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# The long and short of TIPS

Vanguard research

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**Executive summary.** Assets can be considered an “inflation hedge” if either their purchasing power is maintained over the long run or their nominal returns closely track realized inflation over shorter horizons. Since the introduction of the U.S. Treasury Inflation Protected Securities (TIPS) market in 1997, broad-market TIPS returns have generally met both criteria. That said, the aggregate U.S. TIPS market carries considerable interest rate risk, compared to shorter-maturity TIPS benchmarks. This paper compares the correlation of U.S. inflation with TIPS benchmarks in three distinct maturity buckets. We then compare their inflation-hedging properties to those of other asset classes.

We found that the return on a short-term TIPS benchmark (of 0-to-5-year maturities) has been more highly correlated to actual monthly and yearly CPI (Consumer Price Index) inflation than other segments of the U.S. TIPS market over the past decade. Although, in practice, all TIPS securities

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receive the same CPI principal adjustment, short-term TIPS returns tend to most closely track actual CPI inflation because of their lower duration and greater responsiveness to temporary, unexpected inflation spikes. We found similar results for the United Kingdom's inflation-linked gilt market, which has existed since 1981. Short-term TIPS returns have shown markedly lower volatility, yet a similar or higher inflation correlation, than that observed for certain "real assets" such as REITs, commodity futures, and gold.

Our results imply that a short-term TIPS portfolio may be a more appropriate inflation-sensitive investment than the broad TIPS market for risk-averse investors who want their total portfolio to more closely track realized CPI inflation over short horizons. Of course, the higher inflation correlation of short-term TIPS comes at a cost—a lower expected income return versus that of the broad TIPS market. In this sense, the risk–return trade-offs of investing in a short-maturity versus a longer-maturity TIPS portfolio parallel those involved when selecting the interest rate exposure of any other bond portfolio.

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U.S. Treasury inflation-protected securities were introduced by the U.S. Department of the Treasury in January 1997. Since then, the outstanding supply of TIPS has grown substantially, from a market capitalization of approximately \$31 billion at the end of 1997 to nearly \$800 billion as of August 2012. This increased supply, in conjunction with occasional changes in the size and maturity

of U.S. Treasury TIPS issuance, has produced a more even distribution in the market cap and representation of U.S. TIPS across the yield curve.

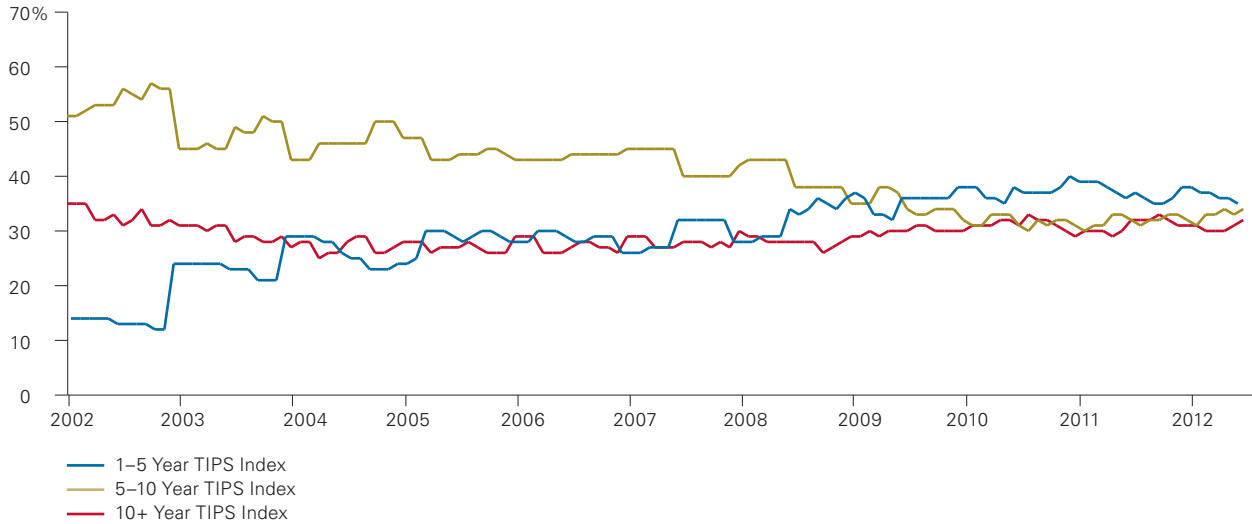
As shown in **Figure 1**, securities in the short-term Barclays U.S. TIPS 1–5 Year Index now make up approximately 35% of the aggregate Barclays U.S. TIPS Index, a weighting similar to the market-cap shares of the intermediate-term (5–10 Year) and long-

*Notes on risk: All investments are subject to risk, including the possible loss of the money you invest. Past performance is no guarantee of future returns. While U.S. Treasury or government agency securities provide substantial protection against credit risk, they do not protect investors against price changes due to changing interest rates. Unlike stocks and bonds, U.S. Treasury bills are guaranteed as to the timely payment of principal and interest. Diversification does not ensure a profit or protect against a loss in a declining market. The performance of an index is not an exact representation of any particular investment, as you cannot invest directly in an index.*

*Bond funds are subject to interest rate risk, which is the chance that bond prices overall will decline because of rising interest rates, as well as to credit risk, which is the chance that a bond issuer will fail to pay interest and principal in a timely manner or that negative perceptions of the issuer's ability to make such payments will cause the price of that bond to decline.*

**Figure 1.** Evolution of U.S. TIPS market and maturity segments: January 2002 through July 2012

Percentage of market cap of Barclays U.S. TIPS Index



Sources: Vanguard calculations, based on data from Barclays.

