Understanding the Term Structure of Interest Rates

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A topic much discussed in recent months is the relationship over the past year or so between long-term and short-term interest rates. Some observers have argued that the failure of long rates to trend up as the Fed has increased its target federal funds rate is a puzzle. Others have argued that Fed policy is ineffective because increasing the rising short rate is not affecting the long rate. I'll not say much about the policy issue, but I do want to address the puzzle.

However, I'm going to define the puzzle somewhat narrowly. I'll not address the current low level of the real rate of interest on long-term bonds. That same puzzle existed a year ago, although it may not have been so obvious at the time. What I'll discuss is the issue of why the long rate has not increased as the Fed has raised the target federal funds rate.

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THE RECENT TERM STRUCTURE PUZZLE

Since June 2004, the Federal Open Market Committee (FOMC) has increased the target federal funds rate by 25 basis points every time they have met, including the recent meeting on May 3. Moreover, the federal funds futures market predicted that the Committee would raise the target funds rate by another 25 basis points at its June meeting. On the other hand, a key long-term interest rate, the yield on 10-year U.S. Treasury securities, has shown little persistent tendency to change, either up or down, over the same period. I refer to this discrepancy in interest rate patterns as the recent *term structure puzzle*.

The eight increases in the target funds rate took it from 1 percent to 3 percent as of May 3, 2005. The 10-year Treasury bond rate, however, has exhibited a different pattern. If we look at monthly average data, which I'll use throughout unless indicated otherwise, we can see that the rate has not had a persistent trend since mid-2002, when the rate was about 4 1/2 percent (a rate that also prevailed at the end of 2003 and again this spring). The monthly average level of the bond rate increased by about 90 basis points from March to June 2004, mostly in response to evidence of stronger economic growth and the beginning of Fed tightening. The June 2004 level of 4.73 percent on the bond rate was the highest since June 2002 and has not been exceeded since.

Some observers like to emphasize that the long rate has declined since the Fed first started

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raising rates in June 2004, but I think the right observation, given the variability of the rate, is to say that the long rate has fluctuated around roughly 4½ percent since mid-2002. June 2004 is not the best month to begin the analysis because the Fed's rate increases were foreseen some months in advance. Based on the July 2004 federal funds futures contract, in late 2003 the market anticipated a funds rate of 1.25 percent or above, but then the expected rate for July fell to nearly 1 percent (i) as the FOMC maintained its 1 percent target funds rate at its January and March 2004 meetings and (ii) as a consequence of somewhat weak economic data. When the FOMC introduced the "measured pace" language at its meeting of May 4, 2004, the market priced-in a policy target of 1.25 percent for the June 2004 FOMC meeting. In any event, I'll frame this puzzle as the *failure of long-term interest rates to increase* as short-term interest rates have risen since the late winter and spring of 2004.

Two phenomena deserve to be distinguished: the *level* of long-term rates and the change in long rates as short rates have risen. Low long-term rates were already in place before the recent term structure puzzle, and some major factors behind low long-term rates do not necessarily help in explaining the term structure puzzle, which concerns changes in rates. Most notably, Fed Governor Ben Bernanke (2005) has convincingly argued that the "global saving glut" has been a depressing factor on U.S. real and nominal interest rates since 2000. Yet this factor does not solve the term structure puzzle, for two important reasons. First, as noted, the glut has been in force throughout this decade, whereas the term-structure puzzle refers to the period since early 2004. Second, the glut is a source of downward pressure on real interest rates at all maturities since 2001, whereas the term structure puzzle instead refers to the recent flat trend of the long rate despite a significant increase in the short rate.

