Using the Term Structure of Interest Rates for Monetary Policy

Marvin Goodfriend

The term structure of interest rates, i.e., the yield curve, has long been of interest to monetary policymakers and their advisers. The transmission of monetary policy is conventionally viewed as running from short-term interest rates managed by central banks to longer-term rates that influence aggregate demand. A central bank's leverage over longer-term rates comes from the fact that the market determines these as the average expected level of short rates over the relevant horizon (abstracting from a term premium and default risk). Working in the other direction, the long bond rate contains a premium for expected inflation and, thus, serves as an indicator of the credibility of a central bank's commitment to low inflation.[1]

Different theoretical perspectives support the two above-mentioned uses of the term structure for monetary policy: John Hicks's (1939) expectations theory of the term structure supports the first, and Irving Fisher's (1896) decomposition of nominal bond rates into expected inflation and an expected real return supports the second.[2] The two views are compatible in principle, although reconciling them creates difficulties of interpretation in practice. For example, does a steepening yield curve indicate a loss of confidence in the central bank's commitment to low inflation, or does it indicate that markets expect tighter

The author is Senior Vice President and Director of Research. This article is an edited version of a paper written for the book *Money and Interest Rates*, I. Angeloni and R. Rovelli, eds., Macmillan 1998, proceedings of a conference sponsored by Banca d'Italia and IGIER, University Bocconi. Macmillan holds the copyright. The comments of Mike Dotsey, Bob Hetzel, Andy Olmem, John Walter, and participants at the Bank of England workshop on "Extracting Information from Financial Markets" are greatly appreciated. The views are the author's and not necessarily those of the Federal Reserve Bank of Richmond or the Federal Reserve System.

[1] See, for example, Goodfriend (1993), King (1995), and Svensson (1992).

[2] The idea that the term structure of interest rates can be explained by investors' expectations about future short-term interest rates dates back at least to Fisher (1896), but the main development of the theory was done by Hicks (1939).

policy in the form of a higher path of short rates pursued by the central bank? The yield curve contains information of use to monetary policymakers, but it needs to be interpreted in light of judicious subsidiary "identifying" conditions, together with other data on the economy. Some circumstances lend themselves to clearer interpretations than others, and there are many pitfalls.

Whether or not one regards longer-term interest rates as economic indicators or as part of the transmission mechanism for policy, or both, the term structure plays a potentially important role in the policymaking process. In spite of its complexity, the term structure cannot be ignored.

This article addresses some issues involved in using the term structure to conduct monetary policy. I begin by discussing the long bond rate as an indicator of inflation expectations. Second, I comment on the role that bond rates have played in recent U.S. monetary history. Third, I explain how information in the yield curve can be used to overcome what I call the "policy in the pipeline problem." Fourth, I review recent empirical evidence supporting the two theoretical views underlying our understanding of the term structure. I explain how "peso problems" associated with "inflation scares" in the bond market may help to account for a serious empirical failure of the expectations theory of the term structure. I also discuss evidence supporting the view that significant movements in long-term interest rates are largely driven by expected inflation. Finally, I point out some pitfalls of using the term structure to make tactical policy decisions.

1. PURSUING LOW INFLATION

The Chairman of the Federal Reserve Board, Alan Greenspan, supports a long-run goal for price stability such that "the expected rate of change of the general level of prices ceases to be a factor in individual and business decisionmaking."[3] The long bond rate is particularly well suited to help a central bank assess the degree to which it has achieved low inflation defined in that way. One could compare the behavior of the yield on a long-term nominal bond to its behavior in a past period in which inflation was very low and the public was reasonably confident that it would stay low. For instance, in the United States the 30-year nominal bond rate ranged from around 3 percent to a little over 4 percent from the mid-1950s until the mid-1960s, a period in which inflation averaged around 1 to 2 percent, and presumably, long-term inflation expectations were no more than that.[4] One would think that if the Federal Reserve (the Fed) were to achieve full credibility for low inflation, the long bond rate would once again move down to the 3 to 4 percent range. Most of the nominal bond yield would

[3] Greenspan (1990), p. 6.

[4] See Salomon Brothers and Hutzler (1969). Inflation as measured by the consumer price index actually jumped temporarily to the 3 to 4 percent range from 1955 through 1957.

then reflect an expected real return in the neighborhood of 3 percent.[5] Consistently low bond rates would constitute a key piece of evidence that inflation expectations had ceased to be a factor in individual and business decisions.

In addition, we would expect to see bond rates display the kind of indifference to incoming data that they showed in the low-inflation period of the 1950s and early '60s. Long bonds were then one of the most conservative investments, with stable bond prices and a dependable real return.[6] In sharp contrast, bond prices and ex post real returns became increasingly variable in the period of high and fluctuating inflation and inflation expectations. The variability of returns was also due in part to the increased range of short-term (real) rates that the Fed had to sustain from time to time in order to bring rising inflation under control.[7] For example, both factors were at work when interest rates peaked in 1981. With inflation then above 10 percent per year, long bond rates were double and bond prices were about half of what they had been in the mid-1970s.

