Insights
Inflation

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How to Beat Inflation: A Europe Case Study

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- Commodities, commodity-themed equities and inflation bonds can partially hedge short-term fluctuations in inflation while equities, especially small caps, 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, outperformance persistence 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 the dynamics of high growth and high inflation will extend to 2022 but that inflation should steadily decline from mid-2022.[1] That being said, the authors also conceded that a key risk to their forecasts is structurally higher inflation engendered by highly accommodative macro policy and rising production costs, among other reasons. 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 conducted the same analysis using European data, 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

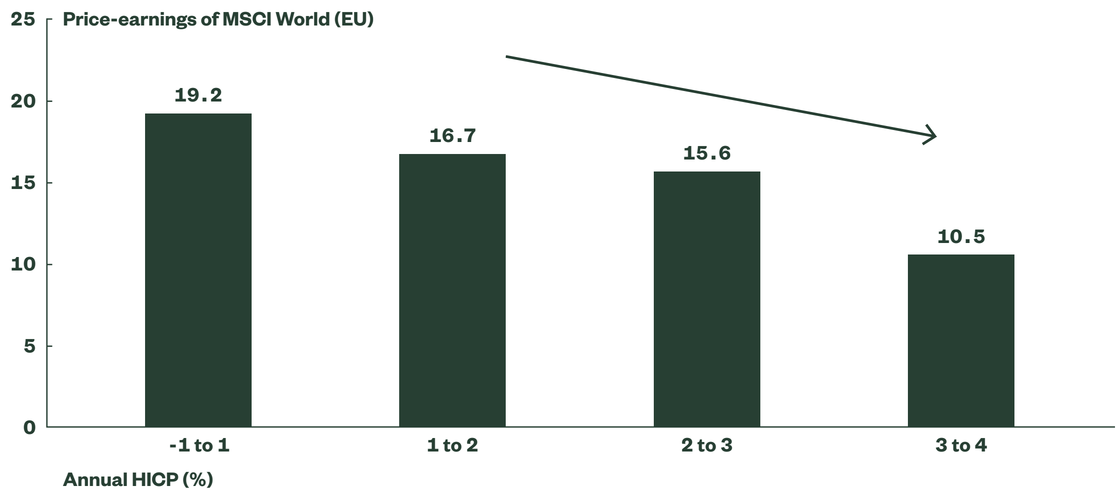
Conventional wisdom suggests that if prices rise across the entire economy, an equity stake in a company should rise since firms should be able to pass on higher costs to consumers. Sure enough, some sectors, being more affected by inflation than others, can directly transfer any price rises to the end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

In recent years, inflation has been largely muted but it may have 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 stay at extremely high levels for a prolonged period of time 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 suggests that the price-earnings ratio of European stocks gradually dropped as inflation went up. 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.

> **“Analysis suggests that the price-earnings ratio of European companies fell as inflation rose.”**

Figure 1
Median MSCI EMU Price-Earnings Ratio Across Different Inflationary Environments



Source: Datastream, Bloomberg, State Street Global Advisors. Data from April 1998 to October 2021.

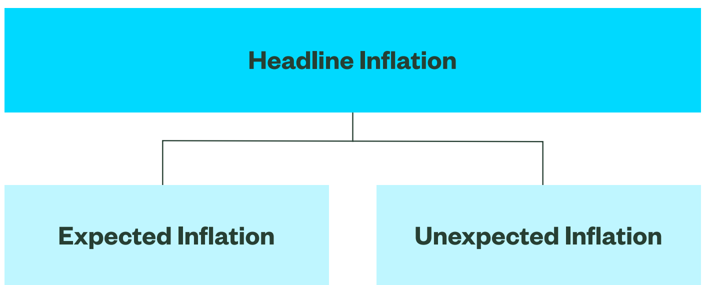
Defining Inflation, Expected Inflation and Unexpected Inflation

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 Harmonised Index of Consumer Prices (HICP), which is a measure of price change of consumer goods and services purchased by euro area households.

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 2).

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 2
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

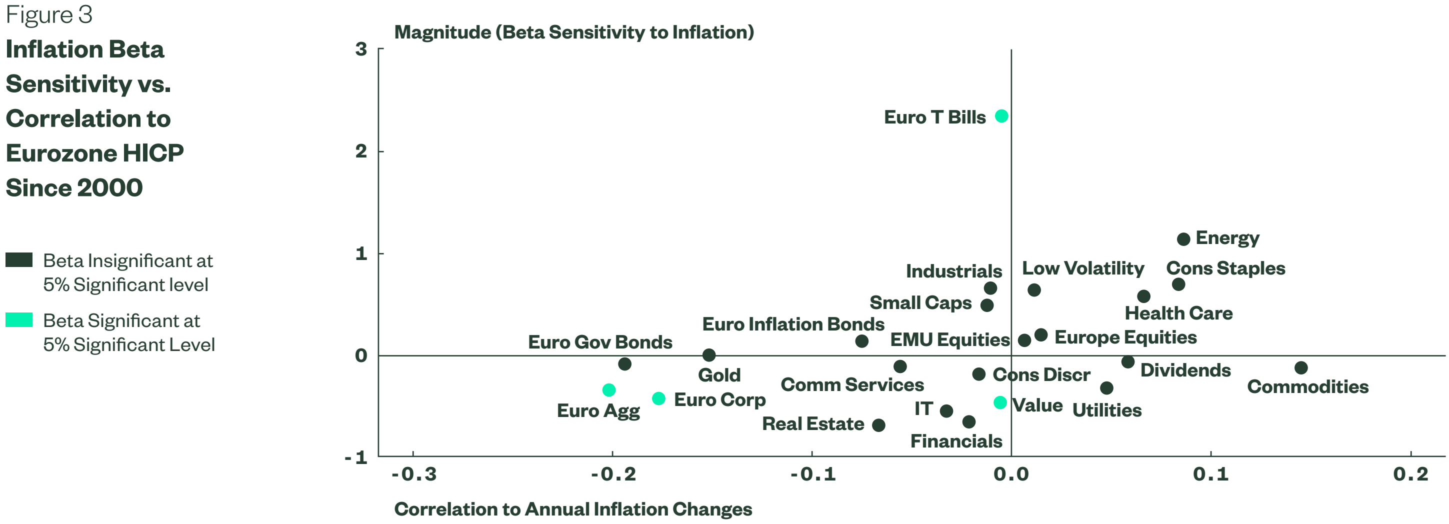
To understand whether an investment exposure can potentially hedge against inflation, we need to look at its correlation with inflation to determine whether they both generally move in the same direction. We also consider sensitivity to inflation (the inflation beta), which provides a magnitude of an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

On a headline inflation basis, commodities and commodity-sensitive equity sectors and cash (Euro T-bills) historically displayed the strongest, yet somewhat inconsistent, correlation with inflation but did not have statistically significant beta sensitivity to it (Figure 3).[5] In the case of commodities, its relatively higher correlation with inflation 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 a significant portion of the European inflation basket, are naturally significant drivers of inflation (Figure 4).