AVERAGE HISTORICAL BEHAVIOR

That there is a puzzle is a consequence of just how atypical the recent behavior of the term structure is. The funds rate and bond rate do typically move in the same direction. A linear regression of the first difference of the bond rate on the first difference of the federal funds rate provides a simple description of the average relationship between the bond rate and funds rate. The regressions indicate that the contemporaneous relationship between the two series is positive and statistically significant. For the entire period from May 1954 to March 2005, the regression coefficient is a bit below 0.2; for the period from January 1984 to March 2005, the coefficient is a bit above 0.3. Using the period from 1984, what the coefficient means is that on average a 100-basis-point change in the funds rate has been associated with a 32-basis-point change in the bond rate in the same direction. Thus, over the past year, as the funds rate rose by 200 basis points, we should have seen an increase of the bond rate of about 65 basis points. Depending on how you eyeball your favorite chart of the 10-year bond rate, instead of increasing, the bond rate has been about flat, or down somewhat, over the past year.

THE EXPECTATIONS THEORY OF THE TERM STRUCTURE

To decide whether there really is a puzzle, or to make sense of the puzzle, we'll need to call on economic theory. According to economic theory, a key reason why the contemporaneous relationship between the funds rate and the bond rate is far from one-for-one is that changes in the bond rate should be closely linked not to today's change in the funds rate but to revisions in expectations of the future path of the funds rate. The theory will provide a framework for an analysis of the recent term structure puzzle.

The essential message of the expectations theory of the term structure is that market forces should make longer-term interest rates a weighted average of the short-term interest rates expected to prevail over the life of the bond. The investor should be indifferent between making N consecutive investments in 1-period securities and investing in an N-period bond. Or at least enough investors should be indifferent to force the N-period bond to trade in the market at the weighted

average of the next N 1-period bonds. To take a simple example, letting time be quarters, the expectations theory says that the 2-quarter interest rate should be equal to the average of today's 1-quarter interest rate and the expected 1-quarter rate next quarter. We assume that today's expectation of next quarter's 1-quarter rate is based rationally on all information available today.

The argument applies to bond rates of any maturity. The simple expectations theory implies that the 10-year bond rate reflects the expected path over the next ten years of the short-term rate. The 10-year bond rate at the beginning of June 2004 incorporated the 1-year rate and the next nine expected 1-year rates, the last of which was a 1-year rate on a security that would be issued in June 2013 and mature in June 2014.

Similarly, the 10-year rate prevailing at the beginning of June this year incorporated the current 1-year rate and the next nine expected 1-year rates, the last of which was a 1-year rate on a security that would be issued in June 2014 and mature in June 2015. After comparing the 10-year bond from a year ago with the one today, we see that nine of the ten 1-year periods are the same. Today's 10-year bond does not include the 1-year rate prevailing in June 2004—that security has matured. Today's 10-year bond does include the expected 1-year rate on a security maturing in June 2015. Thus, the difference in the yields on the two 10-year bonds—last June's and this June's—reflects substitution of (i) the expected 1-year rate for a security to be issued in June 2014 for (ii) the 1-year rate in the market in June 2004 for the security that has just matured in June 2005, *plus revisions* in the expected 1-year rates to prevail every year from 2005 through 2013. The key to understanding changes in the 10-year rate is to understand revisions in those nine expected 1-year rates.

To understand the process by which expected future 1-year rates are revised, it is useful to partition the 1-year rate into a real rate and an inflation premium. How might we anticipate far-off expected real short rates to behave? This variable should respond to new information about the real shocks likely to be facing the economy several years in the future. It would be tempting to think that such new information arises so infrequently that the distant short-term real rate could be treated as constant.

There is considerable evidence against this presumption, however. For example, Laubach (2003) finds that expectations of short-term nominal interest rates beyond five years in the future fluctuate in response to the changes in multiyear budget deficit projections, and some of this fluctuation may reflect revisions to expected real rates. It is not hard to imagine other information that might rationally affect investor expectations about distant real rates. Ultimately, the issue is an empirical one and it does appear that the expected real short rate fluctuates considerably in practice.

