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Federal Reserve Bank of Cleveland

Expected Inflation and TIPS

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In 1997 the U.S. Treasury introduced a new security. This security, a bond called TIPS, for "Treasury Inflation-Protected Securities," is unique in the sense that its returns are indexed to inflation, thus promising bondholders a sure real return over the life of the bond. Unlike nominal Treasury notes, the real return of a TIPS is fixed at auction time. The face value and the coupon payments are indexed to the inflation rate, so they grow at that rate. Once the security is purchased, increases in inflation do not reduce an investor's real return. This is much different than a nominal Treasury note, where changes in inflation directly influence the realized real return of the bond.

The potential benefit of TIPS, however, goes beyond the inflation protection offered to bondholders. TIPS also promise economists and policymakers a potential way to tease out of the data the market's expectations for the future course of inflation. In principle, subtracting the real yield on TIPS from the nominal yield of Treasury notes of the same maturity should give policymakers and economists a market-based measure of expected inflation.

But thus far the results have been less than encouraging. Ten-year expected inflation rates derived from the TIPS market have run approximately 50 basis points lower than the inflation expectations of professional forecasters (obtained from the Survey of Professional Forecasters), and a full percentage point lower than those of households (as measured by the University of Michigan's Survey of Consumers; see figure 1). Of course, survey measures of expected inflation have a multitude of problems associated with them. However, the available evidence strongly suggests that expected inflation derived from the TIPS market underestimates actual expected inflation.

In this *Economic Commentary* we explore why the TIPS-based measure may have underestimated expected inflation. We show that there are two countervailing factors influencing the measure. First, inflation risk, in and of itself, implies that TIPS-based expected inflation should *overstate* actual expected inflation. Second, and even more important, is the relative illiquidity of the TIPS market, which leads TIPS-based expected inflation to *understate* actual expected inflation.

We demonstrate a method of correcting for the biases caused by the illiquidity of the TIPS market and inflation risk. The method produces a TIPS-based series that can serve as a measure of expected inflation, one that is potentially more accurate than the unadjusted TIPS series. Using the adjusted series, we examine several interesting time periods. We show instances where the new series uncovers potential movements in expected inflation that the uncorrected TIPS series does not reveal. Similarly, there are periods for which the uncorrected TIPS series incorrectly indicates movements in expected inflation, but for which the adjusted series suggests no change occurred.

Inflation Risk and TIPS-Based Expected Inflation

Remember that, in principle, expected inflation should be accurately measured by subtracting the real yield on TIPS from the nominal yield on Treasury notes of the same maturity. The reason it is supposed to work this way is that the nominal yield on Treasury notes consists of a real return plus compensation for the inflation rate that is expected to occur over the horizon of the security. But here is the rub: the calculation assumes that the real yields on both securities are equal. Anything that causes these two real returns to differ will cause a bias in a TIPS-based measure of expected inflation.

When inflation-indexed Treasury securities were first introduced, economists hoped that they could be used to measure expected inflation easily. The only difference between securities that were indexed to inflation and those that were not was thought to be the extra compensation regular securities had to pay for what the market thought inflation would be. By now it is pretty clear that inflation-indexed Treasuries differ from regular securities in other ways that show up in the yields. This *Commentary* suggests what these are and discusses a method of correcting for them.

In 1996, even before the Treasury started issuing inflation-protected securities, two economists, John Campbell and Robert Shiller, suggested that if the Treasury were to introduce such a security, estimating expected inflation from it would probably overstate actual expected inflation by 50 to 100 basis points. They reasoned that in addition to compensation for expected inflation, regular Treasury notes must also pay compensation for *inflation risk*, or the possibility that actual inflation will be higher (or lower) than expected inflation.

