

# Commodities and short-term TIPS: how each combats unexpected inflation

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- Unexpected inflation can reduce stock and bond returns. In this paper, we examine several investments with reputations for limiting inflation's negative impact on a portfolio. Treasury Inflation-Protected Securities (TIPS) and commodities are preferred options against unexpected inflation, but each has benefits and risks that investors should consider.
- TIPS match unexpected inflation closely with high stability, but that stability means their inflation protection does not go beyond the invested position. Commodities also match but with higher beta, which can mean inflation protection beyond the invested position. However, commodities are a highly volatile asset class.
- Over long horizons, equities have outperformed inflation, which may be the ultimate protection against inflation. But for shorter-term offsets, commodities and short-term TIPS may be the best alternatives.

## Introduction

Anyone who lived through the 1970s and early 1980s will recall that inflation frequently reached double digits. Investors may also remember the impact on the stock and bond markets—it wasn't good. For instance, high inflation was a primary reason market price/earnings (P/E) ratios fell well below the federal funds rate (in 1980, the P/E of the S&P 500 Index was 7.4x, and the federal funds rate was 18%).

Today, expectations for inflation are low, and the S&P 500 Index has returned an average of 10.8% since 1990.<sup>1</sup> But what if inflation surges the way it did back in the '70s? How might an investor counter such an event?

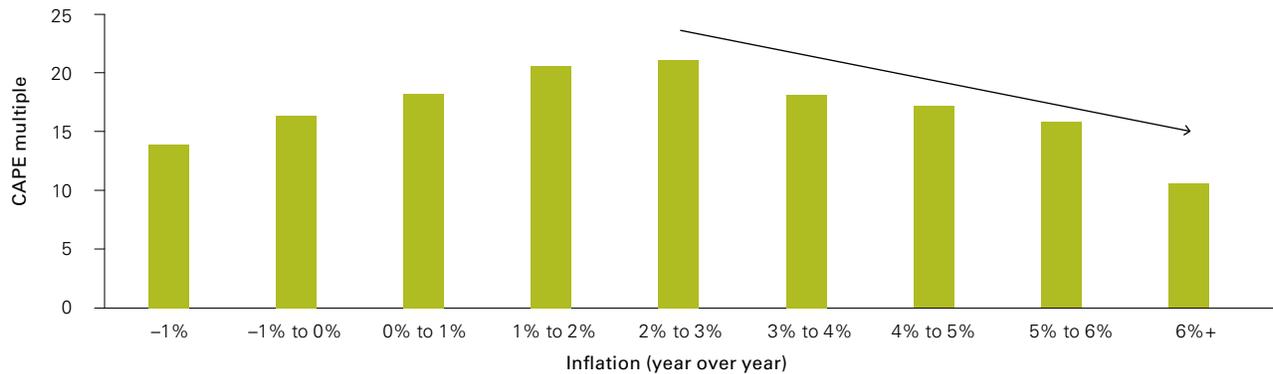
## Inflation as a risk

Markets tend to be fine when inflation is reasonable, but trouble can set in if it exceeds normal levels or expectations. **Figure 1** shows stock valuations during various inflation regimes. While deflation is often a sign of economic distress, there is a sweet spot for P/E ratios in the 0%–3% inflation range. Above that, P/E tends to drop as inflation rises.

Are we at risk of seeing another bout of higher inflation? This paper is not predicting that outcome or attempting to forecast inflation's direction. Rather, it addresses how an investor can gain protection against an inflation surprise. The study looks expressly at reducing inflation risk with alternative asset choices. It does not address their potential diversification benefit for a portfolio's risk or return; that will be the topic of a future research paper.

Figure 1: Inflation affects stock valuation

Median P/E (CAPE), 1900–2018



Note: The price/earnings ratio is represented by the cyclically adjusted price/earnings ratio (CAPE).

Source: Shiller (2015), updated by Vanguard.

### Notes on risk

All investing is subject to risk, including possible loss of principal.

Investments in bonds are subject to interest rate, credit, and inflation risk.

Diversification does not ensure a profit or protect against a loss.

