Liquidity Risk Premia and Breakeven Inflation Rates

By Pu Shen

In recent years, monetary policymakers have monitored several measures of market expectations of future inflation. One of these measures is based on the yield differential between nominal and inflation indexed Treasury securities. This yield spread is also called the "breakeven inflation rate." An increase in the breakeven rate is sometimes viewed as a sign that market inflation expectations may be on the rise. For example, the FOMC frequently refers to the yield spread as a measure of "inflation compensation" and considers the yield spread an indicator of inflation expectations in policy deliberations.[1]

Accurately inferring market expectations of inflation from yield spreads is difficult. The difficulty lies in the differences in market liquidity conditions between nominal and inflation indexed Treasury securities. This article presents evidence that liquidity differences between nominal and inflation indexed Treasuries have been nontrivial. Consequently, simply attributing changes in yield spreads to changes in market inflation expectations and ignoring the liquidity risk premium could lead to overstated inflation expectations.

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The first section of the article gives a brief overview of inflation indexed Treasury securities, the components of the yields of both nominal and indexed Treasuries, and their yield spreads. The second section examines the behavior of the yield spreads over the past few years and explains why changes of the liquidity risk premium have likely played an important role in the changes of the yield spreads. This section also provides some estimates of the changes in the liquidity risk premia during the past seven years and argues that ignoring such changes may lead to erroneous inferences of inflation expectations.

I. INFLATION INDEXED TREASURY SECURITIES AND COMPONENTS OF THE YIELD SPREADS

This section discusses the main features of inflation indexed Treasury securities, which are commonly referred to as TIPS. Next, it examines the components of the yields of nominal securities and TIPS. Finally, it identifies the conditions needed to obtain useful information about market inflation expectations directly from the yield spreads.

TIPS and their markets

The U.S. Treasury began issuing TIPS in 1997. Initially called Treasury Inflation Protected Securities, their official name was later changed to Treasury Inflation Indexed Securities (TIIS). Market participants have continued to call the instruments TIPS.

The first TIPS had a maturity of ten years. Every year since 1997, Treasury has issued additional 10-year TIPS. TIPS with 5-year, 20-year, and 30-year maturities have also been issued intermittently. In December 2005, a total of $329 billion TIPS were outstanding, accounting for about 7.9 percent of the $4.2 trillion in outstanding marketable Treasury securities. Of Treasuries issued with at least two years' maturity, TIPS account for 10.3 percent.[2]

The main advantage of TIPS over conventional nominal securities is that TIPS investors are not exposed to inflation risk.[3] The coupon rate of a TIPS is fixed in real terms at auction, and the dollar value of the principal grows with inflation over the life of the TIPS. The real return, which is measured by purchasing power, does not vary with inflation.

In contrast, the coupon payments and the principal of a nominal Treasury security are fixed in dollar terms. Thus, the purchasing power, or real return, of a nominal Treasury declines as inflation rises.[4]

Components of nominal Treasury yields

To investors, the real rate of return, or real yield, of an investment is important because it measures the result of the investment in terms of purchasing power.[5] The yield of a nominal Treasury contains three main components: the real yield, the yield that is equal to the expected rate of average inflation for the remaining life of the Treasury, and the inflation risk premium (which compensates investors for the risk that the actual inflation rate over the life of the Treasury may be higher than expected).[6]

For example, in the following equation, $y_t^{n,10}$ denotes the yield of a nominal Treasury with ten years to maturity at time t:

(1) $y_t^{n,10} = r_t^{10} + \pi_t^{e,10} + RP_t^{10}(\pi)$,

where r_t^{10} is the average real yield investors require to lend to the U.S. Treasury for ten years at time t, $\pi_t^{e,10}$ is the expected average inflation rate for the next ten years, and $RP_t^{10}(\pi)$ is the inflation risk premium for the nominal Treasury with ten years to maturity.[7]

If investors did not mind inflation risk, then the yield of a 10-year nominal Treasury would simply be the sum of the required real rate for lending to the Treasury for ten years and the expected average inflation rate for the next ten years:

(2) $y_t^{n,10} = r_t^{10} + \pi_t^{e,10}$.

Because inflation erodes the purchasing power of nominal payments, the relevant yield to investors is not the nominal yield, but the real yield. For example, assume investors decide that 2 percent real yield is a reasonable return for lending to the U.S. Treasury for the next ten years. If they collectively forecast that the average inflation rate for the next ten years will be about 2.5 percent, then equation (2) suggests that the nominal yield on a conventional 10-year Treasury would be 4.5 percent. If, instead, most investors believed that average inflation would be 3 percent for the next ten years, then the nominal yield of the 10-year Treasury would have to rise to 5 percent to attract investors.

In reality, most investors would rather avoid the risk of inflation. Therefore, the yield of a nominal Treasury must be a bit higher than the simple sum of the required real yield and the expected inflation rate. The additional yield, $RP_t^{10}(\pi)$, is to compensate investors for bearing the inflation risk.

Components of TIPS yields

The yield of an inflation indexed security usually consists of two components: a real yield and a liquidity risk premium to compensate investors for the risk of having to pay more (than in the case of nominal Treasuries) to liquidate the TIPS before its maturity.[8] Thus, if $y_t^{i,10}$ is the yield on a TIPS with ten years to maturity, then:

(3) $y_t^{i,10} = r_t^{10} + RP_t^{10}(l)$,

where r_t^{10} is the real yield required by investors to lend to the Treasury at t, and $RP_t^{10}(l)$ is the liquidity risk premium included in the TIPS yield.

Generally speaking, the liquidity risk of a security is that investors may incur large costs to buy or sell the security in a secondary market. In Treasury markets, an investor may need to make portfolio adjustments after the initial auction or before the maturity of a Treasury security, and thus is forced to buy or sell the security in the secondary market. As a result, investors need to consider the likely costs associated with such trading. Some of the costs are similar for both nominal Treasuries and TIPS, such as brokerage fees and commissions, and thus are not important to the current discussion. Other costs relate to the ease and convenience of trading, which are more uncertain in nature and usually relate inversely to the liquidity of the market. For example, a seller of a large amount of nominal Treasury securities, say $2 billion, may be able to find a buyer and complete the transaction in minutes. Selling $2 billion worth of TIPS may require a lot more time to search for a buyer or selling at somewhat lower prices to complete the sale in a timely fashion. As most investors need to adjust their portfolios at some point due to unforeseen events, the risk of having to pay a cost for the liquidity is ever present. Since the probability of incurring large liquidity costs

is inversely related to the liquidity of the security, the less liquid security carries higher liquidity risk, and thus must carry a higher yield to attract investors. This additional yield is the liquidity risk premium.