To understand their reasoning, consider a 10-year Treasury note with a nominal yield of 6 percent. Say everyone expects

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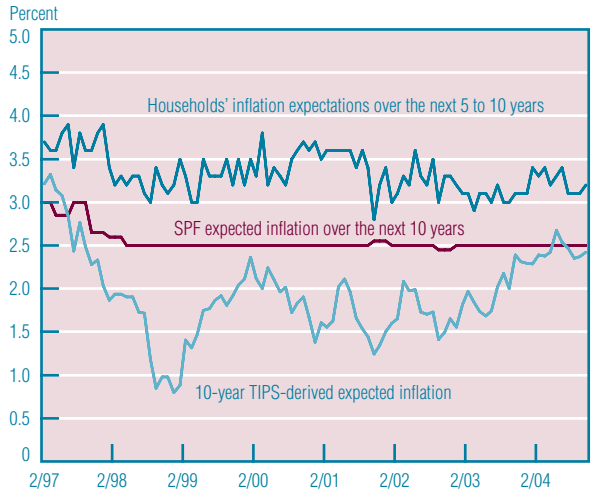
FIGURE 1 VARIOUS MEASURES OF INFLATION EXPECTATIONS



SOURCES: University of Michigan, *Survey of Consumers*; Federal Reserve Bank of Philadelphia, *Survey of Professional Forecasters*; and Bloomberg Financial Information Services.

inflation to average 2.5 percent over the next 10 years—but this is only what they expect. Actual inflation could turn out to be much lower, say 1.5 percent, or much higher, say 3.5 percent. This implies that the actual real yield from holding the bond may be as low as 2.5 percent or as high as 4.5 percent. On average it may be 3.5 percent, but there is an inflation risk associated with holding this bond that does not exist with an inflation-indexed security such as TIPS. Investors must be compensated for this risk, and the result is that the real yield of a nominal Treasury note tends to exceed the real return of an inflation-indexed security. Expected inflation derived from the inflation-indexed security would thus overstate actual expected inflation.

Campbell and Shiller then produced an estimate of the inflation risk premium. They first estimated historical inflation volatility as a means of quantifying the inflation risk people might be inclined to expect, and then they combined that figure with existing measures of the compensation that households require to accept that sort of risk. The premium they calculated was 50 to 100 basis points, which led them to their prediction that inflation-indexed securities would overstate expected inflation by that much. Given that TIPS appear to understate expected inflation by 50 basis points, we have something of a puzzle.

■ Liquidity and the TIPS Market

If we combine Campbell and Shiller's estimate of a 100-basis-point *overstatement* of TIPS-based inflation expectations with the 50-basis-point *understatement* that is actually observed, it suggests that the real yield on nominal Treasury notes is 150 basis points lower than the real yield on TIPS. Given that the real yield on nominal Treasury notes is about 2.6 percent, a real TIPS yield of over 4 percent is quite large! We argue that the difference can be explained as compensation for liquidity risk. Although the TIPS market is deepening, it does not approach the depth of nominal Treasury notes, suggesting that the liquidity risk for TIPS might be important. While this liquidity risk also exists for non-inflation-indexed Treasury notes, it does so to a much reduced extent, as markets for the notes are older and more developed than for TIPS.

Nominal Treasury notes are extremely liquid instruments. If one were to buy a 10-year note today and sell it tomorrow, one could do so without a large loss in capital. The reason is that large and active primary and secondary markets exist for these securities. The secondary market is extremely important because most buyers of Treasury notes do not hold the notes to maturity but sell them long before. It is rare for an investor to buy a 10- or 30-year note and still be holding onto it 10 or 30 years later. Circumstances change, and an investor who wants a long-term bond today does not necessarily want that same bond tomorrow.

Imagine the compensation an investor would need if it were impossible to sell a security once it was purchased. Obviously, investors can sell TIPS, but not nearly as easily as regular Treasury notes. This implies that investors in TIPS must be compensated for the relative illiquidity of these securities. The relative illiquidity of TIPS also introduces uncertainty into their pricing, which affects an investor's return when he or she sells the security early.