Notes: "Year" in Barclays TIPS indexes represents "years to maturity." The aggregate Barclays U.S. TIPS Index excludes TIPS securities with less than 1 year of maturity. As of July 2012, approximately 13.2% of the market cap of the Barclays U.S. TIPS 0-5 Year Index (not shown here) comprised TIPS securities of less than 1 year maturity.

term (10+ Year) Barclays TIPS indexes. This stands in stark contrast to 2000, when the market cap of a short-term TIPS benchmark was about 10%. Most of this growth in the 1-5 year market took place in the early 2000s, a natural evolution of the market due to longer-maturity issues rolling down the yield curve. Today, TIPS securities with less than or equal to 5 years' maturity tend to have greater liquidity (in terms of bid-ask spreads) and trading volume than longer-maturity TIPS securities (Fleming and Krishnan, 2009).

**Inflation protection and sensitivity:  
Do they vary by TIPS' maturity?**

In practice, all TIPS securities receive the same adjustment (or "indexation") of their coupon and principal payments based on changes in the U.S. Consumer Price Index.<sup>1</sup> In this sense, TIPS portfolios

of alternative maturities share the same level of inflation protection as defined by the principal and coupon CPI adjustment.

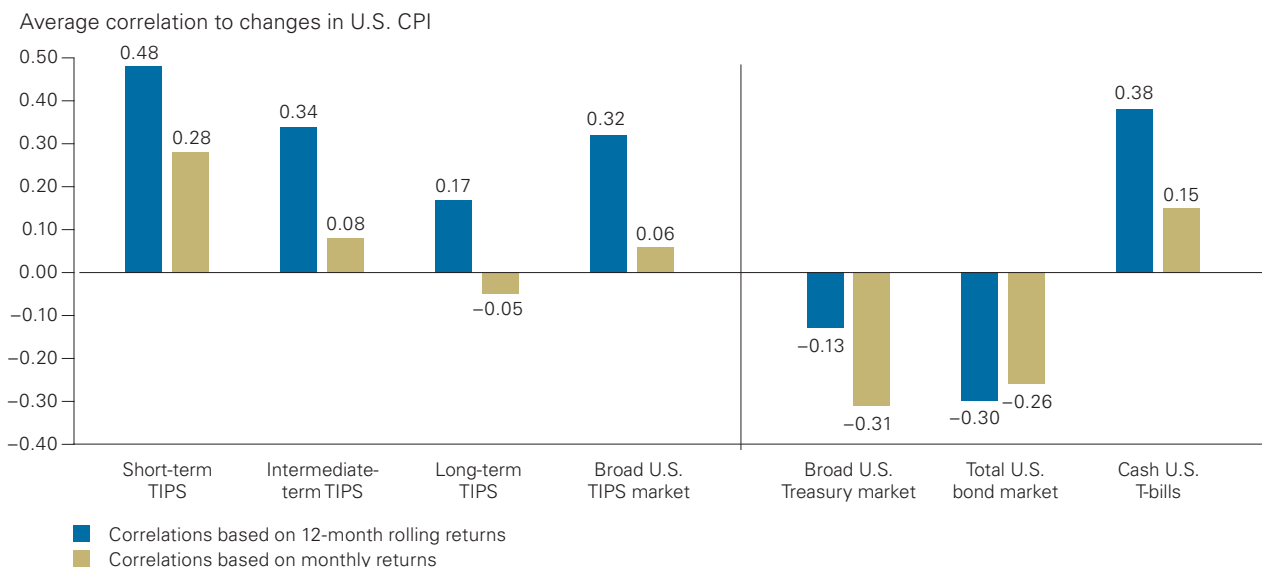
Of course, the observed correlation or sensitivity between the total return on a TIPS portfolio and actual CPI inflation may vary by the duration or interest rate exposure of the TIPS portfolio itself. This is because the total return on a TIPS portfolio reflects not only the inflation accrual but the income and capital appreciation/depreciation associated with the level of—and changes in—TIPS yields. Only in the (unlikely) event that all TIPS yields are both identical (i.e., a flat TIPS yield curve) and unchanged will TIPS benchmarks of various maturities have both an equal return and an identical correlation with inflation. In reality, the inflation sensitivity of TIPS

<sup>1</sup> More precisely, the TIPS inflation adjustment, or "accrual," occurs with an indexation lag to the non-seasonally adjusted U.S. City Average All-Items CPI, calculated by the U.S. Bureau of Labor Statistics. Since TIPS' principal is adjusted to CPI changes, it responds to both inflation and deflation, but with a floor at the par value of the TIPS. Since the interest rate is applied to the principal, both principal and coupon payments are effectively indexed to the CPI. For details, see Gürkaynak, Sack, and Wright (2008).

portfolios should be expected to vary by maturity, given the response of the TIPS and nominal Treasury yield curves to both realized and unanticipated changes in inflation.<sup>2</sup>

To assess whether this has indeed been the case historically, **Figure 2** presents the average correlation of U.S. inflation with the broad Barclays U.S. TIPS Index as well as Barclays TIPS benchmarks of three different maturity buckets—a short-term TIPS index