The liquidity risk premium generally tends to increase during financial market crises because investors' needs to quickly adjust their portfolios tend to increase during crises, making investors' tolerance for liquidity risk decline. In a financial market crisis, investors typically exhibit a pattern of "flight to quality" and stay away from less liquid assets.

The market for nominal U.S. Treasuries is the most liquid debt market and thus is usually considered the benchmark for market liquidity. Relative to nominal Treasuries, almost all other financial instruments are likely to carry some liquidity risk and liquidity risk premia because their markets are not as liquid. In particular, TIPS are relatively new in the United States, and their market liquidity was initially quite low. Consequently, early TIPS likely carried a sizable liquidity risk premium. As the market expanded and liquidity improved, the liquidity risk premium has undoubtedly declined. Nonetheless, it may still be too soon to believe that the liquidity risk premium has disappeared or even stabilized.

Yield spreads and inflation expectations

Many market participants and policymakers are interested in the yield spreads between nominal Treasuries and TIPS because the spreads contain information about market expected future inflation rates. The yield spread between a nominal Treasury and a TIPS can be calculated from equations (1) and (3). From the earlier discussion, it is straightforward to see that the yield spread should be equal to the market expected rate of inflation, plus an inflation risk premium, and minus a liquidity risk premium.[9] For example, using S_t^{10} to indicate the yield spread between 10-year nominal and 10-year indexed Treasuries, then

(4) $S_t^{10} = y_t^{n,10} - y_t^{i,10} = r_t^{10} + \pi_t^{e,10} + RP_t^{10}(\pi) - [r_t^{10} + RP_t^{10}(l)] = \pi_t^{e,10} + RP_t^{10}(\pi) - RP_t^{10}(l)$,

where $\pi_t^{e,10}$ is the expected average annual inflation rate for the next ten years, $RP_t^{10}(\pi)$ is the inflation risk premium for the 10-year nominal Treasury, and $RP_t^{10}(l)$ is the liquidity risk premium for the 10-year TIPS.[10]

Similarly, the yield spread between 5-year nominal Treasuries and TIPS can be calculated by the same method. Using similar notation:

(5) $S_t^5 = \pi_t^{e,5} + RP_t^5(\pi) = RP_t^5(l)$,

where $\pi_t^{e,5}$ is the market expected average inflation rate for the next five years, and $RP_t^5(\pi)$ and $RP_t^5(l)$ are the inflation and liquidity risk premium for the respective Treasuries.

In each of the two yield spreads shown in equations (4) and (5), there is a term for expected inflation over the life of the security. That is, $\pi_t^{e,10}$ represents average inflation expected by investors for the next ten years, while $\pi_t^{e,5}$ represents average inflation expected for the next five years.

For some purposes, it is useful to obtain a measure of longer-term inflation expectations. For example, policymakers may be interested in the average inflation rate expected by investors over a longer-term horizon. One such measure is the average inflation rate for the five-year period five years ahead ($\pi_t^{e,5f}$). This measure, unlike the five-year and ten-year expected inflation discussed above, removes the effect of near term inflation expectation and thus gives policymakers a better picture of where inflation is likely to be in the more distant future. A value for $\pi_t^{e,5f}$ can be easily derived from the 5-year and 10-year expected inflation rates:

(6) $\pi_t^{e,5f} = 2^*\pi_t^{e,10} - \pi_t^{e,5}$.

Using the two yield spreads S_t^5 and S_t^{10}, one can construct a S_t^{5f}, representing a five-year spread five years ahead, to contain information about $\pi_t^{e,5f}$:

(7) $S_t^{5f} = 2^*S_t^{10} - S_t^5$.

The result:

$$S_t^{5f} = \pi_t^{e,5f} + 2^*[RP_t^{10}(\pi) - RP_t^{10}(l)] - [RP_t^5(\pi) - RP_t^5(l)],$$

or,

(8) $S_t^{5f} = \pi_t^{e,5f} + [2^*RP_t^{10}(\pi) - RP_t^5(\pi)] - [2^*RP_t^{10}(l) - RP_t^5(l)]$.

In equation (8), the first component of S_t^{5f} is the expected average inflation rate for the five-year period five years ahead, the second component is the inflation risk premium differential between the 10-year and 5-year nominal Treasury securities, and the third component is the liquidity risk premium differential between the 10-year and 5-year TIPS.[11]

Information about expected future inflation rates in yield spreads

Most market analysts have focused on the component of expected inflation in the yield spread. In particular, if one is willing to assume that inflation and liquidity risk premia are constant over a particular period, then changes in the yield spreads for the period mostly reflect changes in the inflation expectation of market participants.[12] Further, under the same assumption that both inflation and liquidity risk premia are constant, then changes in S_t^{5f} will solely reflect changes in the expected average inflation rate for the 5-year period five years ahead.

For policymakers and some market participants, the separation of the expected future inflation rate and inflation risk premium may be of secondary importance, especially regarding long-term inflation expectations, such as $\pi_t^{e,5f}$ and $\pi_t^{e,10}$. The average inflation rates for the long term should be most closely related to monetary policymakers' view of the desirable level of inflation and their credibility. Therefore, some market commentators also use them as proxies for the FOMC inflation-fighting credibility. In this context, separating the long-term expected inflation rate from the inflation risk premium is unimportant. In fact, the sum of the expected inflation rate and inflation risk premium better represents market participants' view of inflationary pressure. For example, if the sum for the next ten years has declined 0.5 percentage point, then the decline could be due to a 0.5-percentage-point decline in the expected average inflation rate by market participants, to a 0.5-percentage-point decline in the inflation risk premium, or to a combined total decline of 0.5 percentage point in both the expected inflation rate and the inflation risk premium. Whatever the precise cause, it would represent an improvement of FOMC inflation-fighting credibility.

In summary, changes in the yield spreads over a particular period can be useful proxies for changes in market inflation expectations, under the crucial assumption that the liquidity risk premia in TIPS are constant for the period. The next section examines the liquidity risk premium in detail to assess the likelihood of this assumption.