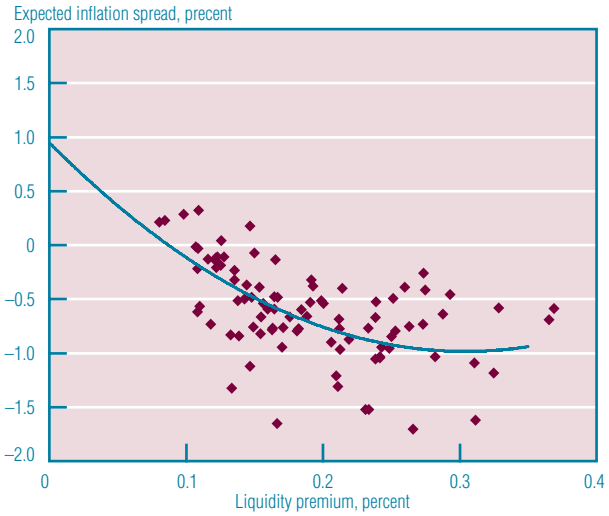
But can this extra liquidity risk explain the missing 150 basis points? Unfortunately, there are no good measures of TIPS market liquidity. However, there is a measure of the liquidity risk that is associated with nominal Treasury notes. We can safely assume that the liquidity risk for TIPS is correlated with the small liquidity risk that exists for regular nominal Treasury notes. Basically, if there is a small liquidity risk associated with holding nominal Treasury securities, there is an even larger liquidity risk associated with holding TIPS.

One measure of liquidity risk for nominal Treasury notes is the difference between returns for securities of the same maturity in the primary market and the less liquid secondary market. For example, the difference between the return on a 10-year Treasury note purchased in the primary market ("on-the-run") and the return on a 15-year Treasury note with 10 years left purchased in the secondary market ("off-the-run") provides a measure of the liquidity risk associated with that instrument. This liquidity risk does exist and since 1997 has varied from a low of 8 basis points to a high of 37 basis points.

■ Liquidity Risk and Expected Inflation

We can estimate the compensation needed to insure against the liquidity risk of TIPS by making three reasonable conjectures. First, the liquidity risk for TIPS is larger than the risk of off-the-run nominal Treasury securities because the TIPS market is less developed. Second, the liquidity premium in the TIPS market is correlated with the liquidity premium in the nominal Treasury market. The third conjecture relates the liquidity risk of TIPS to the difference that

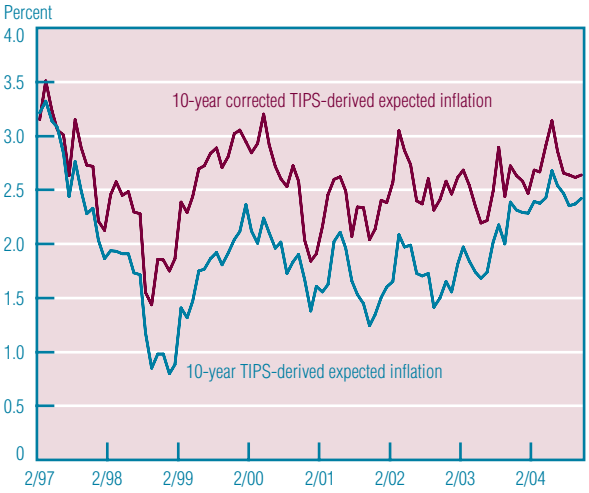
FIGURE 2 EXPECTED INFLATION SPREAD AND LIQUIDITY RISK



NOTES: The expected inflation spread is the difference between TIPS inflation and SPF inflation. The liquidity premium is calculated as the difference between off-the-run and on-the-run 10-year Treasury security yields.

SOURCES: Bloomberg Financial Information Services; Federal Reserve Bank of Philadelphia, *Survey of Professional Forecasters*; and the Board of Governors of the Federal Reserve System.