**Figure 2.** Correlation coefficients of various U.S. bond benchmarks to U.S. inflation: September 2002–July 2012



|                                | 0–5 Year TIPS Index | 5–10 Year TIPS Index | 10+ Year TIPS Index | U.S. TIPS Index | U.S. Treasury Index | U.S. Aggregate Bond Index | U.S. Cash |
|--------------------------------|---------------------|----------------------|---------------------|-----------------|---------------------|---------------------------|-----------|
| Annualized total return        | 4.56%               | 7.07%                | 9.32%               | 6.94%           | 5.17%               | 5.52%                     | 1.75%     |
| Average maturity (years)       | 3.1                 | 7.6                  | 20.8                | 10.1            | 7.3                 | 7.0                       | 0.2       |
| 12-month return volatility     | 3.3%                | 5.6%                 | 8.5%                | 5.3%            | 3.4%                | 2.6%                      | 1.8%      |
| Maximum 12-month return        | 12.7%               | 21.2%                | 31.1%               | 19.6%           | 13.7%               | 13.8%                     | 5.2%      |
| Minimum 12-month return        | -3.8%               | -7.9%                | -10.7%              | -7.5%           | -3.6%               | -0.8%                     | 0%        |
| Correlation to stocks          | 0.15                | 0.12                 | 0.05                | 0.09            | -0.33               | -0.03                     | -0.06     |
| Correlation to aggregate bonds | 0.57                | 0.74                 | 0.80                | 0.78            | 0.88                | 1.00                      | -0.05     |
| Correlation to cash            | 0.02                | -0.07                | -0.09               | -0.07           | 0.04                | -0.05                     | 1.00      |

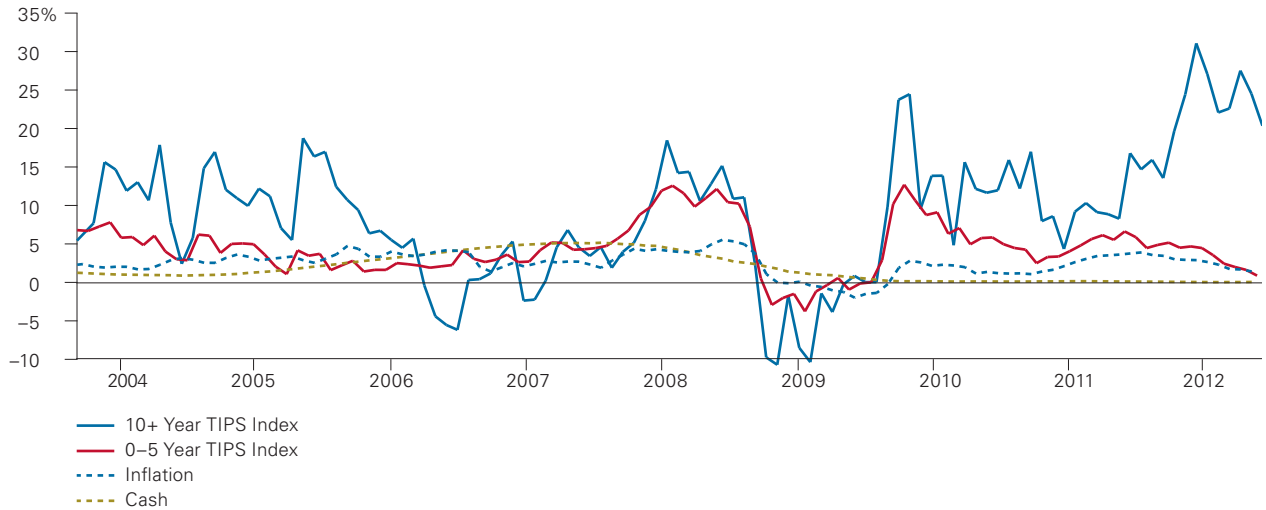
Sources: Vanguard calculations, based on data from Barclays and U.S. Bureau of Labor Statistics.

Notes: Short-term TIPS Index represented by Barclays U.S. TIPS 0–5 Year Index; intermediate term TIPS represented by Barclays U.S. TIPS 5–10 Year Index; long-term TIPS represented by Barclays U.S. TIPS 10+ Year Index; broad U.S. TIPS market represented by Barclays U.S. TIPS Index; broad U.S. Treasury market represented by Barclays U.S. Treasury Index; total U.S. bond market represented by Barclays U.S. Aggregate Bond Index; and “Cash” represented by Barclays 1–3 Month U.S. Treasury Bill Index. Table beneath the figure provides additional historical return, volatility, and correlation statistics for these benchmarks for the period September 2002–July 2012.

2 The difference between the yields of a nominal Treasury bond and a similar-maturity TIPS bond is known as the break-even inflation rate (BEI). The BEI rate represents not only the bond market’s expectation of future inflation over the life (or maturity) of the two bonds but also risk premiums that reflect the uncertainty about future inflation and the bonds’ relative liquidity, among other factors. In this sense, the BEI is the rate of inflation that would give an investor the same return at maturity on both a nominal Treasury security and a TIPS security with identical maturities. The performance of a TIPS portfolio relative to that of a portfolio of similar-maturity nominal Treasury bonds is determined not only by the level of actual inflation but also by whether that realized inflation has exceeded the BEI rate at the time the portfolio was purchased. For further details, see Wallick and Marshall (2009).

