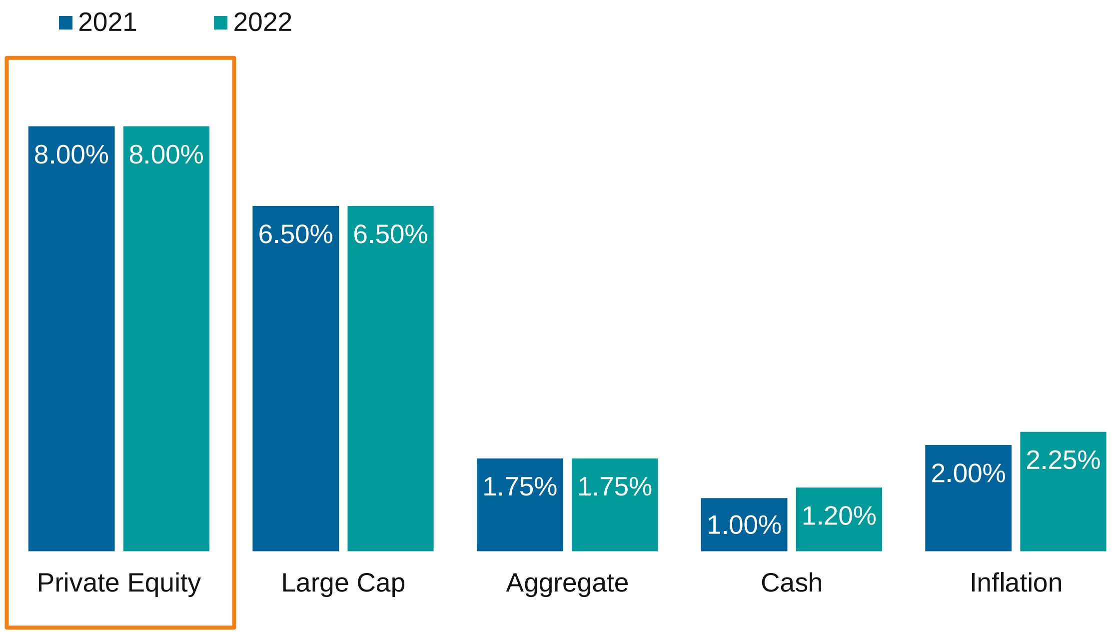
Consequently, the private equity performance expectations did not change relative to where they were last year.

We see tremendous disparity between the best- and worst-performing private equity managers.

The ability to select skillful managers could result in realized returns significantly greater than projected here.

2022 private equity return projection: 8.00% (unchanged)

Return Projections



Real Estate

Background

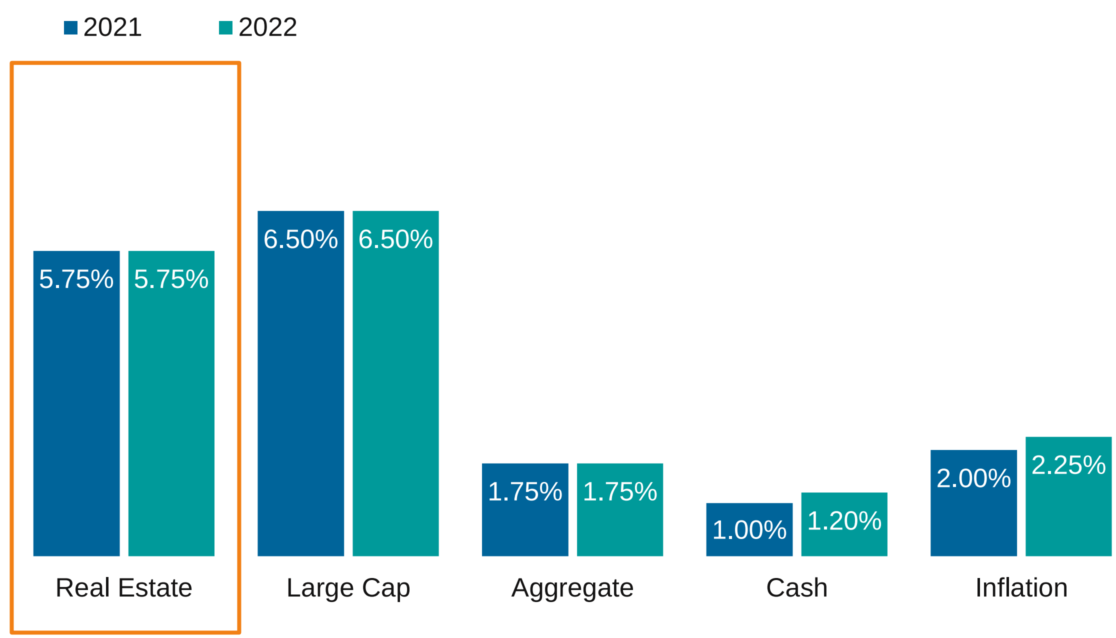
The foreseeable low interest rate environment should help to ensure that real estate continues to garner interest from investors seeking income, supporting returns.