The Fed succeeded in bringing inflation down to 4 percent by 1983 and has brought it down below 3 percent in the 1990s. Yet long bond rates continued to be sensitive to incoming data that raised the odds of higher future inflation and Fed action on short rates to head it off.[8] Bond rate volatility caused by the 1994 inflation scare suggests that the Fed did not then have full credibility for low inflation. Even if *actual* inflation remains low, the low inflation goal will not have been achieved until the United States has low and *stable* bond rates more characteristic of the last period in which the Fed had nearly full credibility for low inflation. The one percentage point decline in long bond rates in 1998 to below 5 percent indicates that the Fed has moved closer to full credibility for low inflation.

The U.S. government recently introduced 5-, 10-, and 30-year index bonds whose market yields reflect an expected real rate of interest over these horizons. The yield gap between an index bond and the comparable-maturity conventional (nominal) bond is a direct market estimate of expected inflation. Going forward, the size and stability of the yield gaps will help the Fed assess the extent to which it has achieved price stability.

---

[5] Theory and evidence both support the view that the expected real return on default-free long-term nominal bonds varies in a range within a percentage point or so of 3 percent. Quantitative work by Ireland (1996) that ties the ex ante real rate to expected consumption growth, which varies little over long horizons, suggests that the long real rate should range near 3 percent. And evidence from U.K. index-linked securities and U.S. index bonds also supports that view.

[6] See Ibbotson (1994).

[7] See Goodfriend (1993, 1997).

[8] See Borio and McCauley (1996) and Gerlach (1996) on the 1994 bond rate volatility. Compare the 1994 experience to the volatility described in Kessel (1965) and Salomon Brothers and Hutzler (1969).

Preemptive Policy

One of the most important lessons learned by central bankers in recent decades is that credibility for low inflation is the foundation of effective monetary policy.[9] The Fed has acquired credibility since the early 1980s by consistently taking policy actions to hold inflation in check. Experience shows that the guiding principle for monetary policy is to preempt rising inflation. The go-stop policy experience of the 1960s and '70s taught that waiting until the public acknowledges inflation to be a problem is to wait too long. At that point, the higher inflation becomes entrenched and must be counteracted by corrective policy actions more likely to depress economic activity.[10]

One might wonder why a preemptive strategy should apply more to fighting inflation than to unemployment? The answer is this. A central bank naturally has more credibility for fighting unemployment when the economy is weak than for fighting inflation when the economy is strong. The reason is that when the economy is weak, the public applauds an easing of policy because the obvious benefits in employment come immediately while any costs in higher inflation come later. On the other hand, tightening policy to preempt a rise in inflation invariably draws criticism because the risks of lower employment come immediately, while the benefit to stabilizing inflation is difficult to perceive.

To be preemptive, monetary policy must be forward-looking. That puts a premium on a forward-looking indicator, especially one that embodies a direct measure of inflation expectations such as a long bond rate. As I will point out below, the bond rate has not been a particularly good forecaster of changes in trend inflation, and so it certainly needs to be used in conjunction with other economic indicators. Yet there is evidence that the long-term nominal bond rate moves primarily as a result of inflation expectations. Sharp bond rate movements ought to be taken as evidence of worsening or improving credibility on inflation, as the case may be, and taken into account in making decisions on short-term policy.

2. THE ROLE OF BOND RATES: THE U.S. EXPERIENCE

In discussing the role of bond rates in recent U.S. monetary history, I present three examples of large bond rate movements that probably influenced policy actions by signaling sharply changing inflation expectations. I also comment on the fact that longer-term rates often seem to lead short-term rates over the business cycle.

[9] See Goodfriend and King (1997) for a formal justification of inflation targeting within what they call the New Neoclassical Synthesis macroeconomic model.

[10] See Goodfriend (1997).

Influential Bond Rate Movements

Significant bond rate movements probably influenced the timing and size of subsequent Fed policy actions on these three occasions.

The February 1980 Inflation Scare

After having tightened monetary policy sharply in the fall of 1979, the Fed, based on evidence of a weakening economy, held short rates relatively steady in January and February of 1980. Meanwhile, the 30-year bond rate jumped by 2 percentage points between December and February. The inflation scare was primarily the result of three factors: (1) inflation as measured by the implicit price deflator was nearly 2 percentage points higher in the first quarter of 1980 than in the previous quarter, partly due to the second oil shock; (2) the Soviet Union's invasion of Afghanistan destabilized financial markets; and (3) the Fed hesitated with its policy tightening in the face of a weakening economy. The Fed's hesitation probably created some doubt about whether the Fed would hold the line on inflation. At any rate, the Fed's decision to resume its policy tightening with a huge 3 percentage point increase in the federal funds rate in March was probably influenced significantly by the sharp prior increase in the long rate.

The 1984 Inflation Scare

The economic recovery from the 1981–82 recession was robust. Real GDP grew by 5 percent in 1983–84. Although inflation was only around 4 percent, the long bond rate rose from about 10 percent in the summer of 1983 to peak the following summer at around 14 percent. Amazingly, this was only about 1 percentage point short of its peak in 1981 even though by mid-1984 inflation was 5 or 6 percentage points lower. The Fed raised short-term interest rates in line with the long rate, and the yield curve remained flat. Although there were clearly other good reasons to tighten monetary policy at the time, the sharp rise in the long rate probably contributed to the Fed's inclination to raise short rates as much and for as long as it did.