As for cash (Euro T-bills), it is not particularly strongly correlated to inflation but has the highest sensitivity to it over the entire period, among all the assets under consideration. This is in stark contrast with the US where cash is relatively strongly correlated with inflation.

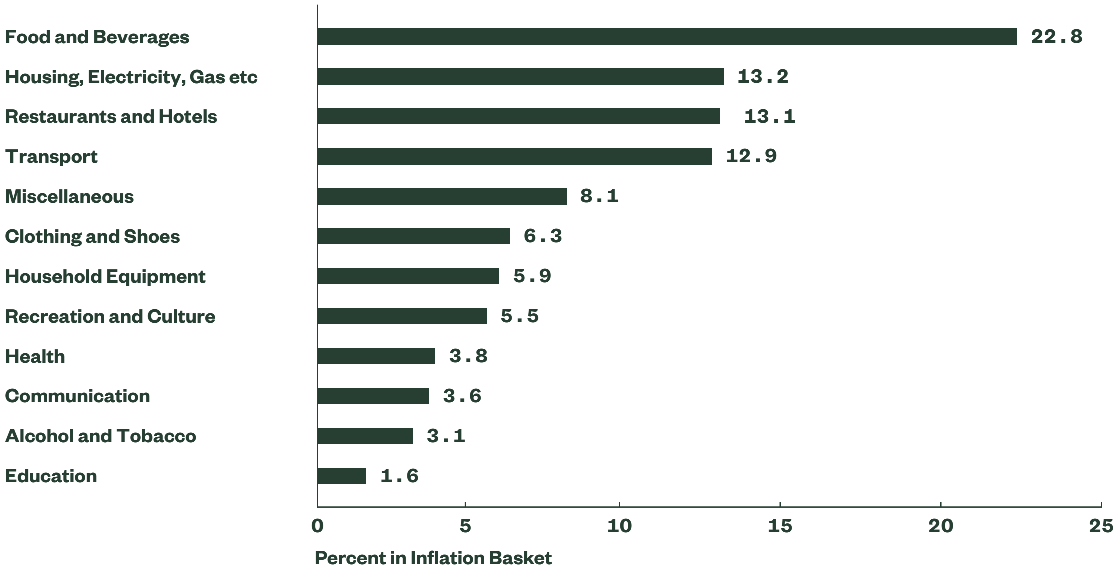
Figure 3

Inflation Beta Sensitivity vs. Correlation to Eurozone HICP Since 2000



Source: Bloomberg, State Street Global Advisors. Data from December 2001 to October 2021. It is not possible to invest in directly an index. "Europe equities" is represented by the MSCI Europe Index. "EMU equities" is represented by the MSCI EMU Index, "Value" is represented by the MSCI Europe Value Exposure Select Index, "Euro Agg" is represented by the Bloomberg Barclays Euro Aggregate index, "Euro Corp" is represented by the Bloomberg Barclays Euro Corporate Bond Index, "Gold Spot" is the spot exchange rate of Gold in EUR, "Euro Gov" is represented by Bloomberg Barclays Euro Treasuries Index, "Commodities" is represented by the GSCI Total Return Index (EUR), "Real Estate" is represented by the FTSE EPRA/NAREIT Developed Europe ex UK Index, "Energy" is represented by the MSCI Europe Energy Index, "Financials" is represented by the MSCI Europe Financials Index, "IT" is represented by the MSCI Europe Information Technology Index, "Health care" is represented by the MSCI Europe Health Care Index, "Industrials" is the MSCI Europe Industrials Index, "Materials" is represented by the MSCI Europe Materials Index, "Com Services" is represented by the MSCI Europe Communication Services Index, "Discretionary" is represented by the MSCI Europe Consumer Discretionary Index, "Low Volatility" is represented by the EURO STOXX Low Risk Weighted 100 Index, "Small caps" is represented by the MSCI Europe Small Cap index, "Dividends" is represented by the S&P Euro Dividend Aristocrats Index, "Inflation-linked bonds" is the ICE BoA Inflation-linked Government Index, "Euro T-bills" is the ICE BoA Euro Treasury Bill Index.

Figure 4
Eurozone HCPI Basket in 2021



Source: Instituto Nacional de Estadística, as of October 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.”**

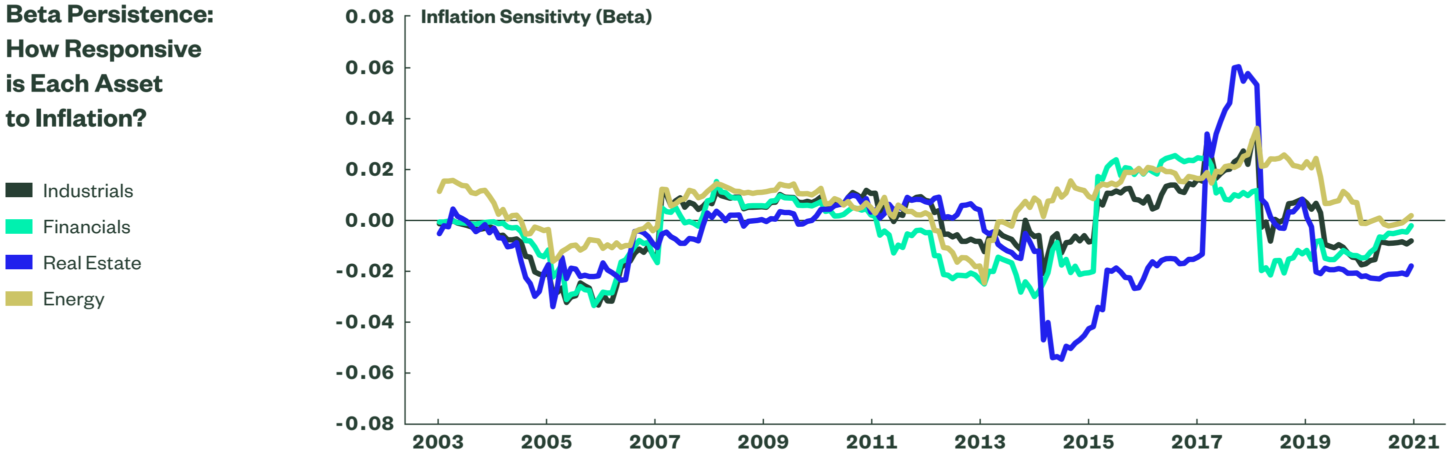
Figure 5 shows that equities tended to go through cycles of highly positive and highly negative beta. In the short run, equities overall did not offer any level of consistent sensitivity to inflation. In terms of fixed income, Euro government bonds often displayed negative sensitivity to beta, whereas inflation-linked bonds experienced inconsistent inflation sensitivity. In terms of gold and commodities, the former's sensitivity to inflation was generally negative whereas the latter's sensitivity to inflation was largely positive.

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.

