

How to Beat Inflation: A US Case Study

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- Commodities, TIPS and cash can partially hedge short-term fluctuations in inflation while equities have consistently outperformed other assets for a longer holding period.
- Our analysis shows that no single asset constitutes a perfect inflation hedge. Inflation hedge effectiveness depends on the correlation between an asset's return and inflation, inflation beta sensitivity and the holding period.
- It is important to take these factors into account before deciding where to invest.

As the global economy emerges from one of the worst shocks since the Great Depression, triggered by the COVID pandemic, investors have once again started to refocus their attention on inflation and its possible trajectory. Recent inflation surprises have only heightened concerns; although, industry commentators generally agree that these surprises are transitory in nature and will only have an ephemeral impact on economic growth.

This view, which State Street Global Advisors also shares, was aptly summarised in the recent **Global Market Outlook**, in which the authors noted that rising input costs and a strong rebound in global demand have been fuelling inflation. While current spikes should moderate later in the year, inflation is expected to remain at elevated levels over the next two years.¹ That being said, the authors also conceded that a key risk to their forecasts is sustained higher inflation. This uncertainty has led some investors to re-evaluate the assets that could help mitigate the potentially negative impact of inflation on investment returns. Inflation is often a key consideration for investors, with the objectives of many investment portfolios directly anchored to inflation rates.

Given the importance of inflation considerations, we have carried out a detailed analysis on how investors can protect against inflation. In this paper, we investigate whether inflation risk can be attenuated through investing in a variety of common, publicly traded investment exposures. Our investigation is built upon the previous work undertaken by researchers at the IMF who utilised inflation beta as the primary statistical measure to appraise the inflation-hedging capabilities of an array of investment exposures.

To extend their work, we have repeated the same analysis using more recent data with a focus on the US, scrutinised the historical performance of these assets under different headline inflationary regimes, and studied whether their performance covaried with expected and unexpected inflation, both of which are estimated from the headline inflation figures via a statistical technique. Finally, we also considered the potential impact on investment exposures from headline inflation shocks, which are defined as a one standard deviation move. The main objectives of this paper are:

- To discuss inflation as a source of risk for investors and provide a definition for inflation;
- To examine how common investment exposures performed historically under different short-run inflationary regimes;
- To evaluate the strength and reliability of these exposures' inflation-hedging capabilities over the short run;
- To assess the correlation between these exposures with expected and unexpected inflation over the short run;
- To study the investment characteristics of these investment exposures over a longer-term horizon; and
- To assess the potential impact on returns in the face of an inflation shock.

Inflation as a Source of Risk

Conventional wisdom suggests that if prices rise across the entire economy, an equity stake in a company should rise since firms should be able to pass on higher costs to consumers. Sure enough, some sectors, being more affected by inflation than others, can directly transfer any price rises to the end consumers and are likely to be rewarded with higher profitability in an inflationary environment.

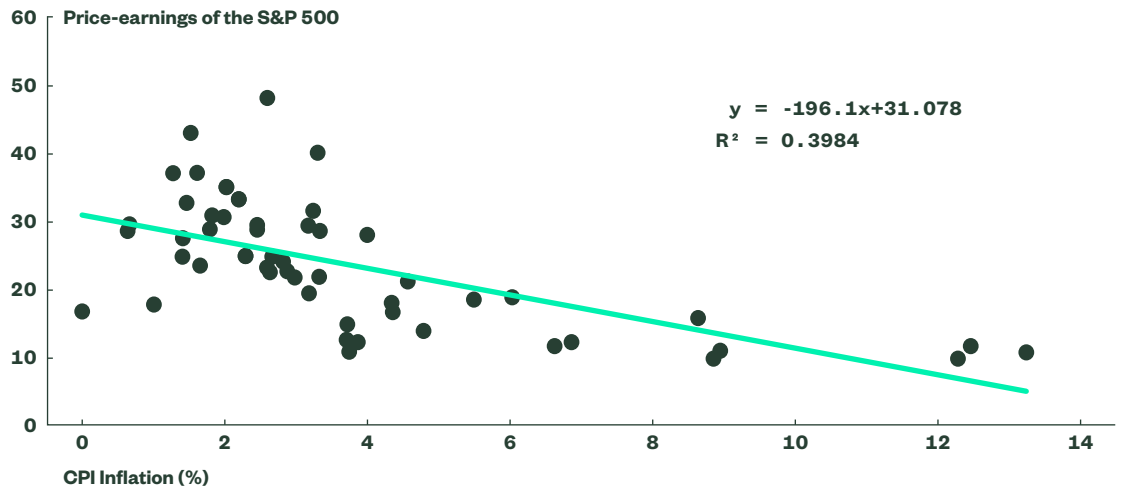
However, this theory may not be completely borne out by reality. Indeed, anyone who casts their mind back to the 1980s and early 1990s would recall that inflation in the US frequently exceeded 10% and that the impact on financial markets was largely unfavourable. A case in point was at the start of the 1980s when the price-earnings ratio of the S&P 500 Index was at around 9–10 and remained at these depressed levels amid high inflation and double-digit interest rates.

In recent years, we have not witnessed macroeconomic conditions such as those from the past, but inflation may yet come back strongly after years of stagnation thanks to supportive central bank policy and, more recently, the COVID pandemic. To be sure, mainstream commentators do not expect inflation to reach levels of the 80s and 90s but it may still be instructive to analyse the assets that fared well during past periods of elevated inflation in order to understand which assets could perform well if inflation were to rise sharply.

Overall, markets can generally cope when inflation is at reasonable levels but are susceptible to substantial turbulence when it exceeds expected levels. Central to the short-term relationship between inflation and equity returns is investors' response to inflation and companies' ability to pass on costs. Figure 1 shows a moderately negative association between the price-earnings ratio and inflation and that the ratio experienced a material decline when inflation exceeded 6% p.a. (Figure 2). A possible explanation for this is that although companies can partially transfer price increases to consumers, this is unlikely to be enough to counteract the negative effects relating to a rise in the market discount rate used to discount increasingly uncertain future income.

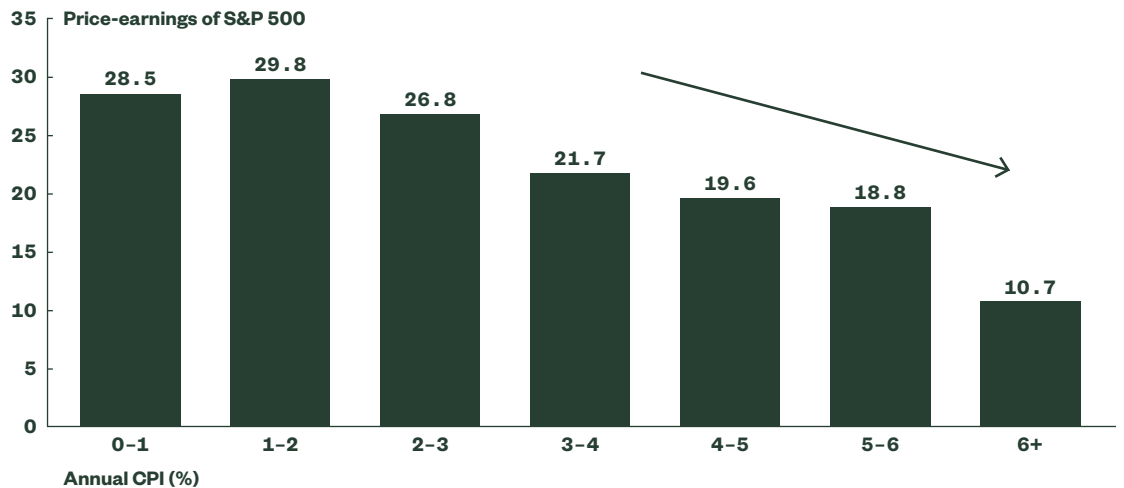
“ There appears to be a moderately negative correlation between the price-earnings ratio and inflation.”

Figure 1
Price-Earnings of the S&P 500 vs. US CPI Since 1970



Source: Robert Shiller website (<http://econ.yale.edu/~shiller/data.htm>), Bloomberg, State Street Global Advisors. Data from December 1970 to July 2021. Price-earnings data represents cyclically adjusted PE, from Robert Shiller's website.

Figure 2
Median S&P 500 Price-Earnings Ratio Across Different Inflationary Environments



Source: Datastream, Bloomberg, State Street Global Advisors. Data from December 1970 to July 2021.