Weakening expectations for some real estate sectors, such as office and retail may continue to be offset by other sectors such as industrial and residential. Non-traditional sectors like medical office and data centers continue to grow in institutional portfolios.

No change to the outlook for real estate returns compared to last year.

2022 real estate return projection: 5.75% (unchanged)

Return Projections



Hedge Funds

Background

Hedge funds can be evaluated in a multi-factor context using the following relationship:

Expected Return = Cash + Equity Beta x (Equity-Cash) + Exotic Beta + Net Alpha

Callan's 10-year cash forecast is 1.2%.

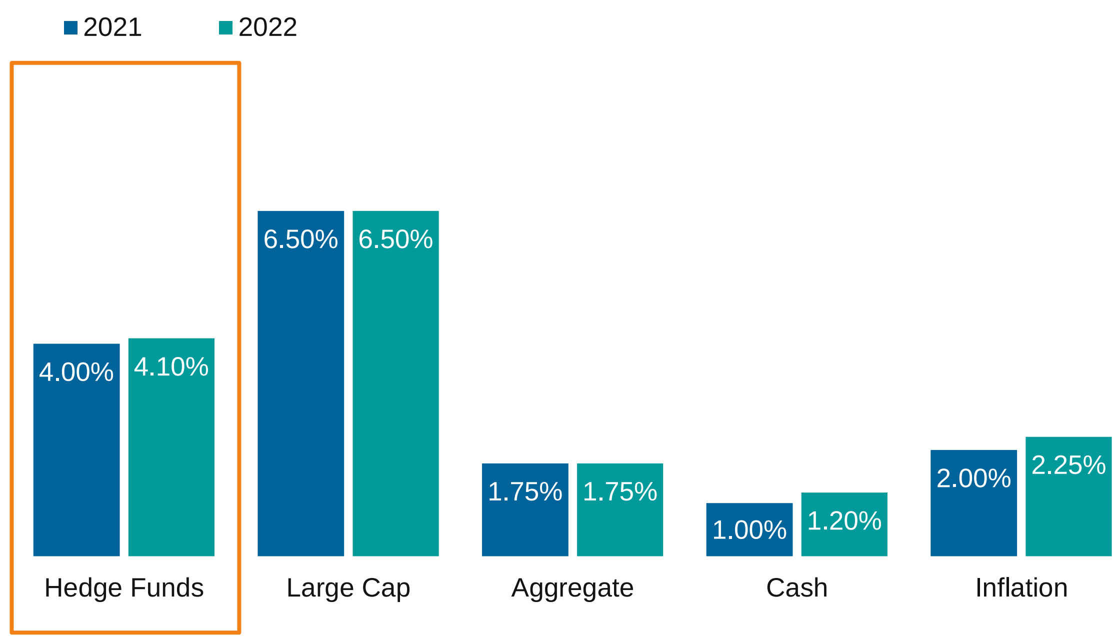
Diversified hedge fund portfolios have historically exhibited equity beta relative to the S&P 500 of about 0.4.

Combined with our equity risk premium forecast, this results in an excess return from equity beta of just over 2%.

Return from hedge fund exotic beta and illiquidity premia is forecast to be 0.5% to 1.0%, to arrive at an overall expected return of 4.1%.