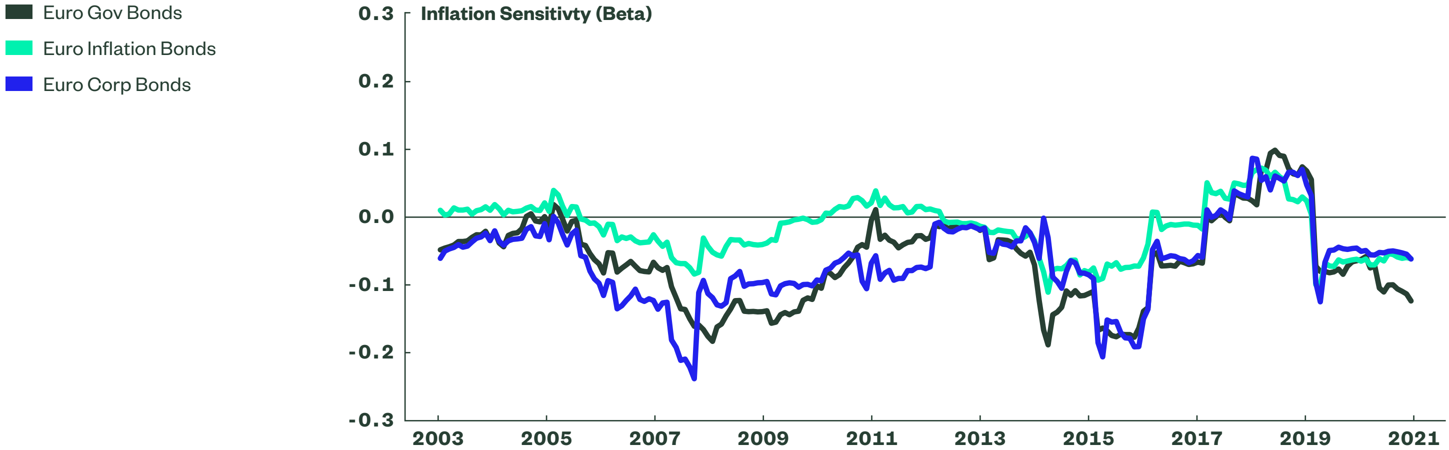
Figure 5

Beta Persistence: How Responsive is Each Asset to Inflation?

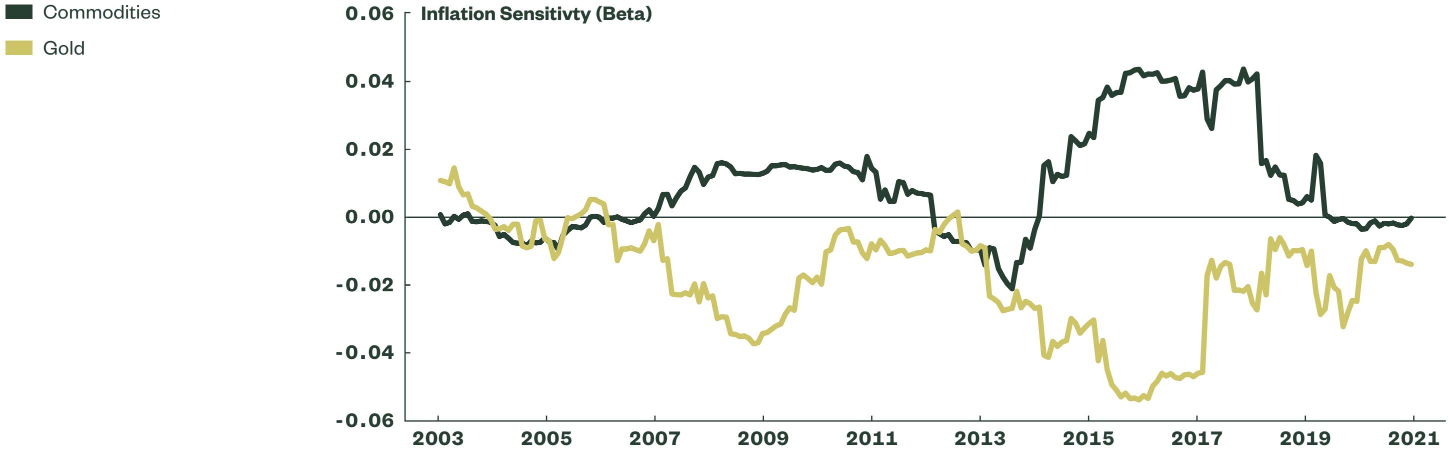
Equities



Fixed Income



Others



Source: Bloomberg, State Street Global Advisors. Data from December 2003 to October 2021. It is not possible to invest in directly an index. "Euro Corp" is represented by the Bloomberg Barclays Euro Corporate Bond Index, "Gold Spot" is the spot exchange rate of Gold in EUR, "Euro Gov" is represented by Bloomberg Barclays Euro Treasuries Index, "Commodities" is represented by the GSCI Total Return Index (EUR), "Energy" is represented by the MSCI Europe Energy Index, "Financials" is represented by the MSCI Europe Financials Index, "Industrials" is the MSCI Europe Industrials Index, "Inflation-linked bonds" is the ICE BoA Inflation-linked Government Index, "Real Estate" is represented by the FTSE EPRA/NAREIT Developed Europe ex UK 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 6), and studied the median return of these assets as well as their correlation to inflation in each of the regimes.

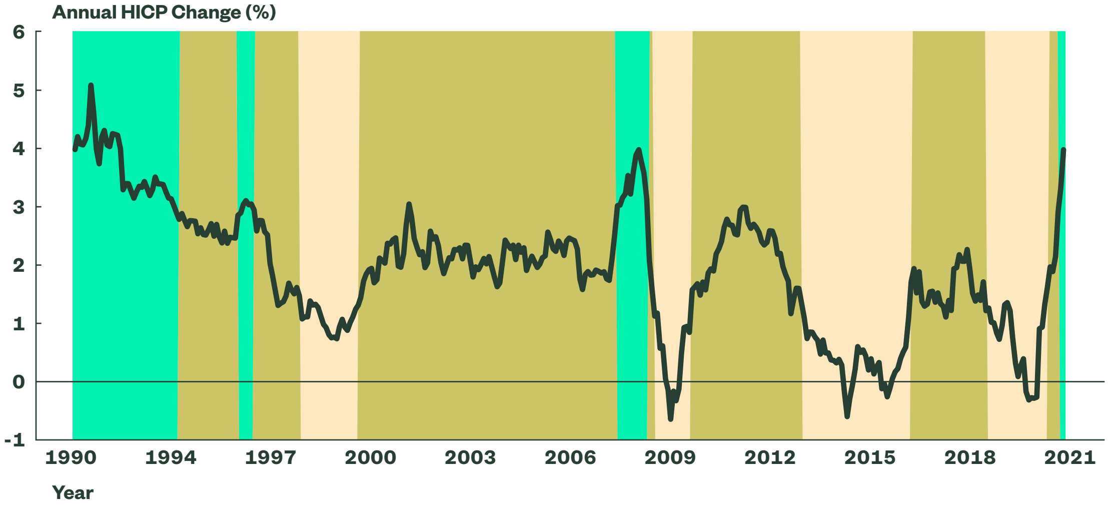
Currently, we are in the high inflation regime. The results are shown in Figure 7. In the low inflation regime, there appears to be little relationship between an asset's correlation with inflation and its median return. In this regime, many types of equities and bonds fared reasonably well.