**Figure 3.** The rolling returns of short-term and long-term TIPS versus inflation: August 2003–July 2012

Rolling 12-month returns and year-over-year percentage change in U.S. CPI inflation



Sources: Vanguard calculations, based on data from Barclays and U.S. Bureau of Labor Statistics.

of 0-to-5 year maturities, an intermediate-term 5-to-10-year maturity TIPS index, and a long-term TIPS index. Figure 2 also depicts the correlation to U.S. inflation of U.S. Treasury bonds, the Barclays U.S. Aggregate Index, and cash (as measured by 3-month Treasury bills). The table beneath Figure 2 provides additional historical return, volatility, and correlation statistics for all of these benchmarks. The sample begins in 2002, given limitations in available data for the short-term TIPS index.

Figure 2 illustrates that the correlation of TIPS returns with actual inflation has indeed varied by the duration or maturity of a TIPS portfolio. In particular, the total return on a short-term TIPS benchmark has displayed a higher average correlation to realized CPI inflation at monthly (0.28) and annual (0.48) horizons than other segments of the U.S. TIPS market over the past decade.<sup>3</sup> Notably, this higher correlation has been accompanied by a lower average return and volatility for the short-term TIPS benchmark vis-à-vis other TIPS indexes (see the table accompanying

Figure 2). As would be expected, nominal Treasury and aggregate taxable bond returns are negatively correlated with monthly and annual changes in CPI inflation.

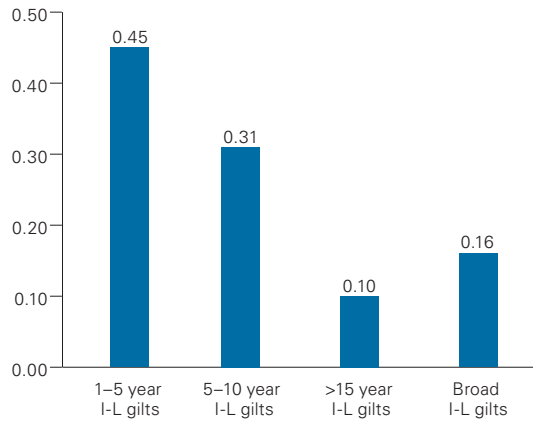
Since 2002, the average correlation of TIPS returns with short-run changes in CPI inflation has been inversely related with the maturity of the TIPS portfolio—lower TIPS interest rate exposure has translated into higher correlation with actual CPI inflation at monthly and annual horizons. Over this period, short-term TIPS have displayed a similar positive correlation with inflation similar to that of cash, although the returns on short-term TIPS have been markedly higher, given the decline in TIPS yields (to now negative territory).<sup>4</sup> Indeed, as Figure 3 illustrates, the short-term TIPS index should not be viewed as a “cash alternative” from an asset allocation perspective. The correlation between short-term TIPS returns and cash over this period has been close to zero, despite sharing a similar correlation with actual inflation.

<sup>3</sup> At a monthly frequency, *actual* percentage changes and *unexpected* changes in the CPI inflation rate are highly correlated, since expected inflation rates tend to be persistent, or “smooth.”

<sup>4</sup> The currently low (even negative) TIPS real yields also suggest that the future returns of TIPS benchmarks of all maturity buckets are likely to underperform the returns realized in the table to Figure 2 for the period September 2002–July 2012. For further discussion, see Donaldson, Philips, and Walker (2012).

**Figure 4.** Correlation of U.K. inflation-linked gilt returns to inflation varied by maturity: October 1986–July 2012

Average correlation of rolling 12-month returns to year-over-year percentage changes in U.K. RPI



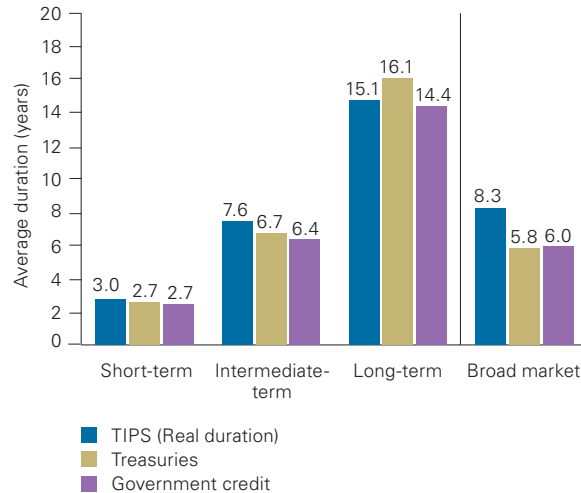
Notes: Returns on "1-5 year I-L gilts" calculated from market-cap-weighted returns on 1-3 Year U.K. Government Inflation-Linked Bond Index and Barclays 3-5 Year U.K. Government Inflation-Linked Bond Index. Returns on "5-10 year I-L gilts" calculated based on market-cap-weighted returns on Barclays 5-7 Year U.K. Government Inflation-Linked Bond Index and Barclays 7-10 Year U.K. Government Inflation-Linked Bond Index. Returns on ">15 year I-L gilts" are represented by the Barclays >15 Year U.K. Government Inflation-Linked Bond Index. Returns on "Broad I-L gilts" are represented by the Barclays U.K. Government Inflation-Linked Bond Index.

Sources: Vanguard calculations, based on data from Barclays.