The 1985 Acquisition of Credibility

The Fed held short rates in the 7 to 8 percent range in 1985 and early 1986, while real GDP grew at 3.3 percent and prices increased at about 3.5 percent. In early 1986, oil prices moved down from around $28 a barrel to less than $15 a barrel. Against these developments, the 30-year bond rate declined from around 12 percent to 7 percent between January 1985 and April 1986, half of the decline coming *before* the collapse of oil prices. The huge 5 percentage point drop in the long rate signaled a big jump in the credibility of the Fed's commitment to low inflation and probably contributed to the Fed's inclination to move short rates down about 2 percentage points in 1986.

Does the Fed Follow the Bond Market?

Economists and financial market analysts have noted that longer-term rates have a tendency to lead short rate movements over the business cycle. In other words, the Fed often appears to follow the market. Some observers argue that the Fed is obliged to follow longer rates and exerts little independent influence of its own. Others recognize that the Fed has considerable discretion over short rates, but they interpret the evidence as indicating that the Fed follows long rates because these are taken to indicate the direction the short rates *ought* to follow for stabilization purposes. This second view is often accompanied by a plea that the Fed should not blindly follow the bond market.

In fact, the Fed has considerable discretion to influence the evolution of short rates. It moves short rates to stabilize inflation and unemployment with the help of a variety of economic indicators, including bond rates. The Fed does not automatically follow longer-term rates though. It only appears to do so at times. The fact that long rates are determined in good part (according to the expectations theory of the term structure) as the average of expected future short rates causes the bond market to try to predict future Fed interest rate policy actions. To the extent that Fed policy contains "systematic follow-through," bond rates move ahead of future changes in short rates. On the other hand, on those occasions when long bond rates jump sharply due to an inflation scare, or fall sharply due to the acquisition of credibility for lower inflation, the Fed might follow with higher or lower short rates, respectively. But the Fed would only take such policy actions if it interpreted the information in long rate movements as consistent with other information signaling a sharp and persistent change in inflation expectations.

Bond Market Vigilantes

The forward-looking nature of bond rates has led some commentators to argue that "bond market vigilantes" are capable on their own of stabilizing the economy against inflation. The argument implies that central banks are now largely irrelevant. This point makes no sense and is actually quite dangerous. Long rates often rise ahead of central bank actions because they reflect a higher expected future path of short rates. If a central bank were to disappoint the bond market by not following through, then bond rates would likely not rise as much in the next potentially inflationary episode. In effect, bond markets are vigilantes only when they are "trained" to be so by credible anti-inflationary monetary policy.

Bond markets would cease to be vigilantes if the central bank ceased to follow a credible low-inflation policy. In such an environment an increase in long rates could reflect higher inflation expectations, i.e., an inflation scare. Rather than acting to restrain spending and inflation, an inflation scare would signal a loss of confidence in the central bank's commitment to low inflation. A central bank might then have to react with a higher path for short-term real

rates to hold the line on inflation.[11] Any way you look at it, bond markets are not capable on their own of automatically maintaining low inflation.

3. POLICY IN THE PIPELINE

It is difficult for a central bank to know when and how much to change short-term interest rates to hold the line on inflation or to resist a recession. In practice, a central bank moves short rates in steps so it can observe the consequences of its actions and assess sequentially the need for each incremental rate change. Policymakers know that it takes some months for the effects of a given change in rates to be felt by the economy. Policy can cumulate "in the pipeline," so to speak, as a sequence of policy actions lengthens. As a tightening proceeds, for example, central bankers become more cautious about taking further actions for fear of overdoing it, and creating a recession. Of course, the opposing risk is that excessive caution might allow inflation to rise.

The term structure of interest rates can play a useful role in assessing how much policy is in the pipeline. If a central bank has credibility as an inflation fighter, then markets may guess correctly that an initial increase in the short rate is likely to be followed by further increases. The expected future path of short rates will be built immediately into the term structure of interest rates. As Dahlquist and Svensson (1996) show, it is possible to extract the expected sequence of future short rates from the spot rate yield curve; the constructed sequence of future rates can then be displayed as a corresponding forward rate curve. Under the assumption of negligible term premia, the forward curve shows the time path of the market's expectation of future short-term interest rates.

Using the forward rate curve, a central bank can see that its initial rate increase carries with it expectations of a whole sequence of increases. Thus, not only the first rate increase but a whole sequence of projected increases in short rates is put into the pipeline the moment a series of tightenings is initiated. Indeed, to the extent that markets begin to expect a sequence of tightening actions before they begin, policy is put into the pipeline before a central bank actually raises short-term rates.

To the extent that a central bank's subsequent interest rate increases were predicted, they would not constitute new policy impulses. A central bank could confidently follow through without being deterred by policy in the pipeline. On the other hand, the central bank could use the forward rate curve to gauge the extent to which the actual path for short rates departed from the initially predicted one. It could thereby keep track of new policy impulses it was putting into the pipeline.

[11] See Goodfriend (1993) and Mehra (1997).