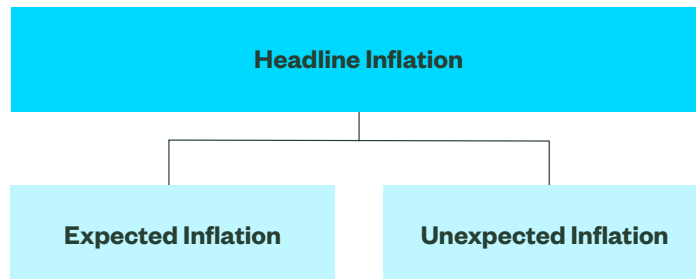
Defining Inflation, Expected Inflation and Unexpected Inflation

Before we discuss the ways to counter inflation, it is important to define what we mean by inflation and its various components. Generally speaking, inflation refers to a sustained rise in price levels and represents the average changes in prices across the economy at a given point in time. While there are different ways of measuring inflation, we have focused on the US Consumer Price Index for All Urban Consumers, which is a measure of price change for urban consumers that reflects the expenditure patterns of an average consumer living in an urban area — approximately 89% of the US population.

Beyond probing the headline figures, we also decomposed it into two components: the part that is anticipated by the market (the so-called “expected inflation”) and the portion that is a surprise (“unexpected inflation”) (Figure 3).

The main difference between expected inflation and unexpected inflation lies in whether it has been foreseen and taken into consideration by the market. In regard to expected inflation, theory dictates that fixed income investors would be compensated with higher interest rates given the slippage between nominal and real returns while equity investors would reap the benefit of higher earnings through the price increases that companies can levy on consumers. Unexpected inflation refers to rises that are not anticipated or priced in by the market. There is no standard way to break down expected and unexpected inflation. Following Razzak (1997)² and Bosse (2019),³ we have used a Hodrick-Prescott (HP) filter to separate inflation into its respective trend (expected inflation) and cyclical (unexpected inflation) components.

Figure 3
**Decomposition of
 Headline Inflation
 — Expected
 and Unexpected**



Source: State Street Global Advisors. The figure is for illustrative purposes only.

The Correlation and Beta of Investment Exposures and Headline Inflation

To understand whether an investment exposure can potentially hedge against inflation, we need to look at its correlation with inflation to determine whether they both generally move in the same direction. We also consider sensitivity to inflation (the inflation beta), which provides a magnitude of an investment's inflation-hedging coverage.⁴

On a headline inflation basis, commodities, commodity-sensitive equity sectors, inflation-sensitive fixed income instruments and cash historically displayed the strongest correlation with inflation in the US and had statistically significant sensitivity to it (Figure 4).⁵ In the case of commodities, this is not surprising as energy commodities are often linked to housing and transport and agricultural commodities are often related to food and beverages, as well as alcohol and tobacco. These components, which make up most of the US inflation basket, are naturally the largest drivers of inflation (Figure 5).

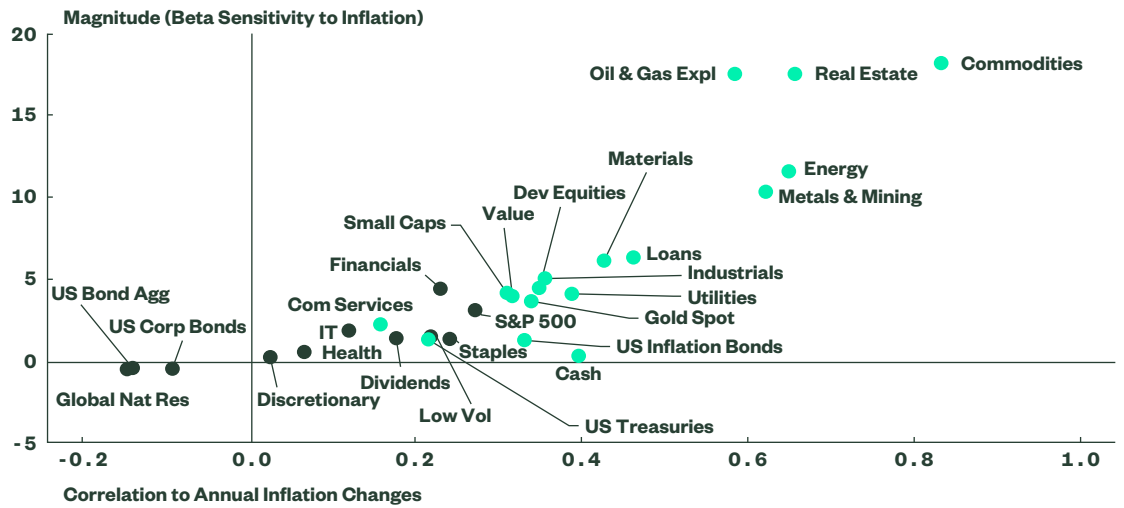
As for cash, it is strongly correlated but not very sensitive to inflation. Put differently, while it often moves in tandem with inflation, it offers little inflation coverage. Cash often moves in the same direction as inflation because it has low duration and can be rolled into new bonds with higher yields in a rising rate, higher inflation environment.

“ Over the short term, commodities, commodity equity sectors as well as inflation-sensitive fixed income instruments appear to be effective inflation hedges.”

Figure 4

Inflation Beta Sensitivity vs. Correlation to US CPI Since 2000

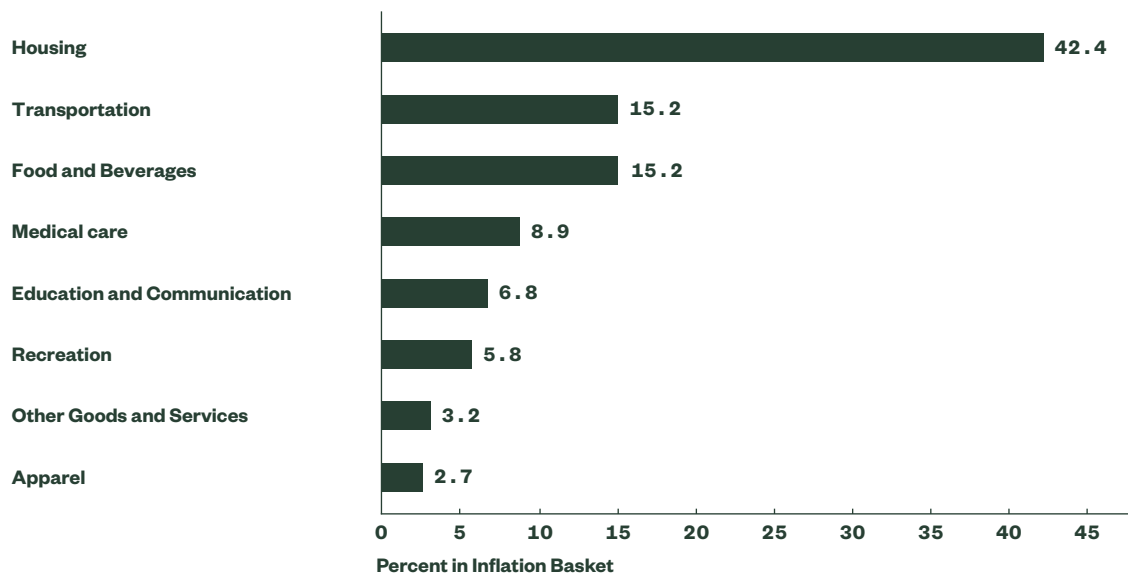
■ Beta Insignificant at the 5% significant level
 ● Beta Significant at the 5% Significant Level



Source: Bloomberg, State Street Global Advisors. Data from June 2001 to July 2021. It is not possible to invest in directly an index. "S&P 500" is represented by the S&P 500 Index. "Dev Equities" is represented by the MSCI World Index, "Small caps" is represented by the Russell 2000 Index, "Energy" is represented by the S&P 500 Energy Index, "Financials" is represented by the S&P 500 Financials Index, "IT" is represented by the S&P 500 Information Technology Index, "Health" is represented by the S&P 500 Health Care Index, "Metals & Mining" is represented by the S&P 500 Metals and Mining Index, "Oil & Gas Expl" is the S&P 500 Oil & Gas Exploration & Production Select Industry Index, "Industrials" is the S&P 500 Industrials Index, "Materials" is represented by the S&P 500 Materials Index, "Com Services" is represented by the S&P 500 Communication Services Index, "Discretionary" is represented by the S&P 500 Consumer Discretionary Index, "Value" is represented by the MSCI US Value Exposure Select Index, "US Bond Agg" is the Bloomberg Barclays US Aggregate Index, "Gold Spot" is the spot exchange rate of Gold in USD, "Commodities" is represented by the GSCI Total Return Index (USD), "Cash" is represented by the Bloomberg Barclays 1-3 Month U.S. Treasury Bill Index, "Loans" is represented by the S&P/LSTA US Leveraged Loan 100 Index, "Global Nat Resources" is represented by the S&P Global Natural Resources Index. "Corp Bonds" is represented by the Bloomberg Barclays US Corporate Bonds Index, "Inflation Bonds" is represented by the US Government Inflation-linked All Maturities Total Return Index, "Real Estate" is represented by S&P 500 Real Estate Sector Index, "US Treasuries" is represented by the Bloomberg Barclays US Treasury Bond Index.