Historically, expected future nominal short rates have often fluctuated in response to changes in inflation expectations. Over the past year, distant inflation expectations, as measured by the spread between conventional and inflation-protected bonds, have not changed markedly. Thus, we can proceed by assuming that long-term expectations of inflation have remained roughly constant in the past year because of confidence in Federal Reserve policies and, in the absence of information to the contrary, that there is no new information about far-off real rates. With these assumptions, the change in the long rate is driven by new information about the medium-term path of short-term real interest rates.

For example, if newly published data suggest greater pressure on aggregate demand in the years immediately ahead, agents will expect a greater degree of offsetting pressure from the Federal Reserve in the form of higher real interest rates, and the expectation of future real rates will be higher than the expectation based on the prior period's information set. My emphasis in this discussion is that new information about the state of the economy drives changes in long-term interest rates.

A DETAILED LOOK AT JANUARY 2004–MAY 2005

Consider the behavior of bond rates since the beginning of 2004 from the perspective of

the expectations theory of the term structure. In January 2004, the 10-year bond rate was 4.15 percent; in January 2005, it was 4.22 percent. I'll concentrate on information that has created revisions to future expected short rates.

Consider revisions to expected real short rates in immediately coming years. In past tightenings, such as in 1994, policy-induced increases in real rates led to sharp contemporaneous increases in bond rates. The past year has not repeated this phenomenon because the Federal Reserve indicated its tightening intentions well in advance and because the economy has performed about as expected.

An indication of what markets were expecting as of January 2004 is given by the Blue Chip Consensus forecast for real gross domestic product (GDP) growth in 2004 of 4.6 percent. In the event, U.S. real GDP growth in 2004 was 4.4 percent. In 2004, the economy performed as close to expected as we will find in the historical record. Events have not much changed the outlook for 2005 either. In January 2004, the Blue Chip Consensus forecast for 2005 real growth was 3.7 percent; the latest (June 10, 2005) Blue Chip forecast is for real growth of 3.5 percent, an extremely small downward revision from the expectation prevailing in January 2004.

To study this matter more carefully, I've examined large daily movements of the 10-year bond rate since January 2004. These are listed in Table 1. The criterion for determining a "large" movement is a change of 10 basis points or more in the bond rate.

See the table for details; I will provide here the flavor of major financial news that occurred on some of the "large change" days. The sluggish recovery of employment during this expansion was reflected in weak payroll data that surprised the market on January 9, 2004, and March 5, 2004, leading to declines in the bond rate of 16 basis points and 19 basis points, respectively. These employment reports led to revisions of market expectations toward a slower expected withdrawal by the Fed of its accommodative policy stance, and, accordingly, expectations of real short rates over the next few years declined.

As another example, the oil price spike on March 9, 2005, was associated with an increase in the bond rate of 14 basis points. Such bond rate increases can be interpreted two ways. One interpretation is that markets did not revise upward their expectations of future inflation but did revise upward their expectations of the Fed monetary policy required to keep inflation stable. Alternatively, the bond rate increase may have reflected expectations that the Fed would accommodate a temporary increase in inflation in the wake of the oil shock.

Expectations of future monetary policy have affected the bond rate significantly from time to time. A recent study by Gürkaynak, Sack, and Swanson (2005), covering a period earlier than that considered here, finds that news about likely future FOMC actions on the funds rate has an important effect on the bond rate, distinct from FOMC actions on the current funds rate. This finding is, of course, in line with the expectations theory. In the period considered here, news about future policy increased bond rates by 11 basis points on January 28, 2004, when the FOMC dropped from its press release the phrase that it expected policy accommodation to prevail "for a considerable period." Once this phrase was dropped, markets revised their expectations of short rates to a higher path than previously, and bond rates accordingly were immediately revised upward.

Although certain data releases did surprise the market, over the period as a whole the data came in about as expected, contributing to the absence of a trend in the bond rate over the period at issue. Likely policy responses to economic data were also known in advance; and, in the absence of economic surprises, FOMC decisions on the funds rate were much as expected. Thus, there was no particular reason over this period for the market to revise its expectations of future interest rates continuously in one direction; the bond rate fluctuated in response to arriving information, but ended up about where it started.