In order to study ways to protect against inflation, we first must define it. There are two components of inflation: the part that is expected by the market, and the portion that is a surprise. Expected inflation typically works its way into the overall equation with manageable results: Higher interest rates compensate bond and cash investors for the slippage between nominal and real returns. Equity investors often do all right as companies “pass through” inflation by means of price increases in their products or services. Currently, Vanguard expects inflation of about 2% over the next five to ten years, well below the long-term average of 3.8% since World War II.<sup>2</sup>

### Definition of unexpected inflation

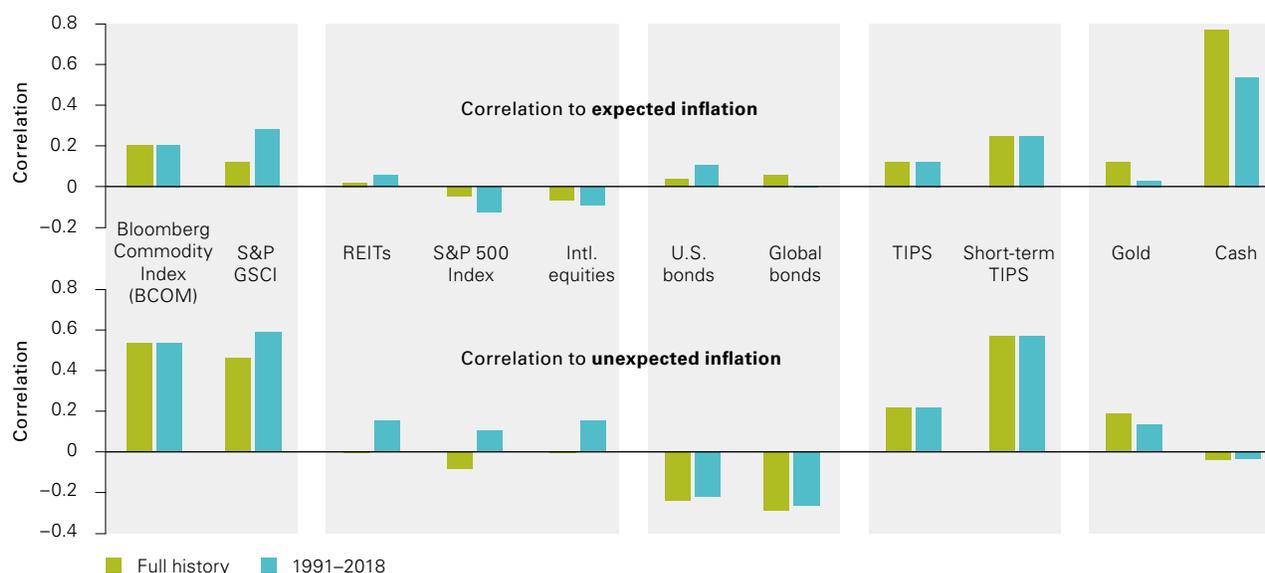
There is no widely accepted way to break down inflation into its expected and unexpected components; we tested several before selecting the Hodrick-Prescott (HP) filter. Following Razzak (1997), we used an HP filter to iteratively separate unexpected inflation from headline inflation, period by period.<sup>3</sup>

The returns of traditional asset classes of stocks and bonds are often negatively influenced by rising unexpected inflation. Equities can appear neutral to inflation in the long term. This may follow from the idea that they eventually pass through inflation, and the markets anticipate that. Yet as shown in Figure 1 and known anecdotally, equities can be hurt by inflation and the related higher interest rates. The weak performance of bonds and uncertain results of equity may be sufficient reasons to add a different investment to counter unexpected inflation.

### The investment choices

Investors have a few options for countering unexpected inflation risk. We tested the major liquid ones to see how they fared over the test period 1991–2018. Despite some data limits, several general conclusions can be gleaned from the results, as shown in Figure 2.

Figure 2. Correlation to expected and unexpected inflation



Notes: 1991 is the start of the Bloomberg Commodity Index. For full history dates and indexes used throughout this paper, see Appendix A-2.

Source: Shiller (2015), updated by Vanguard.

<sup>2</sup> Consumer Price Index for Urban Consumers (CPI-U).

<sup>3</sup> See Appendix A-1 for a more detailed discussion of our HP filter methodology as well as information on other methods considered. Special thanks to Fei Xu, Anatoly Shtekelman, and Eric Yang of Vanguard’s Quantitative Equity Group for their modeling and measurement of the effects of unexpected inflation on asset classes.