Figure 5

US CPI Basket in 2020



Source: US Bureau of Labour Statistics, as of July 2021.

Persistence of Inflation Beta and Consistency of Inflation Protection

Examining the inflation beta and correlation over the entire period provides valuable insight on the inflation sensitivity of a range of investment exposures. However, it is equally important to understand how consistent the inflation-hedging coverage is over shorter and more realistic time periods. In our analysis, we focussed mainly on how persistent the beta is over rolling three-year time horizons.⁶

“ Overall, our analysis shows that no single asset constitutes a perfect inflation hedge.”

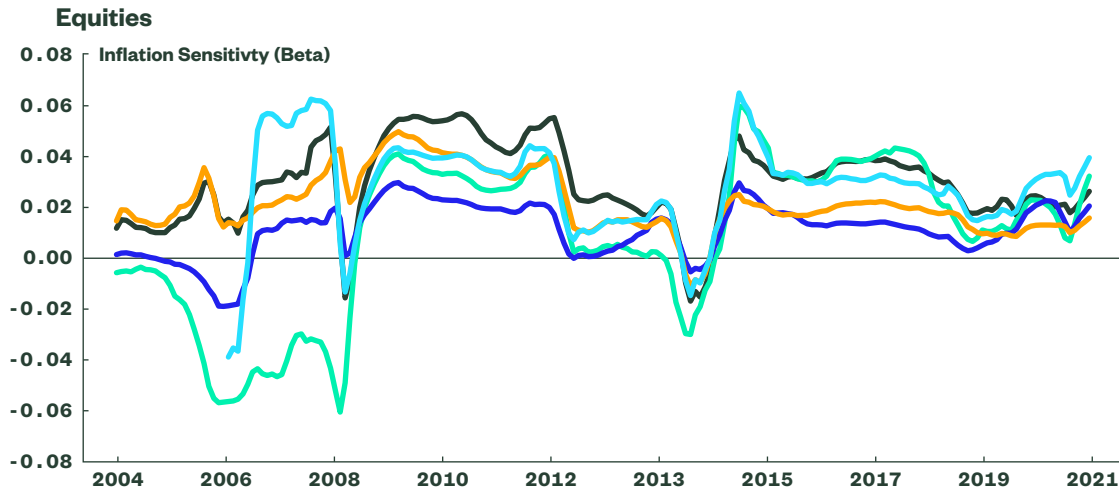
Figure 6 shows that equities tended to go through cycles of highly positive and highly negative beta. In the short run, equities overall did not offer any level of consistent sensitivity to inflation. In terms of fixed income, US government bonds often displayed negative sensitivity to beta, whereas inflation-linked bonds and cash experienced inconsistent inflation sensitivity. In terms of gold and commodities, the former's sensitivity to inflation was generally positive most of the time although it was not as consistent as commodities.

Overall, the analysis shows that there is no single asset that constitutes a perfect inflation hedge. Most assets go through cycles of highly positive and highly negative inflation beta and, even for commodities, the beta can vary quite substantially over time.

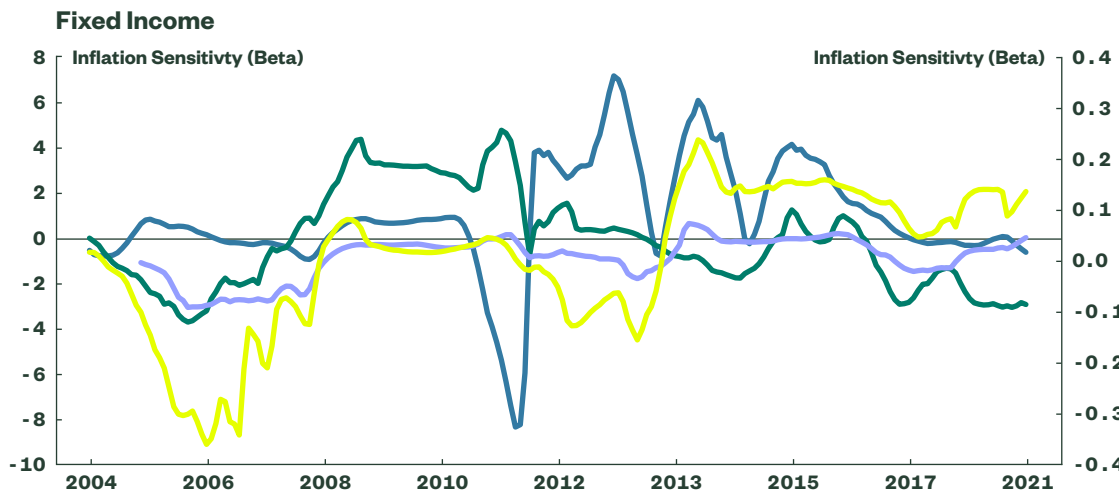
Figure 6

**Beta Persistence:
How Responsive
is Each Asset
to Inflation?**

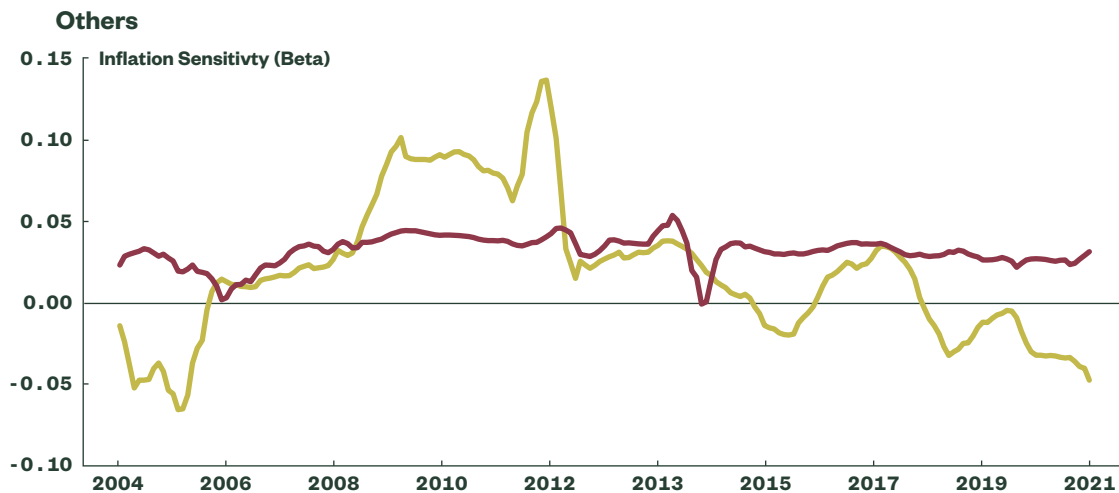
- Energy
- Materials
- Oil & Gas Expl
- Real Estate
- Metals & Mining



- T-bills (lhs)
- Inflation Bonds (rhs)
- Loans (rhs)
- US Treasury Bonds (lhs)



- Gold
- Commodities



Source: Bloomberg, State Street Global Advisors. Data from June 2001 to July 2021. It is not possible to trade an index. "Energy" is represented by the S&P 500 Energy Index, "Metals & Mining" is represented by the S&P 500 Metals and Mining Index, "Oil & Gas Expl" is the S&P 500 Oil & Gas Exploration & Production Select Industry Index, "Materials" is represented by the S&P 500 Materials Index, "Gold Spot" is the spot exchange rate of Gold in USD, "Commodities" is represented by the GSCI Total Return Index (USD), "Cash" is represented by the Bloomberg Barclays 1-3 Month U.S. Treasury Bill Index, "Loans" is represented by the S&P/LSTA US Leveraged Loan 100 Index, "Global Nat Resources" is represented by the S&P Global Natural Resources Index. "Corp Bonds" is represented by the Bloomberg Barclays US Corporate Bonds Index, "Inflation Bonds" is represented by the US Government Inflation-linked All Maturities Total Return Index, "Real Estate" is represented by S&P 500 Real Estate Sector Index, "US Treasuries" is represented by the Bloomberg Barclays US Treasury Bond Index. It is not possible to trade an index.