> **"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, inflation bonds and gold) 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 6
Markov Three-State Regime of Annual Inflation

- Annual Inflation
- High Inflation (average inflation = 3.55%, 15.8% of all observations)
- Medium Inflation (average inflation = 2.09%, 56.9% of all observations)
- Low Inflation (Average inflation = 0.58%, 27.2% of all observations)



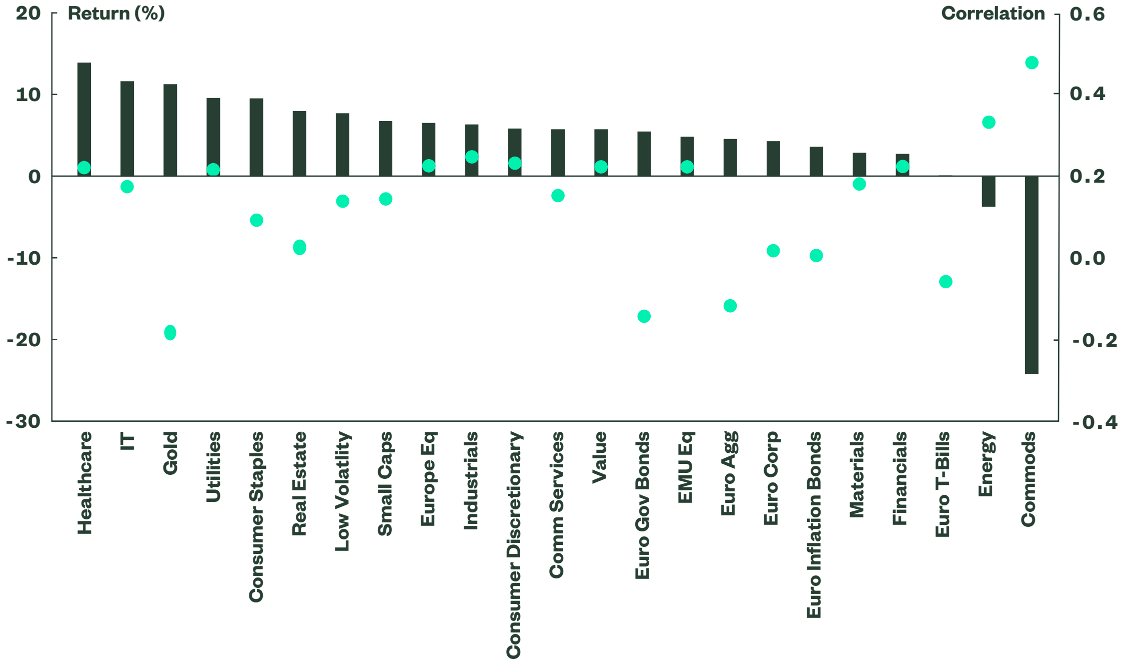
Source: Bloomberg, State Street Global Advisors. Data between December 1990 and October 2021.

Figure 7

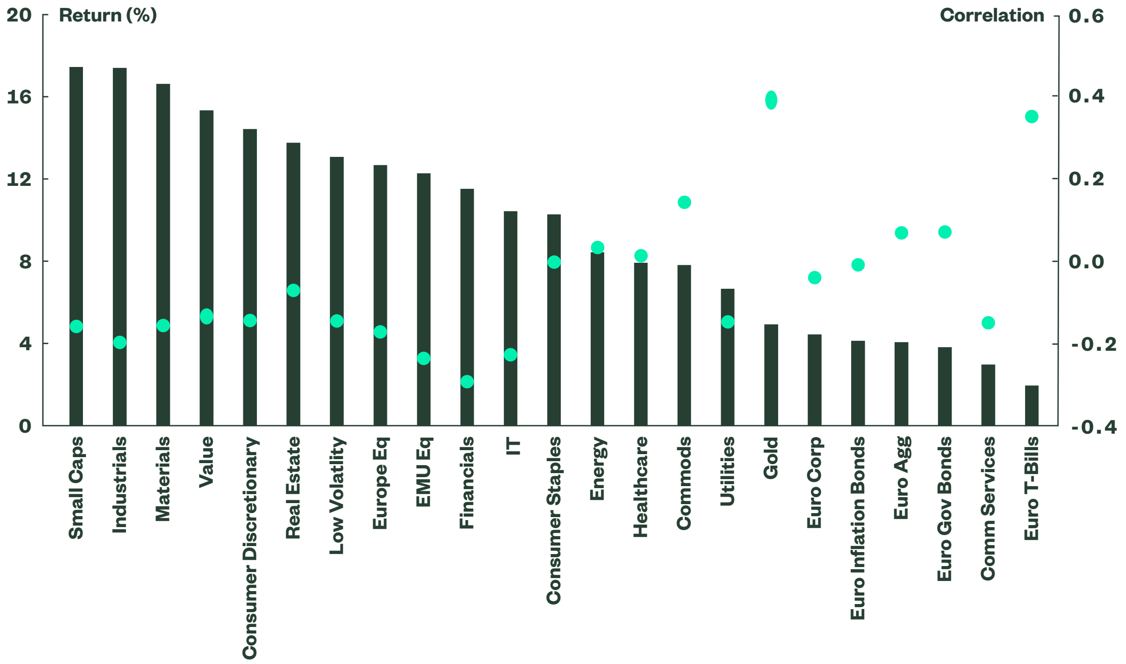
Historical Performance of Select Investments Based on Different Inflation Regimes, Sorted by Their Median Return