FIGURE 3 CORRECTED AND UNCORRECTED TIPS-DERIVED INFLATION EXPECTATIONS



SOURCES: Bloomberg Financial Information Services; and the Board of Governors of the Federal Reserve System.

is observed between two measures of expected inflation—that reported in the Survey of Professional Forecasters and that derived from unadjusted TIPS yields. We assume this difference is largely driven by the liquidity risk.

Figure 2 shows the historical relationship between liquidity risk in the nominal Treasury market (horizontal axis) and the difference between TIPS-derived and professional forecasters' expected inflation (vertical axis). Note that these variables are negatively correlated and that this relationship is nonlinear. The figure implies that if there were no liquidity risk in the nominal Treasury market, and thus no liquidity risk in the TIPS market, expected inflation derived from TIPS would overstate actual expected inflation by 95 basis points. Evidently this overstatement arises from the inflation risk associated with nominal Treasury securities and is basically the size of the inflation risk predicted by Campbell and Shiller. As liquidity risk rises in the nominal Treasury market, liquidity risk in the TIPS market also rises, so that TIPS-based expected inflation understates actual expected inflation.

We use the relationship in figure 2 to correct for the bias in TIPS-derived inflation expectations caused by inflation risk and the illiquidity of the TIPS market. Figure 3 illustrates the difference between the corrected series and the uncorrected series (which is obtained, as you may recall, by subtracting real TIPS yields from nominal Treasury yields). These inflation measures are clearly closely related but some interesting differences do exist.

First, our analysis suggests that inflation over the next 10 years will average around 2.5 percent to 2.6 percent. This is about the same as was expected at the beginning of 2002. Yet the uncorrected series suggests that expected inflation increased by around 85 basis points from 2002 to the present. Without the correction, you might worry that the credibility of the Federal Reserve to keep inflation fairly low and stable was waning, but with the correction, you might conclude the opposite.

A second divergent prediction for the two series occurs in August 1998, after the Asian financial crisis and at the beginning of the Russian default crisis. Looking at the uncorrected series, you might mistakenly conclude that expected inflation dropped precipitously from just over 3 percent in mid-1997 to around 0.8 percent in early 1999. Not surprisingly, however, there were liquidity problems with TIPS around the time and, to a lesser extent, Treasury notes, which affected the liquidity risk of both securities. The corrected series takes this change in risk into account, dropping from just over 3 percent to 1.5 percent.

It is also worth pointing out that our measure suggests that the uncorrected series can also miss changes in expected inflation. Long-term inflation expectations dropped more heading into the 2001 recession than the uncorrected series suggests. Also, from January 2004 to May 2004, our corrected measure of expected inflation increased by nearly 70 basis points, possibly because of inflationary concerns arising from the rapid growth in the U.S. economy at the time. This increase in inflation expectations was reversed only after the initial federal funds rate increase in the summer of 2004. After that, expected inflation once again fell back to its long-term average of around 2.6 percent. The uptick in inflation expectations before the funds rate hike in June might not have been noticed in the uncorrected series, which increased only half as much over the same time span.

■ Concluding Thoughts

This *Economic Commentary* has shown a simple way of using TIPS to obtain a reasonable estimate of expected inflation. In particular, this estimate corrects for the inflation risk associated with nominal Treasury notes and the liquidity risk associated with TIPS. Clearly there are other factors that would influence the accuracy of TIPS-based expected inflation measures. The importance of these factors, however, is likely to be very small. (See an earlier *Economic Commentary* by Ben Craig for a discussion of the various factors influencing the ability to use TIPS to estimate expected inflation.)

We emphasize that the success of TIPS should not be judged on the basis of how well they can be used to measure expected inflation. Measuring expected inflation is a potential side benefit of these securities; it is not the reason they were introduced. The very fact that their popularity is increasing suggests that they have fulfilled their primary purpose—to provide investors with an inflation hedge.

■ Recommended Reading

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

Ben R. Craig, 2003. "Why are TIPS Yields so High? The Case of the Missing Inflation-Risk Premium," Federal Reserve Bank of Cleveland, *Economic Commentary*, March 15.

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