Historical Performance of Investment Assets Based on Inflation Regimes

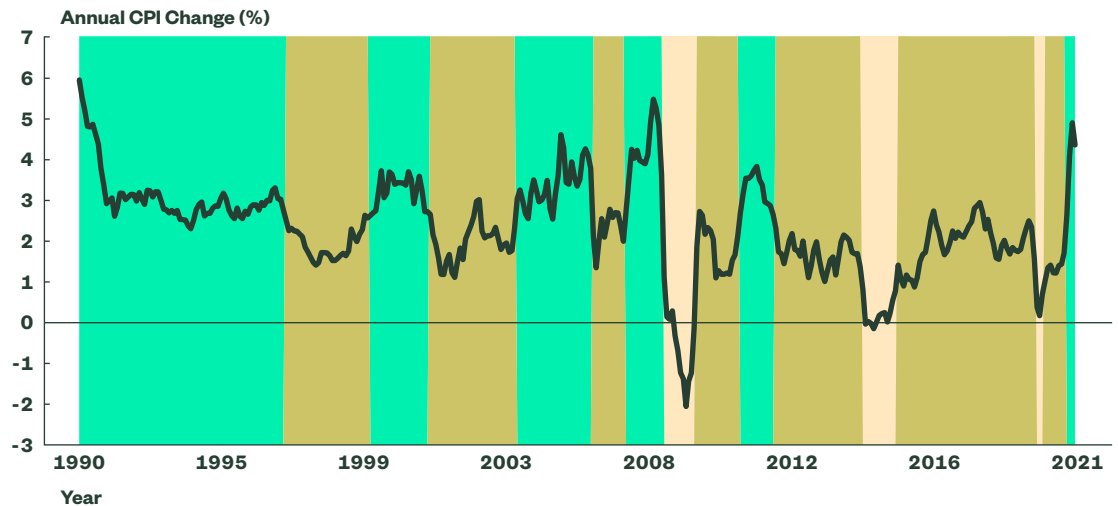
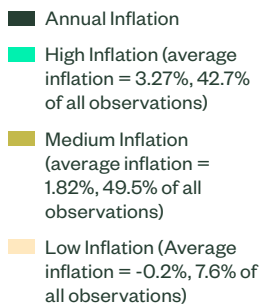
In the last section, we show that the level of inflation sensitivity appears to be somewhat cyclical and varies across different time periods. We therefore proceed to investigate whether the performance of these assets changes according to the inflationary regime. To do this, we parsed the annual inflation time series using a suitable Markov regime switching model,⁷ which consists of three independent states (Figure 7), and studied the median return of these assets as well as their correlation to inflation in each of the regimes.

Currently, we are in the high inflation regime. The results are shown in Figure 8. In the low inflation regime, there appears to be little relationship between an asset's correlation with inflation and its median return. In this regime, many types of equities and bonds fared reasonably well.

“ Equities posted strong median returns in low and medium inflation environments over the short run.”

We observed similar results in the medium inflation regime, where many types of equities continued to perform well and inflation-sensitive assets (namely commodities, cash and inflation-linked bonds) trailed many other assets in this regime. Finally, in the high inflation regime, commodities, commodity-sensitive equities as well as gold ranked best in terms of their median return in this regime.

Figure 7
Markov Three-State Regime of Annual Inflation

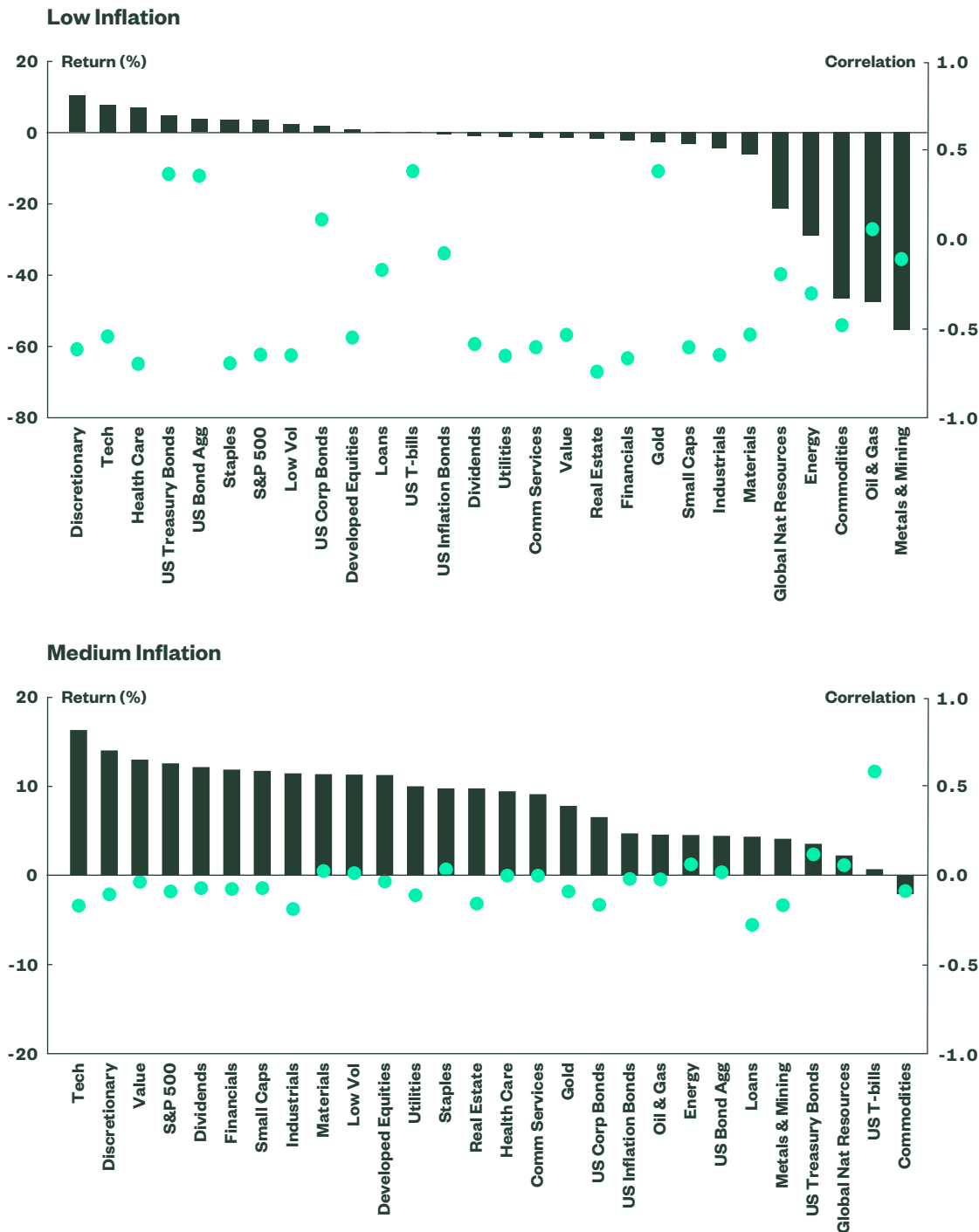


Source: Bloomberg, State Street Global Advisors. Data between December 1990 and July 2021.