2022 hedge fund return projection: 4.1% (up 10 bps)

Return Projections



Private Credit

Background

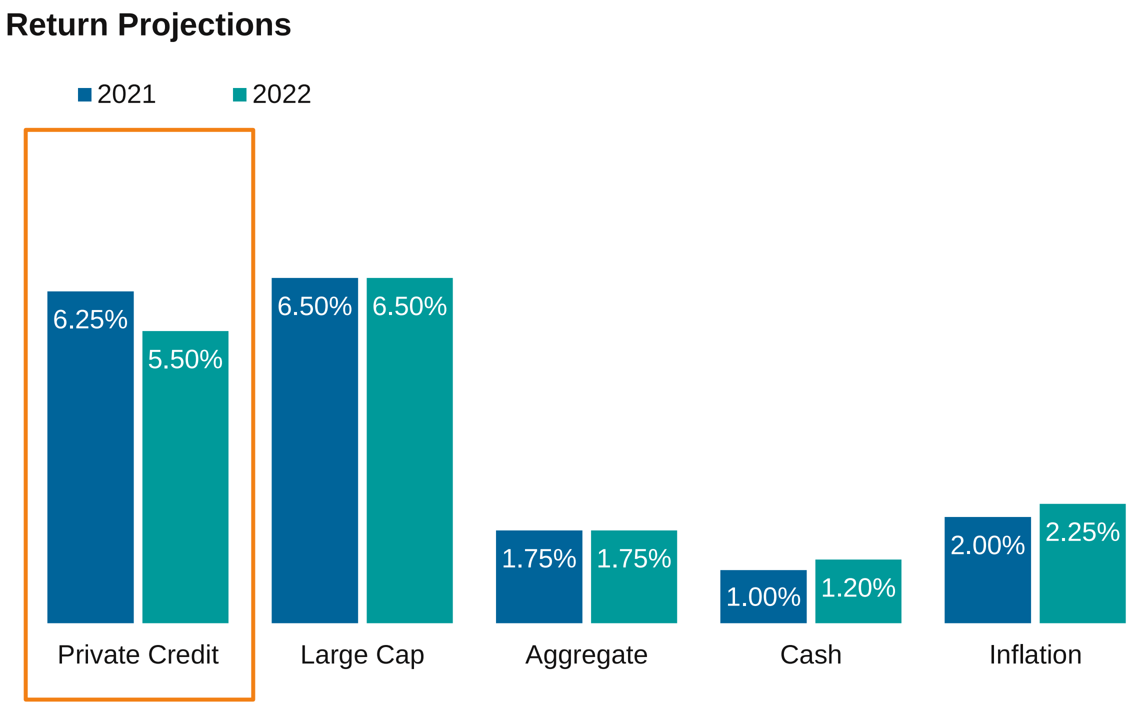
Return projection is anchored on middle market direct lending where yields have returned to pre-COVID lows.

While banks are no longer major investors in this market, there is strong appetite from institutional and retail investors.

~160 bps is a reasonable return premium relative to high yield (3.9%) and leveraged loans.

A portfolio with more distressed and specialty finance exposure would have a higher return though with a lower current yield and higher volatility and higher correlation to public and private equity.

2022 private credit return projection: 5.5% (down 75 bps)



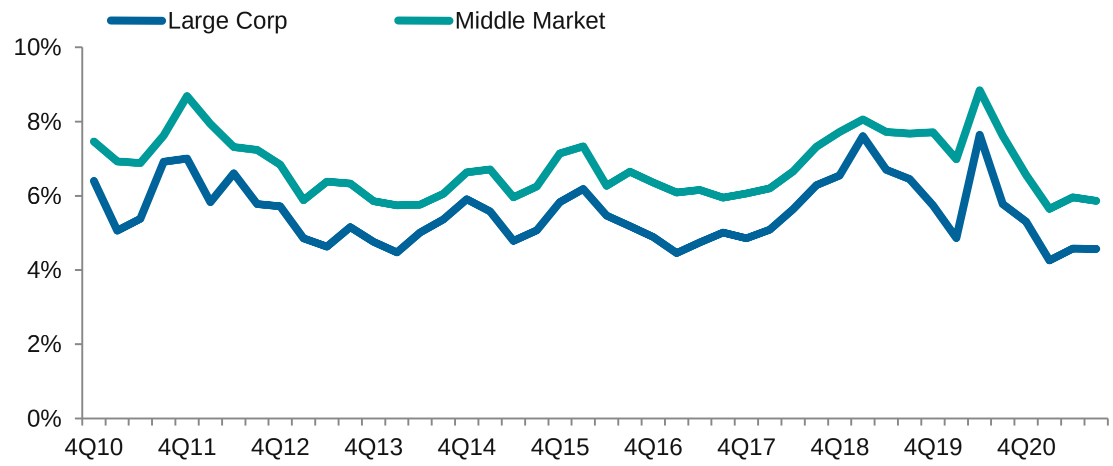
Private Credit

– Return calculations assume 3.7% cost of leverage and 0.75% unlevered loss ratio