The argument I am making is not a new one. There is a huge literature on the expectations theory of the term structure of interest rates, and policymakers have long been aware of the basic ideas. For example, the Radcliffe Committee, a

Table 1

Selected Changes in the 10-Year Treasury Bond Rate, January 2004–May 2005

Date	Bond-yield change, basis points	Main news item	Source
1/6/2004	–12	Weaker-than-expected growth in services sector	Reuters
1/9/2004	–16	Weaker-than-expected payroll data	*DJNW*
1/28/2004	+11	Federal Reserve drops "for a considerable period" language from FOMC statement	*NYT*
3/5/2004	–19	Weaker-than-expected payroll data	*WSJ*
4/2/2004	+24	Higher payroll data	*WSJ*
4/13/2004	+10	Weaker-than-expected retail sales for March 2004	*DJNW*
5/7/2004	+16	Better-than-expected payroll data	*WSJ*
6/15/2004	–20	Better-than-expected May inflation; reaction to Greenspan Senate testimony	*FT*
7/16/2004	–12	Better-than-expected June inflation	*DJNW*
7/27/2004	+13	Better-than-expected July consumer confidence	*DJNW*
8/6/2004	–19	Lower-than-expected payroll data	*WSJ*
10/8/2004	–11	Weaker-than-expected payroll data	*DJNW*
10/27/2004	+10	Higher oil prices	*DJNW*
11/5/2004	+11	Better-than-expected payroll data	*WSJ*
12/3/2004	–13	Weaker-than-expected payroll data	*DJNW*
12/16/2004	+10	Continuing reaction to FOMC statement	*DJNW*
3/9/2005	+14	Concern about spike in oil prices	*NYT*
4/15/2005	–10	Continued rise in energy prices. Disappointing reports from Ford and GM	Bloomberg
4/21/2005	+10	Better-than-expected manufacturing report and jobless claims data	Bloomberg

NOTE: *DJNW, Dow Jones News Wire*; *FT, Financial Times*; *NYT, New York Times*; *WSJ, Wall Street Journal*. Dates refer to the date of the interest rate change; sources refer to same-day wire reports and next-day newspaper reports on the principal economic news accompanying the bond rate movement.

U.K. inquiry into monetary policy in the late 1950s, noted that "It is generally agreed that the more temporary a rise in short rates is expected to be, the less it will cause long rates to rise; correspondingly, the more temporary a drop is expected to be, the less will long rates fall."[1] Arthur Burns, then Federal Reserve Chairman, observed in 1977 that "Long-term interest rates, of course, are of much larger significance to the economy than short-term rates; but the long-term rates are also especially sensitive to inflationary expectations."[2] In a 1976 paper, I studied the implications for monetary policy of the expectations theory and concluded that the "implications of the rational expectations hypothesis for macro modeling are profound... This point is of greatest importance for the auction markets in financial assets" because the expectations theory tells us that "long-term interest rates adjust immediately and fully in response to new information."[3]

The expectations theory of the term structure

[1] Radcliffe Committee (1959, paragraph 447).

[2] Burns (1977, p. 724).

[3] Poole (1976, pp. 471, 503).

has been severely criticized on a number of grounds, but for the problem at hand I believe that the theory tells the basic story correctly. In sum, economic surprises have been minimal over the past year and there has been no reason for significant revision in expected future short-term interest rates. Thus, there has been no reason for a significant trend in long-term interest rates.

FULL CIRCLE

I began by discussing the average term structure relationship, in which long rates change by about 30 basis points for every 100-basis-point change in short rates. Now I'll circle back to that topic.