Figure 8

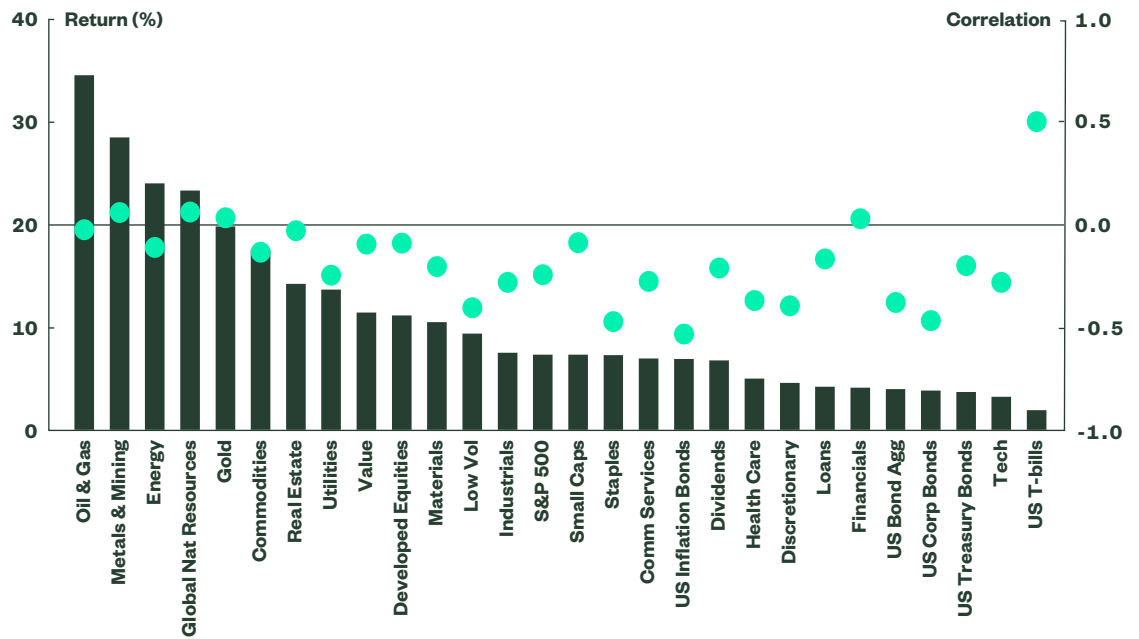
Historical Performance of Select Investments Based on Different Inflation Regimes, Sorted by Their Median Return

■ State Dependent Median Return
● State Dependent Correlation between the Asset's Return and Inflation



Source: Bloomberg, State Street Global Advisors. Data from June 2001 to July 2021. It is not possible to invest in directly an index. "S&P 500" is represented by the S&P 500 Index. "Dev Equities" is represented by the MSCI World Index, "Small caps" is represented by the Russell 2000 Index, "Energy" is represented by the SS&P 500 Energy Index, "Financials" is represented by the S&P 500 Financials Index, "IT" is represented by the S&P 500 Information Technology Index, "Health" is represented by the S&P 500 Health Care Index, "Metals & Mining" is represented by the S&P 500 Metals and Mining Index, "Oil & Gas Expl" is the S&P 500 Oil & Gas Exploration & Production Select Industry Index, "Industrials" is the S&P 500 Industrials Index, "Materials" is represented by the S&P 500 Materials Index, "Com Services" is represented by the S&P 500 Communication Services Index, "Discretionary" is represented by the S&P 500 Consumer Discretionary Index, "Value" is represented by the MSCI US Value Exposure Select Index, "US Bond Agg" is the Bloomberg Barclays US Aggregate Index, "Gold Spot" is the spot exchange rate of Gold in USD, "Commodities" is represented by the GSCI Total Return Index (USD), "Cash" is represented by the Bloomberg Barclays 1-3 Month U.S. Treasury Bill Index, "Loans" is represented by the S&P/LSTA US Leveraged Loan 100 Index, "Global Nat Resources" is represented by the S&P Global Natural Resources Index. "Corp Bonds" is represented by the Bloomberg Barclays US Corporate Bonds Index, "Inflation Bonds" is represented by the US Government Inflation-linked All Maturities Total Return Index, "Real Estate" is represented by S&P 500 Real Estate Sector Index, "US Treasuries" is represented by the Bloomberg Barclays US Treasury Bond Index. It is not possible to trade an index. The bars in the graphs above indicate the median return and the dots indicate the correlation between that asset's return and inflation in that particular inflation regime.

High Inflation



Source: Bloomberg, State Street Global Advisors. Data from June 2001 to July 2021. It is not possible to invest in directly an index. "S&P 500" is represented by the S&P 500 Index. "Dev Equities" is represented by the MSCI World Index, "Small caps" is represented by the Russell 2000 Index, "Energy" is represented by the S&P 500 Energy Index, "Financials" is represented by the S&P 500 Financials Index, "IT" is represented by the S&P 500 Information Technology Index, "Health" is represented by the S&P 500 Health Care Index, "Metals & Mining" is represented by the S&P 500 Metals and Mining Index, "Oil & Gas Expl" is the S&P 500 Oil & Gas Exploration & Production Select Industry Index, "Industrials" is the S&P 500 Industrials Index, "Materials" is represented by the S&P 500 Materials Index, "Com Services" is represented by the S&P 500 Communication Services Index, "Discretionary" is represented by the S&P 500 Consumer Discretionary Index, "Value" is represented by the MSCI US Value Exposure Select Index, "US Bond Agg" is the Bloomberg Barclays US Aggregate Index, "Gold Spot" is the spot exchange rate of Gold in USD, "Commodities" is represented by the GSCI Total Return Index (USD), "Cash" is represented by the Bloomberg Barclays 1-3 Month U.S. Treasury Bill Index, "Loans" is represented by the S&P/LSTA US Leveraged Loan 100 Index, "Global Nat Resources" is represented by the S&P Global Natural Resources Index. "Corp Bonds" is represented by the Bloomberg Barclays US Corporate Bonds Index, "Inflation Bonds" is represented by the US Government Inflation-linked All Maturities Total Return Index, "Real Estate" is represented by S&P 500 Real Estate Sector Index, "US Treasuries" is represented by the Bloomberg Barclays US Treasury Bond Index. It is not possible to trade an index. The bars in the graphs above indicate the median return and the dots indicate the correlation between that asset's return and inflation in that particular inflation regime.

Decomposing Inflation into Expected Inflation and Unexpected Inflation

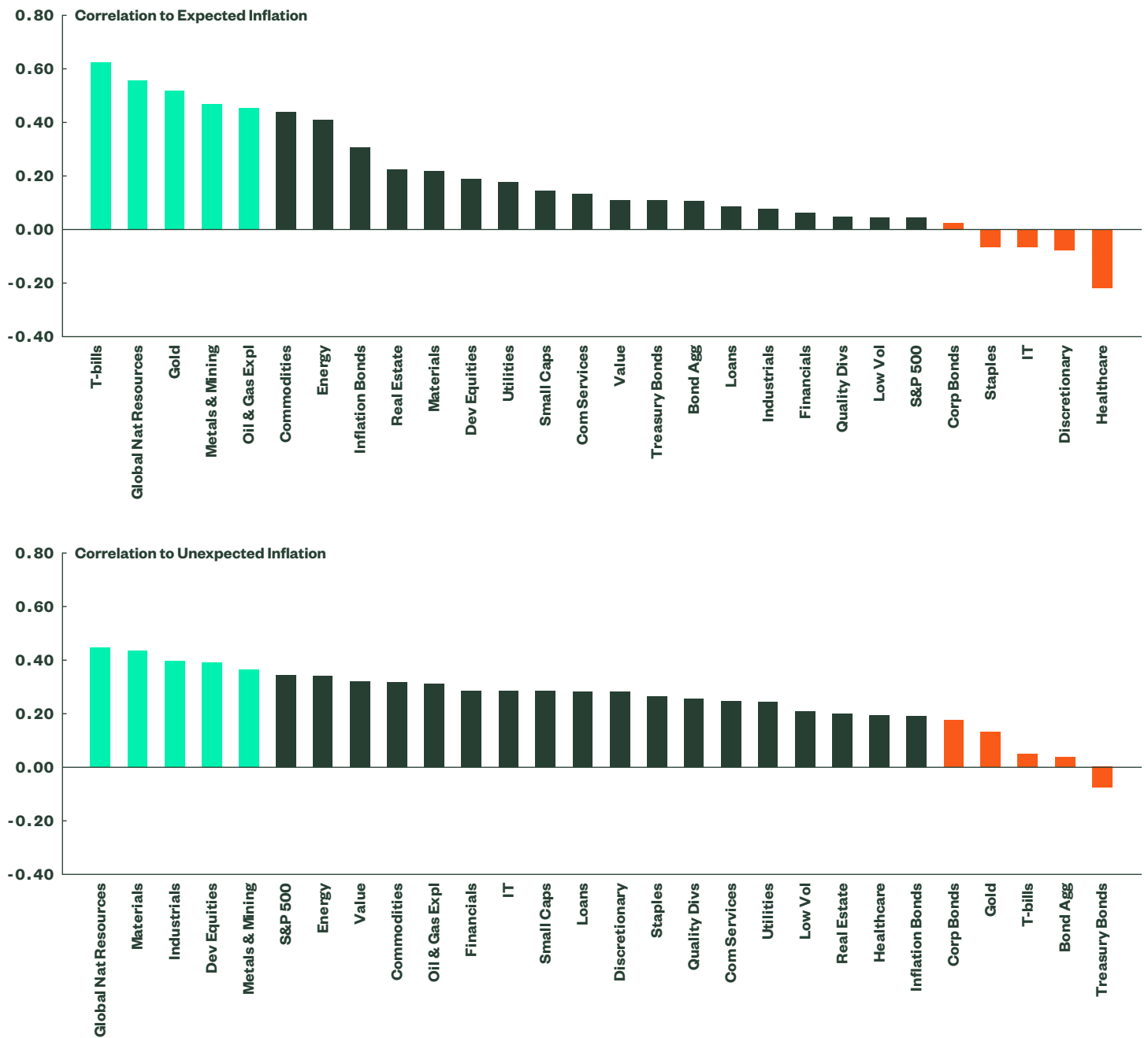
In the previous sections, we established the sensitivity and correlation to inflation as well as the median return for different assets in different headline inflationary regimes. We now proceed to decompose inflation⁸ into expected and unexpected inflation and examine the correlation between different assets and these two types of inflation.

