

TREASURY INFLATION PROTECTED SECURITIES: NEW PERSPECTIVES ON THEIR SIGNIFICANCE TO PORTFOLIOS

Ron D'Vari, Ph.D., Managing Director, State Street Research & Management
Lal C. Chugh, Ph.D., Professor of Finance, University of Massachusetts, Boston

ABSTRACT

The paper analyzes Treasury Inflation Protected Securities (TIPS), one of the new instruments offered in capital markets. TIPS have not received adequate attention to date from academic researchers. More importantly, TIPS role in expressing views on real rate fluctuations have not been emphasized. This paper takes a different approach than the classical portfolio diversification and efficient frontier approaches to justify the need for TIPS. We offer a framework based on utility in expressing views by active fixed income money managers under various economic scenarios. This intertemporal framework is distinct from static asset allocation view point. We offer new perspectives on the risk-reward of TIPS under possible growth and inflation scenarios. The examination of price sensitivities and cash flows of TIPS, floating-coupon bonds, and fixed coupon nominal bonds allows for arguing that TIPS are “market completing”, and hence useful to investors. We further illustrate that TIPS offer additional flexibility to active fixed income portfolio managers to take independent and divergent views on inflation and expected real growth.

INTRODUCTION

Several new securities have been created in the U.S. financial system within the last two decades. Examples are asset-backed securities, strips, puttable common stock, tracking stock and preferred equity-redemption cumulative stock (PERCS). Such innovations have received attention in the academic and business literature. However, one innovation in the U.S. Treasury securities market – issuance of Treasury Inflation Indexed Securities (TIIS) or more commonly called Treasury Inflation Protected Securities (TIPS) – has not been given enough scrutiny by the academicians or business periodicals, even though such securities were first issued by the U.S. Government in January 1997. While there has been some focus on inflation protection characteristics of TIPS, not much mention has been made of its potential as a “deflation hedge”. Inflation protected securities were not new in the global financial system. Countries such as U.K., Canada, Israel, Turkey, and New Zealand had issued such securities before. Since 1997,

the U.S. Treasury has offered ten specific TIPS issues with maturities of 5, 10, and 30 years. Currently, TIPS are about 5% of the total outstanding value of the U.S. Treasury debt and the daily trading volume of TIPS is about 2% of the total trading volume of U.S. Treasuries.

This work attempts to provide a more comprehensive perspective on risk-return characteristics of Treasury Inflation Protected Securities (TIPS) under different economic scenarios, including deflationary, inflationary, growth and slowdown. Early research has focused on diversification benefits of TIPS in portfolios, but has found them to be dependent on the inflationary characteristics of the particular countries. The main purpose of this paper is to provide a consistent set of arguments and concepts that lead to a systematic rationalization of TIPS in the portfolios-based market completeness. The analysis provided hinges on a full anatomy of real and nominal interest rates focusing on expected real rate, expected inflation, and variety of risk premia. In order to analyze the market completeness, behavior of floating and fixed-coupon nominal bonds are compared to TIPS under various economic scenarios. This paper expands on the reasons for TIPS being market-completing instrument, and hence its legitimate role in portfolio diversification. Investors view new instruments in their portfolios from marginal contribution to risk and reward, hence the need for partial return sensitivities to common factors such as inflation and changes in real rate. Collectively, these concepts lead to a systematic rationalization on the use of TIPS in portfolios.

This paper is organized into five sections. The first section, in order to lay the foundation, describes the anatomy of nominal interest rates and components above and beyond expected inflation and real interest rates. The second section introduces the design of inflation protected securities and its implications for valuation and portfolio-building. The third section analyzes the relative performance of TIPS to other securities such as fixed coupon securities and floating rate securities under different economic scenarios. The fourth section describes the market completing role of TIPS. The final section provides a summary of the paper.