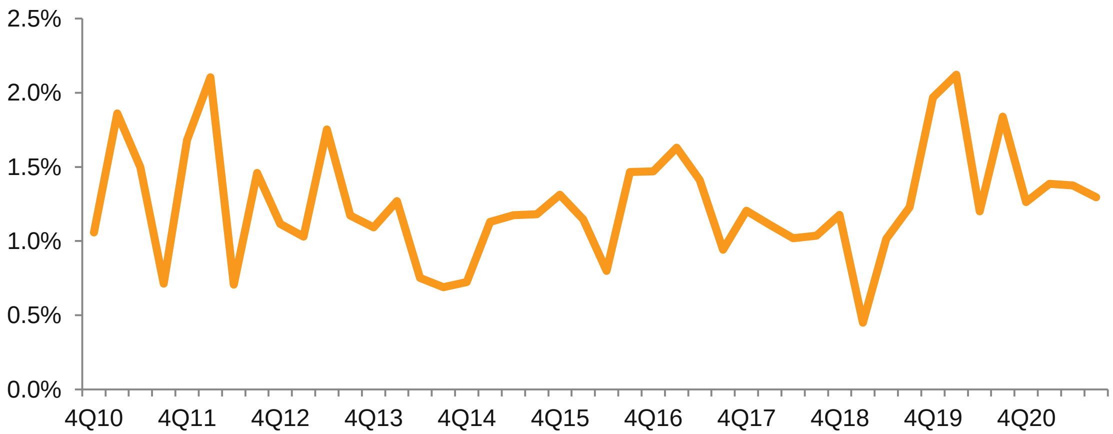
– Corresponds to 5.50% geometric

Unlevered Yield	7.2%
Leverage	0.85x
Levered Yield	10.2%
Management Fee and Operating Expense	1.7%
Incentive Rate	15%
Hurdle	4%
Incentive Fee	0.7%
Total Fees and Exp.	2.4%
Loss Ratio	1.4%
Net Arithmetic	6.4%

Loan Yields



Middle Market Premium



Source: Refinitiv LPC. All-in yield (LIBOR + Spread + OID) assuming 3-year takeout
Note: 2Q20 was deemed less reliable due to lack of data points to calculate a MM institutional all-in yield statistic

Callan

Detailed 2022 Expectations and Resulting Portfolio Returns and Risks

2022 Risk and Returns

Summary of Callan's Long-Term Capital Market Assumptions (2022 – 2031)

