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## *Inflation-Protected Bonds*

*March 2001*

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### *Overview*

In 1997, the US Treasury introduced inflation-protected bonds, called Treasury Inflation-Protection Securities (TIPS). These securities guarantee investors a real (after-inflation) rate of return if held to maturity, thereby providing protection against unanticipated increases in inflation—the greatest source of risk for traditional bondholders.

Currently, 10-year TIPS are offering a real yield of approximately 3.3%. The prospect of a 3.3% guaranteed real return (assuming bonds are held to maturity) is attractive. Inflation will have to be below 1.5% over the next 10 years for a traditional 10-year Treasury bond to offer a 3.3% real yield. Historically (since 1926), long Treasury bonds have generated a real return of just over 2%, while T-Bills have earned less than 1% in real terms.

Over the long-term, TIPS can play a valuable role in a diversified institutional portfolio. They offer protection against unanticipated increases in inflation. This is a valuable attribute because inflation can have an adverse effect on both investment portfolios and operational needs. While inflation has been benign over the past several years, it may unexpectedly emerge again in the future. High bouts of inflation can result in poor portfolio performance, just as needs from the portfolio increase to maintain purchasing power.

Due to the inflation protection offered by TIPS, they should outperform traditional bonds during periods of increasing inflation expectations. During periods of decreasing inflation expectations, TIPS should underperform traditional bonds.

### *Comparison of TIPS and Traditional Treasury Bonds*

Traditional risk-free bond interest rates for a given time horizon are comprised of three components: (1) required real interest rate, (2) expected inflation, and (3) inflation risk premium. The required real interest rate reflects the return investors require on a risk-free investment, net of inflation. The supply and demand for money, economic growth, and the current account balance are factors that influence real interest rate levels. Generally, required real interest rates increase with the time horizon, as investors are compensated for accepting greater exposure to the risk of changes in real interest rates. Expected inflation is the inflation rate the market expects over the time horizon. It must be included in the nominal interest rate for investors to recover the loss in purchasing power due to the eroding effects of inflation. Finally, the inflation risk premium is the return that investors in

traditional bonds should require for taking the risk that they have underestimated the actual inflation rate.

TIPS differ from traditional bonds in that their interest rate is comprised only of the required real return. TIPS recoup inflation through the indexation of the principal and interest to the actual inflation rate. The Consumer Price Index (CPI) is used to adjust the interest and principal for TIPS. Unlike traditional bonds, the principal value fluctuates with inflation. At maturity, the Treasury pays back the inflation-adjusted principal, rather than the original principal. The coupon rate is paid as a percentage of the adjusted principal amount. In this way, the coupon payment increases with inflation, along with the principal amount.

The calculation of the principal amount is relatively straightforward. The current CPI level is divided by the CPI level at the time of issuance and multiplied by the original principal amount.<sup>1</sup> For instance, assume a \$100,000 TIP with a 3.5% coupon payment was issued three years ago. At the time, the CPI level was at 150. Given a current CPI level of 165, the adjusted principal amount would be \$110,000  $[(165 / 150) \times \$100,000]$ . The coupon payment would now be \$3,850  $(3.5\% \times \$110,000)$  annually, rather than the original annual coupon amount of \$3,500  $(3.5\% \times \$100,000)$ .

It should be kept in mind, however, that if we experience a period of deflation, the principal amount would *fall*. However, at maturity, investors will receive the original principal amount at minimum, meaning that TIPS contain a principal “floor.” In the meantime, however, the coupon amount would fall below the initial coupon amount.

As a result of the indexation of principal and interest to the CPI, TIPS are not exposed to losses in purchasing power due to unanticipated increases in inflation. Indeed, investors in TIPS should be indifferent to the level of inflation, or the expectation thereof. TIPS provide a guaranteed real yield for the full life of the security. As such, the real market value of TIPS will not decline during periods of unexpected inflation. In fact, the market value should increase because the principal amount will be adjusted upwards as the higher inflation rates are realized. Essentially, price volatility in TIPS will arise only from changes in required real interest rates.<sup>2</sup>

This is in stark contrast to traditional bonds. Unanticipated inflation represents a substantial risk for bondholders. Investors in traditional bonds could potentially earn negative real returns as a result of inflation. Therefore, traditional Treasury bonds will experience volatility as a result of fluctuations in both real interest rates and inflation expectations.