Figure 9 shows that cash and gold correlate well with expected inflation and commodities as well as commodity-linked equities correlate well with both expected and unexpected inflation.

“ Cash covaried strongly with expected inflation while commodities and commodity-themed equities covaried with unexpected inflation.”

Figure 9

Correlation to Expected and Unexpected Inflation



Source: Bloomberg, State Street Global Advisors. Data from June 2001 to July 2021. It is not possible to invest in directly an index. "S&P 500" is represented by the S&P 500 Index. "Dev Equities" is represented by the MSCI World Index, "Small caps" is represented by the Russell 2000 Index, "Energy" is represented by the SS&P 500 Energy Index, "Financials" is represented by the S&P 500 Financials Index, "IT" is represented by the S&P 500 Information Technology Index, "Health" is represented by the S&P 500 Health Care Index, "Metals & Mining" is represented by the S&P 500 Metals and Mining Index, "Oil & Gas Expl" is the S&P 500 Oil & Gas Exploration & Production Select Industry Index, "Industrials" is the S&P 500 Industrials Index, "Materials" is represented by the S&P 500 Materials Index, "Com Services" is represented by the S&P 500 Communication Services Index, "Discretionary" is represented by the S&P 500 Consumer Discretionary Index, "Value" is represented by the MSCI US Value Exposure Select Index, "US Bond Agg" is the Bloomberg Barclays US Aggregate Index, "Gold Spot" is the spot exchange rate of Gold in USD, "Commodities" is represented by the GSCI Total Return Index (USD), "Cash" is represented by the Bloomberg Barclays 1-3 Month U.S. Treasury Bill Index, "Loans" is represented by the S&P/LSTA US Leveraged Loan 100 Index, "Global Nat Resources" is represented by the S&P Global Natural Resources Index. "Corp Bonds" is represented by the Bloomberg Barclays US Corporate Bonds Index, "Inflation Bonds" is represented by the US Government Inflation-linked All Maturities Total Return Index, "Real Estate" is represented by S&P 500 Real Estate Sector Index, "US Treasuries" is represented by the Bloomberg Barclays US Treasury Bond Index. It is not possible to trade an index.

Inflation-Adjusted Return of Investment Exposures Over Longer Holding Periods

Having evaluated which investment exposures had the strongest inflation-hedging capability over shorter periods of time, we then assessed the same exposures over different holding periods. Figure 10 clearly shows that equities outperformed the other asset classes both from a real return perspective and a return persistence perspective (i.e. the regularity at which the exposures outperformed the real return benchmarks). When examining different holding periods, tech and discretionary often beat other assets while cash and commodities lagged.

“ Over longer holding periods, equities reigned supreme in terms of their ability to generate inflation-beating returns.”

Figure 10
Median Real Return
Over Different
Time Horizons

Median Return	12 months ⁹	36 months ¹⁰	48 months ¹¹
Highest	Discretionary 8.90% (64%)	Tech 29.62% (68%)	Tech 37.83% (69%)
Second Highest	Value 8.23% (61%)	Discretionary 26.82% (71%)	Discretionary 34.22% (67%)
Third Highest	Tech 8.14% (63%)	Gold 26.35% (64%)	Gold 32.83% (64%)
Third Lowest	US Treasury Bonds 0.29% (30%)	Cash -5.26% (0%)	Oil & Gas Expl -2.91% (42%)
Second Lowest	Cash -2.43% (2%)	Metals & Mining -7.56% (46%)	Cash -7.37% (0%)
Lowest	Commodities -3.41% (40%)	Commodities -11.55% (25%)	Commodities -27.39% (28%)

Source: Bloomberg, State Street Global Advisors. Data from June 2001 to July 2021. It is not possible to invest in directly an index. "S&P 500" is represented by the S&P 500 Index. "Dev Equities" is represented by the MSCI World Index, "Small caps" is represented by the Russell 2000 Index, "Energy" is represented by the SS&P 500 Energy Index, "Financials" is represented by the S&P 500 Financials Index, "IT" is represented by the S&P 500 Information Technology Index, "Health" is represented by the S&P 500 Health Care Index, "Metals & Mining" is represented by the S&P 500 Metals and Mining Index, "Oil & Gas Expl" is the S&P 500 Oil & Gas Exploration & Production Select Industry Index, "Industrials" is the S&P 500 Industrials Index, "Materials" is represented by the S&P 500 Materials Index, "Com Services" is represented by the S&P 500 Communication Services Index, "Discretionary" is represented by the S&P 500 Consumer Discretionary Index, "Value" is represented by the MSCI US Value Exposure Select Index, "US Bond Agg" is the Bloomberg Barclays US Aggregate Index, "Gold Spot" is the spot exchange rate of Gold in USD, "Commodities" is represented by the GSCI Total Return Index (USD), "Cash" is represented by the Bloomberg Barclays 1-3 Month U.S. Treasury Bill Index, "Loans" is represented by the S&P/LSTA US Leveraged Loan 100 Index, "Global Nat Resources" is represented by the S&P Global Natural Resources Index. "Corp Bonds" is represented by the Bloomberg Barclays US Corporate Bonds Index, "Inflation Bonds" is represented by the US Government Inflation-linked All Maturities Total Return Index, "Real Estate" is represented by S&P 500 Real Estate Sector Index, "US Treasuries" is represented by the Bloomberg Barclays US Treasury Bond Index. It is not possible to trade an index.

