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Capturing Inflation Breakeven Spread Returns

- USD inflation has been tame for many years, but some investors are worried about future inflation and would like to add protection to their portfolios.
- At first glance, TIPS seem to be a natural choice. However, while clearly outperforming nominal Treasury bonds during inflationary periods, TIPS have often had poor absolute returns because a pickup of inflation was often accompanied by a rise in real yields.
- Ideally, investors worried about increases in expected or realized future inflation should target positive exposure to TIPS breakeven spreads (BE).
- To obtain long exposure to BEs, investors can buy TIPS and sell nominal Treasuries. But how to size this trade? If the trade is sized by relative durations, which duration measure should be used? We discuss how the duration choice needs to reflect portfolio managers' particular views on BE changes.
- To capture changes in BEs, one must short cash Treasuries. Sometimes, this is inconvenient, especially amid today's regulatory environment and balance sheet constraints. Is there a more efficient, yet as effective, way to obtain a desired BE exposure? We show that a "mirror futures index" (MFI) is an effective tool for this.
- Finally, we discuss how investors can use futures to capture the difference between subsequent realized inflation and a TIPS initial BE over a specific holding period. Such a strategy may be appealing to "target date" funds looking to protect a portfolio from realized inflation over a specified period.

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Introduction

US inflation has been tame for quite a few years, but this may change. Many portfolio and risk managers understand that and are looking for ways to add inflation protection to their fixed-income portfolios. Inflation protection strategies involve adding assets to a portfolio that are expected to perform well if inflation increases: commodities (eg, metals, energy), some equities,[1] some non-USD currencies (eg, JPY), equity REITS, and inflation-protected bonds (eg, TIPS).

At first glance, TIPS seem to be a natural choice for such strategies. However, while clearly outperforming nominal Treasury bonds during inflationary periods, TIPS have often had poor absolute returns because a pickup of inflation is often accompanied by a rise in real yields. Figure 1 shows some important historical economic regimes between 1973 and 2014, which include major inflationary periods, as well as recessions. One can see that inflationary periods have been associated with large increases in real yields.[2] For example, during the 1975-1981 inflationary period, 10y real yields increased 259bp.

FIGURE 1

Real Yields in Different Macroeconomic Environments, January 1973-September 2014

Historical Period	Description	Change in 10y TIPS Real Yield (in bp)
Apr 75 - Dec 81	High Inflation	259
Apr 75 - Mar 79	Inflation, Expansion, Monetary Easing	64
Apr 79 - Mar 82	Inflation & Recession	238
Apr 83 - Jun 84	Inflation, Expansion, Monetary Tightening	152
Jan 90 - Mar 91	Recession & Commodity Inflation	-34
Oct 00 - Dec 01	Mild Recession	-36
Jan 08 - Mar 09	Severe Recession & Very Low Inflation	10

Source: Barclays Research

Given today's historically low real rates (Figure 2), TIPS may not be a particularly good choice for an overall inflation protection strategy.

FIGURE 2

10y Real Yields, January 1973-September 2014

Source: Barclays Research

[1] For example, Barclays Equity Inflation-Response Index aims to outperform the broad equity market when inflation is elevated by investing in stocks from sectors that have historically performed well during periods of high inflation.
[2] TIPS started trading only in 1993, so the historical real yield series in Figure 2 is estimated. For details on the estimation methodology, see *TIPS: Predicting History*, M. Pond and C. Mirani, Barclays Research, 13 March 2009.

A position in TIPS provides exposure to real yields. However, this is not what investors need if they worry about increases in expected or realized future inflation. Instead, they need positive exposure to breakeven spreads (BE), which are defined as the yield difference between a nominal Treasury and a TIPS of similar maturity. If worries about inflation were to accelerate, breakeven spreads would likely increase, producing positive returns for a long BE position irrespective of movements in real yields.

Nominal yields incorporate real yields plus a component related to expected inflation, so investors could obtain long BE exposure by buying TIPS and selling nominal Treasuries. Removing the nominal Treasury curve exposure from TIPS leaves the investor with a long BE position. But what should be the hedge ratio for this long-short trade? Which measure of duration should be used? Also, shorting cash Treasuries (likely via repo) is sometimes inconvenient, especially in today's regulatory environment. Is there a more efficient, yet as effective, way to remove the nominal Treasury curve exposure? We show that a "mirror futures index" can accomplish that.

Duration measures for TIPS

A TIPS bond pays its holder a stream of fixed coupons and a return of principal at maturity, together referred to as the promised cash flow (CF) stream. The coupon and principal are stated in real terms. However, TIPS holders will be paid in nominal terms, meaning each stated real-term payment amount will be adjusted (or inflated) by the realized inflation in the period attributable to that payment.

Real Duration

The real, or un-inflated, price (P) of TIPS is a function of the discount rate applied to the promised real cash flows. The single discount rate that correctly prices the bond is referred to as the bond's "real yield" (r). The **real modified duration (RealModDur)** measures the price sensitivity of the bond to a change in its real yield. It is computed by shocking the real yield and re-pricing the bond.

$$P = \sum_i \frac{CF_i}{(1+r)^i}$$

$$\text{RealModDur} = -\frac{1}{P}\frac{dP}{dr}$$

Today, investors often include TIPS in portfolios of nominal bonds. Although the US Aggregate does not include TIPS, many investors managing against it are permitted to hold TIPS, and often do. However, durations of all bonds in the Aggregate are measured with respect to changes in nominal Treasury yields. These are called nominal durations. A consistent duration measure is needed to produce, and report, a portfolio's duration. How does one measure the sensitivity of TIPS to nominal Treasury yields?

We define the TIPS nominal yield (y) as its real yield scaled up by a "breakeven spread" factor, BE.[3]

$$1 + y \equiv (1 + r + \text{BE})$$

$$P = \sum_i \frac{CF_i}{(1+r)^i} = \sum_i \frac{CF_i}{(1+y-\text{BE})^i}$$

[3] The difference between the nominal yield and real yield is typically called the "breakeven inflation rate". BE, however, may reflect more than just expected inflation, for example, liquidity and risk premium differences between the nominal and TIPS Treasury markets.