### The correlation and beta of inflation-sensitive alternatives

We can clearly see that bonds do not fare well during inflation shocks—both U.S. and global bonds are consistently negatively correlated to unexpected inflation. What may come as a surprise is the limited connection between unexpected inflation and asset classes with reputations as good inflation hedges: Gold offers limited help, and REITs even less.

Short-term (ST) TIPS are well-correlated to unexpected inflation, which makes sense given their structure.<sup>4</sup> They earn an interest rate in addition to the measured-inflation Consumer Price Index (CPI) kicker the U.S. government pays the investor.

Commodities are also fundamentally linked to inflation, as members of the commodity index are part of the CPI basket itself. For example, energy commodities are directly linked to transportation and housing, and coffee and corn are part of the food category. Since food and energy are the largest drivers of inflation volatility, it is logical to expect that commodities can provide inflation protection.

The S&P GSCI and the Bloomberg Commodity Index (BCOM) have high correlations to unexpected inflation

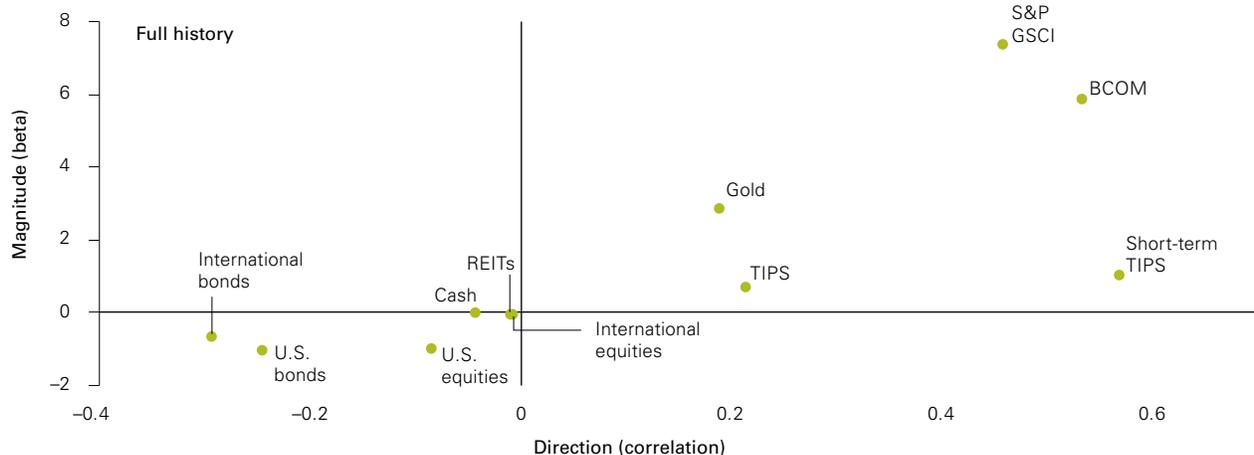
and bring with them magnitude, or “beta.” Beta represents how reactive or variable the asset is to the objective—in this case, unexpected inflation.<sup>5</sup> To help protect the portfolio, a well-correlated asset with high beta can be a good choice.

Here’s why: Buying an asset with high correlation but low beta to unexpected inflation provides excellent coverage for the money, but only for that investment. The rest of the portfolio remains unguarded. Buying an asset that has high correlation and high beta to unexpected inflation means its protection against inflation goes beyond just the invested position—it can help protect the rest of the portfolio, too. For example, if unexpected inflation were to rise by 4%, the return of ST TIPS, with a beta of 1, might rise about 4%. Commodities, with a beta of 6, might rise 24%, providing more portfolio coverage.

Figure 3 shows that the two commodity indexes have significantly higher beta than those of other asset classes along with good correlation to unexpected inflation. ST TIPS have an even higher correlation but a lower beta score. Which choice is best? For the highest stability, ST TIPS are a good choice, but they offer less portfolio coverage. Commodities can protect more of the portfolio, although the connection isn’t quite as strong.

Figure 3: Higher beta protects more of the portfolio

Direction versus magnitude



Source: Shiller (2015), updated by Vanguard.

<sup>4</sup> See Davis et al. (2012).

<sup>5</sup> See Aliaga-Díaz et al. (2018).