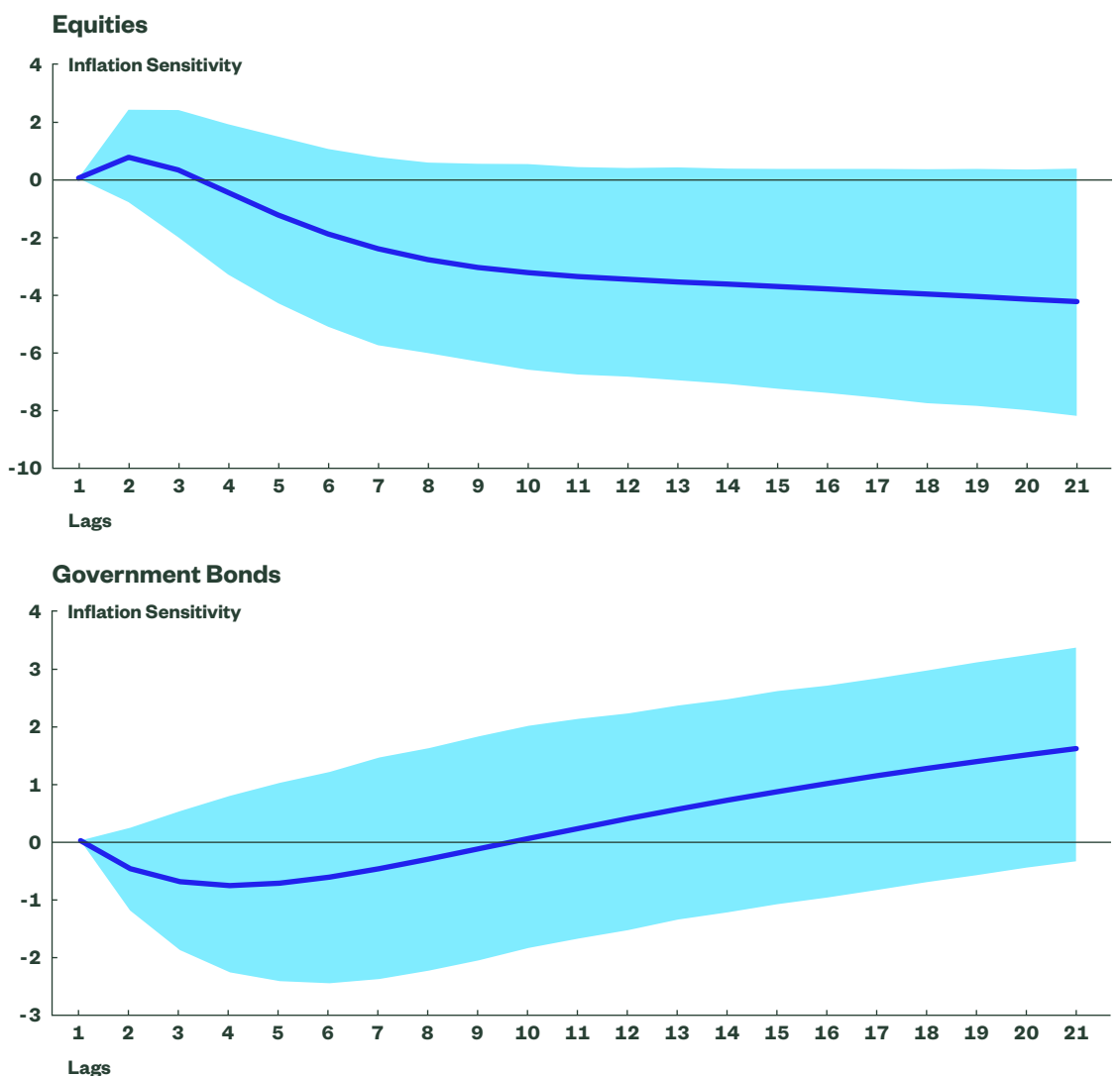
Assessing Inflation Shocks

To assess one-time inflation shocks, we opted to focus mainly on impulse responses, which trace out the impact of a one-off inflation shock on total return, with the other variables held constant.¹² Inflation shocks are defined as a one standard deviation shock to the monthly change in annual inflation. To provide an indication of the uncertainty around parameter estimation, standard error bounds around the response functions, calculated using a bootstrap procedure and 1,000 iterations, are shown. Figure 11 shows the cumulative change in the level of the total return or price index over a 20-year period.

Inflation appears to exhibit some autoregressive properties,¹³ with the effects of a shock lasting for some time. Overall, cash return increased in response to an inflation shock but the increase was gradual and modest. The reason for this may be that cash returns are often determined by monetary policy and real interest rates are targeted by policymakers. In regard to bonds, they initially fell but recovered over the longer run because an inflation shock is likely to lead to higher long-term real yields over the long run, thereby increasing the total return of bonds once the initial effects of the shock are fully taken into consideration.

The behaviour of bonds contrasts starkly with equities, which experienced significant losses shortly after an initial inflation shock but stabilised subsequently. In line with the observations from the researchers at the IMF,¹⁴ it is difficult to make meaningful inferences about the reaction of equities to inflation because the width of the standard error bounds is much wider for equities than for bonds. Cash proved to be a reasonably effective short-term inflation hedge as performance rose after the initial shock but flattened thereafter whereas commodities appeared quite ineffective.

Figure 11
Orthogonal Impulse Response Graph Following an Inflation Shock Over the Last 20 Years



Source: Bloomberg, State Street Global Advisors. Data from June 2001 to July 2021. It is not possible to invest directly in an index. Equities are represented by the S&P 500 Index and "Government Bonds" are represented by the Bloomberg Barclays US Treasury Bond Index. It is not possible to trade an index.

Investment Implications

The investment implications of the analysis in the paper are summarised as follows:

	Shorter-Term Inflation (Monthly)	Longer-Term Inflation	Inflation Shocks
Cash	<ul style="list-style-type: none"> Effective at covering part of the portfolio Some hedging capability against expected inflation 	<ul style="list-style-type: none"> Not effective 	<ul style="list-style-type: none"> Effective over short term horizon following shocks
Equities	<ul style="list-style-type: none"> Generally ineffective (though commodity-themed equities show some hedging potential against both expected and unexpected inflation) 	<ul style="list-style-type: none"> Most effective as most equities managed to beat CPI plus benchmarks across various holding periods 	<ul style="list-style-type: none"> Ineffective
Bonds	<ul style="list-style-type: none"> Generally ineffective (though inflation-linked bonds and senior loans have some inflation-hedging potential, especially expected inflation) 	<ul style="list-style-type: none"> Not effective 	<ul style="list-style-type: none"> Ineffective immediately following the shock
Commodities	<ul style="list-style-type: none"> Effective for both unexpected and expected inflation 	<ul style="list-style-type: none"> Ineffective as commodities generated poor returns over longer periods 	<ul style="list-style-type: none"> Ineffective

**Appendix A:
US Inflation —
Three-State Non-
Switching Variance
Markov Regime**

Dep. Variable:	USCPI	No. Observations:	367
Model:	MarkovRegression	Log Likelihood	1294.244
Date:	Fri, 20 Aug 2021	AIC	-2568.488
Time:	19:48:57	BIC	-2529.434
Sample:	12-31-1990	HQIC	-2552.97
Covariance Type:	approx		

Regime 0 Parameters						
	coef	std err	z	P> z	[0.025	0.975]
const	-0.002	0.001	-1.419	0.156	-0.005	0.001
Regime 1 Parameters						
const	0.0182	0.001	31.817	0	0.017	0.019
Regime 2 Parameters						
const	0.0327	0.001	55.309	0	0.032	0.034
Non-switching parameters						
sigma2	3.81E-05	3.01E-06	12.676	0	3.22E-05	4.40E-05
Regime Transition Parameters						
p[0->0]	0.8924	0.002	447.771	0	0.888	0.896
p[1->0]	0.0106	0.009	1.224	0.221	-0.006	0.028
p[2->0]	0.0043	0.006	0.736	0.461	-0.007	0.016
p[0->1]	0.1076	0.001	155.601	0	0.106	0.109
p[1->1]	0.9559	0.016	57.951	0	0.924	0.988
p[2->1]	0.0282	0.014	1.962	0.05	2.74E-05	0.056

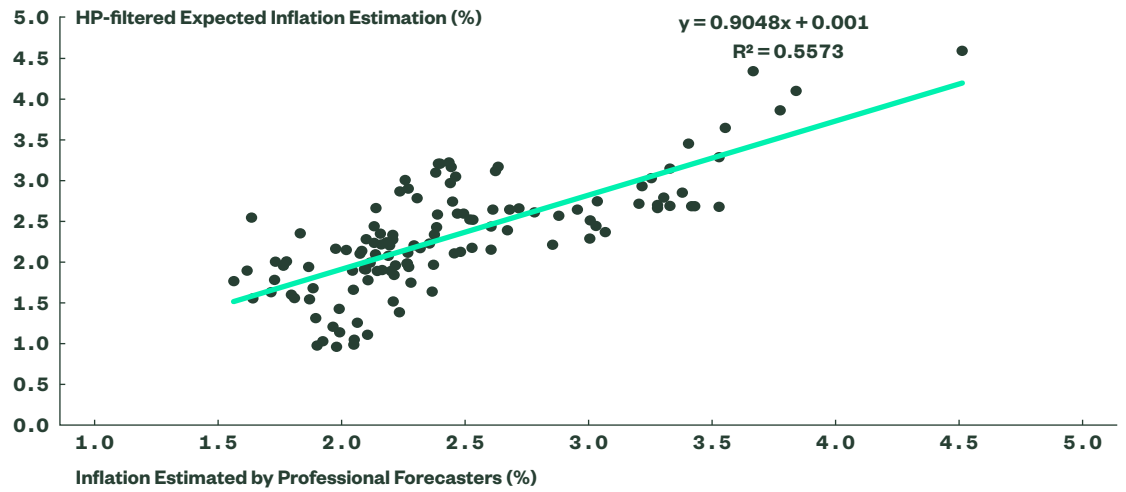
Markov Switching Model Results

Dep. Variable:	USCPI	No. Observations:	367
Model:	MarkovRegression	Log Likelihood	1294.244
Date:	Fri, 20 Aug 2021	AIC	-2568.488
Time:	19:48:57	BIC	-2529.434
Sample:	12-31-1990	HQIC	-2552.97
	-2057		
Covariance Type:	approx		

Regime 0 Parameters						
	coef	std err	z	P> z	[0.025	0.975]
const	-0.002	0.001	-1.419	0.156	-0.005	0.001
Regime 1 Parameters						
const	0.0182	0.001	31.817	0	0.017	0.019
Regime 2 Parameters						
const	0.0327	0.001	55.309	0	0.032	0.034
Non-switching parameters						
sigma2	3.81E-05	3.01E-06	12.676	0	3.22E-05	4.40E-05
Regime Transition Parameters						
p[0->0]	0.8924	0.002	447.771	0	0.888	0.896
p[1->0]	0.0106	0.009	1.224	0.221	-0.006	0.028
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p[1->1]	0.9559	0.016	57.951	0	0.924	0.988
p[2->1]	0.0282	0.014	1.962	0.05	2.74E-05	0.056

Source: Bloomberg, State Street Global Advisors. Data between December 1990 to July 2021.