ANATOMY OF NOMINAL INTEREST RATES

Nominal interest rates are composed of:

- (i) **Expected Real Rate:** This is determined by consumption- investment decisions and the growth of real economic activity. Higher the expected growth rate, higher the expected real rate.
- (ii) **Expected Inflation Rate:** This is a concept well described by Irving Fisher.
- (iii) **Risk Premium:** Overall risk premium consists of several components:
 - a) **Unexpected Real Rate Premium:** The real rates fluctuate and create uncertainty/risk. Investors expect a premium based on the volatility of real rates, i.e. the unexpected real rate. Longer the maturity, the higher price risk for the same level of real rate volatility, hence described as maturity premium in some literature.
 - b) **Inflation Risk Premium:** Investors expect a premium because of uncertainty in inflation.
 - c) **Liquidity and Credit Risk Premia:** Investors demand to be compensated for low liquidity and higher credit risk.
 - d) **Convexity Bias:** Bond prices are nonlinear function of yield to maturity even when they contain no embedded options. Prices of positively convex securities drop marginally less with increasing yield and appreciate marginally more with decreasing yield. Hence, investors value this feature and are willing to sacrifice some yield for higher convexity characteristics. Convexity becomes even more attractive in volatile environments. The convexity bias is an increasing function of maturity and increases approximately at the quadratic rate with maturity.

- e) ***Discount/Premium for Embedded Options:*** Investors will pay for embedded options purchased, and require to be compensated for embedded options given up.
- f) ***Tax Effects:*** Tax treatment of coupon and principal will influence the rates charged by bond investors.

Exhibit I illustrates all the components of the nominal interest rates.

Fisher effect concentrates only on (i) and (ii). U.S. Treasury Securities are not deemed to have credit risk. The market treats the credit risk of the Treasuries as insignificant. Therefore, investors in nominal rate Treasuries have to value five components: 1) expected real yield, 2) expected inflation, 3) unexpected real yield risk premium, 4) unexpected inflation premium, and 5) other risk premia. TIPS attempt to address only one form of risk – inflation. In doing so, this component no longer has to be factored in the price. It may seem, at a first glance, that there is less estimation error in the coupon by investors (because of protection against inflation) and fewer opportunities for total return investors. However, there are two other factors with implications for the risks in TIPS. The productivity of capital fluctuates in natural conditions, so the expected real yield would fluctuate over time with some degree of uncertainty. Secondly, since there is no perfect gauge of inflation, there should still be some inflation risk premium charged for the “inflation basis risk”.

Since TIPS are a small percentage, both in trading volume and outstanding value of the U.S. Treasury Securities, they trade with a liquidity premium. Liquidity premium may vary significantly with time but averages about 25 basis points¹, in the opinion of the authors, above the yield on nominal fixed-coupon U.S. Treasury securities.

¹ A thorough estimate of different risk premia is beyond the scope of this paper but is the subject of ongoing research.

DESIGN OF TIPS

TIPS were issued with the goals of (a) providing a new security for investors who wanted protection against inflation and (b) reducing borrowing cost for the U.S. Treasury, as these securities will not include inflation risk premium in contrast to conventional nominal coupon securities which carry inflation risk premium. There is no empirical evidence that TIPS have reduced the U.S. Treasury's borrowing cost, as the liquidity premium on TIPS has so far exceeded the unexpected inflation risk premium. Therefore, the paper will focus on the design of TIPS and its "market-completing" function. The following describes the basic features of TIPS that are relevant for discussion in this paper:

- i) TIPS are issued with a fixed real coupon.
- ii) The principal will be adjusted by an Index Ratio. Index Ratio will be calculated as 3-month lagged non-seasonally adjusted CPI-Urban (CPURNSA) on settlement date divided by the Reference CPI, i.e. 3-month lagged CPURNSA on issuance date. Therefore, semiannual payments (cash flows) will be principal multiplied by Index Ratio and then multiplied by real coupon rate. During periods of inflation, index ratio will be greater than one and hence semi-annual payments will compensate for inflation. During periods of deflation, Index Ratio will be less than one and semi-annual payments will be reduced. The U.S. Treasury opted for not-seasonally adjusted CPI-Urban of all items for the inflation measure rather than other indices such as Core CPI which excludes more volatile energy and food prices, Producer Price Index (PPI), or Employment Cost Index (ECI). By choosing CPI-Urban NSA, the Treasury makes TIPS more attractive to individual/retail investors. Adoption of Employment Cost Index would have made TIPS more attractive to defined benefits pension manager, as the pension benefits depend upon wage increases. Similarly, corporate treasurers would have preferred Producer Price Index (PPI) to protect them against the commodity inflation. CPI-Urban (all items) in contrast to CPI-Core

makes semi-annual payments more volatile, but provides more protection against inflation.

TIPS provide protection against lagged inflation rather than contemporaneous or expected inflation. Therefore, there is never full protection against inflation in TIPS.

