March 15, 2003

Federal Reserve Bank of Cleveland

Why Are TIIS Yields So High? The Case of the Missing Inflation-Risk Premium

by Ben Craig

Treasury inflation-indexed securities are just like nominal Treasuries, except that their coupon and principal payments are indexed to inflation. The yield spread between the two types of securities should serve as a daily measurement of the market's perception of expected inflation, modified to reflect the cost of inflationary risk. But TIIS yields are about 60 basis points higher than expected. This *Commentary* examines several factors other than inflation that might raise TIIS yields relative to nominal Treasuries.

Since 1997, the U.S. Treasury has been issuing debt with future payments that depend on the future price level. Treasury inflation-indexed securities (TIIS) guarantee a real return by adjusting the principal and coupon payments for inflation. In addition to eliminating default risks, as regular Treasury instruments also do, TIIS eliminate risks associated with future price changes.

The difference between the TIIS yield and that of nominal Treasury securities should be a very good measure of expected inflation: A conventional Treasury instrument's yield should equal the yield on an otherwise similar TIIS plus the expected inflation rate and a premium for inflation risk—the extra return investors require because inflation may be higher or lower than expected.

Surprisingly, the difference in yields between the two types of securities (their yield spread) for 10-year instruments is only about 1.90 percentage points for the 1997–2002 period (see figure 1). Most estimates suggest that people had expected inflation to grow about 2.5 percentage points a year over this period, and actual inflation as measured by the Consumer Price Index (CPI) turned out to be 2.61 percent a year. The assumption that investors expect the inflation rate to decline radically over a 10-year period seems far-fetched in light of historical periods like the 1970s, when the upside risk of very high inflation should have more than balanced out the possibility of a long-term change to very low inflation. Consequently, not only is there no allowance for an inflation-risk premium in the yield spread, there is not even enough of a difference to allow for expected inflation.

Why might the return on TIIS be so perplexingly high compared to securities that pay a nominal yield? In this *Commentary*, we consider several possible reasons.

Keep in mind that as we examine the behavior of TIIS, we mean only to investigate an interesting pricing puzzle—not to assess the success of the TIIS program. The period over which we have TIIS prices is a time during which most buyers expected only small changes in the inflation rate. This condition is quite different from that prevailing in the late seventies, when many economists were calling for this form of security.

The Mechanics of TIIS Payouts

For TIIS—but not for nominal Treasury securities—coupon payments and principal repayments are contingent on the amount of inflation as measured by the CPI. As each coupon comes due, the Treasury adjusts the payment according to the amount of total inflation since the security was issued. (For details of the mechanics of coupon payments for TIIS and Treasury bills, see www.publicdebt.treas.gov/sec/seciis.htm.) Table 1 compares coupon payments for a nominal Treasury security and a TIIS with a hypothetical inflation outcome.

The TIIS coupon payments are all adjusted for the CPI so that if the nominal coupon payment of the TIIS were divided by the index ratio, the resulting real amount would be the same as the nominal payment of the standard Treasury. The index ratio is calculated by dividing the level of the CPI announced just before the coupon payment is made (adjusted a bit) by the CPI on the date the bond was issued. The TIIS principal is repaid according to the same formula, except that if the CPI falls, the minimum nominal amount of principal repaid equals the security's original face value. The coupon payment, on the other hand, is lower than its face value in a time of deflation.

Bond Yields and Inflation

Economic theory separates the yield of a nominal Treasury at its market equilibrium into several components: a real return, the expected rate of inflation, and an inflation-risk premium (which compensates buyers for the fact that the inflation rate is uncertain). A TIIS holder does not have to worry about the inflation component but only about the real rate. Thus, at first glance, the TIIS yield should equal the nominal Treasury rate minus the expected inflation rate and minus a risk-aversion premium. Put another way, the yield spread between a TIIS and a nominal Treasury security of the same duration and coupon schedule should represent expected inflation and the costs of the inflation risk.

ISSN 0428-1276

To explore the difference between the nominal Treasury and TIIS yields, we can look at the two components that are not a part of TIIS yields—expected inflation and the inflation-risk premium—over the period for which we have data on both securities, 1997–2002.