II. THE LIQUIDITY RISK PREMIUM

A closer look at the liquidity risk premium in TIPS suggests that it is relatively large and has changed considerably in recent years. Consequently, taking account of the liquidity risk premium greatly complicates the task of extracting information from the yield spreads about market inflation expectations.

Large and variable liquidity risk premium

Comparing actual yield spreads with other measures of inflation expectations for the sample period of 1999 to early 2006 suggests that liquidity risk premia have been large for most of the sample period.[13] Further, they were sometimes quite variable and have likely declined over time.

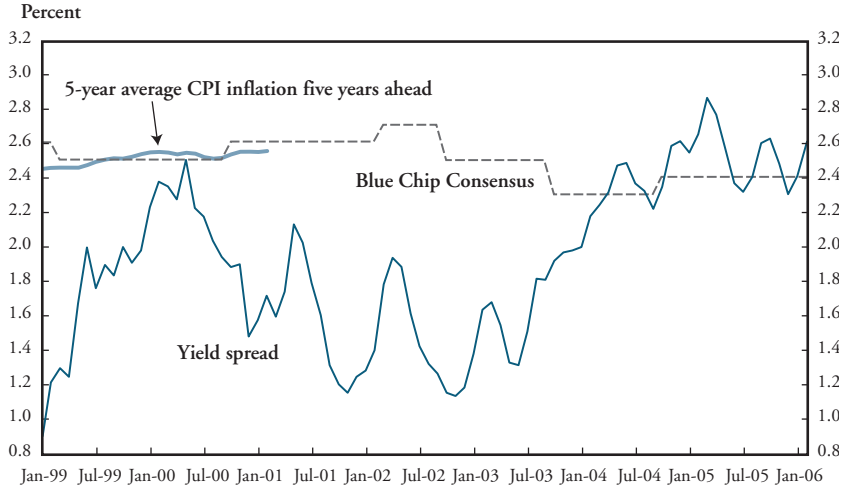
Chart 1 shows the yield spreads between 5-year nominal and indexed Treasuries, as well as the Blue Chip Consensus forecast for the average inflation rate for the next five years from January 1999 to February 2006. It also shows the actual average inflation rates for the five-year periods ahead from January 1999 to March 2001 (the latest month such calculation is feasible).

Chart 2 shows the yield spreads between 10-year nominal and indexed Treasuries, as well as the forecasts of the average inflation rates for the next ten years based on the Blue Chip Consensus forecast, and on the Survey of Professional Forecasters (SPF).[14]

Three observations are immediate from these two charts. First, the liquidity risk premia were likely sizable for most of the sample period. During the first five years of the sample, the yield spreads were mostly well below the expected inflation rate based on Blue Chip Consensus or SPF. In the case of five-year spreads, it is also clear that, for the three year period that data are available, the Blue Chip Consensus was very close to the actual five-year average inflation, while the yield spreads were mostly well below actual inflation rates for the respective periods. There is no reason to suspect that the expected inflation rate in the yield spread would be systematically lower than survey-based measures or would consistently

Chart 1

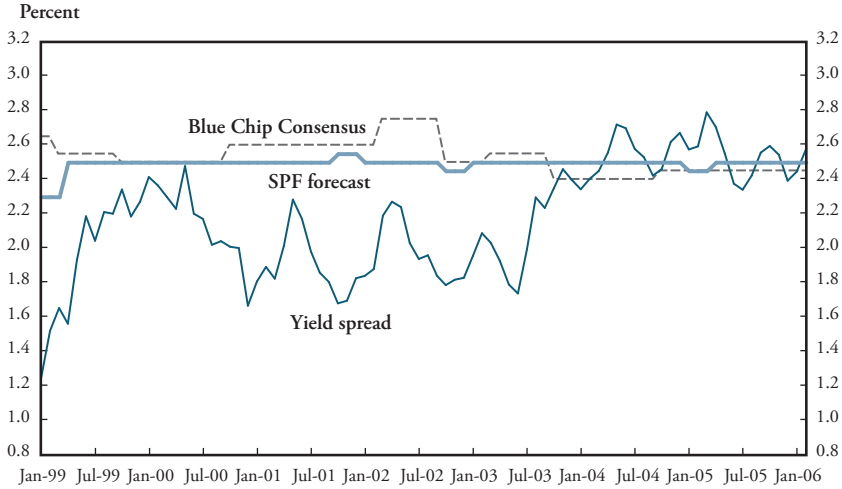
YIELD SPREAD (5-YEAR) COMPARED TO ACTUAL INFLATION AND A SURVEY-BASED INFLATION FORECAST



Sources: Federal Reserve System, Board of Governors; Blue Chip Consensus; author's calculations

Chart 2

YIELD SPREAD (10-YEAR) COMPARED TO SURVEY-BASED INFLATION FORECASTS



Sources: Federal Reserve System, Board of Governors; Blue Chip Consensus; Survey of Professional Forecasters

underpredict actual inflation. The most likely explanation is that the liquidity risk premia in the yields of the TIPS were *larger* than the inflation risk premia in nominal Treasuries during this period.[15]

Subtracting the expected inflation rate of the Blue Chip Consensus forecasts from the 10-year yield spreads reveals that the average difference was negative 0.55 percentage point for the first five years of the sample period. In other words, from 1999 to 2003, the liquidity risk premium in 10-year TIPS was, on average, 0.55-percentage-point higher than the inflation risk premium in 10-year nominal Treasuries. This observation may not surprise active market participants, who usually consider market liquidity conditions an important factor in making buying and selling decisions. It may surprise other market observers, however, who tend to consider the liquidity risk premium to be of secondary importance to the inflation risk premium.[16]

The second observation is that liquidity risk premia are likely to be quite variable. Unlike survey-based inflation expectations that are only updated quarterly or semiannually, yield spreads are derived from trading prices and thus available whenever bond markets are open. Consequently, it is natural that inflation expectations reflected in the yield spread may vary more frequently. Nevertheless, it is highly improbable that the observed magnitudes of the variations are mostly due to changes in market inflation expectations. For example, for the entire sample period, the survey-based expected inflation rate varied within a narrow range of 0.4 percentage point, while for 10-year Treasuries the total variation of the yield spread was within a range of about 1.5 percentage points and for 5-year Treasuries almost two percentage points. Such large magnitudes of changes in the yield spread are unlikely to be mainly due to large swings in the expected future inflation rate and inflation risk premium, given the very subdued movements in the survey-based forecasts of future inflation. Large changes in liquidity risk premia have likely contributed to these sizable movements in the yield spreads.