### Robustness check: U.K. inflation-linked gilts

A potentially important caveat to these reported results is the short history of the U.S. TIPS market. However, we can test the robustness of our results by examining the historical returns in the U.K. inflation-linked gilt market. The British Treasury initiated its inflation-linked gilt program in 1981, more than 15 years before the inception of the U.S. Treasury TIPS program.<sup>5</sup> Figure 4 presents the correlation of the rolling 12-month returns of U.K. inflation-linked gilts to that of the U.K. Retail Price Index (RPI).

**Figure 5.** Duration of different-maturity TIPS benchmarks is similar to that of other markets



Notes: Figure shows average month-end duration for 12 months ended July 2012.

Sources: Vanguard calculations, based on monthly duration data from Barclays.

Despite its longer history, the level and pattern of the average inflation correlation of U.K. inflation-linked gilt returns have been similar to those of the U.S. TIPS market. As shown in Figure 4, the correlation between the returns on a short-term U.K. inflation-linked gilt index and the British annual inflation rate has been 0.45 since the mid-1980s, versus 0.16 for the broad U.K. inflation-linked gilt index. The differences and time-variation of return volatility among short-, intermediate- and long-term inflation-linked gilt returns are similar to those observed for U.S. TIPS.

Overall, the inflation-hedging properties of U.K. inflation-linked gilts would seem to validate the shorter-sample results we have found for the U.S. TIPS market.

<sup>5</sup> The U.K. Debt Management Office (<http://www.dmo.gov.uk/index.aspx?page=Gilts/Indexlinked>) provides a brief history of the inflation-linked gilt market. There are some institutional differences between the U.K. inflation-linked gilt market and the U.S. TIPS market. For example, U.K. requirements for inflation matching in pension funds may affect the inflation-linked gilt market in unique ways.

## Explaining higher correlation of short-term TIPS with actual inflation

Since all TIPS securities receive the same CPI principal adjustment, other factors must explain why short-term TIPS returns tend to track most closely actual CPI inflation over short horizons. The first explanation would simply be the lower interest rate risk or duration of the short-term TIPS benchmark. As illustrated in **Figure 5**, the real duration of short-term TIPS is 3 years, about 5 years shorter than that of the broad Barclays U.S. TIPS Index and much shorter than the 15-year duration of the long-term TIPS index.<sup>6</sup> Similar to its nominal Treasury and corporate bond counterparts, the duration of a short-term TIPS portfolio is much shorter—and therefore its returns tend to be less volatile—than those of the TIPS market as a whole. This clearly reflects the impact of a bond portfolio’s duration on its total return.

The low duration of shorter-maturity TIPS contributes directly to their high correlation with realized inflation. Low price volatility, resulting from short-term TIPS’ lower interest rate sensitivity, allows inflation-indexed income payments to drive a larger proportion of the investment’s total return. However, the lower interest rate exposure of short-term TIPS is not the only factor driving their higher correlation with actual CPI inflation.

Another important factor is the greater and more immediate responsiveness of short-term TIPS prices to short-term volatility in the CPI—typically driven mostly by fluctuations in food and energy prices.<sup>7</sup> We can gauge this responsiveness by measuring the correlation of changes in nominal yields, real yields, and break-even inflation rates with the monthly inflation rate.

**Figure 6**, on page 8, shows the average correlation of the monthly inflation rate with changes in TIPS and nominal Treasury yields using monthly data since 1999. We present correlations for four constant-maturity bonds that span the yield curve. In general, we find that higher monthly inflation rates are consistent with a decline in the TIPS 2-year yield (i.e., short-term TIPS rise in price) and a rise in the BEI rate expected over the next two years. Given the tendency for the 2-year TIPS yield and the 2-year BEI rate to move in opposite directions, changes in the nominal Treasury 2-year yield have only been weakly associated with changes in the CPI since 1999.<sup>8</sup>

In some sense, the higher and more immediate sensitivity of short-term TIPS with near-term moves in CPI inflation and commodity prices parallels the higher correlation that short-term Treasury bonds display with changes in the actual federal funds rate. All else equal, this should be expected, since long-maturity Treasury and TIPS securities reflect the bond market’s expectations for (and uncertainty surrounding) inflation and short-term interest rates over the *entire life* of the long-maturity bond, rather than simply the next month or year.

## Inflation hedging and portfolio construction

### *What is an “inflation hedge”?*

The growing interest in inflation hedging spotlights the need to appreciate the complex relationship that can exist between asset returns and inflation.<sup>9</sup> Indeed, assets can be considered an “inflation hedge” if either the purchasing power of their returns is not eroded by inflation over the long run, or their nominal returns closely track actual realized inflation over shorter horizons.

6 The duration of a TIPS portfolio is measured relative to changes in real interest rates, and as such is typically referred to as “real duration.” Investors should note that since nominal and real yields differ by the break-even inflation rate (as discussed in footnote 2), they need not move in tandem, or even in the same direction. So while a portfolio of nominal Treasuries and TIPS securities may have similar durations, the securities can produce very different price movements, depending on the movement of break-even inflation.