Median Return
Correlation

Low Inflation

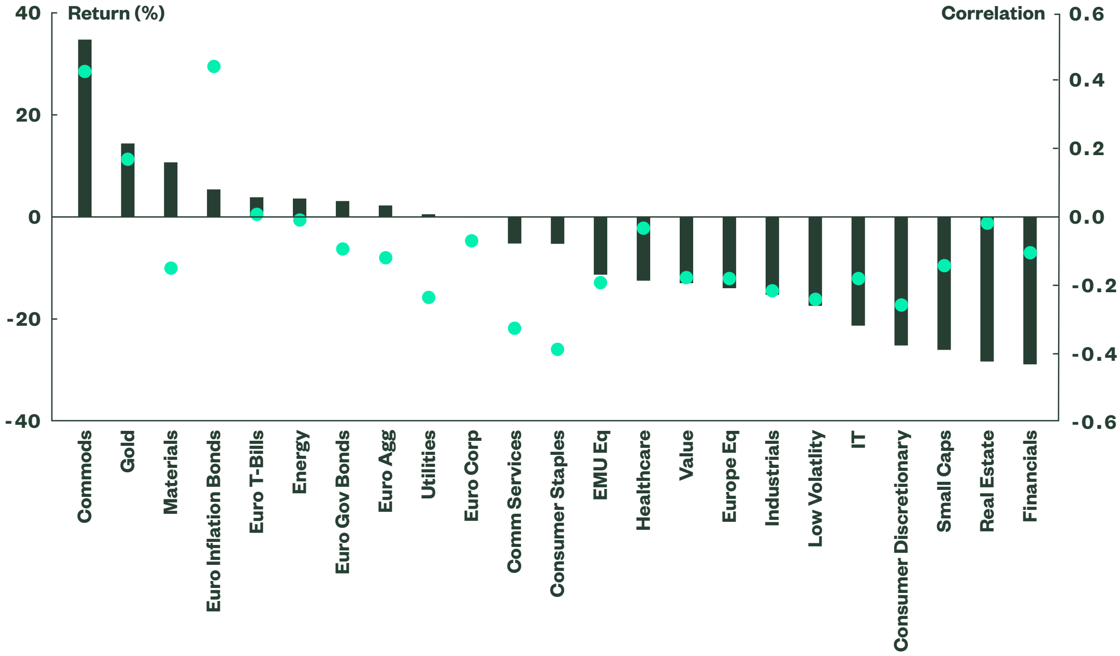


Medium Inflation



Source: Bloomberg, State Street Global Advisors. Data from December 2001 to October 2021. It is not possible to invest in directly an index. "Europe equities" is represented by the MSCI Europe Index. "EMU equities" is represented by the MSCI EMU Index, "Value is represented by the MSCI Europe Value Exposure Select Index, "Euro Agg" is represented by the Bloomberg Barclays Euro Aggregate index, "Euro Corp" is represented by the Bloomberg Barclays Euro Corporate Bond Index, "Gold Spot" is the spot exchange rate of Gold in EUR, "Euro Gov" is represented by Bloomberg Barclays Euro Treasuries Index, "Commodities" is represented by the GSCI Total Return Index (EUR), "Real Estate" is represented by the FTSE EPRA/NAREIT Developed Europe ex UK Index, "Energy" is represented by the MSCI Europe Energy Index, "Financials" is represented by the MSCI Europe Financials Index, "IT" is represented by the MSCI Europe Information Technology Index, "Health care" is represented by the MSCI Europe Health Care Index, "Industrials" is the MSCI Europe Industrials Index, "Materials" is represented by the MSCI Europe Materials Index, "Com Services" is represented by the MSCI Europe Communication Services Index, "Discretionary" is represented by the MSCI Europe Consumer Discretionary Index, "Low Volatility" is represented by the EURO STOXX Low Risk Weighted 100 Index, "Small caps" is represented by the MSCI Europe Small Cap index, "Dividends" is represented by the S&P Euro Dividend Aristocrats Index, "Inflation-linked bonds" is the ICE BoA Inflation-linked Government Index, "Euro T-bills" is the ICE BoA Euro Treasury Bill 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 December 2001 to October 2021. It is not possible to invest in directly an index. "Europe equities" is represented by the MSCI Europe Index. "EMU equities" is represented by the MSCI EMU Index, "Value is represented by the MSCI Europe Value Exposure Select Index, "Euro Agg" is represented by the Bloomberg Barclays Euro Aggregate index, "Euro Corp" is represented by the Bloomberg Barclays Euro Corporate Bond Index, "Gold Spot" is the spot exchange rate of Gold in EUR, "Euro Gov" is represented by Bloomberg Barclays Euro Treasuries Index, "Commodities" is represented by the GSCI Total Return Index (EUR), "Real Estate" is represented by the FTSE EPRA/NAREIT Developed Europe ex UK Index, "Energy" is represented by the MSCI Europe Energy Index, "Financials" is represented by the MSCI Europe Financials Index, "IT" is represented by the MSCI Europe Information Technology Index, "Health care" is represented by the MSCI Europe Health Care Index, "Industrials" is the MSCI Europe Industrials Index, "Materials" is represented by the MSCI Europe Materials Index, "Com Services" is represented by the MSCI Europe Communication Services Index, "Discretionary" is represented by the MSCI Europe Consumer Discretionary Index, "Low Volatility" is represented by the EURO STOXX Low Risk Weighted 100 Index, "Small caps" is represented by the MSCI Europe Small Cap index, "Dividends" is represented by the S&P Euro Dividend Aristocrats Index, "Inflation-linked bonds" is the ICE BoA Inflation-linked Government Index, "Euro T-bills" is the ICE BoA Euro Treasury Bill 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

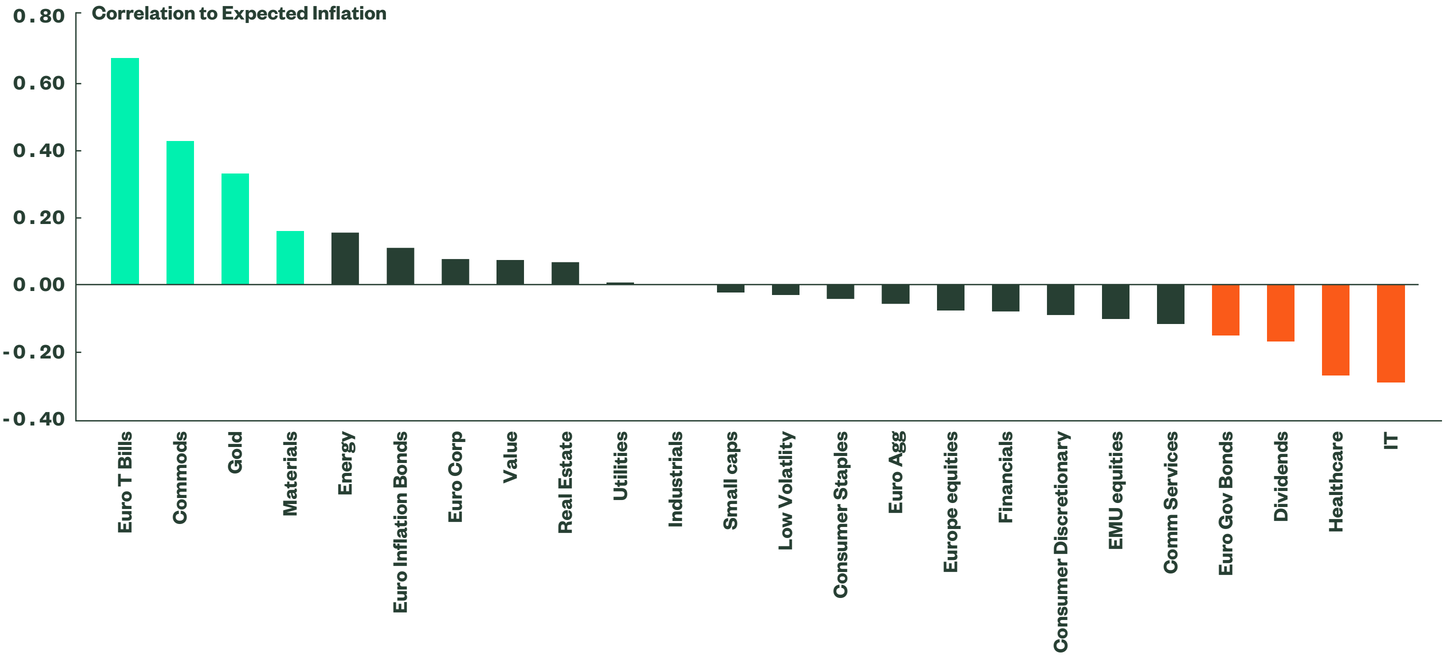
In the previous sections, we established the sensitivity and correlation to inflation as well as the median return for different assets in different headline inflationary regimes. We now proceed to decompose inflation[8] into expected and unexpected inflation and examine the correlation between different assets and these two types of inflation.