Third, liquidity risk premia in TIPS have likely declined in recent years. In both Charts 1 and 2, the yield spreads were mostly *below* the survey forecasts of future inflation rate before 2004 (and the realized average inflation rate in the 5-year case), but mostly *above* the survey forecasts after 2004. Both yield spreads started the sample period more

than one percentage point below the corresponding survey forecasts of future inflation. In other words, the liquidity premia in TIPS were at least one whole percentage point larger than the inflation risk premia in nominal Treasuries. Since early 2004, neither spread has been more than 0.15 percentage point below the survey forecasts of inflation, indicating that the liquidity risk premia were close to the size of inflation premia. It is possible that such movements can be due entirely to large increases in inflation risk premia. But this scenario is highly improbable given the fact that survey forecasts of future inflation rates barely moved for the entire sample period. A more plausible explanation is that at least part of the changes was caused by decreases in the liquidity risk premia in TIPS.

The likely decline of liquidity risk premium in TIPS

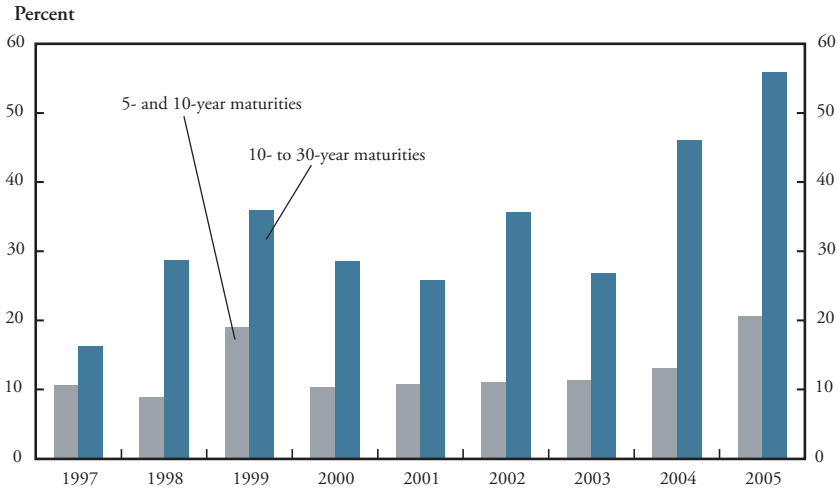
One reason that the liquidity risk premium in TIPS is likely to have declined during the sample period is that the market for TIPS deepened considerably during this time. Chart 3 shows the issuance of TIPS relative to nominal Treasuries with similar maturities for each fiscal year since 1997. The gray bars in the chart are the ratios of newly issued TIPS to nominal Treasuries with maturities of five or ten years. The black bars are the ratios of TIPS to nominal Treasuries with maturities of ten to 30 years.[17] By fiscal year 2005, the issuance volume of TIPS with maturities of at least ten years was more than 50 percent of the total issuance volume of nominal Treasuries with maturities of at least ten years. Clearly, the newly issued TIPS markets have become more comparable to the nominal Treasury markets.

Market interest and TIPS trading have also grown considerably. TIPS have gained the interest of pension funds, insurance companies, direct individual investors, and, since late 2003, the interest of exchange-traded funds. In 1999, only a handful of mutual funds focused on TIPS. Today, there are many more such funds. Chart 4 shows the transaction volumes of TIPS through primary dealers who regularly participate in Treasury security auctions.[18] Trends in overall trading volumes in TIPS should be closely related to the trading volume that goes through primary dealers, which has gradually increased.

Chart 3

ISSUANCE OF TIPS RELATIVE TO NOMINAL TREASURIES

(Fiscal Year)

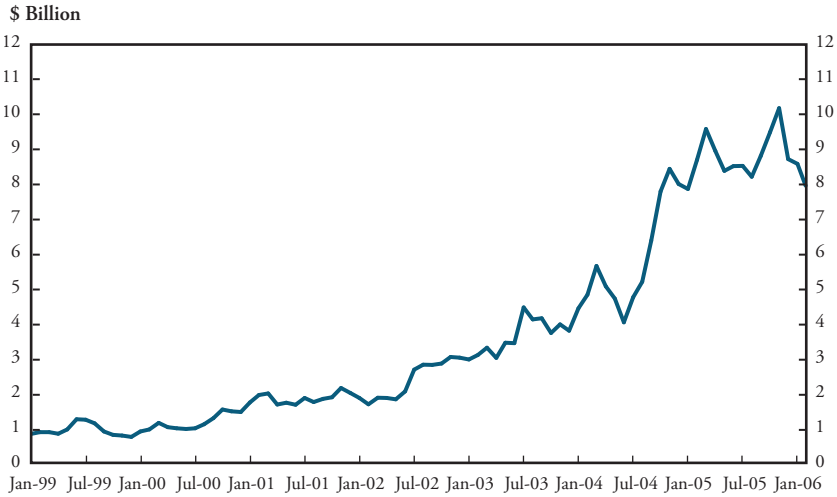


Source: U.S. Treasury

Chart 4

TIPS TRANSACTION VOLUME THROUGH PRIMARY DEALERS

(3-Month Moving Average)



Source: Federal Reserve System, Board of Governors

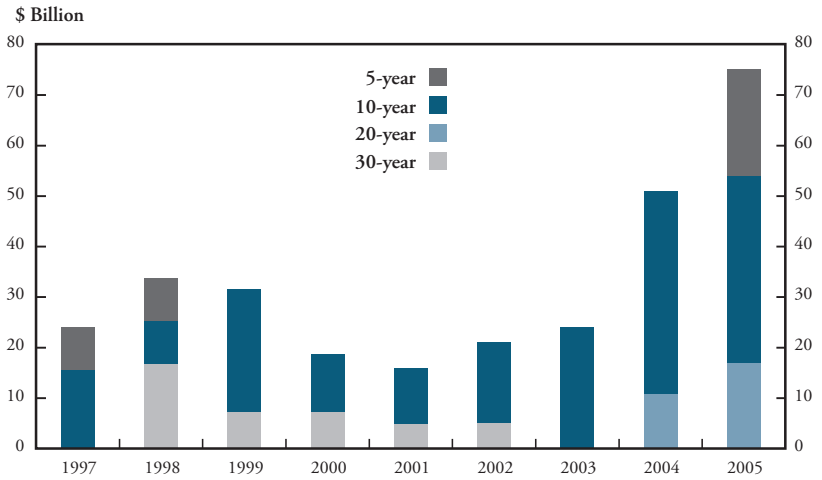
The deepening market for TIPS is likely to be associated with a decline of the liquidity risk premium for TIPS for two reasons. One, as the market deepens, it is easier for investors to find a counterparty to buy a TIPS after its initial auction or to sell a TIPS before its maturity. That is, the deeper market has improved the market liquidity for TIPS and reduced liquidity risk. Less liquidity risk, in turn, has led investors to require a smaller liquidity risk premium for TIPS.