The inflation protection in TIPS should not come without a cost. Financial theory suggests that TIPS have a lower expected return than traditional bonds, as TIPS should not receive the inflation risk premium. That said, as

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<sup>1</sup> There is a three-month lag in all CPI calculations. Therefore, if a bond was issued in June, the starting CPI level would be considered the CPI at the end of March. The same three-month lag applies to the ending CPI level as well.

<sup>2</sup> The indexation of the principal to inflation will also create some price volatility, but the volatility contributed in this manner is not meaningful from a risk standpoint, since it is serving to *reduce* risk by guaranteeing a real return.

we will discuss later, TIPS do not appear priced to earn lower returns than traditional Treasury bonds at this time.

*Performance*

Since their introduction, TIPS have underperformed traditional bonds. Table 1, below, compares the return of the Salomon Brothers Inflation Linked Bond index to that of traditional bond indices, including the Lehman Aggregate Bond index and the Lehman Government Bond index. Since March 1997, the Salomon Brothers Inflation Linked Bond index has underperformed the Lehman Government Bond Index by 1.6 percentage points, annualized.

*Table 1: Annualized Return Comparison  
(March 1997 through February 2001)*

|  | (%) |
|--|-----|
| Salomon Brothers Inflation Linked Bond Index | 6.3 |
| Lehman Government Bond Index                 | 7.9 |
| Lehman Aggregate Bond Index                  | 7.7 |

TIPS have underperformed traditional bonds in recent years because inflationary expectations have declined. Nominal interest rates have declined since March 1997, which has helped the performance of traditional bond indices. Real yields, however, are unchanged since March 1997. The fact that nominal rates have decreased while real yields have remained unchanged suggests that inflation expectations have declined. Recall that TIPS should underperform bonds during periods of declining inflation expectations.

Since TIPS are insulated from changing inflation expectations, they have, as shown in Table 2 below, exhibited less risk than traditional bond indices. Since 1997, the standard deviation on the Salomon Brothers Inflation Linked Bond Index has been three-quarters of that on the Lehman Government Bond Index.

*Table 2: Annualized Standard Deviation Comparison  
(March 1997 through February 2001)*

|  | (%) |
|--|-----|
| Salomon Brothers Inflation Linked Bond Index | 2.9 |
| Lehman Government Bond Index                 | 3.9 |
| Lehman Aggregate Bond Index                  | 3.5 |

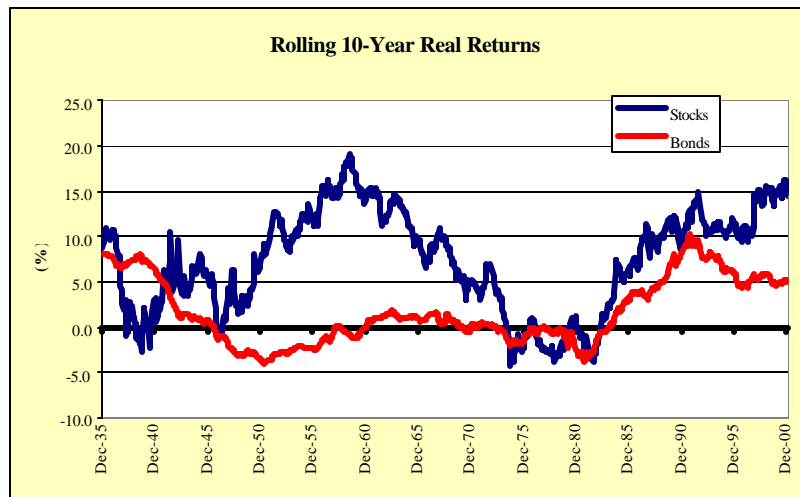
Regardless, it is difficult to draw any conclusions based on the performance statistics over just a three-year period, especially a period of declining inflation expectations. Therefore, we must rely upon financial theory to generate reasonable return and risk expectations for the asset class.