Expected inflation is measured in two ways. One is the telephone survey of forecasters or consumers. The typical survey of forecasters calls about 50 professionals, asking them to predict the rate of inflation at various points in the future. There are also several surveys (the most widely cited is one conducted at the University of Michigan) of consumers' inflation expectations. The other approach uses statistical models to predict inflation. These statistical models, however, are not completely independent from surveys of professional forecasters, most of whom base their views at least partly on similar statistical models.

These surveys and statistical models calculate inflation expectations differently, but they all yield similar estimates of the rate at which people expect inflation to grow over the next year. Between 1997 and the beginning of 2002, these different approaches put the estimate at roughly 2.5 percent on average. The appropriate figure to use in this analysis is the rate expected when the TIIS is purchased. This estimate turns out to be very close to the average actual rate over this period. And although other market inflation measures may give different figures, only estimates of CPI inflation matter for TIIS because that is the measure used to calculate their coupon and principal payments.

Of all the attempts to measure the cost of the inflation risk, the most thorough is reported in a 1996 paper by Campbell and Shiller (see Recommended Reading). Using a structural model of the economy to describe investors' behavior, they estimate that the risk-aversion premium is between $^1/_2$ percentage point and 1 percentage point, depending on the assumptions they impose. If that estimate is correct, investors should be willing to pay between 50 and 100 basis points (a basis point is 1 percentage point divided by 100) of their yield at current rates just to know the exact amount of future inflation.

TABLE 1 PAYMENT SCHEDULES FOR NOMINAL AND INFLATION-INDEXED SECURITIES[a,b]

	Realized CPI	Nominal Treasury payment	TIIS payment
Initial issue	200		
Coupon 1	220	$ 10	$ 11
Coupon 2	240	$ 10	$ 12
Coupon 3[c]	180	$ 100	$ 100
Hypothetical principal repayment (deflation)	180	$ 100	$ 100
Hypothetical principal repayment (inflation)	240	$ 100	$ 120

a. Hypothetical coupon payments on a nominal and a TIIS bond with a 10 percent coupon and $100 face value.
b. For the sake of clarity, both the nominal and the TIIS bond have the same coupon rate of 10 percent, though normally the coupon value of the TIIS would be smaller than that of the nominal.
c. Coupon 3 is paid after a severe deflation.

These estimates of expected inflation and the risk-aversion premium suggest that the difference between comparable conventional Treasuries and TIIS yields should be between 3 and 3.5 percentage points—about 2.5 percentage points from expected inflation plus $^1/_2$ to 1 percentage point from the risk-aversion premium. The actual differences during this period were much smaller, averaging only 1.90 percentage points. There is no risk premium (or indeed a negative risk "premium") for inflation. Moreover, the difference of 1.90 percentage points does not even cover all of the expected inflation. In short, TIIS yields seem too high.

Can Technical Adjustments Explain High TIIS Yields?

For technical reasons, the simple difference between the yield for a TIIS and that of a nominal Treasury of the same duration does not equal the expected inflation rate exactly. First, a TIIS must be compared to a nominal security that is adjusted slightly for a difference in coupon payments. For a nominal Treasury with a constant coupon rate, each coupon pays the same amount throughout the tenure of the bond. However, the adjustment for inflation in a time of rising prices means that more of the payment for a TIIS with the same maturity occurs in the latter part of its payment schedule. Thus, a TIIS is not entirely comparable to its corresponding nominal Treasury security. Nonetheless, an appropriate comparison can be made by using information contained in the yield curve to produce a figure that reflects the difference in payment schedule. This adjustment results in a modest change—the average difference is only 3 basis points from the raw difference reported earlier.

Another adjustment allows for the wrinkle that a TIIS always pays at least the nominal value of its principal, even if there is deflation. Thus, the principal has an option value because the nominal value of the principal's repayment can be higher than its original nominal value but can never be lower. However, the option appears to have had a negligible value in 1997–2000 because there is only a miniscule possibility of deflation after the long period when the principal is repaid.