This price equation is a useful way to interpret breakeven spreads. While most will recognize it, many would expect to see the familiar "OAS", rather than BE, in the denominator. In addition, OAS would be *added* to the nominal Treasury yield, not subtracted. For TIPS, however, BEs can be viewed as a negative spread over the nominal Treasury yield. An increase in BE (all else equal) produces greater TIPS performance.[4]

Nominal Duration: Analytical vs. Empirical

There are many possible nominal duration measures for different kinds of bonds in the Aggregate Index, eg, corporate bonds. The same is true for TIPS. We discuss two nominal TIPS duration measures: **analytical duration** and **empirical duration**.

Nominal analytical duration (OAD) measures TIPS sensitivity to changes in y, holding BE constant. In other words, analytical duration does not take into account any expected movements in BE for a given change in y:

$$\frac{dP}{dr} \approx \frac{dP}{dy}\Big|_{\text{BE constant}}$$

Holding BE constant, the change in P for a given change in y will be very close to the RealModDur. Because nominal analytical duration assumes no change in BE as y changes, the change in y will be the same as the change in r.

However, suppose there is a stable relationship between changes in y and BE. In other words, dBE/dy is not zero and is somewhat predictable. If so, the change in y will not be the same as the change in r. **Nominal empirical duration** estimates the TIPS sensitivity to changes in y, incorporating the relationship between changes in y and changes in BE. There is a variety of estimation techniques to measure the y – BE relationship. Many investors use historical data and a simple linear regression model:

$$\Delta BE = \alpha + \beta_{\text{BE}} \times \Delta y + \varepsilon$$

The "breakeven" beta is the estimate of how much a TIPS's BE will change per unit change in the matched-maturity nominal Treasury yield.

Using, $P = \sum_i \frac{CF_i}{(1+y-\text{BE})^i}$; $\frac{dP}{dy}\Big|_{\text{BE constant}} = -\frac{dP}{dBE}\Big|_{\text{y constant}}$; and the differential of P with respect to y:

$$-\frac{1}{P}\frac{dP}{dy} = -\frac{1}{P}\left[\frac{\partial P}{\partial y} - \frac{\partial P}{\partial \text{BE}}\frac{d\text{BE}}{dy}\right]$$

Empirical Duration | Analytical Duration | Breakeven Duration | β_{BE}

we have:

$$EmpDur = AnalyticalDur \times (1 - \beta_{\text{BE}})$$

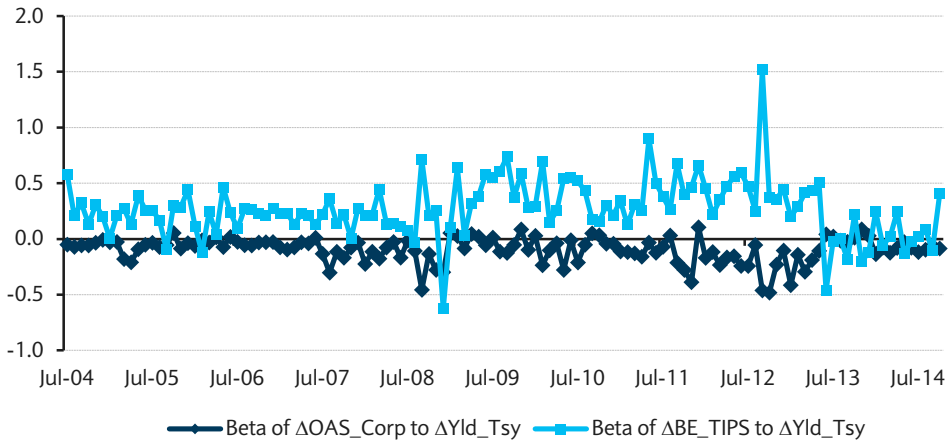
There has been some historical relationship between changes in y and changes in BE. Figure 3 shows the empirical 1m (non-overlapping) β_{BE} based on daily data since 2005. For

[4] For a discussion of how this BE interpretation influenced our risk modeling framework for TIPS, see *Risk Modelling and Performance Attribution for Inflation-linked Securities*, A. Lazanas and J. Rosten, Fixed Income Liquid Markets Research, Lehman Brothers, October 2005.

comparison, we also estimate the historical relationship between changes in y and changes in corporate OAS (*i.e.*, corporate $\beta_{CorpOAS}$).

FIGURE 3

Estimated 1m (non-overlapping) β_{BE} and $\beta_{CorpOAS}$ Based on Daily Data, TIPS and Corporate Index vs. Duration-Matched Treasury Index, January 2005-September 2014



Note: We estimate monthly betas using all daily observations in a calendar month. Until recently, t-statistics have been consistently greater than 2.0. Source: Barclays Research

Since 2008, β_{BE} has averaged 0.30 with minimum and maximum values of -0.63 and 1.52, respectively. Since June 2013, β_{BE} has been close to zero, which is a bit unusual. Nevertheless, given that β_{BE} has been systematically greater than zero for most of this historical period, there is motivation to consider using empirical durations.

Adding TIPS to Nominal Portfolios: Sizing the Trade

Adding TIPS to a nominal Aggregate portfolio increases the portfolio's active strategy "breadth." While the portfolio management team likely already has views on changes in nominal yields (y), adding TIPS brings a new dimension: explicit views on changes in BE. Adding TIPS also involves selling nominal Treasuries, and the size of the sale is determined by the need to match the TIPS' duration. But which duration measure should be used?

For client-reporting purposes, the use of analytical duration seems appropriate. After all, while a corporate bond has both analytical and empirical duration measures, PMs have no hesitation about using analytical durations in their reports. As discussed, analytical duration measures the sensitivity of the portfolio to changes in the nominal Treasury curve holding spreads (whether BE or OAS) unchanged.