The other reason that a deepening market may lead to lower liquidity risk premium is that it reduces the uncertainty regarding future market liquidity. When TIPS were new to the U.S. market, participants were uncertain about whether or not the Treasury would remain committed to the program. Earlier in the sample period, some investors might have worried that the Treasury would decide to stop issuing TIPS, which would have quickly dried up trading in existing TIPS, leading to deteriorated market liquidity. But as the TIPS market continues to deepen, the risk of a sudden disappearance of the market declines, which in turn should lessen the liquidity risk premium.

Growth of the TIPS markets has not occurred uniformly. In fact, it is possible that 10-year TIPS may have become more liquid than 5-year TIPS because of Treasury's differing commitment to the two securities. Treasury has issued 10-year TIPS every year since the TIPS program began in 1997. The 5-year TIPS, in contrast, were issued in 1997 and 1998, but then not again until 2005. This changing pattern of issuance was related partly to overall changes in the Treasury market: The federal government ran a budget surplus from 1998 to 2001, which reduced its need to borrow and allowed suspension of the 5-year and 30-year TIPS programs. Since 2002, the budget deficit has come back decisively. In response, Treasury has steadily increased total TIPS issuance, reissuing the 5-year TIPS and introducing a 20-year TIPS (Chart 5).

In addition to improving market liquidity, another general development may have also helped lower the TIPS liquidity risk premium. Over the sample period, investors in general may have become less worried about liquidity risk. Liquidity risk premia should generally be lower if investors become more tolerant to liquidity risk, even if the

Chart 5
TIPS ISSUANCE BY MATURITY
(Fiscal Year)



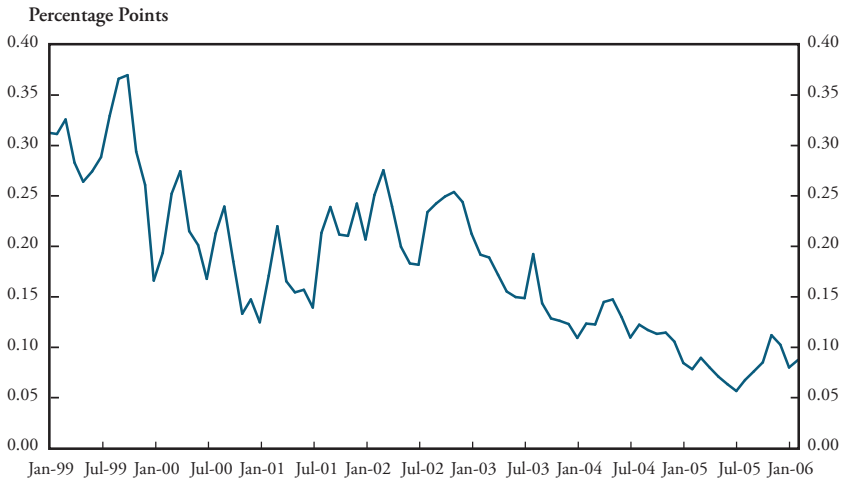
Source: U.S. Treasury

magnitudes of the risk are unchanged.[19] The sample period began in 1999, shortly after the financial market crisis in the fall of 1998. That particular crisis was partly characterized by heightened demand for the most liquid assets—nominal Treasuries. The liquidity risk premia on many other assets increased. Thus, the financial crisis likely had a lingering effect on the new TIPS markets by leaving investors deeply concerned about liquidity risk.

With the passing of time, various risk management measures have been adopted gradually, both in market structures and in many investment firms. It also appears that over the years investors have become more tolerant of liquidity risks. Chart 6 shows the yield difference between off-the-run and on-the-run 10-year nominal Treasuries. On-the-run Treasuries are the most recently auctioned Treasuries and thus are typically traded more frequently. Off-the-run Treasuries are those that were auctioned one or more auctions earlier, and thus most of them are already settled in investors' portfolios and traded less frequently. Therefore, the main difference between these nominal

Chart 6

YIELD DIFFERENCE: OFF-THE-RUN LESS ON-THE-RUN
(10-Year Nominal Treasuries)



Source: Federal Reserve System, Board of Governors

Treasuries is their market liquidity. On-the-run Treasuries are more liquid, and the yield difference between the two securities is the liquidity risk premium.[20]

Chart 6 shows that the yield difference between the off-the-run and on-the-run nominal Treasuries has generally declined over the sample period. As the nominal Treasury market was already highly developed at the beginning of the sample period and the relative liquidity between on-the-run and off-the-run 10-year Treasuries has not changed materially, this yield difference mainly reflects investors' tolerance of liquidity risks in general, which has evidently become greater.

Estimating changes in the liquidity risk premium

With three components in yield spreads, it is difficult to directly estimate the component of liquidity premium. To this end, we first construct a variable, called Risk Premia Differentials (RPD), which are the difference of the yield spread and the Blue Chip Consensus inflation

forecast for the respective horizon. Under the assumption that the consensus forecast follows the same process generating expected inflation rates in the yield spreads, then RPD is the difference between the inflation risk premium and the liquidity risk premium. Implicitly, this assumes that the expected inflation rates built into the yields of Treasuries are essentially the same as the Blue Chip Consensus forecasts. While this may be true on average, long-term Blue Chip Consensus forecasts are only updated semiannually, and therefore some of the changes in the expected rates of inflation may have been left in the RPDs and grouped with the inflation risk premium.