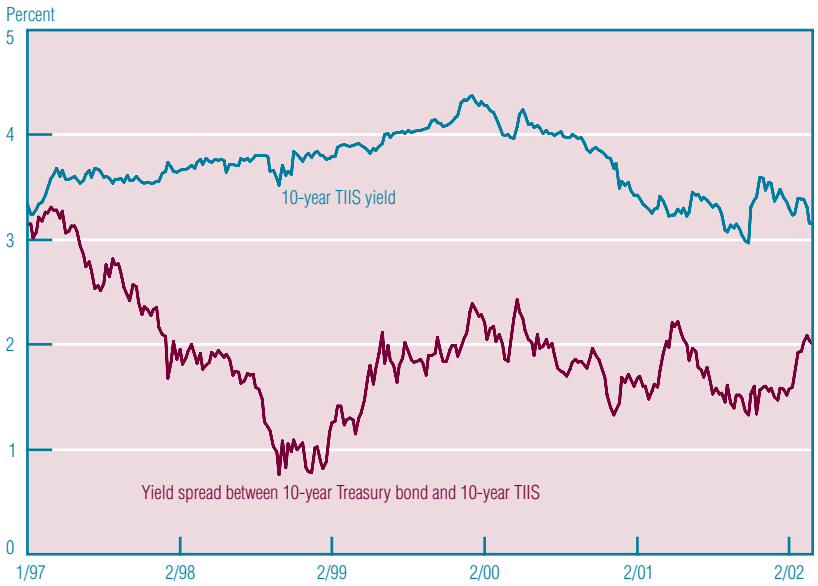
One last possible technical explanation: The average of a function is not the same as the function of an average because of nonlinearities. That is, an investor who calculates the possible yields on a TIIS and then observes their mean will get a different result than the one who calculates the mean yield on a nominal security and then subtracts from it the average inflation value. Most researchers estimate that this "Jensen inequality effect" is only about 5 basis points over a 10-year maturity. The highest estimate is 11 basis points and the lowest is 2 basis points.

Having considered the result of several technical adjustments, one must conclude that whatever their values may be, they are almost certainly tiny and cannot by themselves solve the mystery of the high TIIS yield.

Other Possible Explanations

The unexpectedly small difference between nominal Treasury yields and TIIS yields may have other causes as well. TIIS are new, complex securities,

FIGURE 1 YIELD ON TREASURY INFLATION-INDEXED SECURITIES



SOURCE: Bloomberg Financial Information Services.

so investors may require stronger inducements to hold them. For example, TIIS volatility characteristics may not be well known because the instrument has no historical price pattern from which to deduce them. Investors, who may not know how to fit this novel security into their portfolios to balance risk or hedge debt, may also look for a yield higher than they would usually demand. However, if newness were what was keeping the inflation premium low, its effect should attenuate over time, as investors learn more about the security. But in reality, since 1997, when TIIS were first introduced, the observed inflation premium has diminished instead of reaching the level we would expect.

Another possible reason for higher TIIS yields is that dealers generally have nominal debt they must hedge. Because their debt is not indexed to inflation, TIIS holders do not rely on these instruments as hedges against specific debt. So the characteristics that distinguish TIIS holders from holders of nominal Treasury securities might drive differences in the securities' yields that have nothing to do with inflation. Indeed, participation in the nominal Treasury market is more weighted toward the primary dealers than in the TIIS market. A relatively small set of traders account for the lion's share of TIIS transactions, unlike the trading activity in nominal securities. Furthermore, primary dealers of indexed securities tend to roll these instruments over, whereas they hold large positions (either long or short) in nominal Treasuries.

Like the explanations examined earlier, differences in dealers may account for some of the higher TIIS yield, but if it were the main cause of an understated inflation premium, its effect should have been attenuated throughout the period since the introduction of TIIS, as traders arbitraged away the profit opportunity. Large institutional investors still predominate as holders of TIIS, and the number of medium- to large-sized institutions that include TIIS in their portfolios is growing. Smaller holders are becoming a more important source of demand as well. But once again, although there are major changes in the characteristics of those who demand TIIS, there are no correspondingly large changes in the inflation premium. Clearly, something else is happening here.