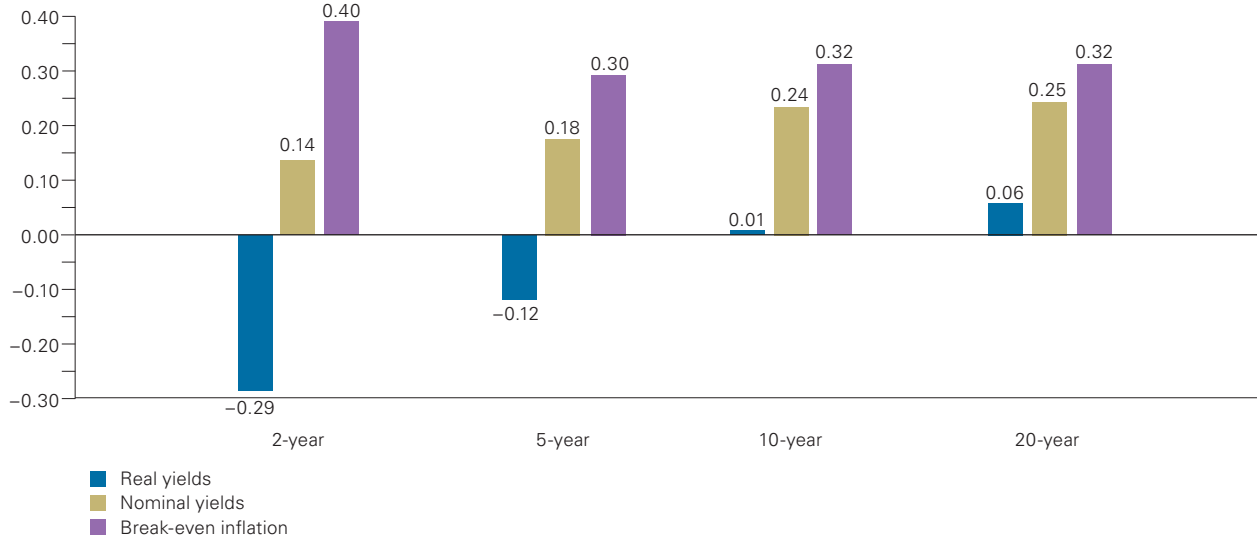
7 According to the U.S. Bureau of Labor Statistics, food and energy prices represented approximately 24% of the weight in the CPI basket as of July 2012. However, fluctuations in the CPI food and energy price indexes have historically accounted for approximately 85%–90% of the volatility in the monthly CPI inflation rate.

8 It should be noted that the average correlations in **Figure 6** should be expected to fluctuate at times (and perhaps even change sign) based on the source of the inflation shock (i.e., whether demand or supply driven), its perceived duration (whether a temporary or permanent rise in commodity prices), and the bond market’s assessment of the implications for future monetary policy

9 See also Bhardwaj, Hamilton, and Ameriks (2011).

**Figure 6.** Short-term TIPS prices are more correlated with short-term inflation rate: January 1999–July 2012

Average correlation to monthly percentage changes in Consumer Price Index, by maturity



Sources: Vanguard calculations, based on data from Barclays, U.S. Bureau of Labor Statistics, Federal Reserve Bank of St. Louis, and Federal Reserve Board.

Notes: TIPS yield data between January 1999 and December 2003 reflect continuously compounded zero-coupon yields as calculated by Gürkaynak et al. (2008) and are available on the Federal Reserve’s website, <http://www.federalreserve.gov/pubs/feds/2008/200805/200805abs.html>. Since 2004, TIPS data reflect constant-maturity inflation-indexed yields (source: Federal Reserve Statistical Release H.15). Figures reflect average correlation over the period January 1999–July 2012, except for the TIPS two-year yield and two-year BEI rate (available beginning in January 2004).

A key question then is whether investors should care about managing sensitivity to short-term inflation, or whether they should focus more on managing long-term purchasing power (i.e., positive inflation-adjusted or real long-run returns). In our view, a realistic answer is “both.”

For those with long-term investment horizons, risky assets like stocks and nominal bonds may earn returns high enough to overcome erosion in

purchasing power due to inflation, on average. However, to the extent that investors care about the short- to medium-term impact of inflation on their portfolio, introducing assets that hedge this risk can make sense. As we discuss in the next section, there are costs in the form of an expected long-run return “give-up” associated with constructing a portfolio with higher inflation sensitivity.



Based on our analysis, we would expect the inflation-hedging properties of TIPS (as defined by their short-term correlation to realized inflation) to endure even if their exceptionally strong trailing real returns do not. Indeed, our analysis has shown that short-term TIPS should be expected to correlate more with actual changes in CPI inflation over shorter horizons than longer-term TIPS, regardless of the relative levels of real yields.

### *Comparing TIPS versus “real assets”*

Of course, TIPS are not the only asset considered an inflation hedge. Some also strongly consider certain “real assets” as a valid and efficient investment in a broader portfolio because they offer the prospect of both positive expected long-run returns over inflation and a positive correlation with inflation over shorter horizons.

To help assess the relative merits of TIPS versus “real assets” in portfolio construction, we compared the historical correlation of year-over-year CPI inflation with the returns of both TIPS and some popularly cited “real assets,” namely U.S. REITs, commodity futures, and the spot price of gold. We then compared these observed correlations with inflation with the historical volatility of the total returns on the assets themselves.

**Figure 7**, on page 10, presents our results using monthly returns since 1970. The bars are sorted left to right by their average correlation to year-over-year percentage changes in actual CPI inflation. At 0.48, the correlation of short-term TIPS returns with annual CPI inflation is slightly higher than the correlations of CPI inflation with either gold prices (0.43) or commodity futures (0.34). In this context, REITs have fared poorly as a short-term inflation hedge, with average inflation correlation effectively zero. Like U.S. stocks in general, investors should consider the inflation-hedging potential of REITs based on the likelihood of generating positive long-run real returns, not short-term sensitivity to inflation.