As RPDs have two risk premia, neither of which is directly observable, it remains a difficult task to ascertain changes to each individual component from changes of RPDs. It may be possible to estimate changes in the liquidity risk premium, however, by recognizing that the determinants of the liquidity risk premium and the inflation risk premium are very different. As discussed above, the depth of the TIPS market and investors' general tolerance of liquidity risks are closely related to the liquidity risk premium in TIPS, but are unlikely to be directly linked with the inflation risk premium in nominal Treasuries. Therefore, these variables can be used to estimate the contribution of changes in liquidity risk premium to the changes in the RPDs.

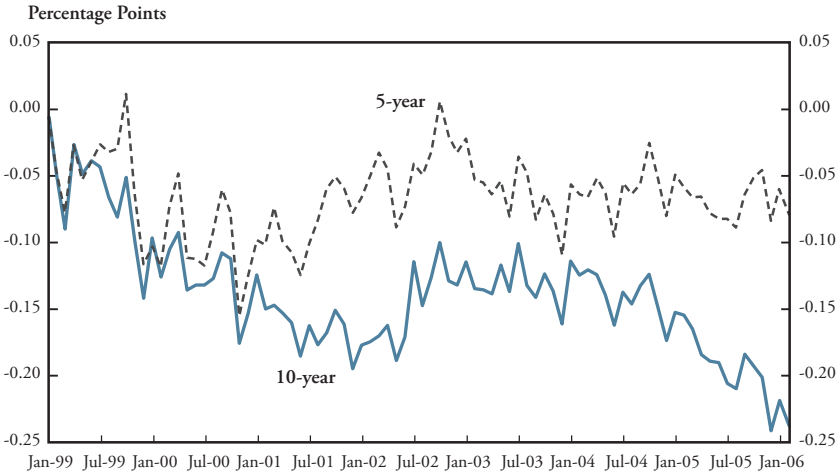
Specifically, we assume that the following statistical model is a reasonable approximation of the changes in the 10-year risk premium differentials:

(9) $\Delta RPD_t^{10} = a_1^{10}\Delta ratio_t + a_2^{10}\Delta volume_t + a_3^{10}\Delta spread_t + u_t^{10}$

where Δ indicates changes of the variables;[21] RPD_t^{10} is the risk premium differential for 10-year Treasuries at time t; $ratio_t$ is the ratio of total outstanding TIPS issued at a maturity of five or ten years to nominal Treasuries issued at maturities of two to ten years;[22] $volume_t$ is the logarithm of the transaction volume of all TIPS with primary dealers;[23] $spread_t$ is the yield spread between off-the-run and on-the-run nominal 10-year Treasuries; and u_t^{10} is the residual, which includes both changes in the inflation risk premium in the 10-year nominal Treasury (could be different by a constant) and errors that are due to other factors.[24]

Chart 7

CUMULATIVE CHANGES IN THE ESTIMATED LIQUIDITY RISK PREMIA



Source: Author's calculations

Equation (9) provides a base for regression analysis as long as factors influencing changes in the inflation risk premium are unrelated to factors influencing the liquidity risk premium, which seems reasonable, as $ratio_t$ is determined by the Treasury and thus can be viewed as exogenous to the inflation process. The variables $spread_t$ and $volume_t$ are not as clearly exogenous as $ratio_t$, as it is possible that views about future inflation risk may lead investors to change their trading patterns regarding nominal and inflation indexed Treasuries. Yet, it seems reasonable to conjecture that such consideration would be secondary.

Chart 7 shows the estimated changes of liquidity risk premia for the 5-year TIPS (dashed line) and 10-year TIPS (solid line). For example, the solid line in Chart 7 is the accumulation of the fitted model $a_1^{10}\Delta\, ratio_t + a_2^{10}\Delta\, volume_t + a_3^{10}\Delta\, spread_t$, where a_1^{10}, a_2^{10}, and a_3^{10} are the estimated coefficients. That is, the solid line in Chart 7 is the cumulative of the estimated changes of liquidity risk premium for the sample period. The dashed line in Chart 7 is obtained similarly, with the regression on corresponding five-year RPDs.

For the solid line in Chart 7, the value of each point represents the relative changes in the liquidity risk premium in the 10-year TIPS relative to January 1999, and the difference of the values of any two points reflects changes in the liquidity risk premium between these two dates. For example, at May 2004, the solid line has a value of -0.14, meaning that the liquidity premium in 10-year TIPS at that time was 0.14 percentage point smaller than the liquidity premium in 10-year TIPS in January 1999. By February 2006, the solid line has a value of -0.24, implying that the liquidity premium in 10-year TIPS then was 0.24 percentage point smaller than that at January 1999. Consequently, from May 2004 to February 2006, the liquidity risk premium in 10-year TIPS declined by 0.1 percentage point (-0.24 minus -0.14 equals -0.10).

The estimates suggest that the liquidity risk premium in TIPS has indeed declined, but the degree of the decline is smaller for 5-year TIPS than for 10-year TIPS. Compared with the beginning of 1999, the liquidity premium in 10-year TIPS has declined about 0.24 percentage point, while the liquidity risk premium in the 5-year TIPS has declined only 0.08 percentage point.[25] Both liquidity premia declined earlier in the sample, until the end of 2000. Then they diverged. The liquidity premium in 5-year TIPS gradually drifted upward for the next two years and peaked in the fall of 2002. It then declined slightly and has been relatively stable for the past three years. The liquidity premium of the 10-year TIPS, in contrast, continued its downward drift until the spring of 2002, then moved up and stabilized for two years before resuming its downward trend in the fall of 2004.

The differing patterns of the two liquidity premia are not surprising considering the differing patterns of issuance for 5-year and 10-year TIPS, as discussed earlier (Chart 5). However, both the changes in the liquidity premia and the differing patterns of changes in the liquidity premia for 5-year and 10-year TIPS have important implications. They suggest that ignoring the liquidity risk premium and equating changes in the yield spread to changes in inflation expectation and inflation risk premium may lead to erroneous conclusions.