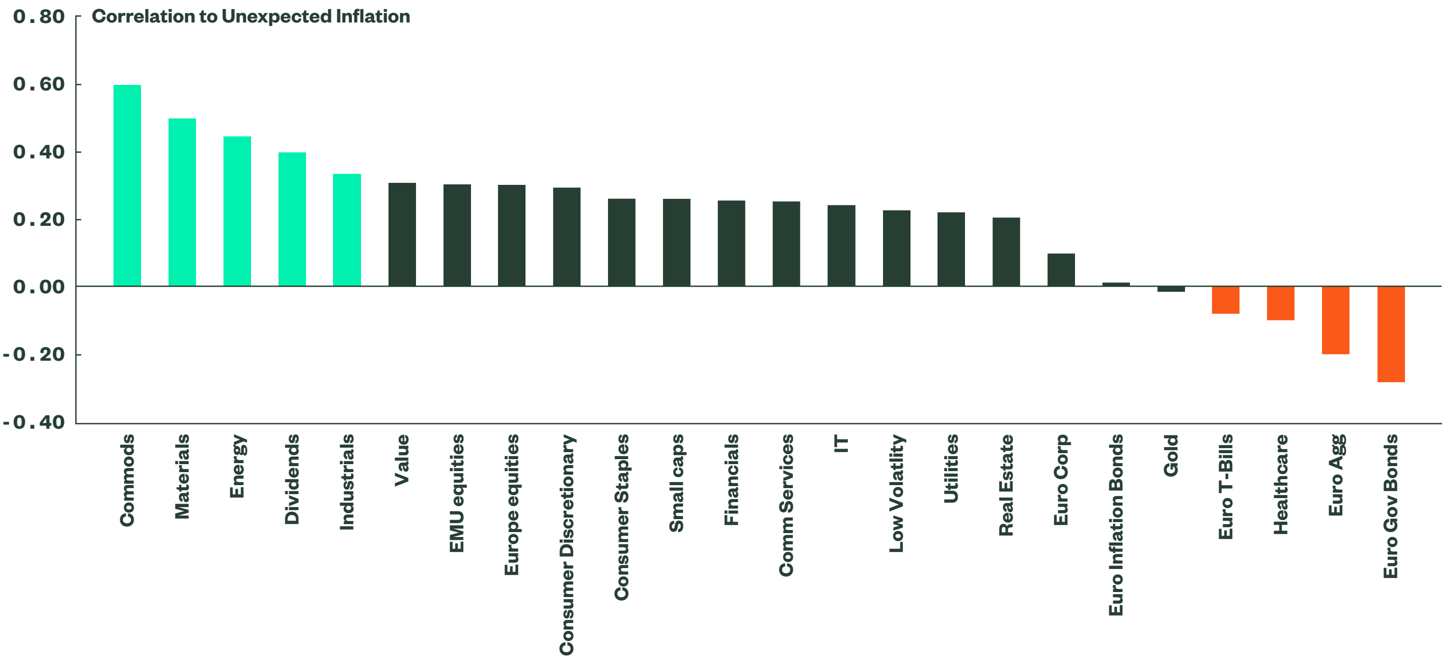
Figure 8 shows that cash (Euro T-bills) and gold correlate well with expected inflation and commodities as well as commodity-linked equities correlate well with both expected and unexpected inflation.

> **"Cash covaried strongly with expected inflation while commodities and commodity-themed equities covaried with unexpected inflation."**

Figure 8

Correlation to Expected and Unexpected Inflation





Source: Bloomberg, State Street Global Advisors. Data from December 2001 to October 2021. It is not possible to invest in directly an index. “Europe equities” is represented by the MSCI Europe Index. “EMU equities” is represented by the MSCI EMU Index, “Value” is represented by the MSCI Europe Value Exposure Select Index, “Euro Agg” is represented by the Bloomberg Barclays Euro Aggregate index, “Euro Corp” is represented by the Bloomberg Barclays Euro Corporate Bond Index, “Gold Spot” is the spot exchange rate of Gold in EUR, “Euro Gov” is represented by Bloomberg Barclays Euro Treasuries Index, “Commodities” is represented by the GSCI Total Return Index (EUR), “Real Estate” is represented by the FTSE EPRA/NAREIT Developed Europe ex UK Index, “Energy” is represented by the MSCI Europe Energy Index, “Financials” is represented by the MSCI Europe Financials Index, “IT” is represented by the MSCI Europe Information Technology Index, “Health care” is represented by the MSCI Europe Health Care Index, “Industrials” is the MSCI Europe Industrials Index, “Materials” is represented by the MSCI Europe Materials Index, “Com Services” is represented by the MSCI Europe Communication Services Index, “Discretionary” is represented by the MSCI Europe Consumer Discretionary Index, “Low Volatility” is represented by the EURO STOXX Low Risk Weighted 100 Index, “Small caps” is represented by the MSCI Europe Small Cap index, “Dividends” is represented by the S&P Euro Dividend Aristocrats Index, “Inflation-linked bonds” is the ICE BoA Inflation-linked Government Index, “Euro T-bills” is the ICE BoA Euro Treasury Bill Index. It is not possible to trade an 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 9 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, small caps often beat other assets while cash (Euro T-bills) and commodities lagged.

> **"Over longer holding periods, equities (particularly small caps) reigned supreme in terms of their ability to generate inflation-beating returns."**

Figure 9
Median Real Return Over Different Time Horizons

Median Inflation-Benchmark Excess Return	12 months[9]	36 months[10]	48 months[11]
Highest	Small Caps 11.39% (64.17%)	Consumer Staples 21.39% (65.3%)	Small Caps 35.86% (71%)
Second Highest	Industrials 10.38% (62.5%)	Small Caps 20.93% (73.6%)	Real Estate 31.56% (70.5%)
Third Highest	Consumer Discretionary 8.19% (59.2%)	Real Estate 19.78% (69.4%)	Tech 29.10% (61.5%)
Third Lowest	Euro Corp 0.62% (30%)	Financials 1.56% (40%)	EU Inflation Bonds 4.08% (30.5%)
Second Lowest	Euro T-bills -1.72% (2.92%)	Euro T-Bills -3.49% (0%)	Euro T-Bills -4.12% (0%)
Lowest	Commodities -3.6% (41.25%)	Commodities -12.16% (23.61%)	Commodities -35.58% (24.5%)