The answer to the question of which duration to use for TIPS depends on how the TIPS PM expresses his or her views. For example, consider a TIPS PM who thinks that BE will increase. The PM wants to add $10mn market value of 5y TIPS to the Aggregate portfolio, which will likely require a sale of nominal Treasuries. Further, suppose the historical β_{BE} = 0.388. Clearly, the choice of the duration measure determines which, and how much, nominal Treasuries will be sold. If the PM uses analytical duration (say, 4.9 for a 5y TIPS), then he will sell approximately $10mn market value of 5y nominal Treasuries with a comparable duration. However, if the PM uses the empirical duration (eg, 3.0 = analytical duration × (1 - β_{BE})), he will sell either $6.1mn of the 5y nominal Treasuries or $10mn of 3+y nominal Treasuries with a duration of 3.0.

Which duration measure the PM uses should mirror his BE view. To see this, consider two portfolios, one of which uses analytical duration to size the TIPS trade and the other empirical duration.[5]

FIGURE 4
Portfolio 1: Analytical Duration for TIPS

Bond	$MV	Nominal OAD	BE Duration	EmpDur
TIPS	$10	4.9	-4.9	3.0
Nominal	($10)	-4.9	0	-4.9
Portfolio 1		0	-4.9	-1.9

Source: Barclays Research

Using nominal analytical duration to size the trade, we see that, by construction, the portfolio's nominal duration (OAD) is zero, but its BE duration is -4.9, equal to that of the TIPS. The portfolio's empirical duration is -1.9, reflecting the long 3.0 of the TIPS and the short 4.9 of the 5y nominal Treasury. Note that the portfolio is neutral to changes in nominal yields but remains fully exposed to changes in BE.

The portfolio has an explicit view that BEs will increase in absolute terms. It has no outright view on nominal yields in isolation. However, the manager knows that if historical correlations hold, BEs are likely to increase if yields increase. So the PM's view is correlated with a rates view, which may accentuate or attenuate the rate views of other PMs.

This has some implications for performance attribution. Suppose the TIPS manager is long BEs (using analytical duration) and the rates manager is positioned for a rise in rates. Subsequently, rates increase and BEs increase exactly as expected based on the historical relationship. Both managers will outperform. Did the TIPS manager outperform because he correctly predicted rates, or BEs? Was the TIPS manager simply following the rates manager, or did the TIPS manager have a truly independent view?

For Portfolio 2, the PM uses empirical duration to size the TIPS trade:

FIGURE 5
Portfolio 2: Empirical Duration for TIPS

Bond	$MV	Nominal OAD	BE Duration	EmpDur
TIPS	$10	4.9	-4.9	3.0
Nominal	($6.1)	-3.0	0	-3.0
Cash	($3.9)	0	0	0
Portfolio 2		1.9	-4.9	0

Source: Barclays Research

For Portfolio 2, where the duration values have been scaled down by the relative position sizes, the portfolio's nominal duration (OAD) is non-zero (+1.9), so the portfolio is not neutral to changes in nominal yields in isolation. However, as changes in BE is expected to move in tandem with y, the full effect on the portfolio of any change in y should be zero because the net empirical duration is zero. In other words, the PM has no rates views in the portfolio: whether rates rise or fall, as long as BEs move according to the assumed relationship, there will be no effect on the portfolio. However, if changes in BEs are more

[5] In these figures, we follow the usual convention of reporting a long duration exposure as a positive number.

(less) sensitive than expected to changes in y, the portfolio will make (lose) money. In other words, the implicit view of this portfolio is that BEs will increase net of the estimated correlated movement, irrespective of whether nominal yields rise or fall. This portfolio will have a net exposure only if nominal yields and BEs do not move in the 1.9/4.9 = 0.338 ratio.

To see the difference in views more clearly, consider the following scenario: nominal yields parallel-shift up 25bp, and BEs increase 7bp. The expected increase in BEs is 9.7bp (= 0.388 × 25bp). What happens to the two portfolios (ignoring carry):

Portfolio 1: Return_Δy = -0.0 × 25bp = 0.0bp

Return_ΔBE = -(-4.9) × 7bp = +34.3bp

Total Return = +34.3bp

Portfolio 2: Return_Δy = -1.9 × 25bp = -47.5bp

Return_ΔBE = -(-4.9) × 7bp = +34.3bp

Total Return = -13.2bp

Breakevens increased. Both portfolios were long TIPS. However, Portfolio 1 made money, whereas Portfolio 2 lost money. As discussed, Portfolio 1 with its TIPS analytical duration had an outright view on changes in BEs, whereas Portfolio 2 with its TIPS empirical duration had a view on the *net* change in BEs, after subtracting the expected correlated component caused by the change in y. BEs did increase, but they were expected to increase 9.7bp. Since they increased only 7bp, the portfolio suffered from a "net" decrease in BEs.

Why might a TIPS PM use empirical durations? First, perhaps the PM is not permitted to have a position with sensitivity to nominal yield changes. This exposure may be solely a prerogative of the duration manager. As we have just shown, analytical duration would leave the TIPS position sensitive to changes in nominal yields, which may conflict with the views of the duration manager. Second, perhaps the PM has a neutral BE view. Instead of unloading the TIPS position, he may hedge the position using nominal Treasuries and empirical duration. Third, the PM may have the long-short trade on as a pure inflation carry trade and want to profit from an inflation surprise without having any explicit view on changes in BEs. In this case, he will want to insulate the position from nominal yield changes and assume that BEs move as expected with changes in y.

Empirical durations are relatively popular with TIPS PMs – much more so than empirical durations are with corporate PMs. This is a bit odd, as many TIPS PMs seem to form views on the absolute change in BEs, not the change net of the correlated change. Perhaps the reason is that the TIPS market is relatively new compared with most sectors of the Aggregate Index. Many TIPS managers have long managed TIPS-only portfolios and always thought of using nominals only as a total return hedge. For that purpose, the PM would use an empirical duration. More recently, TIPS have been much more integrated in Aggregate portfolios, but the practice of using empirical durations seems to persist.