The above discussion can be made more concrete by reference to the 1994 policy tightening. Campbell (1995) constructs and reports a set of forward rate curves extracted from the corresponding U.S. spot yield curves at different dates in 1994. The Fed raised short-term interest rates in a series of seven steps from 3 percent beginning in early February 1994 to 6 percent in early February 1995. The first point of note is that one-year-ahead forward rates rose from 3 to 4 percent in early January 1994, indicating that the bond market expected a significant tightening well before it began. Second, just after the Fed first increased the short rate by 25 basis points in February 1994, the market expected the Fed to raise short rates to 5 percent by early 1995. By early May 1994 the market was looking for 6 percent short rates in May 1995. In mid-May 1994, after having moved the spot short rate up to 4.25 percent, the Fed announced its belief that further policy moves would be unnecessary in the short term, and the forward rate curve fell, indicating that the market then expected a May 1995 short rate of around 5.25 percent.

Judging by the behavior of the forward rate curves, it seems fair to say that the bulk of the Fed's policy impulses were delivered in three major steps—the first percentage point increase by early January, an additional percentage point in early February, and a third by early May. The announcement in mid-May constituted an impulse for easier policy, and so on.

The bottom line is this. Most of the seven federal funds rate policy actions did not put much new policy into the pipeline at the time that they were actually taken. The actions merely supported longer-term interest rate increases that had already happened. Generally speaking, an uncoupling of policy actions and impulses should be expected to characterize episodes of policy tightening or easing. Using the term structure to distinguish between actions and impulses is the first step in dealing with the policy in the pipeline problem. Of course, it will take considerable effort to work out a comprehensive method for dealing with the problem in practice.

4. EVIDENCE ON THE DETERMINATION OF BOND RATES

The two theoretical foundations of our understanding of long bond rates, the expectations theory of the term structure and the Fisher decomposition, have been extensively assessed on empirical grounds. Some recent work shows how the monetary policy perspective complements the finance-theoretic understanding and interpretion of the behavior of the yield curve.

The Expectations Theory of the Term Structure

Empirical work that tests the expectations theory of the term structure with U.S. data finds some unsettling results. Campbell and Shiller (1991, p. 505)

summarize the main findings this way: "The change in the long-term rate does not behave as predicted—the slope of the term structure almost always gives a forecast in the wrong direction for the short-term change in the yield [to maturity] on the long-term bond, but gives a forecast in the right direction for long-term changes in short rates." In other words, long rates seem to overreact to short rates.

We can understand the force of Campbell and Shiller's comment by reviewing the logic behind two key implications of the expectations theory of the term structure. The first implication begins with the idea that, in equilibrium, the interest rate on a long-term bond must equal the average expected level of short rates over the relevant horizon (abstracting from a term premium and default risk). If the long rate were above the expected average of future short rates, then investors would prefer to hold a long-term bond rather than a sequence of short-term securities. But that calculation on the part of investors would cause the bond price to rise until the long-term interest rate fell enough to equate the expected returns on the two investment strategies. The upshot is that when the short rate is below the long rate, the expectations theory of the term structure says that future short rates must be expected to rise, and vice versa. Assuming that market expectations are formed rationally, the theory predicts that short rates will actually rise on average in this case or fall if the short rate is above the long rate. This is the first important implication of the expectations theory of the term structure.

The second implication follows by comparing the expected one-period return to holding a short-term security with the return of a long-term bond held for one period. By holding the short-term security, an investor would earn the short-term interest rate. There is no risk of capital gain or loss on the short security because it matures after one period. Now consider a long bond that makes a constant coupon payment each period and matures a few periods in the future. The one-period return on the long bond has two components. The first component is the coupon divided by the bond price, i.e., the interest yield. The second component will equal the one-period expected appreciation (or depreciation, if any) of the bond price divided by the bond purchase price.

Once again, theory tells us that these two one-period returns must be equal in equilibrium. If the current bond price is such that the one-period interest return on the long bond is above the short rate, then the market must be expecting the bond price to fall. Since the coupon payments are fixed, the lower future bond price, in turn, must imply that the yield to maturity on the long bond is expected to move still higher (because both the interest and the price appreciation components of the bond move higher). The upshot here is that when the short rate is below the long rate, the expectations theory of the term structure says that long bond returns must be expected to rise. Assuming that expectations are formed rationally, the theory predicts that the long rate will actually rise on average when it is higher than the short rate or fall if the short

rate is above the long rate. This is the second important implication of the term structure of interest rates. It is this implication that Campbell and Shiller point out is not observed in the data. Instead of being followed by a change in the long-term interest rate in the same direction as the sign of the slope of the yield curve (long rate minus short rate), the long rate tends to move in the opposite direction.

Bekaert, Hodrick, and Marshall (1997) offer an explanation for this empirical failure that is driven by small-sample anomalies caused by peso problems in the data analysis. They explain how the interest rate data could have been generated by investors who behave according to the expectations theory of the term structure and form their expectations efficiently. Bekaert et al. (1997, p. 13) explain the peso problem this way: "Suppose that short-term interest rates can evolve in three different regimes, with the mean and volatility of rates increasing together as we move across regimes. Further, suppose that any shock that increases the short-term rate also increases the probability of switching to a higher-rate regime. Then, as short rates rise, the term spread may rise as agents rationally forecast a transition to a higher-rate regime. However, if in a particular sample, the higher-rate regimes are observed less frequently than their unconditional probabilities, this increase in the spread will appear unjustified ex post. Thus, increases in the spread are subsequently followed by surprising persistence of lower-rate regimes. At the same time, short rates immediately following the shock will tend to be higher than their unconditional value even if rates stay within a low-rate regime, since they are highly serially correlated. This could account for the puzzling ability of the term structure to predict the direction of short rates but not long-bond returns mentioned above."