*Rationale for Holding TIPS*

The primary reason for an institution to consider holding TIPS is that they provide direct protection against inflation, as measured by the change in the CPI, while generating an attractive real return. No other asset class offers this feature. Stocks tend to provide inflation protection over the long-term, since corporations can often pass along higher costs to customers. Over the short-term, however, stocks are not always an effective inflation hedge. In fact, stocks have gone as long as 19 years with a negative real return (mid-1963 through mid-1982).

As an illustration of the harmful effects of inflation, Chart 1, below, plots the rolling 10-year real return on stocks and bonds beginning in 1926 to 2000.<sup>3</sup> As the chart shows, both stocks and bonds have experienced extended periods of negative real returns. Bondholders lost purchasing power for an extended period following the Great Depression and World War II. The real return on bonds was negative for the 10-year periods ended July 1946 through November 1957. Both stocks and bonds lost purchasing power as inflation picked up in the late 1960's and skyrocketed in the 1970's. Stocks experienced negative real returns for nearly all of the 10-year periods ended May 1973 through December 1983.

*Chart 1: Rolling 10-Year Real Returns on Stocks and Bonds*



The real return on bonds during the 1970's makes clear the need for securities that hedge against inflation. Bonds provided little diversification benefit to stocks in the 1970's, because bonds were also feeling the ravaging effects of inflation. Bonds are the most effective diversifier in periods of economic crises that lead to deflation, such as during the Great Depression, but they will fall short during economic crises that lead to higher inflation.

In relation to historical realized real returns, the current real yield on 10-year TIPS of 3.3% is attractive. Traditional bonds have failed to reach that mark in more than two-thirds of their historical rolling 10-year periods since 1926. Equities have missed the mark in one-quarter of the historical rolling 10-year periods.

There are asset classes besides TIPS that can provide some degree of inflation protection. Real assets, such as real estate or commodities, are useful in hedging inflation risk over the short-term, but they represent single components of total inflation; therefore, they do not provide complete inflation protection. T-Bills and other cash equivalent securities provide very good inflation protection, since short interest rates will rise or fall with inflation expectations. However, the real yield on cash is lower than that of TIPS, now that the Fed has begun lowering short-term interest rates (as of January 2001).

<sup>3</sup> We use the S&P 500 as a proxy for the stock market. Between 1926 and 1972, a blend of 5-Year and 20-Year Treasury bonds are used for a bond proxy. The Lehman Aggregate is used for bonds from its inception in 1973.

TIPS can also act as a hedge against an institution’s operational needs, which is not as easily quantified through mean-variance asset allocation analysis. For institutions whose liabilities increase with inflation, unanticipated inflation can result in a “double whammy.” As was the case in the 1970’s, unanticipated inflation can have a negative impact on portfolios, just at the point when additional money is needed from the portfolio to maintain purchasing power in the face of rising operational costs.

From a purely practical perspective, a weakness of TIPS is that the inflation rate to which they are indexed—the Consumer Price Index—may not be the most relevant inflation rate for institutions. For instance, the Higher Education Price Index, calculated by Research Associates of Washington D.C., measures the inflation rate for colleges and universities. Between 1961 and 1998, the increase in the Higher Education Price Index outpaced the CPI by nearly 0.7 percentage points, annualized (5.3% versus 4.6%). Nonetheless, the Consumer Price Index captured more than 85% of the total inflation for colleges and universities. TIPS are less compelling for institutions whose liabilities do not rise with inflation. Such an example is pension plans without a cost of living adjustment.<sup>4</sup>

*Expectations*

As previously mentioned, TIPS are less risky than traditional Treasury bonds because they are not exposed to inflation risk. Therefore, TIPS should not receive the inflation risk premium. Recall, the inflation risk premium is the return that investors in traditional bonds should require for accepting the risk that inflation may be higher than they originally anticipated. Empirical research pegs the inflation risk premium at 0.4% to 0.6%, annualized (Hammond, et al. 1999). Investors in TIPS, on the other hand, should not receive the inflation risk premium. Indeed, one of the reasons cited by the Treasury for issuing TIPS was that the interest savings would be available because it would not be necessary to pay the inflation risk premium. Consequently, TIPS should be priced to provide a lower expected return than traditional bonds.

