FRBSF WEEKLY LETTER

Number 93-15, April 16, 1993

Interpreting the Term Structure of Interest Rates

This Weekly Letter *is adapted from the discussion at the Conference on Macroeconomic Stabilization Policy held at Stanford University on March 5 and 6, 1993. The conference was jointly sponsored by the Federal Reserve Bank of San Francisco and the Center for Economic Policy Research at Stanford.*

The term structure of interest rates—sometimes called the yield curve—refers to the curve traced out by interest rates on securities as their maturity ranges from short to long-term. Typically, interest rates on long-term securities are higher than rates on short-term securities, so the term structure generally slopes upward. But sometimes, long-term rates are lower than short-term rates; in this case, the yield curve is described as "inverted."

The term structure of interest rates is important because it contains information about the market's forecasts of future inflation and interest rates as well as about its perception of risk. For example, in recent months, long-term interest rates have fallen relative to short-term rates. To some extent, this may reflect beliefs that inflation will be lower in the future, that deficit reduction will reduce future short-term real interest rates, or that risks associated with long-term investments may have diminished. If properly understood, this information can help investors and policymakers formulate long-term plans.

This *Weekly Letter* explains how to interpret the information in the yield curve. It reviews the basic theory of the term structure, discusses the empirical importance of various theoretical factors, provides some insight into the events of the 1980s, and interprets the recent decline in long-term interest rates.

The theory of the term structure

The simplest theory of the term structure is known as the Expectations Hypothesis. According to this theory, the expected return earned by holding long and short-term bonds over the same period of time should be the same. For example, suppose an investor has a choice between two long-term investment strategies, either to buy a long-term bond and hold it until it matures, or to roll over a sequence of short-term bills. If investors were not concerned about risk, they would choose the strategy which pays the higher expected return. Then, in equilibrium, the two strategies would have the same expected return. For example, if the expected return on long-term bonds were greater than the expected return on rolling over short-term bonds, investors would sell short-term bonds and buy long-term bonds. This would increase yields on short-term bonds, while the return on long-term bonds would fall. Investors would continue this operation until expected returns were equalized.

Similarly, suppose an investor has a choice between two short-term investment strategies, either to buy a 3-month bill and hold it until it matures, or to buy a long-term bond, hold it for three months, and then sell it. The Expectations Hypothesis predicts that the interest rate on 3-month bills should be the same as the expected return on holding the long-term bond three months. Therefore, the difference between actual holding returns on long and short bonds, which is called the "excess holding return," should be unpredictable.

According to the expectations theory, the shape of the yield curve is determined by expectations about future changes in short-term interest rates. In particular, the term structure slopes upward when short rates are expected to rise, and it slopes downward when short rates are expected to fall. To see why, suppose that future short-term rates are expected to rise. If the yield curve were flat, investors could make more money by rolling over short-term bills than by holding long-term bonds. To eliminate this arbitrage opportunity, the long-term bond yield must be greater than the current short-term rate. In this case, the yield curve must slope upward.

While the Expectations Hypothesis certainly contains an element of truth, most economists

believe that it is oversimplified. In particular, while the Expectations Hypothesis implies that expected holding returns on long and short-term bonds should be the same, empirical studies show that there are predictable differences. This suggests that the expectations theory leaves out an important ingredient. Many economists believe that the missing ingredient is risk. When interest rates change, the value of pre-existing long-term bonds also changes, and the longer the time to maturity the greater is the capital gain or loss. Thus long-term bonds are subject to greater capital risk than short-term bonds. In addition, some bonds are subject to default risk, although this does not apply to Treasury bonds. Since many investors dislike risk, they require a higher expected return—a risk premium—on long-term bonds.

The presence of a risk premium complicates the interpretation of the term structure, since an upward sloping yield curve might indicate that markets expect short-term rates to rise or that there is greater uncertainty about the future. Similarly, if the risk premium is large enough, the yield curve can slope upward even when short-term rates are expected to fall. Thus it is important to account for time-varying risk premia when interpreting the term structure.