Capturing Breakeven Inflation Returns

We assume a PM wants to capture the full movement in BEs. We consider two instruments for removing the nominal yield exposure from a TIPS portfolio: cash nominal Treasuries and Treasury futures contracts.

Capturing BE Returns Using Cash Treasuries

Suppose a PM or a plan sponsor wants to capture BE inflation returns. As changes in BEs would likely reflect changes in the market's expectation for inflation, long exposure to BEs

will add expected inflation exposure as well. Going long TIPS and short nominals gives the investor a long BE position with no exposure to changes in real yields.

To capture returns from absolute changes in BE, the PM will size the trade using analytical durations. The return on the strategy will be:

$$\begin{aligned}\text{Strategy Return} &= \text{Total return TIPS - Total return Treasuries}\\ &\approx -\text{OAD} \times (\Delta\text{real yield}) + \text{TIPS carry} - (-\text{OAD}) \times (\Delta\text{real yield} + \Delta\text{BE}) - \text{Nominal carry}\\ &= \text{OAD} \times \Delta\text{BE} + \text{net carry}\end{aligned}$$

Note that the portfolio is shielded from changes in real rates.

How does a long BE position behave? To examine this, we construct a portfolio of long TIPS and short nominals. We assume the investor goes long a diversified portfolio of TIPS, as represented by the TIPS Index (Series-L).[6] For the nominal portfolio, we construct a well-diversified OAD duration-matched "Nominal Index" of Treasuries that very closely matches the OAD of the TIPS Index. We construct this Nominal Index and its returns as follows:[7]

1. We sort nominal Treasuries into 0.5y non-overlapping OAD buckets and calculate the bucket OAD and monthly returns;
2. For each bond in the TIPS Index, we take its beginning-of-the-month analytical OAD value, and we identify two OAD Treasury buckets that straddle this value and weight them to match the TIPS' OAD;
3. The matching nominal return for this TIPS bond is the weighted average return of the two corresponding OAD buckets; and
4. The Nominal Index return is the weighted average matched nominal return for all TIPS in the Index, using the beginning-of-month market value TIPS Index weights for each TIPS.

The Nominal Index will closely match the analytical duration of the TIPS Index, both at the index level and for each TIPS. Since the Nominal Index uses a wide array of Treasury bonds, there is little idiosyncratic risk. To produce BE returns, we subtract the Nominal Index total return from the TIPS Index total return. As both the TIPS and Nominal Indices are funded indices, we add a 1-month T-bill return to obtain the final BE series. Figure 6 shows the cumulative TIPS Index, Nominal Index and BE returns since January 2005.

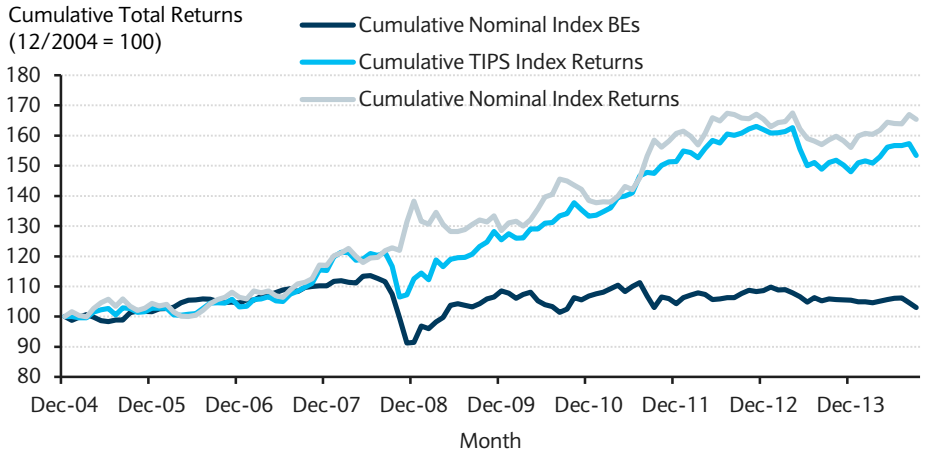
Since January 2005, the TIPS and Nominal Indices have generally tracked each other pretty well (Figure 6). However, we see a pretty dramatic divergence in fall 2008 and early 2009, when TIPS underperformed severely during the financial crisis, but then recovered.

[6] "Series-L" refers to the legacy Lehman Brothers TIPS index. There is also a legacy Barclays TIPS index called "Series-B." Both are available via POINT or Barclays Live. The two differ in terms of whether Federal Reserve TIPS holdings are removed from the index amount outstanding (yes for Series-L and no for Series-B) and the assumed settlement convention (same day for Series-L and T+1 for Series-B). Correlation of monthly returns for Series-L and Series-B has been 0.998.

[7] This is not the only way to represent the nominal portfolio. Alternatively, we could have identified a single nominal Treasury whose maturity was closest to that of each TIPS. This is what the Barclays Comparator Bond Indices do. For example, for each TIPS bond in the US Series-B Index (there is no Comparator Index for Series-L), a nominal Treasury bond is selected whose maturity is closest to the maturity of the TIPS bond. The size of the nominal position is adjusted so as to have the same market value as the TIPS bond's position in the TIPS Index. Then, all the nominal Treasury positions are aggregated to form the Comparator Index. So if the TIPS index has 34 bonds, the Comparator Index will likely have approximately 34 bonds (it could have fewer than 34 if a single nominal bond is used for two TIPS bonds). However, there is no assurance that the OAD of the Comparator Index will match that of the TIPS index, which limits its usefulness for our exercise. At month-end September 2014, the OAD for the Series-B was 8.62, versus 7.50 for its US TIPS Comparator. There are Comparator Bond Indices for many linker markets and they are available via POINT and Barclays Live.