**Persistence: How consistent is the protection?**

Correlation and beta are only part of the story; it is also important for an investment to show good persistence, or consistency, in its relationship with the objective. The four charts in **Figure 4** give us a look at our choices.

**U.S. equities and bonds:** The bond index (blue) beta line is stable and often below 0, indicating the negative relationship between interest rates and unexpected inflation—a steady negative persistence. Equities, on the other hand, tend to cycle between periods of high positive and high negative beta—their effect is not persistent. Our earlier analysis showed a near-zero correlation, but the actual beta experience is inconsistent. In essence, equities will suffer from unexpected inflation at times, and at other times they may perform better. But a consistent inflation counter they are not.

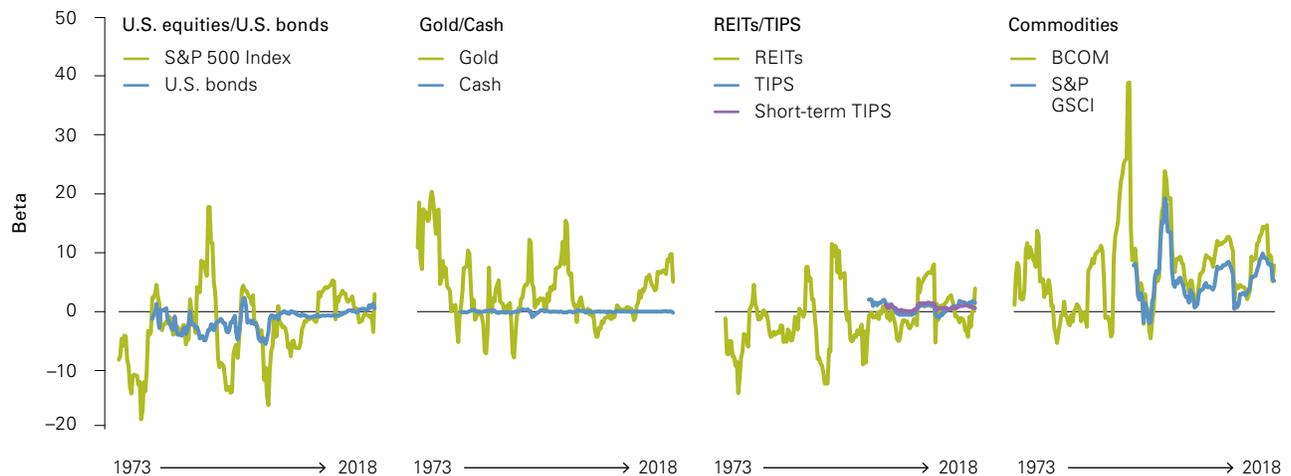
**Gold and cash:** On average, it appears gold’s beta is generally positive but volatile, with some significant negative spikes. Cash is neutral to unexpected inflation, though we know from analysis that it is well-correlated to expected inflation.

**REITs and TIPS:** While often viewed as a real estate proxy, REITs are a hybrid asset in the short term, with an income stream, equity market exposure, and a real estate component. In the long term, they move like real estate (Philips et al., 2011), but in the shorter and intermediate term, their additional parts make them more volatile. On average, REITs have a negative profile to unexpected inflation and volatile persistence and are not good inflation counters.

TIPS show a stable beta persistence to inflation, as they should. If relationship stability is highly valued, they are a solid choice. The beta for ST TIPS is flatter, indicating strong persistence.

**Commodities:** We see a tight connection between the S&P GSCI and the BCOM (which started in 1991). While earlier results showed high and generally positive correlation to unexpected inflation over time, these observations show significant volatility. Commodities’ high beta can offer coverage for the portfolio, but investors should be aware that the degree may vary over the short term.

**Figure 4: Beta persistence: How reactive is each asset to unexpected inflation?**



Note: Charts show three-year rolling averages.

Source: Vanguard.

No asset has proven to be the ideal anti-inflation instrument, combining consistent correlation with a large beta. Those assets with steady positive correlation may lack beta (ST TIPS), and those with a useful beta are less consistent (commodities). This may also be a function of the target objective being inconsistent, as our definition of unexpected inflation is a manufactured one based on our best attempt to build it. Nonetheless, the analysis should be a warning to investors: There is no sure thing.