- iii) At the time of maturity, the principal is adjusted by the Index Ratio to compensate for inflation. However, the U.S. Treasury guarantees full payment of the original face value despite any deflation. Semi-annual cash flows can increase or decrease depending upon inflationary or deflationary environment, whereas principal at maturity can increase with inflation, but cannot decline with deflation. Therefore TIPS provide “Inflation Hedge” on the cash flows and the principal. In addition, TIPS provide “Deflation Hedge” on the principal. Conventional bonds do not provide hedge against unanticipated inflation on either cash flows or principal, but do provide “Deflation Hedge” on both.
- iv) The semi-annual cash flows (including inflation adjustment) would be taxed as ordinary income. Therefore, the semi-annual cash flows, during periods of high inflation could mean a higher tax burden with progressive tax system and the after-tax real cash flow could be negative. Conventional bonds have built in anticipated inflation premium and therefore investors plan on paying taxes with or without inflation; whereas TIPS investors will pay taxes on inflation premium only after inflation has taken place. Given the uncertainty of inflation, long-term tax planning is more difficult with TIPS than with conventional bonds.
- v) Cash flows from TIPS will increase with and after inflation, whereas conventional bonds, with embedded inflation premia, get more cash flows earlier and before inflation. Therefore, the duration of conventional bonds is shorter than that of TIPS. However, it does not mean that TIPS will be more volatile than conventional bonds. Volatility of TIPS will depend upon the volatility of real interest rate, whereas the volatility of conventional bonds will depend upon the volatility of nominal rates (composed of real rate, inflation rates, and other premia). Generally speaking, nominal rates are more volatile than the real

rate and hence conventional bonds are likely to be more volatile. However, during periods of stable inflation and high cyclical real activity, TIPS could become more volatile.

There are other models of designing inflation index notes: 1) “Interest Indexed” which indexes coupon payments with inflation but not the principal; 2) “Zero Coupon Inflation Bond” which compounds at variable inflation rates and a constant real rate; 3) “Indexed Annuity” offers an annual payment that is indexed to inflation. Zero Coupon bond offers the most inflation hedge and the Interest Indexed offers the least. The U.S. model is referred to as “Capital Indexed” which offers better protection against inflation than some of the other designs.

The characteristics of the U.S. TIPS make them valuable especially to retail investors who want to hedge against inflation the interim cash flows as well as the principal, and care for the safety of their principal under deflationary conditions. However, such investors will experience reductions in their nominal cash flows under deflationary conditions and possible reductions in real cash flows under inflationary and escalating tax brackets situations. Whereas investors in conventional bonds will not experience any reduction in nominal cash flows, but reductions in real cash flows under inflationary conditions. Investors who are betting on stagflation – low growth and high inflation – would be interested in TIPS, as low growth and lower real rates will enhance the price of TIPS and simultaneously provide inflation protection. On the other hand, conventional bonds are desirable for investors who are betting on declining inflation and low growth, as both will combine to raise the price of conventional bonds. TIPS are tailored for a different set of investor expectations in contrast to conventional bonds and hence TIPS are “market completing”. The paper discusses this aspect of TIPS in more detail later on.

RELATIVE PERFORMANCE OF TIPS AND ECONOMIC SCENARIOS

In order to analyze the role of TIPS in portfolios, the paper compares risk/reward characteristics of TIPS with other bond instruments, i.e. fixed coupon nominal bonds and floating coupon bonds. The risk/return characteristics of these instruments are examined in terms of marked-to-market pricing.

PRICE SENSITIVITY EFFECTS

Prices of nominal fixed-coupon bonds, floating-coupon bonds, and TIPS vary with expected inflation, expected real rates (real GDP), and changes in risk premia. When examining price sensitivity of TIPS (derivative or duration), one can focus on “direct” or “partial” derivative or “total” derivative/ sensitivity inclusive of all secondary interaction terms. An increase in the inflation rate will lower the price of fixed coupon bond, even when real rate and other risk premia stay constant, This is an example of “direct” or “partial” sensitivity. If higher rate of inflation causes an increase in growth rate and hence real rate, the impact on the price of fixed coupon bond would be larger and would be an example of “total” price sensitivity. The combinations of different GDP growth rates and price changes form various economic scenarios, and investors are most interested in the “total” price response which can be observed, as opposed to “partial” sensitivity which is not directly observable.