Let us look at an illustrative example. Table 1 shows how the estimated changes in the sum of expected inflation rate and inflation risk premium (denoted as the inflation compensation in the table) from July 2003 to February 2006 vary depending on whether the liquidity

Table 1

INFERENCE OF INFLATION OUTLOOK DIFFERS WHEN LIQUIDITY PREMIUM IS TAKEN INTO ACCOUNT

	Change for the next five years (1)	Change for the next ten years (2)	Change for the 5-year period five years ahead (3)
Changes in yield spreads	1.10	0.58	0.06
Changes in estimated liquidity premia	-0.04	-0.12	-0.20
Changes in inflation compensation when liquidity premia are accounted for	1.06	0.46	-0.14

risk premium is taken into account. In the table, column (1) is obtained directly from Charts 1 and 7 and equation (5), and column (2) is obtained from Charts 2 and 7 and equation (4). Column (3) is derived from columns (1) and (2) based on equations (7) and (8): column (3)=2*column (2)−column (1). For example, the first number, 0.06, in column (3) is calculated according to equation (7) (2*0.58 - 1.10 = 0.06).

As the liquidity risk premium generally declined during the period, accounting for changes in the liquidity risk premium leads to smaller increases in inflation compensation. In particular, while the five-year breakeven inflation rate five years ahead appears to have drifted up slightly (0.06 percentage point) during this period, once the changes in the liquidity risk premium have been taken into account, the sum of expected inflation rate and inflation risk premium actually edged down slightly (0.14 percentage point).

Looking forward, the liquidity risk premium may continue to decline as the markets for TIPS continue to deepen. The above example shows that ignoring such changes in the liquidity risk premium can lead to erroneous inferences from yield spreads, as a decline in the liquidity risk premium may be interpreted as an increase in the market expected inflation rate or an increase in the inflation risk premium. Further, if 5-year TIPS are issued more regularly, the liquidity risk premium in their

yield may decline faster than the liquidity premium in 10-year TIPS, making it necessary to adjust the derived spread, S_t^{5f}, to accurately reflect changes in the "longer-term inflation expectations."

Other factors that may affect yield spreads

In addition to the three fundamental components in yield spreads, other factors that temporarily influence the demand for and supply of nominal Treasuries and TIPS may also affect the yield spreads in the short term, suggesting additional cautions may be called for in interpreting changes in the yield spread. In particular, changes in the demand for and supply of the Treasury debt can lead to changes in prices, and therefore yields, of the Treasury securities.

Relative changes in the supply of longer-term nominal Treasuries. All else being equal, a relative reduction of the supply of longer-term nominal Treasuries to longer-term TIPS will lead to relatively higher prices for nominal Treasuries. As yields and prices are inversely related, this leads to lower yields for nominal Treasuries and therefore to a smaller yield spread. Similarly, all else being equal, when such a change is stopped or reversed, the opposite is likely to happen and the yield spread may increase. This, in fact, is likely to happen in the near future.

In the past five years, Treasury has decreased the average maturity of outstanding nominal Treasuries significantly, from its recent peak in 2001 of about 67 months, to about 48 months in the beginning of 2006–a steep drop of about 30 percent.[26] In the meantime, the relatively new supply of TIPS to nominal Treasuries on the longer end have increased from about 30 percent from 1998 to 2003 to more than 50 percent in fiscal year 2005 (Chart 3). If such a shift in supply had not been accompanied by a similar shift in demand, then it should have led to a somewhat narrower yield spread as nominal longer-term Treasuries became more scarce. In contrast, going forward, the average maturity of nominal Treasuries as well as the relative supply of TIPS are likely either to stabilize or reverse; thus, the past downward pressure on the yield spreads will dissipate or reverse as well, leading to somewhat higher yield spreads. This event should not be interpreted as an increase in expected inflation rates in the market or as a higher inflation risk premium.

Possible impact from future pension fund reform. Many market commentators have discussed the potential impact to Treasury securities markets from possible pension fund reforms. One conceivable change in the regulations regarding pension funds is related to the matches between assets and liabilities of defined benefit pension plans. Defined benefit pension plans typically have long and steady liabilities, which are promised payments to retirees. In contrast, many of the pension fund investments are either in assets with shorter durations, such as mortgage-backed securities, or assets with volatile returns, such as stocks. Therefore, an important issue for pension fund regulators is how closely a pension fund's assets are matched in cashflow and duration of its liabilities. But any changes in this regard can potentially alter the demand for long-term Treasuries, both nominal and inflation indexed. In particular, it is possible that regulatory changes may affect demand for nominal and inflation indexed Treasuries differently, leading to changes in the yield spreads that are unrelated to expected inflation rates or inflation risk premia.[27]

Recent experience in the United Kingdom suggests that the potential magnitude of the impact to Treasury demand from pension fund reform can be sizable. In the months after last October's release of proposed new regulations regarding UK pension systems, yields on the nominal 50-year UK government debt securities declined about 0.4 percentage point, while the yields on the inflation indexed 50-year UK government debt declined about 0.7 percentage point, widening the yield spread 0.3 percentage point. Many market commentators suggest that the proposed new regulations, which require closer matches between pension fund assets and liabilities, have likely contributed to the movements in yields and yield spreads.

III. SUMMARY AND CONCLUSION

The liquidity risk premium in TIPS is an important component of the yield spread between nominal Treasuries and TIPS. In all likelihood, from 1999 to 2003 the liquidity risk premium was consistently larger than the inflation risk premium. As the TIPS market has deepened, the

liquidity risk premium has generally declined—and is likely to continue to decline for a while, at least for 5-year TIPS. Consequently, when evaluating market-expected future inflation rates and inflation risks from the yield spreads, it is important to consider the impact of possible changes in the liquidity risk premium.

ENDNOTES

[1]FOMC minutes, March 22, 2005.

[2]The U.S. Treasury Department maintains a website with much information regarding TIPS, as well as other Treasury securities. For slightly more theoretical depiction of the benefits and risks of TIPS, Shen (1998) may be useful.

[3]Investors in TIPS are free from inflation risk only if they do not have to pay income tax on the investment income, such as investment made in tax shield accounts. Otherwise, income tax brings back a portion of the inflation risk (Shen 1998).

[4]An example can illustrate the point that TIPS shield investors from inflation risk, while nominal Treasuries do not. In January 2006, the Treasury auctioned 10-year TIPS with a coupon rate of about 2 percent, and in February, a 10-year nominal Treasury security with a coupon rate of about 4.5 percent. If an investor bought the January TIPS at the auction and holds it to maturity, the real return to the investment will be 2 percent, but the nominal yield will depend on the actual Consumer Price Index (CPI) inflation rate for the next ten years. If CPI inflation turns out to average 2.5 percent in the next ten years, the average nominal yield on the TIPS will be 4.5 percent. If instead, inflation turns out to average 3.5 percent, the investor's nominal yield will be 5.5 percent. In contrast, the real return to an investor who bought the February nominal Treasury at auction will be 2 percent in the first scenario, but only 1 percent in the second scenario.