Source: Bloomberg, State Street Global Advisors. Data from December 2001 to October 2021. It is not possible to invest in directly an index. "Europe equities" is represented by the MSCI Europe Index. "EMU equities" is represented by the MSCI EMU Index, "Value" is represented by the MSCI Europe Value Exposure Select Index, "Euro Agg" is represented by the Bloomberg Barclays Euro Aggregate index, "Euro Corp" is represented by the Bloomberg Barclays Euro Corporate Bond Index, "Gold Spot" is the spot exchange rate of Gold in EUR, "Euro Gov" is represented by Bloomberg Barclays Euro Treasuries Index, "Commodities" is represented by the GSCI Total Return Index (EUR), "Real Estate" is represented by the FTSE EPRA/NAREIT Developed Europe ex UK Index, "Energy" is represented by the MSCI Europe Energy Index, "Financials" is represented by the MSCI Europe Financials Index, "IT" is represented by the MSCI Europe Information Technology Index, "Health care" is represented by the MSCI Europe Health Care Index, "Industrials" is the MSCI Europe Industrials Index, "Materials" is represented by the MSCI Europe Materials Index, "Com Services" is represented by the MSCI Europe Communication Services Index, "Discretionary" is represented by the MSCI Europe Consumer Discretionary Index, "Low Volatility" is represented by the EURO STOXX Low Risk Weighted 100 Index, "Small caps" is represented by the MSCI Europe Small Cap index, "Dividends" is represented by the S&P Euro Dividend Aristocrats Index, "Inflation-linked bonds" is the ICE BoA Inflation-linked Government Index, "Euro T-bills" is the ICE BoA Euro Treasury Bill Index. It is not possible to trade an index.

Assessing Inflation Shocks

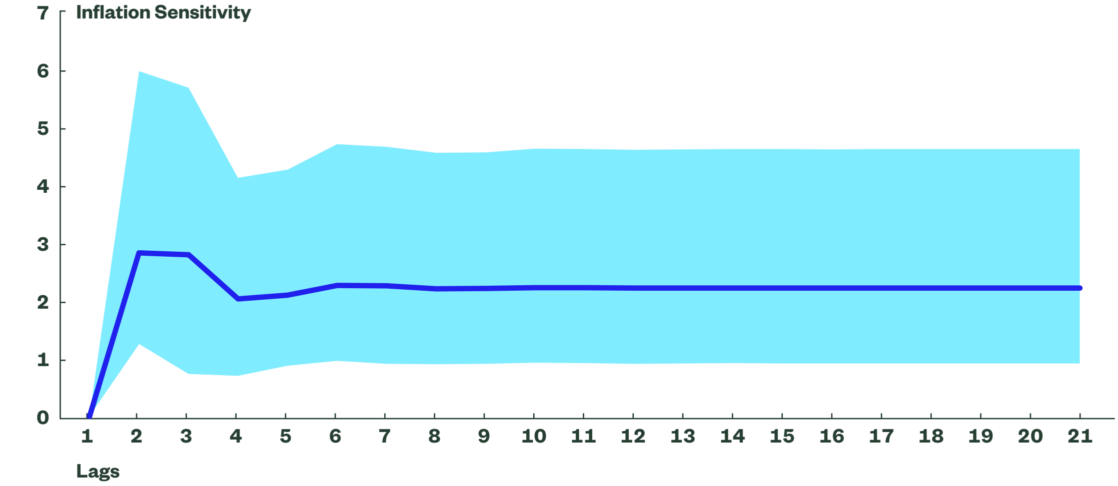
To assess one-time inflation shocks, we opted to focus mainly on impulse responses, which trace out the impact of a one-off inflation shock on total return, with the other variables held constant.[12] Inflation shocks are defined as a one standard deviation shock to the monthly change in annual inflation. 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 10 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. In Europe, the sensitivity of cash (Euro T-bills) to inflation decreased in response to an inflation shock and remained negative. This stands in stark contrast with the US where the cash return increased following an inflation shock even though the increase was gradual and modest.

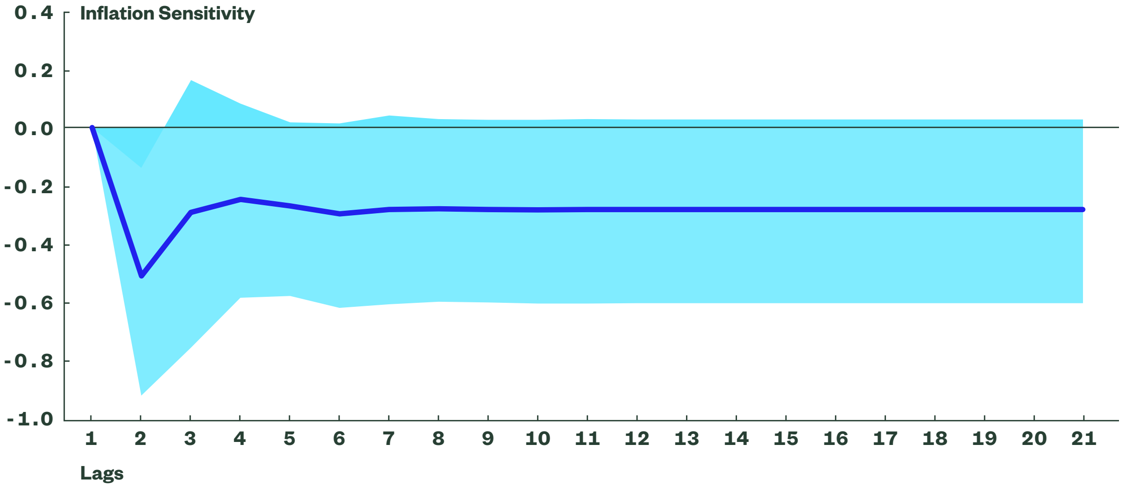
The behaviour of bonds contrasts starkly with equities, which experienced gains shortly after an initial inflation shock but stabilised subsequently. This contrasts markedly with the US where equities experienced significant losses shortly after an initial inflation shock and does not align with the observations from the researchers at the IMF.[14] Nevertheless, 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. Equities and commodities appeared to be a reasonably effective short-term inflation hedge as performance rose after the initial shock.

Figure 10
Orthogonal Impulse Response Graph Following an Inflation Shock Over the Last 20 Years

Equities



Government Bonds



Source: Bloomberg, State Street Global Advisors. Data from June 2001 to October 2021. It is not possible to invest directly in an index. Equities are represented by the MSCI EMU Index and "Government Bonds" are represented by the Bloomberg Barclays Euro Government 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 (Euro T-bills)	• Effective for expected inflation	• Not effective	• Not effective
Equities	• Generally not effective (though commodity-themed equities show some hedging potential against both expected and unexpected inflation)	• Most effective as most equities (especially small caps) managed to beat HICP plus benchmarks across various holding periods	• Effective over the short time horizon following shocks
Bonds	• Generally not effective (though inflation-linked bonds have some inflation-hedging potential, especially expected inflation)	• Not effective	• Not effective
Commodities	• Effective for both unexpected and expected inflation	• Not effective as commodities generated poor returns over longer periods	• Effective over the short time horizon following shocks