		Projected Return			Projected Risk
Asset Class	**Index**	**1-Year Arithmetic**	**10-Year Geometric***	**Real**	**Standard Deviation**
Equities					
Broad U.S. Equity	Russell 3000	8.00%	6.60%	4.35%	17.95%
Large Cap U.S. Equity	S&P 500	7.85%	6.50%	4.25%	17.70%
Small/Mid Cap U.S. Equity	Russell 2500	8.75%	6.70%	4.45%	21.30%
Global ex-U.S. Equity	MSCI ACWI ex USA	8.70%	6.80%	4.55%	20.70%
Developed ex-U.S. Equity	MSCI World ex USA	8.25%	6.50%	4.25%	19.90%
Emerging Market Equity	MSCI Emerging Markets	9.80%	6.90%	4.65%	25.15%
Fixed Income					
Short Duration Gov't/Credit	Bloomberg 1-3 Yr G/C	1.50%	1.50%	-0.75%	2.00%
Core U.S. Fixed	Bloomberg Aggregate	1.80%	1.75%	-0.50%	3.75%
Long Government	Bloomberg Long Gov	1.85%	1.10%	-1.15%	12.50%
Long Credit	Bloomberg Long Cred	2.60%	2.10%	-0.15%	10.50%
Long Government/Credit	Bloomberg Long G/C	2.30%	1.80%	-0.45%	10.40%
TIPS	Bloomberg TIPS	1.35%	1.25%	-1.00%	5.05%
High Yield	Bloomberg High Yield	4.40%	3.90%	1.65%	10.75%
Global ex-U.S. Fixed	Bloomberg Gl Agg xUSD	1.20%	0.80%	-1.45%	9.20%
Emerging Market Sovereign Debt	EMBI Global Diversified	4.00%	3.60%	1.35%	9.50%
Alternatives					
Core Real Estate	NCREIF ODCE	6.60%	5.75%	3.50%	14.20%
Private Infrastructure	MSCI Glb Infra/FTSE Dev Core 50/50	7.10%	6.10%	3.85%	15.45%
Private Equity	Cambridge Private Equity	11.45%	8.00%	5.75%	27.60%
Private Credit	N/A	6.40%	5.50%	3.25%	14.60%
Hedge Funds	Callan Hedge FOF Database	4.35%	4.10%	1.85%	8.20%
Commodities	Bloomberg Commodity	4.05%	2.50%	0.25%	18.00%
Cash Equivalents	90-Day T-Bill	1.20%	1.20%	-1.05%	0.90%
Inflation	CPI-U		2.25%		1.60%

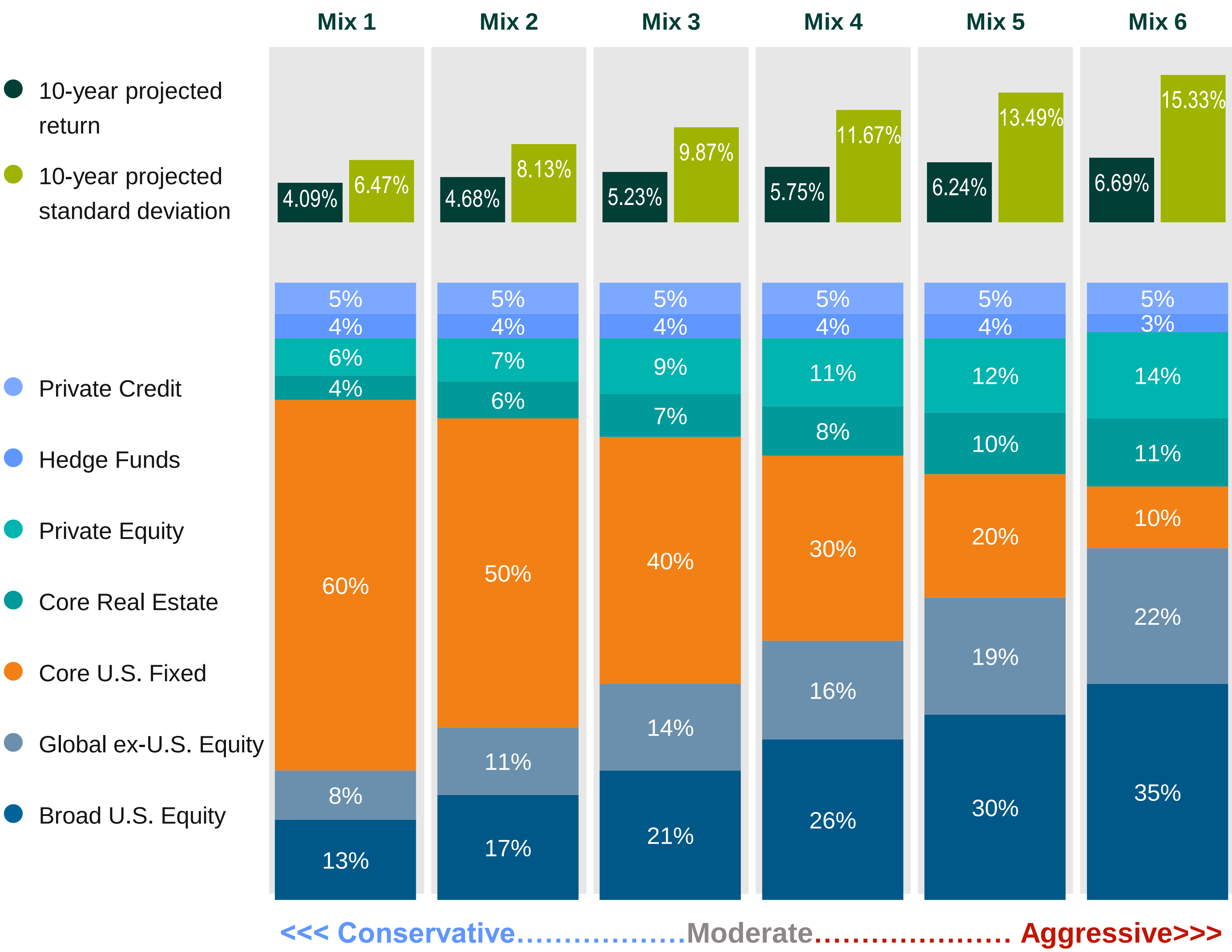
* Geometric returns are derived from arithmetic returns and the associated risk (standard deviation).