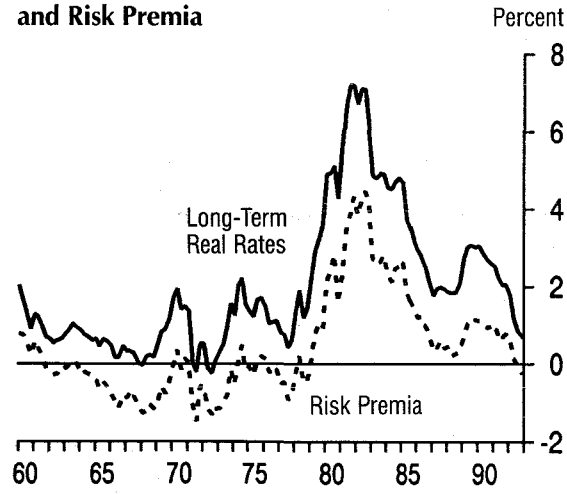
Time-varying term premia

To induce risk-averse investors to hold long bonds for one quarter, the expected holding return on long bonds must include a one-quarter risk premium. To induce risk-averse investors to hold long bonds until maturity, long bonds must offer a sequence of quarterly risk premia, covering the period from now until maturity. The yield to maturity on long bonds includes a long-term risk premium which is equal to the present discounted value of the sequence of expected short-term risk premia.

One can interpret the predictable variation in excess holding returns as evidence of variation in short-term risk premia. Thus one can estimate the long-term risk premium by constructing a forecasting model, generating forecasts of excess holding returns over long horizons, and then discounting those forecasts back to the present.

My forecasting model is adapted from Fuhrer and Moore (1993). It predicts future excess holding returns using past observations of short-term bill rates, realized excess holding returns, detrended output, and inflation. The short-term interest rate is the 3-month Treasury bill rate, and the long-term interest rate is the 10-year Treasury bond rate. Output is measured by per capita GDP, and inflation is measured by the percent change in the implicit GDP deflator. I estimated the model using quarterly data over the period 1959 to 1992. The results are shown in the figure, which shows the implied long-term risk premia as well as estimates of the long-term real interest rate. The distance between the two curves is the expected real return earned by rolling over short-term bonds.

Long-Term Real Rates and Risk Premia



If the Expectations Hypothesis were correct, the long-term risk premium would be zero at all dates in the sample, and variation in the long-term real interest rate would be due entirely to variation in the expected rollover return on bills. In contrast, the figure shows that most of the variation in the long-term interest rate is due to variation in the risk premium. Relatively little is due to the expected rollover return. Thus the shape of the yield curve appears to depend primarily on time-varying risk premia. The factors emphasized by the expectations theory appear to be of secondary importance.

Risk premia vary countercyclically; output tends to be below trend when risk is high. Holding risk constant, the real rollover return varies procyclically. It tends to be higher than average when output is above trend and risk is low. Yield spreads are useful for predicting risk premia, but they do not help to forecast the real rollover return on bills. Thus the ability of yield spreads to

forecast output fluctuations (e.g., Huh 1993) appears to be related to uncertainty about future interest rate fluctuations.

Events of the 1980s

During the 1980s there was a substantial increase in long-term interest rates, and most of this was due to an increase in risk premia. For example, during the 1960s and 1970s, the average long-term real interest rate was approximately 1 percent, and risk premia were small, averaging −0.3 percentage points. Negative risk premia may seem anomalous, but they can occur when investors believe that there is a small chance of making a large capital gain on long bonds. During the 1980s, the risk premium averaged 2 percentage points, and average long-term real rates increased to 4.1 percent.

What caused such a large increase in risk? The timing suggests that it might be related to uncertainty about disinflation. Risk premia began to rise around the middle of 1979 and reached a peak in the third quarter of 1982. This roughly coincides with Chairman Volcker's efforts to drive down the inflation rate. At the time, there was a great deal of uncertainty about how long the Federal Reserve would persist in its efforts to reduce inflation. As unemployment began to rise, many people believed that the Federal Reserve might reverse course in order to stabilize employment. Since the commitment to disinflation was in doubt, it became very difficult to predict the path of inflation and thus very risky to hold long-term nominal bonds. Risk premia rose dramatically to compensate investors for the unusually high degree of uncertainty about inflation.