Figure 5 presents a statistical review of the asset classes. Three of them show a significant relationship with unexpected inflation: the two commodities indexes and ST TIPS. U.S. bonds are nearly significant, but negatively so, while TIPS (all) are borderline positive.

Figure 5. Statistical review of asset classes’ relationship to unexpected inflation, 1991–2018

	Beta	T-stat	P-value	
BCOM	5.86	6.60	0.00	Significant
S&P GSCI	9.28	7.58	0.00	Significant
REITs	2.01	1.65	0.10	Not significant
S&P 500 Index	1.07	1.08	0.28	Not significant
International equities	1.86	1.65	0.10	Not significant
U.S. bonds	-0.60	-2.39	0.02	Borderline
TIPS	0.66	2.05	0.04	Borderline
Short-term TIPS	0.98	5.52	0.00	Significant
Gold	1.19	1.40	0.17	Not significant

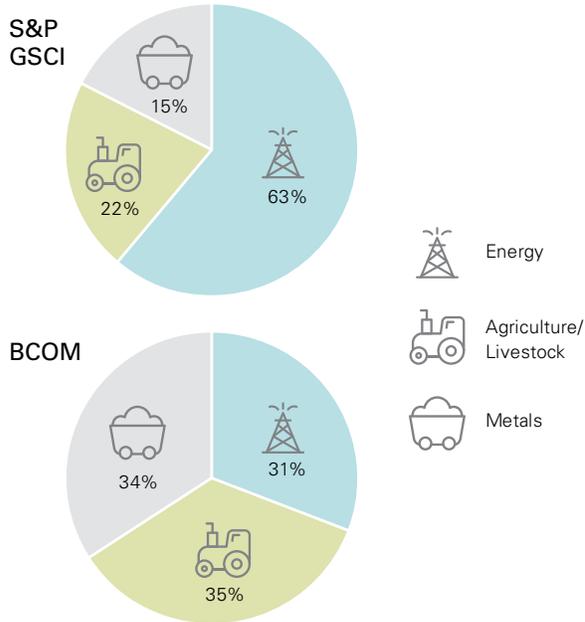
Source: Vanguard.

**Which commodities: S&P GSCI or BCOM?**

If the investor accepts the volatile nature of commodities in order to gain the beta they bring, then which of the two vehicles is preferable? The S&P GSCI has a longer history, a somewhat higher beta, and a correlation similar to that of the BCOM—wouldn’t it be the best choice? Perhaps not.

As shown in Figure 6, the S&P GSCI puts a large weight on the energy sector, which has been a key inflation driver in the past. Will that remain true in the future? That isn’t clear. The BCOM has more balance between the key components of energy, metals, and agriculture/livestock. Either choice is likely to have high sensitivity to inflation, so the investor must consider the better historical results of the S&P GSCI versus the more diversified input profile of the BCOM.

Figure 6: S&P GSCI has correlated better to unexpected inflation but has a large emphasis on energy



Note: Data are based on the average contract reference prices for the 2018 annual calculation period.  
Source: Vanguard.

### The cost of reducing inflation's impact

Commodities may offer the ability to counter unexpected inflation, but what does it cost the investor to “buy” inflation coverage? **Figure 7** shows the long return history of several assets. It reveals that commodities' long-term returns are not much different than cash, which makes intuitive sense. Improving technology and productivity gains constantly erode their prices, substitution and innovation can limit scarcity gains, and the cost of storage also has an impact. Over time, returns do not keep up with those of the long-term asset choices.

### Alternative “futures”

Investors seeking protection against inflation should keep in mind alternate scenarios, such as deflation. There are cogent arguments that inflation is unlikely to surprise on the upside and deflation may be possible (as Japan has experienced since 1990). Or slowing global growth could