FIGURE 6

Cumulative Total Returns, TIPS Index, Nominal Index, and BEs, January 2005-September 2014



Source: Barclays Research

We also see that BE returns have been very low since 2005. From 2005 up to the crisis, BEs were steadily increasing. However, this rise came to an abrupt halt with the crisis. BEs returns rebounded but have been relatively flat since 2010. Not only have they not recovered to their previous June 2008 peak, but lately they have dipped as investors presumably became less worried about future inflation.

This breakeven series was constructed using a very well-matched Nominal Index consisting of many Treasury bonds. This Nominal Index could be viewed as an idealized nominal portfolio to extract "pure" BE returns from the TIPS Index. In fact, selling the Nominal Index and maintaining this short position over time would indeed be very cumbersome and impractical. To simplify matters, we could have constructed a nominal index that uses one nominal bond per TIPS (ie, the Comparator Index). Even so, as of September 2014, this would still require shorting 34 Treasury positions, in the right ratios to match OADs, and maintaining it over time.

Capturing BE Returns using Mirror Futures

An alternative way to remove the nominal yield curve exposure from a TIPS portfolio is to use a Mirror Futures Index (MFI). As we will show, the TIPS MFI is a convenient and effective way to do so.

An MFI is a basket of Treasury futures contracts and a cash (T-bill) deposit. Each index (or bond) has its own MFI. While many details of the MFI construction methodology are available in our original research publication,[8] we provide a brief review using the TIPS (Series-L) as the example.

To construct the TIPS MFI, we first partition the TIPS Index constituents into five OAD buckets based on the index constituents' beginning-of-the-month (BOM) analytical OAD. We then assign a *single* futures contract to each OAD bucket. Figure 7 shows the five OAD buckets and their assigned futures contracts.

[8] *Barclays Mirror Futures and Duration Hedged Benchmarks*, K Y Ng, B. Upbin, C. Hackel and B. Phelps, Barclays Research, September 2013.

FIGURE 7

Mapping of USD Futures Contracts to OAD Buckets, 29 August 2014

OAD Bucket	Mapped Futures Contract	Futures OAD
[0-3)	TU (2y futures)	2.07
[3-5)	FV (5y futures)	4.40
[5-7.5)	TY (10y futures)	6.56
[7.5-15)	US (bond futures)	11.53
[15+	WN (ultra futures)	16.97

Source: Barclays Research

We compute the MFI weights using the market value contribution to OAD for each of the five OAD buckets and the OAD for the futures contracts:[9]

$$MFI_{\text{futures weight OAD bucket}} = ContrOAD_{\text{TIPS Index OAD bucket}}/OAD_{\text{futures}}$$

The actual number of contracts depends on the price of the futures and the notional contract amount.

Futures contracts are unfunded instruments, so we assume each MFI futures position has a companion 1m cash deposit (T-bill) with zero duration. If the total cash deposit position in an MFI does not equal the total market value of the corresponding index, a cash "stub" position (either positive or negative) is included in the MFI. This ensures that the MFI weights sum to 100%.[10]

The month-to-date (MTD) return of an MFI futures position is calculated by dividing the current closing futures price by the BOM closing futures price and subtracting 1.0. This is the MTD return on a $1 implied market value futures position. It is sometimes called the unfunded futures return. To this unfunded return we add the MTD return on the funding position to arrive at the futures position's MTD total return. We sum these funded returns across all the positions in an MFI, applying their respective BOM MFI weights, to compute the MTD MFI total return (Figure 8).

FIGURE 8

Month-to-Date US TIPS (Series-L) Mirror Futures Index Total Return, 29 August - 30 September 2014

Futures Contract	MFI Weights (%)	MTD Return (%)
TUH4	18.31	-0.0918
FVH4	15.44	-0.4856
TYH4	18.28	-0.9059
USH4	33.28	-1.5605
WNH4	11.58	-1.9284
USD T-bill	3.11	0.0009
MTD TIPS MFI Return	100.00%	-1.0000% (or, -100.0bp)

Source: Barclays Research

MFI returns are not adjusted for margin or transactions costs. The opportunity cost of initial margin is also ignored, as is any opportunity cost/gain from the month-to-date variation margin. In addition, we assume the month-end price equals the closing exchange price, so we make no allowance for any slippage between a closing price that an investor might realize and the closing exchange price.

[9] USD Futures OADs are computed using the Barclays Futures Model, which models potential changes in the yield curve and estimates a new CTD bond for each possible change. For details, see *US Treasury Bond Futures Model Update*, POINT, Barclays Research, 19 March 2012.

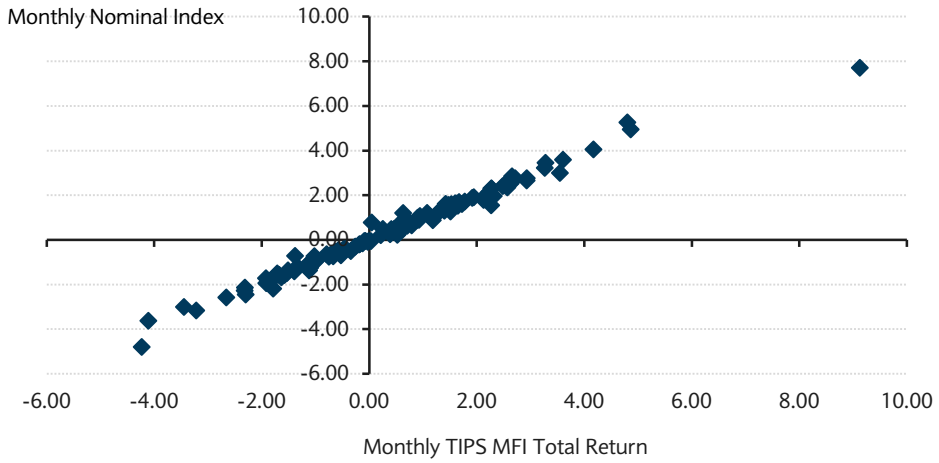
[10] TIPS MFI constituents are available via Bloomberg. We also publish the MFI for the Series-B TIPS Index.