Perhaps most notably, **Figure 7** illustrates that short-term TIPS have historically offered a favorable correlation with annual CPI inflation while having markedly lower return volatility (3.3%) compared to that for commodity futures (24.7%) and gold (29.1%). In effect, the returns on commodity futures and gold have a higher “inflation beta,”<sup>10</sup> which can be approximated for each asset by the product of the blue and gold bars in **Figure 7**.

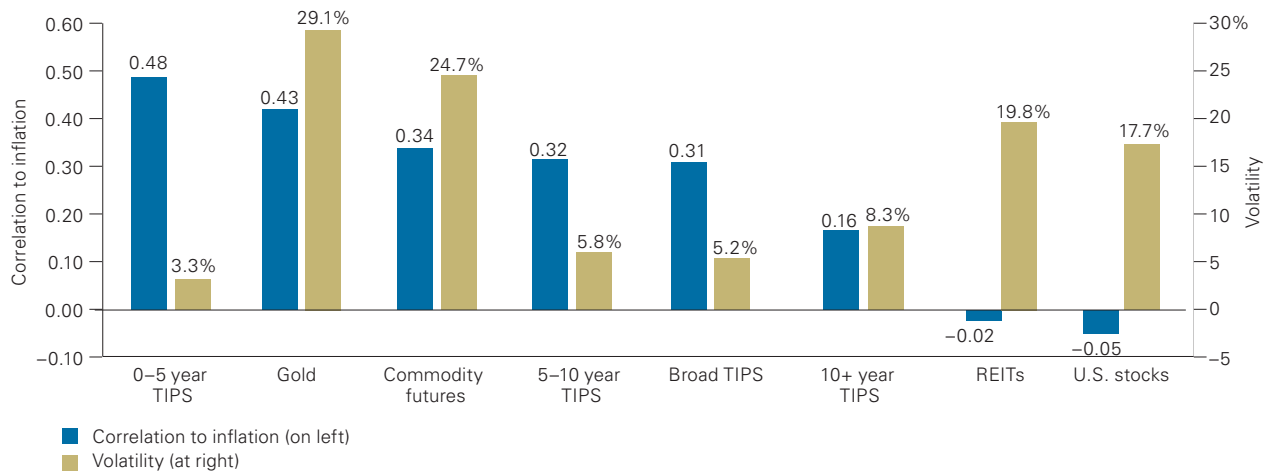
### *Portfolio allocations to TIPS*

No single solution for preserving purchasing power is appropriate for all policy portfolios, but TIPS can be a useful option in a real-return strategy (Bennyhoff, 2009). To frame a discussion about an appropriate allocation to TIPS in a broader tax-deferred bond portfolio, an investor can start by summarizing the relative market capitalization of the TIPS market (Wallick and Marshall, 2009). It is essential that investors carefully weigh asset-location considerations when allocating to TIPS in taxable accounts, given the unique tax treatment for TIPS. In addition, investors should be aware that allocating a portion of their portfolio to TIPS or any other inflation-sensitive asset does not imply a full hedge for their entire portfolio, but merely a marginal reduction in inflation risk.

Examining the composition of the broader fixed income market can provide a reference point when setting a portfolio allocation. As illustrated in **Figure 8**, on page 11, TIPS represent only a modest portion (5.3%) of the overall U.S. taxable fixed income market, as represented by the Barclays U.S. Aggregate Bond Index. For investors considering substituting TIPS for standard Treasuries, TIPS would represent 13.9% of the Barclays U.S. Treasury Index.

<sup>10</sup> Similar to the concept of market beta, the term *inflation beta* refers to the co-movement (i.e., regression beta) between a change in inflation and the corresponding change in an asset’s returns. For instance, the returns of an asset with an inflation beta equal to 1 co-move one-to-one with inflation.

**Figure 7.** Relationship between short-term inflation protection and nominal asset volatility:  
Data available January 1970–July 2012