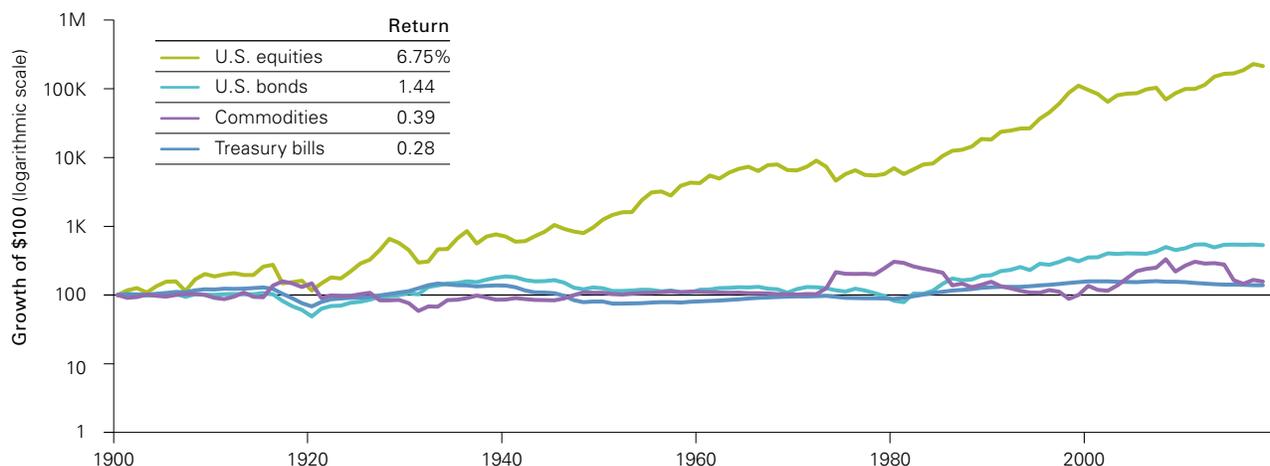
make an inflation counter-position unnecessary. Figure 1 showed that deflation is typically unfriendly to the stock market. A deflation period would probably push a commodity position lower as equities fell. TIPS might suffer too, but their lower beta means this would be less disruptive to portfolio value. Quality bonds would be the counterweight to this scenario.

Also unknown is where inflation may come from. As the world economy continues to segue from manufacturing-based to service-oriented, commodities might not provide the shelter they have in the past. Consider medical or financial inflation—a commodity position might protect against neither.

Finally, remember the short-term volatility of commodities. Holding them steadily in a portfolio may prove challenging. A volatile asset class is often viewed in isolation, leading to investor anxiety or, worse, inviting attempts to “time” the asset class—an extremely difficult endeavor.

Figure 7. Long-term performance

Real returns, 1900–2018



**Notes:** The commodities return is based on spot price and does not represent the return of a futures-based investment. See Appendix A-3 for more information on the long-term returns of commodities.

**Sources:** Vanguard, Global Financial Data, U.S. Federal Reserve, and Bloomberg.

## Conclusion

Investors concerned with the reemergence of inflation may want an asset that is inflation-sensitive to counter the possible decline of stocks and bonds. This study examined asset classes for their efficacy in reducing the impact of unexpected inflation. It concentrated specifically on inflation analysis rather than addressing portfolio diversification. We concluded that short-term TIPS are a stable and persistent choice. However, their modest beta means a large position must be taken to achieve significant inflation coverage. Commodities are well-correlated to unexpected inflation and have sufficient beta to provide a higher degree of inflation coverage but are much more volatile. As there is no ideal choice, investors must base their decision on their preferences and risk tolerance.

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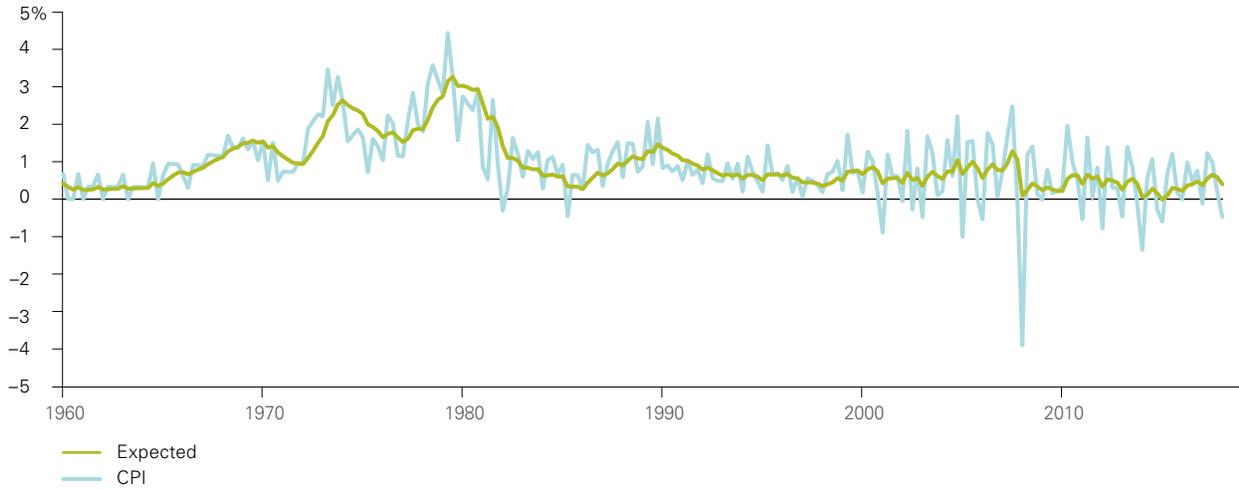
**Appendix A-1: Unexpected Inflation measures**