High and volatile interest rates were more common in recent decades in the United Kingdom than in either Germany or the United States. According to the peso-problem view, one would expect there to be less evidence against the expectations hypothesis of the term structure in countries with a sample that is more representative of the population distribution. Bekaert et al. emphasize that the evidence supports the peso-problem view since there is only weak evidence against the expectations hypothesis in U.K. data.

Bekaert et al.'s peso-problem interpretation of U.S. interest rate data fits nicely with the idea, emphasized in Goodfriend (1993), that the inflation-scare concept helps understand the behavior of bond rates in the United States. To appreciate the connection, consider this: As Bekaert et al. (1997, p. 2) put it, underlying the peso-problem interpretation of U.S. data is the idea that the true "data generating process includes a low probability, usually catastrophic, state that generates extreme disutility to economic agents. Because the state has low probability, it is unlikely to be observed in a given small sample of data. Because it is catastrophic, the possibility that this state may occur substantially affects agents' decisions, which in turn determines equilibrium prices and rates of return. . . . When a peso problem is present, the sample moments calculated

from the available data do not coincide with the population moments that agents actually use when making their decisions."

Although Bekaert et al. do not mention it, from the inflation-scare point of view the catastrophic state can be interpreted as one with a high trend rate of inflation, perhaps much higher than the 13 percent inflation rate the United States experienced temporarily in the early 1980s. According to the inflation-scare interpretation, long bond rates in the United States jumped sharply on many occasions, reflecting an increased likelihood of a transition to a higher trend inflation state that never materialized because the Fed happened to take countervailing action to resist it in this small data sample. The bond rate came down after the inflation scares, but future short rates remained higher for a while because a higher path for short-term real interest rates was needed to restore credibility for low inflation.

The Fisher Decomposition

Irving Fisher (1896) pointed out that a nominal interest rate on a security is composed of an expected real return and a premium to compensate investors for inflation expected over the life of the security.[12] The introduction of index-linked bonds in the United Kingdom in the early 1980s has by now created a reasonably long time series of direct evidence on the Fisher decomposition of nominal bond rates. Barr and Campbell (1997) report the results of an empirical study of the expected real interest rate and the expected inflation components of the bond rate, assuming that the log version of the pure expectations hypothesis holds. Their major findings are these. Somewhat surprisingly, short-maturity nominal bonds are less risky than short-maturity real bonds, but long-maturity nominal bonds are riskier than long-maturity real bonds. They recognize that this pattern is explained by the large negative short-run correlation between real interest and expected inflation. At longer horizons this correlation is very weak and has little effect on the variability of nominal bond returns.

At longer horizons the real interest rate becomes less variable, leaving expected inflation as the dominant factor driving bond returns. Almost 80 percent of the movement of long-term nominal rates in the United Kingdom appears to be due to changes in expected long-term inflation. The series on expected inflation computed using the indexed and nominal bonds forecasts actual inflation better than the nominal bond rates.[13] The regressions for short horizons

[12] See Ireland (1996) for a modern exposition of Fisher's idea.

[13] Breedon (1995) also reports that medium-term expectations of inflation derived from the U.K. index bonds in conjunction with the nominal bonds predict changes in future inflation reasonably well, though they exhibit a consistent tendency to overpredict future inflation itself.

Using the above technique, the Bank of England's Inflation Report for May 1997 reports that expected inflation at ten years fell by about 50 basis points on the announcement of the Bank of England's independence.

confirm Mishkin's (1990b) finding for the United States that the term structure of six months or less contains no information about the path of future inflation.

The above-mentioned findings indicate that long bond rate movements are largely driven by expected inflation. The findings support the idea that sharp long rate movements can be interpreted as indicative of shifts in the credibility of the central bank's commitment to low inflation. At the same time, although the expected real interest rate becomes less variable at longer horizons, there still appears to be room for a central bank to exercise a degree of influence on longer-term real rates through its management of short rates. Finally, the large short-run negative correlation between expected inflation and the expected real rate is consistent with the fact that central banks manage short-term nominal rates closely and smooth them against shocks. With short nominal rates kept constant by a central bank, a shock to the inflation expectations component of the rate implies an equal and opposite movement in the expected real rate.

5. PITFALLS IN USING THE TERM STRUCTURE

There are serious pitfalls in using bond rates to gauge the inflation risk in the outlook for the economy, or in gauging the degree to which a series of short-term interest rate policy actions will be transmitted to the economy through longer-term interest rates. I discuss these briefly below.

Bond Rate Forecasting Failures

The long bond is arguably a good indicator of the market's perception of a central bank's commitment to low inflation. That alone makes significant bond rate movements deserving of the attention of central bankers. A related but separate question is the extent to which bond rates actually have proven to be good forecasters of future inflation trends. As discussed above, an ongoing inflation trend is reflected in higher bond rates. And the term structure does contain information for forecasting cyclical swings in inflation.[14] But when it comes to foreseeing changes in the trend rate of inflation, bond rates have not done as well. For instance, U.S. bond rates did not foresee the big jump in trend inflation that occurred in the late 1960s and early 1970s. Rates did move up, but only in line with the actual deterioration in current inflation.