The average relationship reflects average business cycle experience in which information surprises change expectations about future short rates. But a casual glance at the data will show how variable these periods have been. In some cases, long rates rose by much more than 30 basis points for every 100-basis-point increase in short rates, and in some cases much less. For example, over the 12 months ending July 1987, the bond rate rose by 115 basis points while the federal funds rate was rising by only 2 basis points. In contrast, over the 24 months ending in July 1963, the 10-year bond rate rose by only 10 basis points while the federal funds rate was rising by 185 basis points. Clearly, I've picked out particular cases to serve as examples; but I can assure you that, if you look at the data systematically, you will find that the average term structure relationship of about 30 basis points on the bond rate for every 100 basis points on the funds rate is the average of very diverse experience. If I were writing a Ph.D. thesis, I could explore in great detail the flow of information and how both short and long rates responded as new information changed expectations about inflation, real growth, and Fed policy.

Because the role of changes in inflation expectations has been so important historically, but not very important over the past decade or so, consider an example from the 1980s. The 10-year bond rate declined sharply over 1984-86, from 11.67 percent in January 1984 to 7.11 percent in December 1986. Kozicki and Tinsley (2005, p. 427) suggest that this decline reflected continued adjustment of 10-year-ahead expectations of inflation in the wake of the Volcker disinflation. They argue that the decline in consumer price index (CPI) inflation to about 4 percent in 1983 was not accepted as a lasting change until the mid-1980s, whereupon it became more fully reflected in long-term bond yields.

An episode that more closely resembles the 2004 experience is the period 1987-89. Here the FOMC raised the target federal funds rate sharply, but the long rate was fairly trendless. Kozicki and Tinsley (2005, Figure 1) show that the late 1980s was a period where 10-year-ahead expectations of inflation continued to decline, even though 1-year-ahead expectations rose. The rise in 1-year-ahead expectations probably reflected inflation already in the pipeline. Actual Fed policy over this period was, by contrast, disinflationary. It seems that this episode corresponds to one where the Fed adjusted down its long-run inflation objective. The long-term bond market understood this change and discounted the rise in CPI inflation as not reflecting the long-term direction of monetary policy.

FINAL THOUGHTS

It should be clear by now that I do not believe that there is a term structure puzzle reflected in interest rate behavior over the past year or so. Recent experience is unusual but far from unprecedented. The real economy has performed very close to expectation at the beginning of 2004. The major surprise has been the large increase in energy prices. The market has interpreted this increase as a relative price change and not a sign of higher long-run inflation. The spread between conventional and inflation-protected bonds has increased over the near-term horizon but not over the period 5 to 10 years out.

The fact that the 10-year bond has not exhibited a persistent trend over the past 18 months or so while the Fed has been increasing the target federal funds rate by 200 basis points is not evidence that something is awry with monetary policy. Think of the issue this way. At the begin-

ning of a planning period the Fed has in mind a probable course for the economy and expectations about the policy adjustments that will be consistent with long-run policy objectives. Suppose the market has the same understanding as the Fed. Suppose also that events turn out largely as expected. Then, everything goes according to plan, including policy adjustments and the course of bond rates. In fact, in January 2004 the eurodollar futures contract for June 2005 traded at an average rate of 2.81 percent, which was not far off the target federal funds rate of 3.0 percent set by the FOMC on May 3, 2004.

I am not claiming that the Fed had a firm plan in mind in January 2004 to reach a target federal funds rate of 3 percent in May 2005, but rather that events have simply worked out that way, corresponding rather closely to the market's best guess as to how events would unfold. In any event, the fact that everything goes about as expected is certainly not evidence of a policy problem.

I would be delighted, as would professional forecasters, for the string of accurate forecasts to continue. But we would be well advised not to forget those forecast standard errors. They have not vanished. With respect to forecast errors, the future is more likely to be like the past several decades than like the past year. If real growth and/or inflation depart significantly from current expectations, then we will see a persistent trend in the bond rate. I hope we do not see such an outcome, for I believe that the current outlook for the economy is quite favorable. I hope that current expectations are realized.

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