The standard HP filter considers  $t + i$  ( $i > 0$ ) observations to construct current period  $t$ . This can be misleading, as the output (unexpected inflation) calculated for each period  $t$  will be dependent on future values, which is unrealistic in practice. The modified, one-sided approach we use in this paper eliminates this concern by only considering observations up to  $t$  and is therefore purely backward-looking.

The three other methods we considered for decomposing inflation were aggregated predictions from the Federal Reserve Bank of Philadelphia’s Survey of

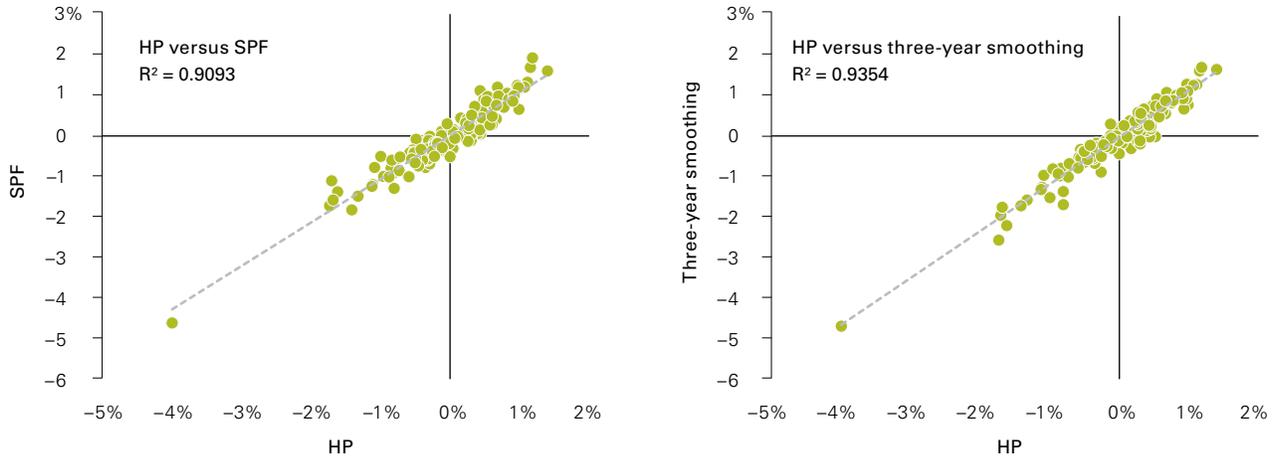
Professional Forecasters (SPF), a 12-month moving average of headline inflation, and breakeven inflation. These are more intuitive, relying on the wisdom of the crowds, historical data, and the expectations of the market, respectively. Though we ultimately chose to use the HP filter because of its strong academic support and empirical precedent, its output is highly correlated to those of the other methods. This works as a robustness check, indicating that our results would not have changed significantly had we used an alternative methodology.