As another example, consider that the U.S. 30-year rate was roughly in the same 8 percent range in early 1992 as it was in early 1977, in spite of the fact that inflation was 3 percentage points lower in 1992 than in early 1977. Assuming a real long-term interest rate of around 3 percent, the long-term expected rate of inflation would have been about 5 percent in both years. Apparently, investors perceived the 6 percent inflation rate as temporarily high in early

[14] See, for instance, Mishkin (1990a) and references contained therein.

1977, and they perceived the 3 percent inflation rate in 1992 as temporarily low. However, the five years beginning in 1977 saw the worst inflation of the period, and inflation has fallen by a percentage point or more since 1992.

Even more spectacular, the fact that the U.S. long rate rose to around 14 percent in the summer of 1984 seems incredible in light of the fact that trend inflation since then has remained around 4 percent or less. Clearly, bond rates have not always been very good predictors of changes in inflation trends.

Policy Actions and Long Rates

The Fed moved short-term rates up by about 3 percentage points from the spring of 1988 to the spring of 1989, but the 30-year bond rate increased relatively little, and the yield curve was inverted for most of 1989. In contrast, the Fed again moved short rates up by 3 percentage points from February 1994 to February 1995. Yet in this latter case the long rate moved up from a trough of less than 6 percent in October 1993 to peak at over 8 percent in November of 1994, and the yield curve did not invert.

The two episodes of policy tightening were similar in magnitude and not far removed in time. Moreover, inflation rose only modestly in the late 1980s and actually held steady at around 3 percent in 1994–95. Yet the behavior of the long rate differed enormously in the two periods. What should one conclude? Apparently, the effect of a policy tightening on long rates can differ widely depending on the circumstances. This suggests that the transmission of a sequence of interest rate policy actions to the economy depends on underlying factors such as the state of the business cycle or the nation's commitment to low inflation.

An alternative interpretation might be this: In fact, the long rate actually jumped by 2 percentage points from January to September 1987 just before the stock market correction. The bond rate registered an inflation scare in 1987, but perhaps the Fed's response was delayed by the transition from Chairman Volcker to Chairman Greenspan, which took place in the summer, and later by the October stock market correction. Under this interpretation a 2 percentage point bond rate move accompanied a 3 percentage point short rate increase in both the 1988 and 1994 periods. One might conclude that the only difference is that the policy tightening associated with the bond rate rise was delayed by a year in the earlier period.

Even if these two episodes can be seen as reflecting similar correlations between the bond rate and the short rate, is there any reason to expect the correlation to be stable in the future? Clearly the answer is no. Long rates varied relatively little with short rates in the low-inflation 1950s and '60s.[15]

[15] See the nice demonstration of this point in Chadha and Ganley (1995), who show that the correlation between short and long U.K. interest rates in the low-inflation 1870–1914 period is much smaller than in the high-inflation 1970–1995 period.

Inflation expectations were then securely anchored, and the range in which the Fed varied short rates to stabilize the economy was smaller in the low-inflation period than it was in the 1970s, ’80s, and ’90s. If the Fed succeeds in acquiring full credibility for low inflation in the years to come, then short and long rates should once again co-vary as in the earlier period. In retrospect, the late 1980s and mid-1990s may be seen as a transition period in which short and long rates continued to exhibit the kind of covariation observed in the period of high inflation.

Direct Policy Leverage on the Long Real Rate

Monetary policy transmission is conventionally viewed as running from short-term real interest rates managed by central banks to longer-term real rates that influence aggregate demand. There are two major pitfalls to overcome in estimating such direct policy leverage on the long real rate. First, as discussed in the policy in the pipeline section above, one must distinguish policy actions from policy impulses. Interest rate policy actions that have been anticipated clearly would not be expected to affect longer-term rates much, if at all. One should construct and use a sequence of policy impulses in order to gauge the effect of policy on longer-term rates. Second, when current inflation is stable and inflation expectations are well-anchored, then it is reasonable to interpret the effect of a nominal short rate policy impulse on the nominal long-term rate in real terms. While those conditions were probably satisfied in the 1950s and early ’60s United States, they probably have not been satisfied completely since then. Actual inflation has been well-behaved in the 1990s, but the relatively large movements in long bond rates suggest that inflation expectations are still not firmly anchored.