[5]As investors may not purchase a Treasury at par and hold it to maturity, the yield of a Treasury is usually different from its return. Nevertheless, for narrative simplicity, "yield" and "return" are used interchangeably in this article.

[6]As the U.S. Treasury Department has never reneged its debt obligations and is considered by most investors as highly unlikely to do so in the future, the credit risk and credit risk premium associated with Treasury securities are generally assumed to be zero.

[7]The potential existence of a premium for the risk associated with real interest rates is ignored. Theoretically, the risk of real interest rate fluctuation may be used by investors to hedge other risks that they are exposed to, and thus the risk premium may be negligible, if not a discount (Den Haan). Empirically, real yield curves tend to be much closer to flat, suggesting negligible risk premia associated with real rate fluctuations.

[8]Again, the potential risk premium or discount associated with fluctuations of the market prevailing real rate of interest is ignored. Some other factors that may influence TIPS' yields are also ignored in the current discussion. For example, as the dollar payments of TIPS are indexed to the non seasonally adjusted overall CPI index with a three-month lag, past inflation may affect yields of TIPS through its impact to the dollar prices of existing TIPS. Another factor that may influence TIPS' yields is the probability of deflation. As investors are promised to receive at least par values of TIPS at maturity, real returns of TIPS are only fixed if inflation is positive. Under deflation, real returns of TIPS increase. Therefore, TIPS can be viewed as true "real bonds" combined with an option, the value of which goes up when the risk of deflation increases.

[9]In both charts and statistical analysis presented later, the actual data used are usually called "breakeven inflation rate (BEI)." Conceptually, these are basically the same as yield spreads. Technically, they are constructed by finding a future inflation rate that will make the cashflow of a nominal Treasury identical to that of an indexed Treasury of similar maturity (Sack).

[10]As the real yields in both nominal and inflation indexed Treasuries reflect the required rate of return for investors to lend to the federal government, they ought to be the same for Treasuries with similar maturity. Therefore, the real yields in the nominal and indexed Treasuries with similar maturity cancel each other out in the yield spread.

[11]If the inflation (liquidity) risk premia in the 5-year and 10-year nominal Treasuries (TIPS) are identical, then the risk differential in the sizes of these two differential terms in the 5-year spread five years ahead will be identical to these in the spread between 5-year nominal and inflation indexed Treasuries.

[12]Alternatively, if changes in the inflation and liquidity risk premia are of the same direction and magnitude for the period, then they will cancel each other out exactly, leaving the changes in the yield spread equal to changes in expected inflation rates. In reality, however, this assumption is hard to justify as factors affecting the inflation risk premium tend to be very different from factors affecting the liquidity risk premium.

[13]Although the TIPS program started in 1997, the first two years of its existence were characterized by sparse TIPS and thin trading activity. The yield spread data used in this article are, therefore, not available until the beginning of 1999, as these are based on the estimated smoothed TIPS yield curve which requires a decent amount of data about both trading activity and around various maturity points (Sack).

[14]Both Blue Chip Consensus and SPF forecasts are the median forecasts of groups of professional forecasters. Blue Chip Consensus asks forecasters for their projections of inflation rate for each of the next ten years, from which the author calculates the average inflation rate for the next five or ten years. SPF directly asks the group of forecasters their projections of the average rate of inflation for the next ten years. Both these forecasts are considered reasonably good summaries of sensible forecasts of future inflation. Studies suggest that most forecasters tend to be slow in adjusting their expectations when the inflation process turns directions. But this should not be a serious issue for our sample period (Kozicki and Tinsley).

[15]Campbell and Shiller provide some estimates of the sizes of inflation risk premia in nominal Treasuries.

[16]For example, this author speculated before the inception of TIPS that "even if there is some difference in (market) liquidity, the difference may not be great enough to warrant a sizable liquidity premium" (Shen, 1995).

[17]The bars in the chart are created by combining two or three maturities together partly because the next longer-term TIPS contribute to the expected future market liquidity. For example, 10-year TIPS issued in 1997 became 5-year TIPS in 2002.

[18]As there are large month-to-month variations, the volume in Chart 4 is the 3-month moving average of the monthly volume.

[19]A liquidity risk premium is roughly the product of a liquidity risk and the price of such a risk. If investors have become more tolerant to the liquidity risk, its price falls, thus leading to a smaller liquidity risk premium even if the liquidity risk per se is unchanged.

[20]Of course, off-the-run Treasuries will mature one or two auction cycles earlier than on-the-run Treasuries with the same maturity, but the yield spreads used here have already been adjusted for this slight difference in maturity.

[21]For statistical reasons, the regression of changes of these variables is better than of levels, as it avoids possible spurious correlations between the levels of the variables. The actual regression also allows a constant term.

[22]This is due to data restrictions: The Treasury Department provides disaggregate data on outstanding volumes of bills (debt instruments with maturity less than one year), notes (debt with maturity between two to ten years), and bonds (debt with maturity longer than ten years).

[23]As the author cannot find separate data on transaction volumes on 5-year and 10-year TIPS through primary dealers, the total transaction volume is used for both 5-year and 10-year regressions even though separate volumes would be preferable.

[24]The data are monthly, and a 12-lag autocorrelation is allowed for the residuals.

[25]Compared with some other estimates, the estimated sizes of the decline of liquidity risk premia appear to be small, and should probably be viewed as conservative. For example, Carlstrom and Fuerst estimated that the liquidity risk premium in the 10-year TIPS declined about 85 basis points between the beginning of 2002 and late 2004 (compared to no more than 10 basis points here).

[26]Some market analysts have suggested that this relative decrease in the supply of longer-term to shorter-term nominal Treasuries may also explain part of the flattening of the nominal yield curve.

[27]Some market analysts even speculate that many investors, including pension funds and insurance companies, may have increased their purchases of longer-term Treasuries, either in an attempt to meet the future reforms preemptively, or in anticipation of the price improvements when such reform proposals becomes law. If this is indeed the case, then some of the effect may have already, at least partially, been reflected in the current yield spreads.

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