A final possibility, and perhaps the most convincing one, involves the characteristics of the markets in which Treasury securities are sold and traded. For example, nominal Treasuries are very liquid instruments. As a result, the holder of a nominal Treasury can easily find a buyer when he wants to readjust his portfolio to new information quickly. This may give the nominal Treasury a premium when liquidity is important to the market. In other words, the yield on nominal Treasuries may be lower than normal in times when investors see liquidity as an especially valuable quality. In the fall of 1998, when both the domestic and foreign financial markets were particularly volatile, liquidity was highly valued by investors who needed an instrument that could balance their portfolios quickly. In October 1998, for example, nominal Treasury yields dropped, and the implied inflation premium fell with them, reaching a very low 88 basis points. Yields on TIIS did not fall as low because investors perceived that they could not be sold as promptly as nominal Treasuries. Little is known about how to measure liquidity premiums, but the large premiums that prevailed in the autumn of 1998 suggest that liquidity concerns may account for at least part of the missing inflation premium in the yield spread between TIIS and nominal Treasury securities.

However, some researchers feel otherwise. They point out that while the desperate liquidity needs in autumn 1998 did cause the inflation premium to change considerably, it was only for a brief time. Indeed, there was not much trading in TIIS initially, but as investors began to understand how to use them, they gradually became more popular and now trade at a fairly high rate. Thus, liquidity needs that are especially well satisfied by the nominal Treasury market may not explain the small TIIS inflation premium, which has prevailed since their introduction.

Interpret with Caution

TIIS have enormous potential for guiding policy. By design, this security removes both inflation's erosion and its risk, when compared to a standard nominal Treasury. So the yield spread between them should serve as a daily measurement of the market's perception of expected inflation, modified to reflect the cost of inflationary risk. In essence, it should provide an instant reading of inflation's cost to the economy and could be highly useful in making policy decisions that may affect inflation. However, even the adjusted difference between TIIS and nominal Treasuries yields is too small to account for both inflationary expectations and the cost of risk. Until their relationship is better understood, the yield spread between

TIIS and nominal Treasuries will remain a statistic that policymakers should handle with caution.

In one sense, the market for TIIS is very young. The TIIS were designed as a hedge during periods of high inflation uncertainty such as the late 1970s, a market environment that has not prevailed during the five years of the TIIS market's existence. Until we see the market operating during such a period of high inflation volatility, one cannot judge the success of the program.

Yet the mystery remains. Apparently, securities that hedge completely against the uncertainty created by inflation actually pay their holders, on average, to hedge. The excess yield for TIIS over comparable nominal bonds seems to be at least 60 basis points, a large number for bond traders who normally would arbitrage away profit opportunities much smaller than this. The extra liquidity risk of the TIIS may provide the most likely clue to their excess yield.

Recommended Reading

John Y. Campbell and Robert J. Shiller (1996). "A Scorecard for Indexed Government Debt," NBER Working Paper No. 5587.

Brian Sack (2000). "Deriving Inflation Expectations from Nominal and Inflation-Indexed Treasury Yields," *Journal of Fixed Income* 10, 1–12.

Ben Craig is an economic advisor at the Federal Reserve Bank of Cleveland.

Economic Commentary *is published by the Research Department of the Federal Reserve Bank of Cleveland. To receive copies or to be placed on the mailing list, e-mail your request to* 4d.subscriptions@clev.frb.org *or fax it to* 216-579-3050. Economic Commentary *is also available at the Cleveland Fed's site on the World Wide Web:* www.clev.frb.org/research, *where glossaries of terms are provided.*

We invite comments, questions, and suggestions. E-mail us at editor@clev.frb.org.

Federal Reserve Bank of Cleveland
Research Department
P.O. Box 6387
Cleveland, OH 44101

Return Service Requested:
Please send corrected mailing label to the above address.

PRSRT STD
U.S. Postage Paid
Cleveland, OH
Permit No. 385