Assuming that real rates are positively correlated to the inflation rate and short floating rates adequately compensate investors for ongoing real rate adjustments, Exhibit II summarizes “direct” and “total” sensitivity of various instruments to inflation, real interest rate, and nominal interest rates:

Exhibit II : Price Sensitivities (duration) of Various Bond Instruments to Inflation, Real Interest Rate, and Nominal Rate Changes†.

	INFLATION		REAL RATE		NOMINAL RATE	
	Partial	Total*	Partial	Total*	Partial	Total*
Floating-Coupon Bond	0	0	0	0	0	0
Fixed-Coupon Bond	Inverse	Inverse	Inverse	Inverse	Inverse	Same as Partial
TIPS	0	Inverse	Inverse	Same as Partial	0	Inverse

† Inverse sensitivity is equivalent to positive duration.

* Total sensitivities assume that real rates are positively correlated to the inflation rate and short floating rates adequately compensate investors for ongoing real rate adjustments.

It is worthwhile to take a look at some specific cases in Exhibit II as it could offer additional insights to more expanded use of TIPS in portfolio applications. Mathematically, prices of TIPS stay unaffected with inflation changes, if real rates are artificially held unchanged, hence zero partial sensitivity to inflation. However, in real life when inflation increases, the real rates tend not to remain constant. More frequently, inflation increases are accompanied by increases in real GDP and, in turn, expected real rates. Therefore, the “total” price sensitivity of TIPS to inflation is inversely related as well through changes in expected real rates. Investors who use TIPS “naively” as a hedge against inflation relying only on “partial” sensitivity, could become disenchanted when they discover that from a marked-to-market standpoint their positions have not been “perfectly hedged” against inflation. Therefore, from this discussion it is not necessarily obvious that TIPS are best in times of moderate inflation that accompanies moderate growth.

Similarly, the “direct” price sensitivity of TIPS would be zero to a decrease in inflation, provided that real rates were held constant. Consider a situation following right after an economic expansion where there is a slow down in economy with inflation trending down, an environment following 2nd quarter of 2001 to present. A “naïve” view of TIPS, which relies on

only “partial” price sensitivity, would indicate that TIPS are not necessarily a good investment under conditions of slowing down of inflation. However, if you consider the “total” price impact, including real rate changes, TIPS of longer maturities with greater sensitivities to real rate will be highly desirable in one’s portfolio during conditions of slowing down of inflation. In fact, TIPS were one of the best performing assets in 2001 and 2002. The key driver has been not inflation but lower expected real rates. The real rate on 10 and 30 year TIPS has gone from a high of 4.40% close to 3.30%.

The pure government floating rate instruments² (none issued in the US) will not be “direct” sensitive to inflation, real rate, and nominal rate changes, as the short term rates will reflect inflation and real rate changes. However, it is possible that liquidity premium for long term bonds may adjust during periods of steep nominal yield curve. There may be a modest “total” sensitivity. The nominal fixed coupon bonds have an inverse “total” sensitivity to inflation, real rate, as well as nominal rate. Interestingly, TIPS also have an inverse “total” relationship to inflation and real rate changes. The “naïve” view which focuses on “partial” sensitivity suggests that TIPS have no price sensitivity to inflation. However if one considers the “total” sensitivity including growth and real rate change accompanying inflation, TIPS will have an inverse relationship to inflation. Exhibit III summarizes relative price performance/instantaneous returns of various types of bonds. Nominal bonds perform best under lower real growth and lower inflation, whereas TIPS will dominate in performance under lower growth but higher inflation.. Under higher expected growth environment, floating rate instruments are expected to perform the best amongst the three types of bonds.

² There are no full faith and credit of U.S. government floating rate instruments at this time. However, there are government sponsored enterprise floating securities that often has additional features, such as call or cap.

Exhibit III : Instantaneous returns under various real growth and inflation scenarios.