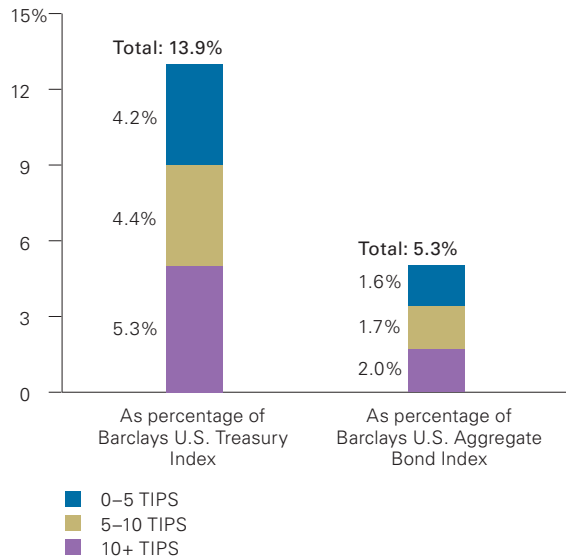


|   | 0-5 Year<br>TIPS | Gold   | Commodity<br>futures | 5-10 Year<br>TIPS | Broad<br>TIPS | 10+ Year<br>TIPS | REITs  | Stocks |
|---|------------------|--------|----------------------|-------------------|---------------|------------------|--------|--------|
| Returns since   | 9/2002           | 1/1970 | 1/1970               | 1/2002            | 3/1997        | 6/2000           | 2/1972 | 1/1970 |
| Volatility (12-month returns)                                   | 3.3%             | 29.1%  | 24.7%                | 5.8%              | 5.2%          | 8.3%             | 19.8%  | 17.7%  |
| Maximum 12-month return   | 12.7%            | 197.1% | 106.8%               | 21.2%             | 19.6%         | 31.1%            | 106.7% | 66.5%  |
| Minimum 12-month return   | -3.8%            | -36.5% | -60.1%               | -7.9%             | -7.5%         | -10.7%           | -58.2% | -43.2% |
| Correlation to year-over-year<br>inflation                      | 0.48             | 0.43   | 0.34                 | 0.32              | 0.31          | 0.16             | -0.02  | -0.05  |
| Correlation to monthly inflation                                | 0.28             | 0.14   | 0.14                 | 0.08              | 0.08          | -0.05            | -0.02  | -0.08  |
| Correlation to year-over-year<br>inflation since September 2002 | 0.48             | 0.40   | 0.76                 | 0.34              | 0.32          | 0.17             | 0.24   | 0.26   |

Notes: TIPS returns are represented by Barclays U.S. TIPS indexes (0-5 Year, 5-10 Year, and 10+ Year); REITs returns represented by FTSE NAREIT All Equity REITs Index; U.S. stock returns represented by Dow Jones U.S. Total Stock Market Index; commodity futures returns represented by S&P GSCI Index; gold represented by the average price for each month from Moody's Analytics Data Buffet.

Sources: Vanguard calculations based on data from Barclays, FTSE, Dow Jones, Standard & Poor's, and U.S. Bureau of Labor Statistics.

**Figure 8.** TIPS as percentage of taxable bond market, as of July 2012



Sources: Vanguard calculations, based on data from Barclays.

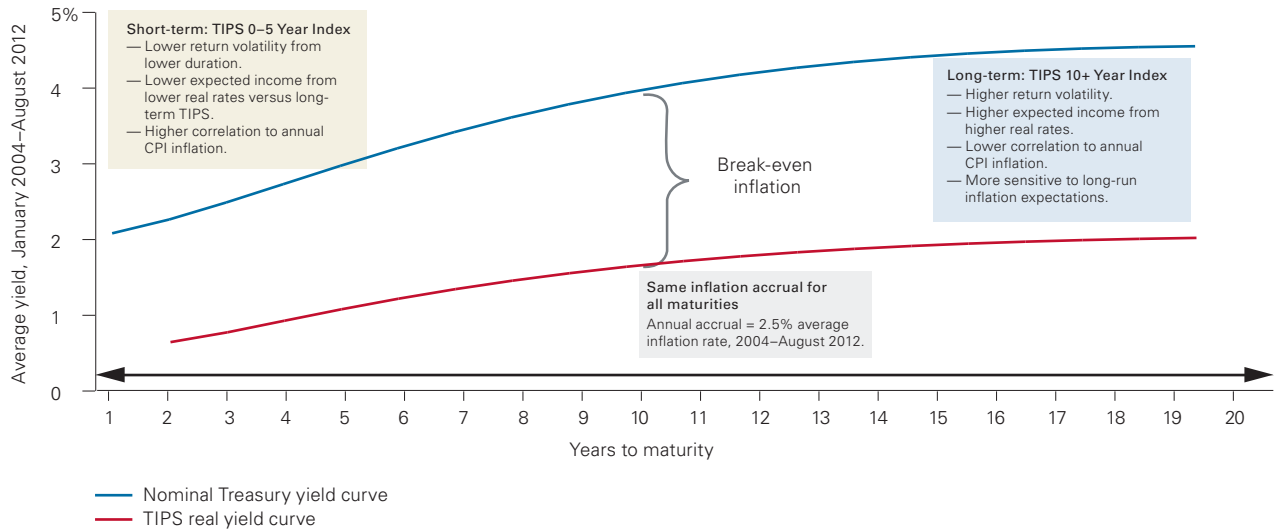
### Conclusion: Common fixed income trade-offs

Our analysis implies that although all TIPS securities receive the same inflation accrual regardless of their maturity, short-term TIPS prices exhibit a higher correlation to headline CPI inflation. Thus, a short-term TIPS portfolio may be a more appropriate inflation-sensitive investment than the broad TIPS market for investors who wish their total portfolio to more closely track actual realized CPI inflation over short horizons.

We must stress, of course, that the higher inflation correlation of short-term TIPS is not “costless,” but, rather, should come at the expense of a lower expected income return than for longer-term TIPS portfolios (as typically reflected by an upwardly sloping TIPS yield curve). Conversely, a long-duration TIPS portfolio may be more appropriate for investors willing and able to incur more real duration risk in the attempt to increase their long-run return, but who still want inflation protection in the form of inflation-indexed income. In this case, a hypothetical example could be an investor whose liabilities are expected to have an inflation rate higher than the average CPI rate (as has historically been the case with education and health care costs, for example).

In this sense, the risk–return trade-offs in allocating between a short- and a longer-duration TIPS portfolio (illustrated in **Figure 9**, on page 12) parallel those involved when selecting the interest rate exposure of a portfolio of U.S. Treasuries, corporate bonds, or municipal bonds.

**Figure 9.** Average shape of U.S. Treasury and TIPS yield curves: January 2004–August 2012



Sources: Vanguard calculations, based on data from Barclays, U.S. Bureau of Labor Statistics, Federal Reserve Board of St. Louis, and Federal Reserve Board.

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