With those caveats in mind, consider some simple evidence on the leverage that short rate policy actions exert on long rates. Cook and Hahn (1989) found for the United States in the late 1970s that a 100-basis-point increase in the Fed’s nominal federal funds rate target increased the nominal 30-year rate by 13 basis points on average. Cook and Hahn used a narrow day or two time window in their calculations. Two rough calculations in my 1993 paper suggest a larger 25-basis-point effect on the 30-year rate per 100-basis-point short rate policy action in 1979 and 1980.[16] Assuming that both actual inflation and inflation

[16] The sharp 2.3 percentage point federal funds rate rise from September to October 1979 pulled the long bond rate up 0.7 percentage points. And the sharp 8.6 percentage point funds rate reduction between April and June 1980 pulled the long rate down 1.6 percentage points. Averaging the two effects yields about 25 percent as the fraction of aggressive funds rate policy actions transmitted to the long rate. Among all the sequences of aggressive policy actions in the period I studied, these two seemed the best candidates to gauge the size of direct leverage of policy over the long rate in real terms. They were very large moves, surprising in their timing and magnitude. Further, they were taken in only a few weeks’ time when inflation and, plausibly, inflation expectations were relatively unchanging. See Goodfriend (1993), p. 13.

expectations were relatively unchanging on average when these policy actions were taken, we can interpret these estimates of policy leverage in real terms.[17]

Taken as a whole, the year-long episode of policy tightening in 1994 suggests the potential for much greater direct policy leverage over the long real rate. As mentioned above, the nominal long rate moved about two-thirds as much as the nominal short rate in 1994. Since inflation held steady, the 3 percent increase in nominal short rates was entirely real. The one to two-thirds leverage, however, should be considered an upper bound on the direct term structure effect running from real short to real long rates because the long rate rise almost certainly included an increase in inflation expectations as the inflation scare ran its course.

We can say more. As it happened, the 1994 long bond movements in the United Kingdom paralleled those in the United States: both rose by about 2 percentage points.[18] Using the U.K. index bond, Barr and Campbell (1997) show that the 1994 rise in the U.K. ten-year nominal bond rate was due in equal parts to a rise in expected inflation and a rise in the expected real yield. Applying a similar decomposition to the rise in the U.S. long rate cuts the apparent direct leverage of short-term real rates over the long real rate down to 30 basis points per 100-basis-point short rate action, more in line with the evidence described above.

It bears repeating that the leverage exerted by short rates over long rates is regime dependent. Policy leverage will depend on the market's expectation of what a given central bank policy action implies for the expected path of future short rates. For the 1970s period in the United States examined by Cook and Hahn, the Fed was not yet in a full-fledged inflation-fighting regime. That might explain why the leverage found by Cook and Hahn is smaller than for the early 1980s or for 1994. Moreover, one might think that policy leverage in the 1950s was relatively weak too, since policy actions needed to stabilize the economy were relatively small and of short duration.[19] The point is that

[17] A change in the central bank's short rate target can itself convey information that simultaneously influences long-run inflation expectations one way or the other. Markets could become more concerned about future inflation because the central bank has revealed *its* concern; or markets could feel more confident of price stability because the central bank *is* taking action against inflation. The statement in the text assumes that these two effects cancel each other. Clearly, this question needs to be addressed in a more sophisticated way, controlling explicitly for changes in expected inflation, perhaps using index-bond market data.

[18] See Borio and McCauley (1996).

[19] An important point to keep in mind is that a given short-rate policy action will exert a greater effect on the long rate the shorter the average life of the bond as measured by its duration. The duration of a coupon bond may be thought of as the term to maturity of an equivalent zero coupon bond that makes the same total payments and has the same yield. The duration of a very long-term bond selling near par is approximately $1/r$, where r is the per-annum yield to maturity. The duration of the 30-year bond, for instance, is only about 12 years at an interest rate of 8 percent, but it rises to 33 years at a 3 percent interest rate. Other things the same, policy leverage

relatively aggressive short rate actions are required to *restore* credibility for low inflation after it has been compromised, whereas policy actions taken to *maintain* credibility for low inflation can be quite modest.

6. SUMMARY

The term structure of interest rates can play an important role in the making of monetary policy. Long rates indicate the extent to which a central bank has achieved price stability. Significant bond rate movements influence the timing and magnitude of monetary policy actions. On the other hand, the ability of bond rates to forecast changes in inflation trends is not particularly good. Moreover, the influence of policy actions on longer-term rates can be quite variable. In particular, the degree of restraint transmitted by policy is difficult to manage in a transition between high- and low-inflation regimes. The effect of policy on the economy becomes more predictable once low inflation is secure.

The peso-problem interpretation of some anomalies in the empirical assessment of the expectations hypothesis literature squares nicely with the inflation-scare interpretation of sharp movements in bond rates. Recent empirical findings on the Fisher decomposition of nominal bond rates also accord well with the influence of inflation scares and central bank interest rate smoothing on interest rates.

Some points about the use of the term structure for making tactical policy decisions are worth reiterating: (1) the need for policy to preempt a rise in inflation and inflation expectations puts a premium on the long bond rate as an indicator of credibility for low inflation; (2) policy leverage on long rates is regime dependent and, in particular, will vary with a central bank's commitment to price stability and its credibility for low inflation; (3) policy often follows long rates because long rates embody expectations of future short rate policy actions and because long rate movements often signal changing inflation expectations that may precipitate a policy reaction; (4) bond market vigilantes do not make central banks irrelevant; and (5) the yield curve can be employed usefully to distinguish policy actions from policy impulses in order to tell how much policy is in the pipeline.