In 1982 the inflation rate fell from roughly 8 percent to around 4 percent, and it remained around 4 percent for the rest of the decade. Risk premia declined more gradually, which suggests that the Federal Reserve's steady inflation policy gained credibility only gradually. After 1986, the risk premium decline to roughly 0.6 percent. Although the likelihood of a return to high inflation was relatively low, unlikely events do sometimes occur.Thus the risk premium on long bonds remained higher than in the 1960s and 1970s. The evidence suggests that our temporary experience with high inflation in the late 1970s and early 1980s had a lasting effect on long-term real interest rates.

Recent events

Over the last few months the term structure of interest rates has become flatter, as long-term yields have fallen while short-term rates were more or less unchanged. In particular, the spread between 10-year Treasury bond rates and 3-month Treasury bill rates fell by roughly 40 basis points. Complete data for the first quarter are not yet available, so one can make only rough guesses about the factors underlying this change. Based on staff estimates of the missing data, my model suggests that this reflects roughly equal declines in risk and expected short-term real rates. For example, in the first quarter of 1993, the expected rollover return on short-term bills fell by 18 basis points, while the risk premium on long bonds declined by 11 basis points. The long-term real interest rate fell to 0.5 percent, a level not seen since 1977.

The timing of the change in the yield curve suggests that it was driven by news about deficit reduction. For example, the biggest drop in long-term rates occurred after President Clinton's economic address, in which he outlined his strategy for reducing the federal budget deficit. This reduces long-term interest rates in two ways. Deficit reduction increases national saving and thus eases pressure on short-term real interest rates. Deficit reduction also reduces the risk of a return to high inflation by slowing the growth of nominal aggregate demand in the intermediate run and by reducing the likelihood that the government will monetize its deficits in the long run.

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Index to Recent Issues of *FRBSF Weekly Letter*

DATE	NUMBER	TITLE	AUTHOR
10/23	92-37	Southern California Banking Blues	Zimmerman
10/30	92-38	Would a New Monetary Aggregate Improve Policy?	Motley
11/6	92-39	Interest Rate Risk and Bank Capital Standards	Neuberger
11/13	92-40	NAFTA and U.S. Banking	Laderman/Moreno
11/20	92-41	A Note of Caution on Early Bank Closure	Levonian
11/27	92-42	Where's the Recovery?	Cromwell/Trenholme
12/4	92-43	Diamonds and Water: A Paradox Revisited	Schmidt
12/11	92-44	Sluggish Money Growth: Japan's Recent Experience	Moreno/Kim
12/25	92-45	Labor Market Structure and Monetary Policy	Huh
1/1	93-01	An Alternative Strategy for Monetary Policy	Motley/Judd
1/8	93-02	The Recession, the Recovery, and the Productivity Slowdown	Cogley
1/22	93-03	U.S. Banking Turnaround	Zimmerman
1/29	93-04	Competitive Forces and Profit Persistence in Banking	Levonian
2/5	93-05	The Sources of the Growth Slowdown	Motley
2/12	93-06	GDP Fluctuations: Permanent or Temporary?	Moreno
2/19	93-07	The Twelfth District Agricultural Outlook	Dean
2/26	93-08	Saving-Investment Linkages in the Pacific Basin	Kim
3/5	93-09	A Single Market for Europe?	Glick/Hutchison
3/12	93-10	Risks in the Swaps Market	Laderman
3/19	93-11	On the Changing Composition of Bank Portfolios	Neuberger
3/26	93-12	Interest Rate Spreads as Indicators for Monetary Policy	Huh
4/2	93-13	The Lonesome Twin	Throop
4/9	93-14	Why Has Employment Grown So Slowly?	Trehan

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