By examining the difference between the yield on TIPS and Treasury bonds, we can gain some insight into the market’s expectation for inflation. The difference between the two should reflect the market’s expected inflation plus the inflation risk premium. In Table 3, below, we compare the yield on TIPS to the yield on Treasury bonds for various maturity dates.

*Table 3: Comparison of Yields on T-Bonds and TIPS  
(As of March 14, 2001)*

| <i>Maturity Date</i> | <i>Yield on T-Bond (%)</i> | <i>Yield on TIPS (%)</i> | <i>Difference (%)</i> |
|----------------------|----------------------------|--------------------------|-----------------------|
| 2002                 | 4.36                       | 2.27                     | 2.09                  |
| 2007                 | 4.76                       | 3.20                     | 1.56                  |
| 2011                 | 4.84                       | 3.33                     | 1.51                  |
| 2029                 | 5.44                       | 3.44                     | 2.00                  |

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<sup>4</sup> With higher inflation rates, the present value of the future liabilities for pension plans without a cost of living adjustment declines, benefiting the funding status of the plan.

As the table shows, the difference between the yield on T-Bonds and TIPS is narrow. (Recall, since the principal on TIPS is adjusted upwards with inflation, the yield should be below that of T-Bonds.) For bonds maturing in 2011, there is only a 1.5% difference between the yield on a T-Bond and TIPS. The difference between the two is the inflation break-even rate. If inflation is above 1.5% between now and 2011, TIPS maturing in 2010 will outperform Treasury bonds maturing in 2011. If inflation is below 1.5%, TIPS will underperform Treasury bonds.

Theoretically, this break-even inflation rate of 1.5% over ten years should include the market's expected inflation rate plus the required inflation risk premium. If the required inflation risk premium were 0.5%, for instance, the market's inflation expectation would be 1.0%. It is difficult to fathom, however, that the market expects inflation below 1.5% over the next 10 years, let alone the 1.0% inflation rate necessary to provide a 0.5% inflation risk premium to traditional bondholders. (Of course, back in 1990, we may have found it difficult to believe that inflation would remain consistently below 3%, as it did in the latter half of the 1990's.)

An alternative explanation for the low implied inflation rate priced into TIPS is the lack of liquidity. TIPS are a relatively new fixed income asset class, and they represent less than 5% of government bonds outstanding. In addition, they have not gained acceptance by institutional investors at large. As a result, liquidity for these bond issues has been rather low. Bonds with low liquidity should have a higher yield than more liquid bonds.

Based on the differential between the yield on TIPS and on traditional Treasury bonds, TIPS do not appear priced to earn lower returns than traditional Treasury bonds. (A case could be made that TIPS are priced to earn more than Treasury bonds because of the low break-even inflation rate.) Consequently, we forecast a 3.5% real return for the asset class, the same real return that we expect for traditional fixed income asset classes.

However, since TIPS are not exposed to the risk of unexpected inflation, we expect the volatility on TIPS to be *below* that of traditional bonds. We forecast that TIPS will experience an annual standard deviation of  $\pm 4.0\%$  versus  $\pm 6.5\%$  for traditional bonds.

### *Conclusion*

TIPS are an appropriate investment for institutional funds, particularly for those whose liabilities increase with inflation. The performance of TIPS has been uninspiring since their introduction, as they have underperformed traditional bonds due to declining inflation expectations. The break-even inflation currently priced into TIPS, however, suggests that they should perform well in the future. Depending upon the needs of a particular institution, an allocation to TIPS totaling one-quarter to one-half of the total bond allocation may be appropriate.

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