As we will show, the TIPS MFI offers an opportunity to remove nominal Treasury duration exposure in a very easy, effective, and economical fashion.

The key question is how well the TIPS (Series-L) MFI tracks the Nominal Index, which is our idealized representation of a carefully constructed OAD-matched nominal Treasury portfolio. Figure 9 shows that the two portfolios track each other well (monthly correlation = 99.3%). Since January 2005, the average monthly return difference between the two has been 1.5bp, with a standard deviation of 24.4bp. The worst return differences occurred during the financial crisis. Excluding September 2008-March 2009, the average return difference has been 1.2bp, with a standard deviation of 16.7bp.

FIGURE 9

Monthly Nominal Index Total Returns vs. TIPS MFI Total Returns, January 2005-September 2014

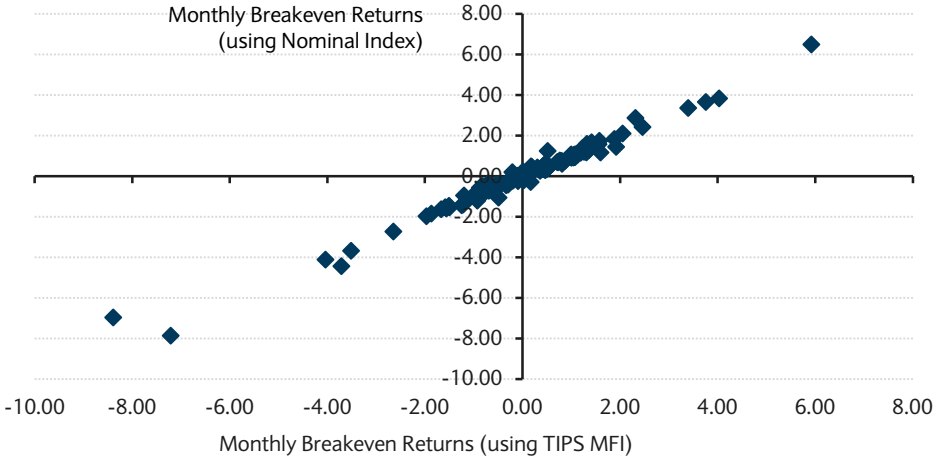


Source: Barclays Research

The close tracking of MFI and Nominal Index total returns will also be reflected in the close tracking of their corresponding BE return series (Figure 10). Clearly, TIPS MFI is an efficient and effective way to capture BEs.

FIGURE 10

Monthly Breakeven Returns: TIPS MFI vs. Nominal Index, January 2005 – September 2014



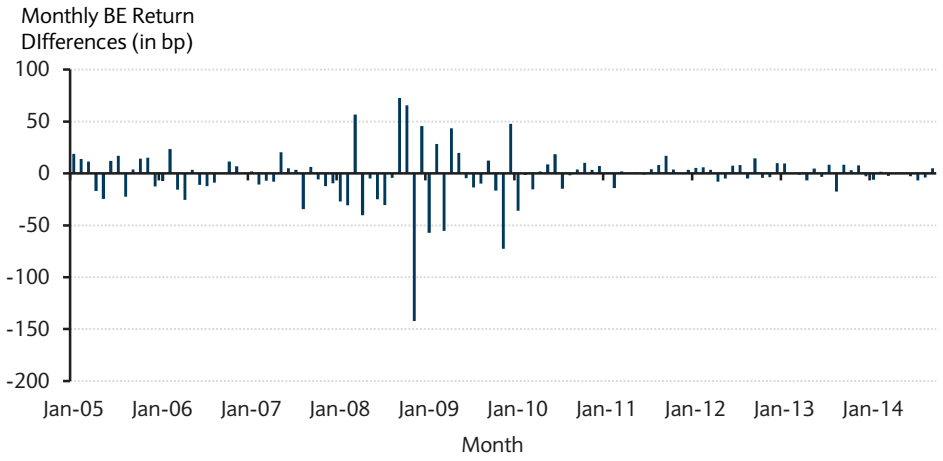
Source: Barclays Research

Figure 11 shows the monthly BE return differences between using Treasury futures and the cash Nominal Index. As shown, return differences were large during the 2008-09 crisis because of the volatility in the cash-futures basis. Since the crisis, however, they have been

very small. They were small before the crisis as well, but were somewhat larger than post-2008. This was likely because of the relatively small number of bonds in the TIPS Index and the more limited ability of the available Treasury futures contracts to match closely the full nominal Treasury curve exposure of the TIPS Index.[11] Nevertheless, while tracking has been good for most of the data period, there is always the possibility of a disruption that could lead to a repeat of the poor tracking performance of 2008-09.

FIGURE 11

Monthly Return Differences, MFI BEs vs. Nominal Index BEs, TIPS (Series-L), January 2005-September 2014



Source: Barclays Research

Just as effectively, TIPS MFI can be used to create a short BE exposure (ie, expected deflation). An investor can short a TIPS portfolio, provided that the bonds already have a substantial inflated price, and go long the TIPS MFI.

Capturing Realized Inflation

A long TIPS/short duration-matched nominal Treasury portfolio gives investors exposure to changes in breakeven spreads. However, such a strategy does not necessarily lock in realized inflation. Breakevens can change for reasons other than changes in the market's inflation expectations (eg, changes in the liquidity environment). Furthermore, the market's inflationary expectations may not be realized.

A portfolio constructed to capture changes in breakeven spreads will not serve an investor who wants realized inflation protection over, say, the next five years. Investors worried about realized inflation over a specific holding period need to match the duration of the breakeven exposure with their horizon.

One potential strategy is to enter into a CPI swap that will pay the realized CPI return over its term. Another is to hold TIPS and short nominals with the duration equal to the desired inflation protection horizon. Such a strategy should produce a return equal to subsequent realized inflation *less the initial breakeven BE*. In other words, the gain/loss on the strategy should be directly related to movements in realized inflation over the holding period.