**Figure 1: Inflation breakdown using HP filter**



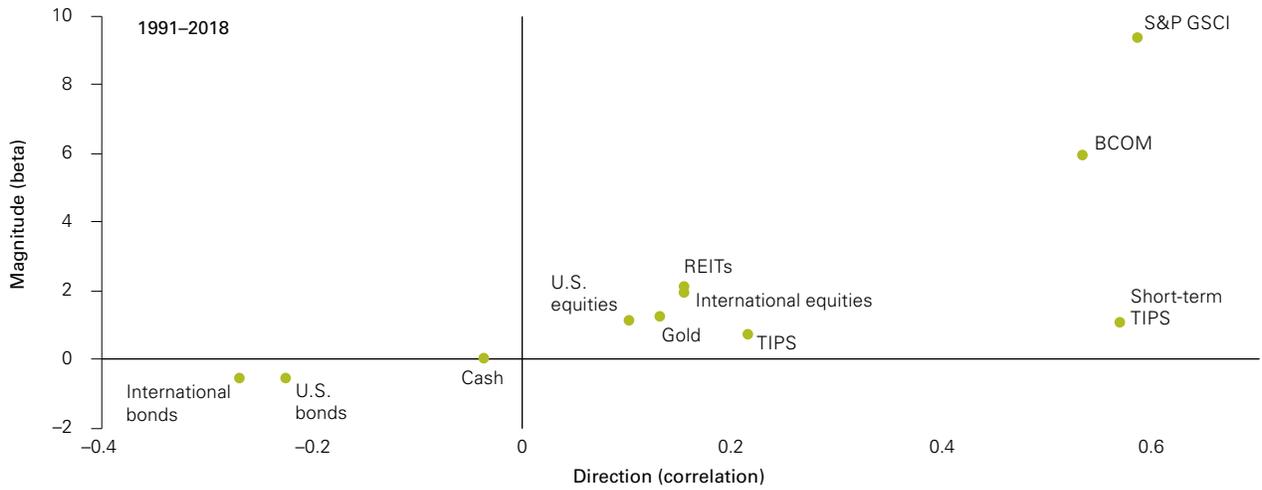
Source: Vanguard.

Figure 2: Measurement of unexpected inflation, 1981–2018



Note: All data are quarterly.  
Source: Vanguard.

Figure 3: Alternate time period for beta/correlation



Source: Vanguard.

## Appendix A-2: Data series

Indexes used to represent asset classes throughout this paper are as follows.

**Commodities:** Bloomberg Commodity Total Return Index since March 29, 1991, and S&P GSCI Total Return Index since March 31, 1970.

**REITs:** FTSE NAREIT Equity REITS Total Return Index since December 31, 1971.

**U.S. equities:** S&P 500 Index (reinvested monthly) since December 30, 1960.

**International equities:** MSCI World ex USA Total Return Index since December 31, 1969.

**U.S. bonds:** Bloomberg Barclays U.S. Aggregate Bond Index since March 31, 1976.

**Global bonds:** Bloomberg Barclays Global Aggregate Credit ex-U.S. (USD Hedged) Index since March 30, 1990.

**TIPS:** Bloomberg Barclays U.S. Government Inflation-Linked All Maturities Total Return Index since March 31, 1997.

**Short-term TIPS:** Bloomberg Barclays U.S. Treasury Inflation-Protected Securities (TIPS) 0-5 Years Total Return Index - USD since September 30, 2002.

**Treasury bills:** FTSE 3 Month US T-Bill + 4% Index (cash) since March 31, 1978.

**Gold:** Gold spot price per ounce since December 30, 1960.

## Appendix A-3: Long-term returns for commodities

<b>Tropical agriculture</b>	<b>1865–1888</b>	<b>1888–2002</b>	<b>2002–2010</b>
Annual compound growth rate	0.7%	–1.0%	0.3%
Cumulative growth rate	16.3%	–67.2%	2.5%
Duration (years)	23	114	8
<b>Nontropical agriculture</b>	<b>1889–1932</b>	<b>1932–1994</b>	<b>1994–2010</b>
Annual compound growth rate	0.4%	–1.0%	0.4%
Cumulative growth rate	20.2%	–46.9%	6.9%
Duration (years)	43	62	16
<b>Metals</b>	<b>1865–1881</b>	<b>1881–1974</b>	<b>1974–2010</b>
Annual compound growth rate	0.1%	–0.7%	1.0%
Cumulative growth rate	1.7%	–48.2%	43.8%
Duration (years)	16	93	36
<b>Crude oil</b>	<b>1875–1925</b>	<b>1925–1962</b>	<b>1962–2010</b>
Annual compound growth rate	1.5%	–1.1%	2.8%
Cumulative growth rate	114.2%	–32.5%	280.0%
Duration (years)	50	37	48

**Note:** This table displays the descriptive statistics of long-term trends identified in the ACF BP filter decomposition analysis.

**Source:** Ocampo (2013).

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