2022 Correlations

	Lg Cap	Smid Cap	Dev	Em Markets	Short Duration	Core Fixed	Long Gov	Long Credit	TIPS	High Yield	Gl ex-US Fixed	EM	Core Real Est	Private Infra	Private Equity	Private Credit	Hedge Funds	Comm	Cash Equiv	Inflation
U.S. Large Cap	1.00																			
U.S. Smid Cap	0.90	1.00																		
Dev ex-U.S. Equity	0.77	0.77	1.00																	
Em Market Equity	0.79	0.76	0.84	1.00																
Short Dur Gov/Credit	-0.06	-0.08	-0.06	-0.10	1.00															
Core U.S. Fixed	-0.10	-0.12	-0.11	-0.14	0.78	1.00														
Long Government	-0.15	-0.16	-0.13	-0.16	0.67	0.84	1.00													
Long Credit	0.28	0.25	0.26	0.24	0.64	0.80	0.69	1.00												
TIPS	-0.08	-0.08	-0.09	-0.10	0.56	0.70	0.53	0.52	1.00											
High Yield	0.71	0.68	0.69	0.69	-0.01	0.00	-0.08	0.40	0.06	1.00										
Global ex-U.S. Fixed	0.01	0.00	0.05	0.08	0.48	0.50	0.42	0.49	0.45	0.12	1.00									
EM Sovereign Debt	0.56	0.54	0.55	0.61	0.08	0.14	0.05	0.35	0.18	0.60	0.15	1.00								
Core Real Estate	0.64	0.60	0.60	0.56	-0.01	-0.04	-0.09	0.24	-0.02	0.53	-0.02	0.33	1.00							
Private Infrastructure	0.65	0.60	0.61	0.58	0.00	0.01	-0.03	0.27	-0.02	0.50	0.03	0.35	0.76	1.00						
Private Equity	0.77	0.73	0.73	0.72	-0.10	-0.19	-0.21	0.15	-0.14	0.59	0.06	0.40	0.50	0.62	1.00					
Private Credit	0.68	0.65	0.65	0.64	0.00	-0.06	-0.10	0.28	-0.09	0.63	0.06	0.48	0.47	0.52	0.65	1.00				
Hedge Funds	0.79	0.74	0.75	0.74	0.10	0.13	0.07	0.39	0.09	0.64	0.05	0.53	0.45	0.47	0.57	0.61	1.00			
Commodities	0.28	0.27	0.27	0.27	-0.10	-0.10	-0.10	0.01	0.10	0.15	0.15	0.19	0.21	0.18	0.23	0.17	0.23	1.00		
Cash Equivalents	-0.06	-0.08	-0.10	-0.10	0.30	0.15	0.08	-0.05	0.12	-0.11	0.00	-0.07	0.00	-0.07	0.00	-0.06	-0.04	-0.02	1.00	
Inflation	-0.02	0.02	0.00	0.03	-0.21	-0.25	-0.23	-0.25	0.08	0.05	-0.10	0.00	0.10	0.06	0.06	0.06	0.15	0.29	0.05	1.00

Optimization Set – Public Stocks and Bonds Plus Alternatives

Asset mix alternatives



Private Credit:

Absolute constraint: <5%

Note on public equity:

We tune large cap, small cap, developed ex-U.S. and emerging separately.

Prefer to optimize portfolios with broad U.S. and broad global ex-U.S. equity

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