The alert reader may have noticed that I have not discussed how the term structure might help a central bank forecast the risk of recession. There is a literature showing that term spreads are useful for predicting recessions as much as two years ahead. Bernard and Gerlach (1996) document the evidence for eight countries over two decades. While this finding seems robust, it is of less use to central banks than one might think. The reason, as Bernard

---

over longer-term rates will be much smaller at low interest rates such as those observed in the 1950s and early '60s.

and Gerlach recognize, is that over this sample period most recessions follow periods in which central banks have tightened monetary policy to fight inflation. A term spread that is inverted by a deliberate tightening of monetary policy may contain little additional information of use to central bankers.

REFERENCES

Barr, David G., and John Y. Campbell. "Inflation, Real Interest Rates, and the Bond Market: A Study of U.K. Nominal and Index-Linked Government Bond Prices," *Journal of Monetary Economics*, vol. 39 (August 1997), pp. 360–84.

Bekaert, Geert, Robert J. Hodrick, and David A. Marshall. " 'Peso Problem' Explanations for Term Structure Anomalies," Stanford University Graduate School of Business Research Paper 1145, July 1997.

Bernard, Henri, and Stefan Gerlach. "Does the Term Structure Predict Recessions? The International Evidence," Bank for International Settlements Working Paper 37, September 1996.

Borio, Claudio E. V., and Robert N. McCauley. "The Economics of Recent Bond Yield Volatility," Bank for International Settlements Economic Paper 45, July 1996.

Breedon, Francis. "Bond Prices and Market Expectations of Inflation," *Bank of England Quarterly Bulletin*, vol. 35 (May 1995), pp. 160–64.

Campbell, John Y. "Some Lessons from the Yield Curve," *Journal of Economic Perspectives*, vol. 9 (Summer 1995), pp. 129–52.

_____, and Robert J. Shiller. "Yield Spreads and Interest Rate Movements: A Bird's Eye View," *Review of Economic Studies*, vol. 58 (May 1991), pp. 495–514.

Chadha, Jagjit S., and Joe A. Ganley. "Monetary Policy, Inflation Persistence and the Term Structure of Interest Rates: Estimates for the U.K., Germany, and the U.S." Mimeo, Bank of England, 1995.

Cook, Timothy, and Thomas Hahn. "The Effect of Changes in the Federal Funds Rate Target on Market Interest Rates in the 1970s," *Journal of Monetary Economics*, vol. 24 (November 1989), pp. 331–51.

Dahlquist, Magnus, and Lars E. O. Svensson. "Estimating the Term Structure of Interest Rates for Monetary Policy Analysis," *Scandinavian Journal of Economics*, vol. 98 (June 1996), pp. 163–83.

Fisher, Irving. "Appreciation and Interest," *American Economic Review Publications*, vol. 11 (August 1896), pp. 331–442.

Gerlach, Stefan. "Monetary Policy and the Behavior of Interest Rates: Are Long Rates Excessively Volatile?" Bank for International Settlements Working Paper 34, January 1996.

Goodfriend, Marvin. "Monetary Policy Comes of Age: A 20th Century Odyssey," Federal Reserve Bank of Richmond *Economic Quarterly*, vol. 83 (Winter 1997), pp. 1–22.

_____. "Interest Rate Policy and the Inflation Scare Problem: 1979–1992," Federal Reserve Bank of Richmond *Economic Quarterly*, vol. 79 (Winter 1993), pp. 1–24.

_____, and Robert G. King. "The New Neoclassical Synthesis and the Role of Monetary Policy," in Olivier J. Blanchard and Stanley Fischer, eds., *NBER Macroeconomics Annual 1997*. Cambridge, Mass.: MIT Press, 1997.

Greenspan, Alan. Statement before the U.S. Congress, House of Representatives, Subcommittee on Banking, Finance and Urban Affairs. *Zero Inflation*. Hearing, 101 Cong. 1 Sess. Washington: Government Printing Office, 1990.

Hicks, John. *Value and Capital*, 2d ed. London: Oxford University Press, 1939.

Ibbotson Associates. *Stocks, Bonds, Bills, and Inflation 1994 Yearbook*. Chicago: Ibbotson Associates, 1994.

Ireland, Peter N. "Long-Term Interest Rates and Inflation: A Fisherian Approach," Federal Reserve Bank of Richmond *Economic Quarterly*, vol. 82 (Winter 1996), pp. 21–35.

Kessel, Reuben A. "The Cyclical Behavior of the Term Structure of Interest Rates," National Bureau of Economic Research Occasional Paper 91, 1965.

King, Mervyn. "Credibility and Monetary Policy: Theory and Evidence," *Bank of England Quarterly Bulletin*, vol. 35 (February 1995), pp. 88–91.

Mehra, Yash P. "A Federal Funds Rate Equation," *Economic Inquiry*, vol. 35 (July 1997), pp. 621–30.

Mishkin, Frederic S. "The Information in the Longer Maturity Term Structure about Future Inflation," *Quarterly Journal of Economics*, vol. 105 (August 1990a), pp. 815–28.

_____. "What Does the Term Structure Tell us about Future Inflation?" *Journal of Monetary Economics*, vol. 25 (January 1990b), pp. 77–95.

Salomon Brothers and Hutzler. *An Analytical Record of Yields and Yield Spreads*. New York: Salomon Brothers and Hutzler, 1969.

Svensson, Lars E. O. "Targets and Indicators with a Flexible Exchange Rate," in *Monetary Policy with a Flexible Exchange Rate*. Sveriges Riksbank, 1992.