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

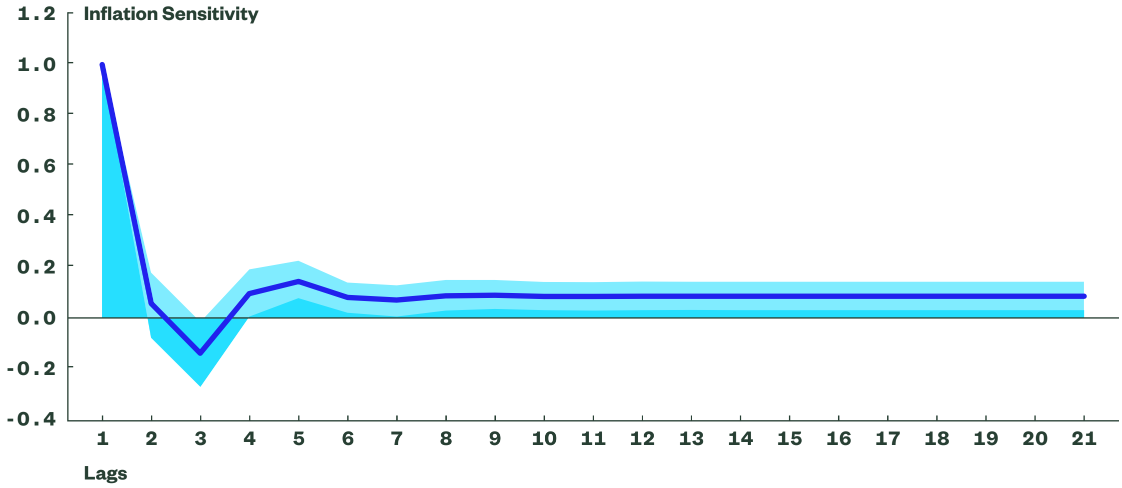
Dep. Variable:	EUCPI	**No. Observations:**	371
Model:	MarkovRegression	**Log Likelihood**	1407.228
Date:	Wed, 17 Nov 2021	**AIC**	-2794.456
Time:	13:50:05	**BIC**	-2755.294
Sample:	12/31/1990	**HQIC**	-2778.902
Covariance Type:	-2060		

Regime 0 Parameters						
	coef	**std err**	**z**	**P>|z|**	**[0.025**	**0.975]**
const	0.58%	0.001	10.471	0	0.005	0.007
Regime 1 Parameters						
const	2.09%	0	48.362	0	0.02	0.022
Regime 2 Parameters						
const	3.55%	0.001	38.988	0	0.034	0.037
Non-switching parameters						
sigma2	2.29E-05	1.77E-06	12.905	0	1.94E-05	2.64E-05
Regime Transition Parameters						
p[0->0]	0.9562	0.001	1093.34	0	0.954	0.958
p[1->0]	0.0182	0.009	2	0.046	0	0.036
p[2->0]	3.04E-15	nan	nan	nan	nan	nan
p[0->1]	0.0438	0	155.437	0	0.043	0.044
p[1->1]	0.9645	0.013	73.635	0	0.939	0.99
p[2->1]	0.037	0.025	1.476	0.14	-0.012	0.086

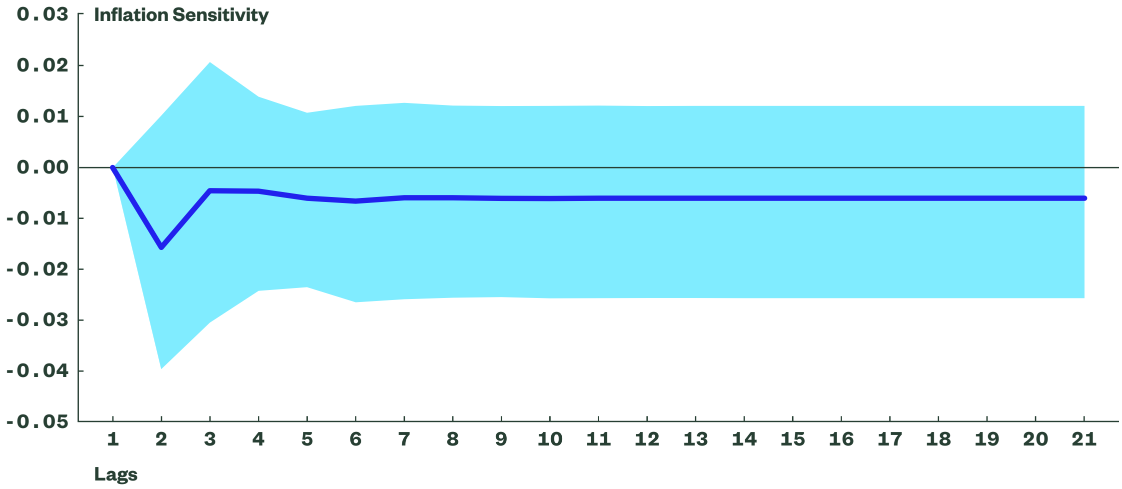
Source: Bloomberg, State Street Global Advisors. Data between December 1990 to July 2021.

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

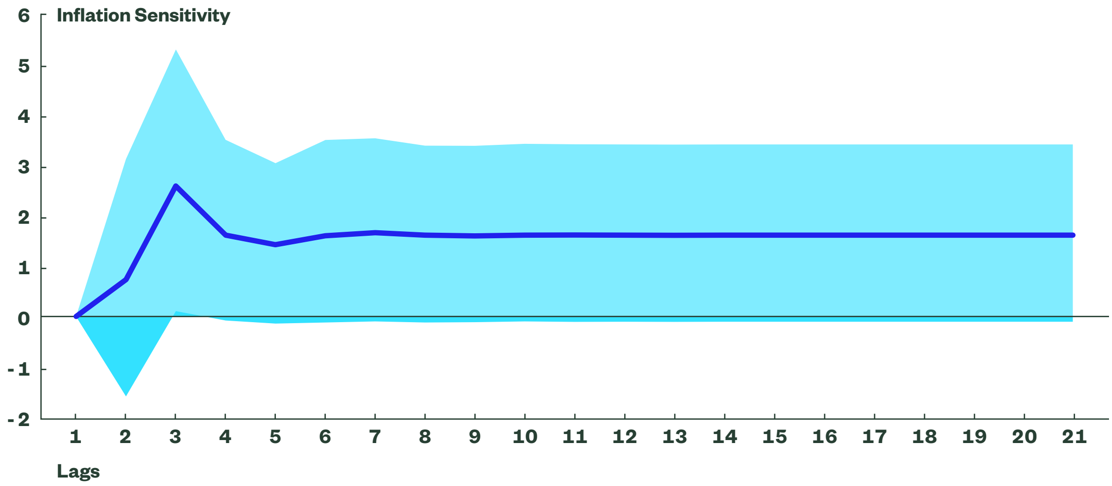
Inflation



Cash (Euro T-bills)



Commodities



Source: Bloomberg, State Street Global Advisors. Data from June 2001 to October 2021. It is not possible to invest directly in an index. “Commods” is represented by the GSCI Total Return Index (EUR) and “Cash” is represented by ICE BoA Euro Treasury Bills Index.

Endnotes

1 Global Market Outlook, December 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 HICP+1.5%.

10 Benchmark is HICP+3%.

11 Benchmark is HICP+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.
† This figure is presented as of September 30, 2021 and includes approximately $59.84 billion of assets with respect to SPDR products for which State Street Global Advisors Funds Distributors, LLC (SSGA FD) acts solely as the marketing agent. SSGA FD and State Street Global Advisors are affiliated.

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