Strategy Return = Total return TIPS portfolio - Total return nominal portfolio

= initial real yield + realized inflation - (initial real yield + initial BE)

= realized inflation - initial BE

[11] The long Ultra futures contract was not introduced to the MFI basket until March 2010.

As discussed above, shorting cash nominal bonds may be difficult or inconvenient, so we also investigate whether a long TIPS/short Treasury futures strategy can capture subsequent realized inflation.

Capturing Realized Inflation Using Treasury Bonds or Futures

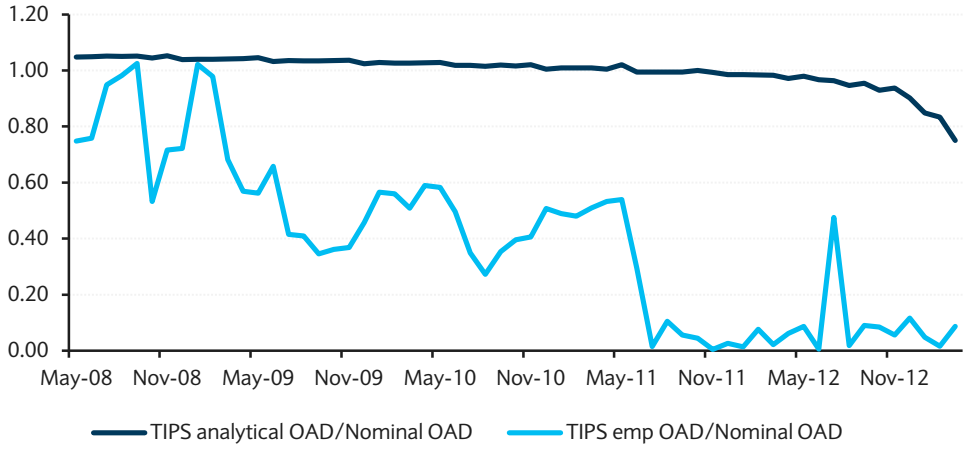
On April 30, 2008, assume that an investor wants to go long realized inflation over the next five years. The investor buys the TIPS 0.625% of April 15, 2013 (912828HW). At the time of purchase, the real yield = 0.826%, Price = 99.024, current BE = 2.153%, and analytical nominal duration = 4.86. The closest matching maturity Treasury bond at the time is the 3 1/8% of April 30, 2013 (912828HY) with an OAD equal to 4.64.

To remove the nominal yield exposure, we assume the investor shorts either the cash Treasury note or Treasury futures. In the case of cash, we use the ratio of the cash bond OAD to the TIPS duration to determine the short position in the cash Treasury note. For the futures, we assume the investor shorts the two futures contracts whose OADs straddle the TIPS duration. The relative weights of the contracts are such that the weighted futures OAD matches the TIPS duration.[12] We rebalance the futures positions monthly and roll the contracts at the end of the month prior to expiration (quarterly roll).

Figure 12 shows the duration ratios – TIPS OAD/Nominal OAD and TIPS empirical OAD/ Nominal OAD – over the five-year life of the bonds.[13] Figure 12 highlights how volatile TIPS empirical durations can be. The ratio of the TIPS empirical duration hedge ratio ranged from zero to slightly above 1.0. In contrast, the ratio of the TIPS analytical duration to the OAD of the nominal Treasury remained close to 1.0 until just before maturity.

FIGURE 12

Monthly Strategy Duration Hedge Ratios, 5y TIPS and 5y Nominal Treasury, May 2008-March 2013



Source: Barclays Research

For our example, we assume the investor wishes to gain or lose to the extent that realized inflation exceeds or falls short of the initial BE. Consequently, we use TIPS analytical duration to size the trade. For comparison, we also report the strategy's performance assuming the investor used TIPS empirical durations.

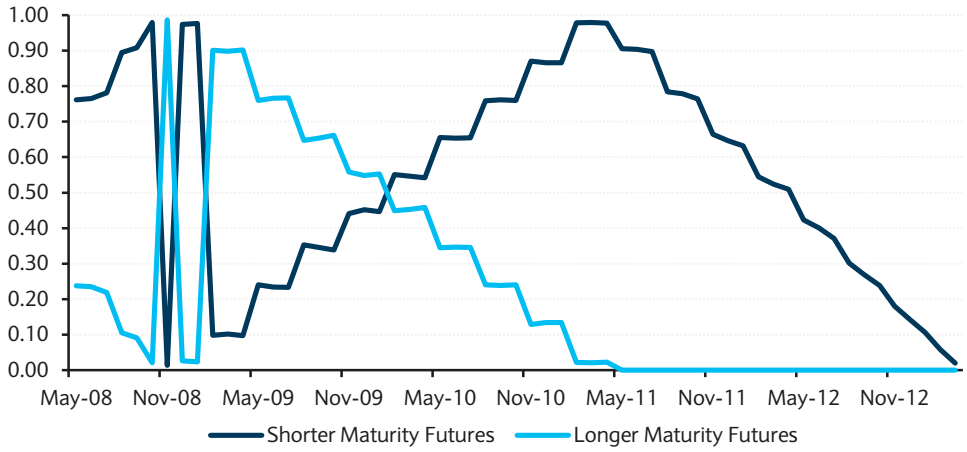
[12] If the OAD of the shortest-maturity futures contract is greater than the TIPS duration, we construct a combination of T-bills and that futures contract.

[13] For the Empirical OAD, we used the value from POINT. This empirical duration is estimated by constructing a min-variance portfolio of 5y, 10y and 30y TIPS bonds using 60 days of returns history and is available in POINT under "Empirical OAD". For more information see *Risk Characteristics of TIPS Compared to Nominal Treasury Securities*, P. Vankudre and P. Lindner, Lehman Brothers, May 1997. This paper originally included the 3y Treasury in the min-variance portfolio.