INSTANTANEOUS RETURNS		
	HIGHER GROWTH	LOWER GROWTH
HIGHER INFLATION	NOMINAL FIXED < TIPS < FLOATING	NOMINAL FIXED < FLOATING < TIPS
LOWER INFLATION	TIPS < NOMINAL FIXED < FLOATING	FLOATING < TIPS < NOMINAL FIXED

MARKET COMPLETENESS ROLE OF TIPS

In order to see whether TIPS are “Market Completing”, one has to identify specific set of investor expectations such that TIPS will meet the goals of maximizing returns for such investors. Furthermore, floating rate bonds and fixed coupon nominal bonds will not meet the needs of such investors and not maximize their returns. One can reasonably assume that investors and active fixed income asset managers form “views” on expected inflation and expected growth rate affecting the real rate. Investor expectations which conform to the generally accepted or consensus forecasts can be defined as “no views”, because market consensus forecasts are already embedded into the price of bonds. Whereas investors who have different expectations from the market have “views”, and hence such investors will reallocate their portfolios to maximize their returns. The reallocation may involve more or less of TIPS relative to other securities.

Exhibit IV summarizes the ability of three types of instruments to express directional “views” on inflation and growth .

Exhibit IV: Usefulness of instruments in allowing investors to express explicit “views” on real growth and inflation

INSTRUMENT	Usefulness in Expressing Views on Rate of Change	
	GROWTH	INFLATION
Floating-Coupon Nominal Bond	Not Useful	Not useful
Fixed-Coupon Nominal Bond	Useful	Useful
TIPS	Useful	Not Useful

To illustrate, active investors who have “views” on real growth rate and real interest rate, but with “no views” on inflation could use TIPS to capitalize on their “views”. If the investors believe that the growth rate of GDP is likely to be lower than the market forecast, these investors will allocate more assets towards TIPS. TIPS would be of great value to investors who have “views” of higher inflation and lower growth (than the market) such as stagflation of late 1970’s and early 1980’s. Investors with “views” of stable inflation and moderate to high real growth, such as mid 1990’s, will not do well with TIPS. Investors who have “views” of stable inflation and lower growth rate will also stand to gain from TIPS. At times, the drivers of growth and inflation could take on different paths. Hence, TIPS offer unique opportunities to investors with explicit “views” on real growth but not on inflation. Therefore, TIPS play a useful role in completing the markets.

Investors with “no views” on inflation and growth would gravitate towards floating rate bonds. Such investors will be hedged against unexpected fluctuations of both. Therefore, floating coupon bonds will not be useful to active investors who want to capitalize on their “views” on inflation and growth changes not yet incorporated into the prices by the market.

Active investors who have views on changes to both real growth and inflation not yet expected by the market could use fixed coupon nominal bonds to increase or reduce their exposures depending on their views.

Therefore, fixed income managers, who have views on real growth rate (real rate), but have no explicit views on inflation, which are different from the market, could use TIPS to capitalize on their views. Whereas, floating and fixed coupon nominal bonds will not allow fixed income managers to express explicit views on real growth combined with no views on inflation. Therefore, TIPS will serve an important role in completing the market.

CONCLUSION

The paper has analyzed one of the new instruments offered in capital markets. TIPS have not received adequate attention to date. More importantly, TIPS role in expressing views on real rate fluctuations have not been emphasized. This paper takes a different approach than classical portfolio diversification and efficient frontier approaches to justify the need for TIPS. We offer an expanded perspective on the risk-reward of TIPS under possible growth and inflation scenarios. We offer a framework based on utility in expressing views by active fixed income money managers under various economic scenarios. This intertemporal framework is distinct from static asset allocation.

We find TIPS offer additional flexibility to active fixed income portfolio managers to take independent and divergent views on inflation and expected real growth. Fixed income managers, who have views on real growth rate and real rate, but have no explicit views on inflation, can use TIPS to capitalize on their view beyond the opportunities provided by floating and fixed coupon nominal bonds. Therefore, TIPS will serve an important role in completing the market by providing additional opportunities to maximize their intertemporal total return.

BIBLIOGRAPHY

1. D'Vari, Ron, "Inflation Bonds – A Risk-Free Asset", Derivatives Week, Institutional Investor, Inc., July 19, 1996.
2. D'Vari, Ron; "Relative Value of Inflation Bonds", Derivatives Week, Institutional Investor, Inc., December 16, 1996.
3. Roll, Richard; "U.S. Treasury Inflation Indexed Bonds: The Design of a New Security", Journal of Fixed Income, December 1996.
4. Holtz, Piet, M.A.,", Journal of Fixed Income, Dember 1993
5. Shen, PU & Corning, Jonathan, "Can TIPS Help Identify Long Term Inflation Expectations?" Economic Review, Federal Reserve Bank of Kansas City, vol. 86, No. 4, 2001.

Exhibit I: Anatomy of nominal interest rates