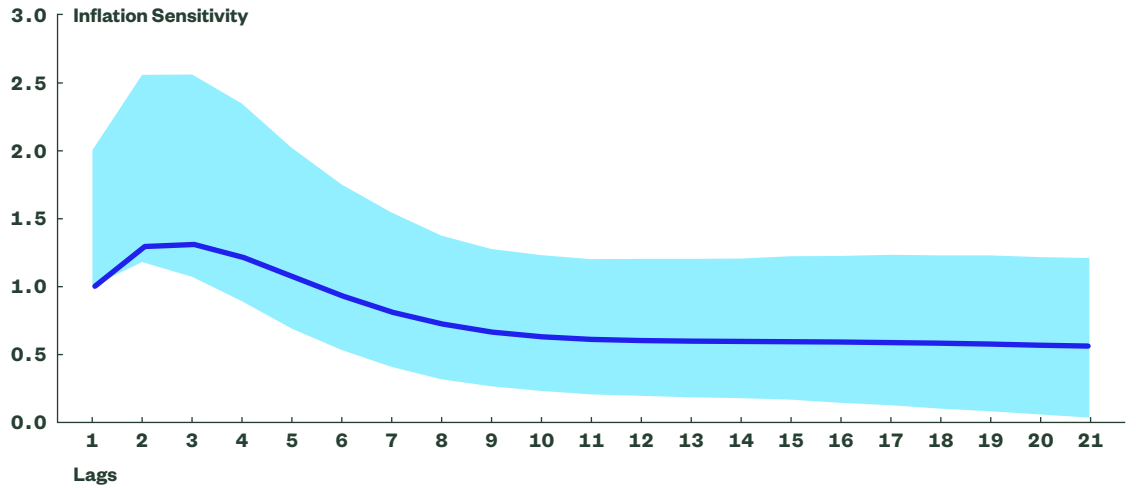
**Appendix B:
Regression Between
Correlation
Estimated by HP-
Filter and Forecasts
Done by Professional
Forecasters**



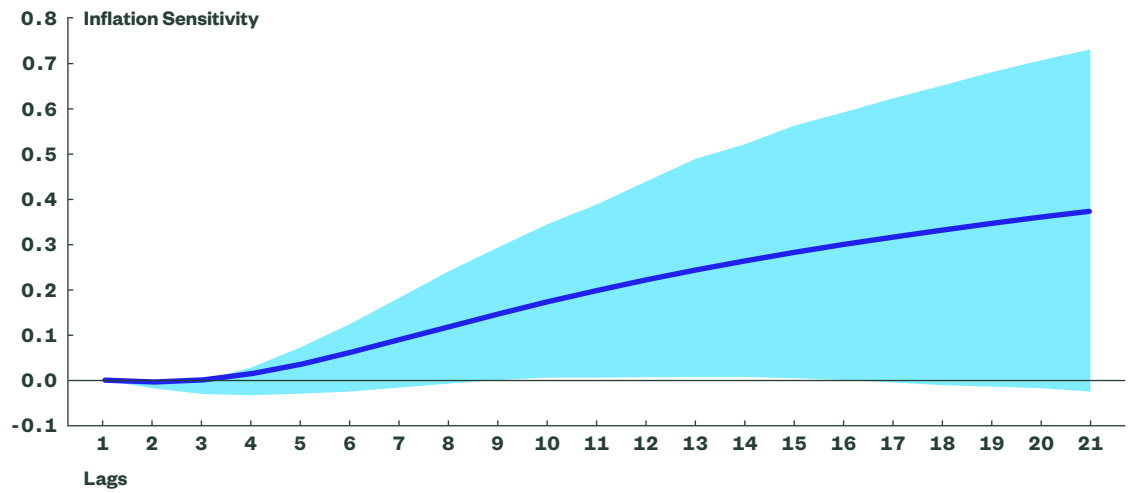
Source: Survey of Professional Forecasters — Federal Reserve Bank Philadelphia. State Street Global Advisors. Data from December 1990 to July 2021. Forecasts are based on certain analyses and assumptions. There is no guarantee that the forecasts will be met.

**Appendix C:
Orthogonal Impulse
Response Graph
Following an Inflation
Shock Over the Last
20 Years**

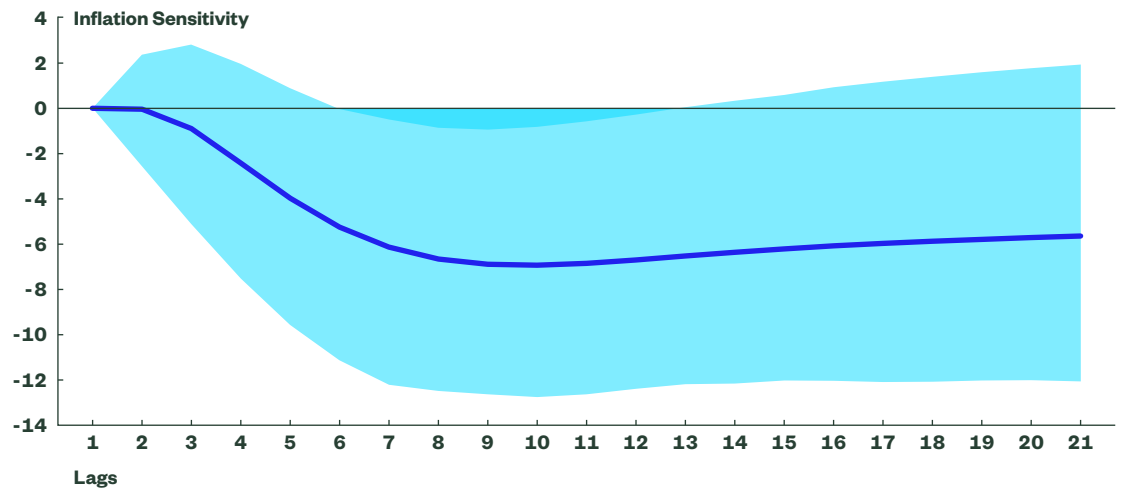
Inflation



Cash



Commodities



Source: Bloomberg, State Street Global Advisors. Data from June 2001 to July 2021. It is not possible to invest directly in an index. "Commod" is represented by the GSCI Total Return Index and "Cash" is represented by "Bloomberg Barclays 1-3 month Treasury Bills Index" rate.

Endnotes

- 1 *A Kernel of Caution in a Robust Recovery*, Global Market Outlook June 2021, State Street Global Advisors.
- 2 Razzak, Weshah, 1997. The Hodrick-Prescott Technique: A Smoother Versus a Filter: An Application to New Zealand GDP. *Economics Letters* 57(2): 163–168.
- 3 Bosse P, 2019. Commodities and short-term TIPS: How each combats unexpected inflation. Vanguard.
- 4 Investing in an asset that has high correlation but low beta to inflation means that it provides good inflation-hedging coverage for that investment alone and does not provide protection for other investments in the portfolio.
- 5 This finding is likely to be different depending on the region in question.
- 6 This analysis is adapted from Bosse (2019), *Commodities and short-term TIPS: How each combats unexpected inflation*, Vanguard.
- 7 A variety of Markov switching models (including switching variance and autoregressive Markov models) were tested and the model that best fit the time series was selected. See Appendix A.
- 8 Inflation is decomposed into its trend and cyclical components using the HP-filter. The expected inflation generated from HP-filter correlates well with the inflation predictions by professional forecasters (see Appendix B).
- 9 Benchmark is CPI+1.5%.
- 10 Benchmark is CPI+3%.
- 11 Benchmark is CPI+4%.
- 12 To isolate an inflation-specific shock, some restrictions need to be imposed on the estimated long-term relationship (“the system”).
- 13 See Appendix C for the rest of the analysis.
- 14 Attilé and Roache (2009), **Inflation Hedging for Long-Term Investors, IMF Working Paper.**

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*Pensions & Investments Research Center, as of December 31, 2020.

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