To maintain the proper short nominal Treasury futures position (using analytical durations), one needs to rebalance the futures. Figure 13 shows the monthly relative futures positions over the life of the strategy. During the crisis, when yields fell sharply, analytical durations rose, which produced volatility in the allocation across the two futures contracts. Overall, however, the strategy gradually increased its use of the shorter futures contract (initially the FV, then the TU) and reduced its use of the longer futures contract (initially the TY, then the FV) as the TIPS neared it maturity date.

FIGURE 13

Monthly Strategy Treasury Futures Weights, Analytical Durations, May 2008-March 2013



Source: Barclays Research

For our example, the holding period is 59 months: May 2008-April 2013. By month-end April 2013, we have:

- TIPS annualized total return = 2.64%
- Realized inflation annualized return = 1.73%
- Nominal Treasury (OAD-matched) annualized total return = 3.09%
- Nominal Treasury (EmpDur-matched) annualized total return = 1.75%
- Treasury futures (OAD-matched) annualized total return = 3.32%
- Treasury futures (EmpDur-matched) annualized total return = 2.07%

The returns on the strategy were:

- Using analytical duration: The cash strategy's annualized return was -51bp and the futures strategy's return was -72bp. Realized inflation (1.73%) was less than BE at the initiation of the strategy (2.15%). The realized return should be closely related to the degree that realized inflation was less than the initial breakeven inflation (1.73% - 2.15% = -42bp). In other words, as the realized inflation was less than the initial BE the strategy should have lost money – and it did. The futures strategy's return was worse than the cash strategy because the futures basket return outperformed the underlying nominal Treasury return.[14]
- Using empirical duration: The cash strategy's annualized return was +85bp and the futures strategy's return was +53bp. This is a bit of a surprise. As discussed, scaling the nominal

[14] For details on futures-based replication and the drivers of tracking errors versus cash indices, see *Futures-Based Excess Returns*, K. Y. Ng and B. Phelps, Barclays Research, December 2014.

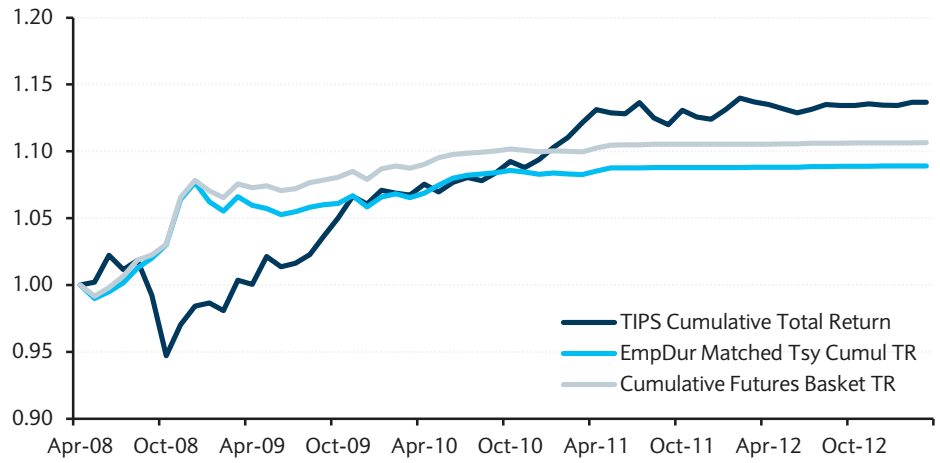
Treasury position by the TIPS' empirical duration should provide a total return hedge, assuming that the estimated empirical duration matched the realized empirical duration. But the TIPS return of 2.64% exceeded the 1.75% total return on the EmpDur-matched cash Treasury bond. Why did the TIPS outperform the nominal Treasury?

Figure 14 shows the time series of returns for the TIPS bond and its EmpDur-matched Treasury bond. There were two distinct periods when the returns diverge. The first is the crisis period and subsequent recovery. TIPS performed very poorly, much worse than their empirical duration would predict. Nominal yields declined, but BEs fell sharply as investors shunned the TIPS market. Consequently, TIPS underperformed their EmpDur-matched Treasury but recovered as the crisis ebbed. The next period is December 2010 to May 2011, when nominal yields fell by almost 30bp but BEs *increased* by 40bp. During this period, the estimated β_{BE} was approximately +0.50. BEs increased much more than expected based on their assumed correlated movement, producing TIPS outperformance that persisted until maturity.

While the TIPS outperformed the EmpDur-matched cash Treasury position by +85bp, the outperformance versus the EmpDur-matched futures portfolio was less, at +53bp, because of the futures position outperforming the nominal Treasury bond.

FIGURE 14

Cumulative Strategy Returns, TIPS vs. EmpDur-Matched Cash Treasury and Futures, May 2008-March 2013



Source: Barclays Research

Treasury futures can be used to gain exposure to realized inflation over a desired holding period. Our example used a single TIPS bond, but investors can use this approach with a basket of TIPS of a targeted maturity range.

Conclusion

Investors often hold TIPS to shield their portfolios from inflation. But historically, as inflation rises, real yields tend to rise as well. This often leads to TIPS' disappointing absolute performance. Instead, investors should have positive exposure to breakeven spreads, ie, the difference between nominal yields and real yields, by establishing a long position in TIPS and a short position in nominal Treasuries.

Investors who want full exposure to movement in BEs can set the size of the long/short trade by scaling the nominal Treasury duration to match the TIPS duration. Generally, analytical duration should be used to size the trade, but empirical duration can also be used

under certain assumptions. As shorting a large number of nominal Treasuries may be inconvenient, an MFI (mirror futures index, a futures-based basket) is a useful alternative because of its excellent tracking record to nominal Treasuries. An MFI is easy to construct and is tradable.

Lastly, investors who want to capture realized inflation over certain period often go long TIPS and short nominal Treasury of the same maturity. We show that replacing cash bonds with Treasury futures may achieve a similar result.

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