

The Yield Curve And Inflation Expectations

By C. Alan Garner

Long-term interest rates rose sharply relative to short-term rates in the first half of 1987. The resulting difference between yields on long-term bonds and short-term bills was the largest since 1984. This dramatic rise in long-term rates relative to short-term rates steepened the yield curve, which shows how security yields vary as the term to maturity lengthens. Did this steepening of the yield curve carry a message for business forecasters and decisionmakers?

Many economic and financial analysts viewed the steepening of the yield curve as a sign of rising inflation expectations. The curve steepened amid general concern about the inflation outlook. Oil prices had firmed after declining sharply in 1986, industrial commodity prices were increasing rapidly, and the depreciation of the dollar against other major currencies was raising import prices. Other analysts were skeptical, however, feeling that an increase in long-term inflation

expectations was unwarranted and that the steepening of the yield curve was reflecting other factors.

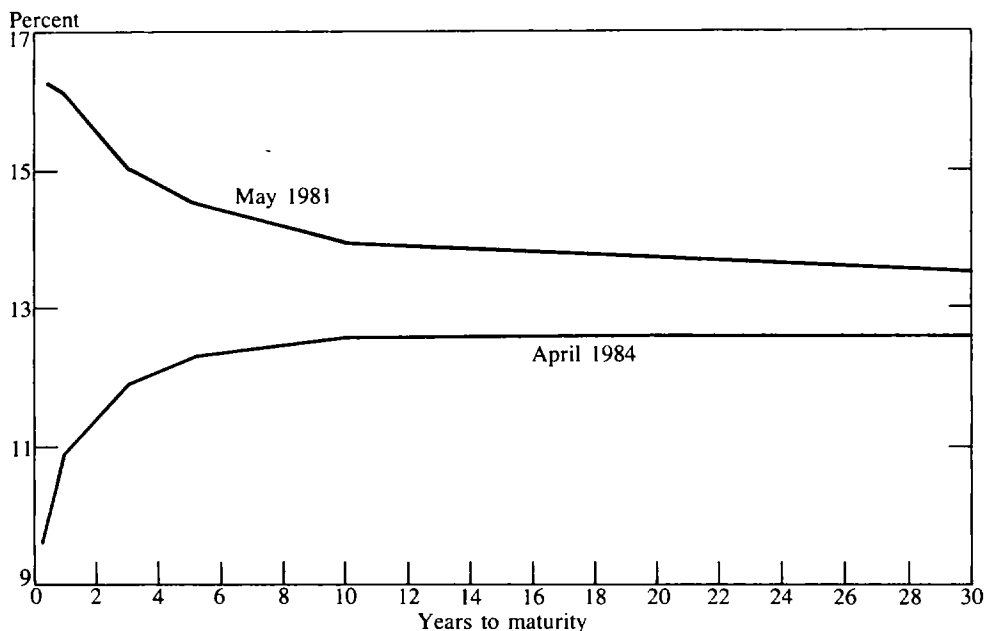
This article examines whether the shape of the yield curve can give useful information about inflation expectations. The first section explains how increasing inflation expectations could steepen the yield curve. But the second section shows that other factors could steepen the curve without increasing expected inflation. The third section examines recent evidence on inflation expectations and the shape of the yield curve. The yield curve is found to be a useful—but not infallible—indicator of inflation expectations.

Inflation expectations and the steepening yield curve

The view that the yield curve is an indicator of inflation expectations has a basis in economic theory. Inflation expectations influence the shape of the yield curve by affecting expected short-term interest rates. When investors revise their expectations about long-term future inflation rates upward, theory predicts the yield curve will

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CHART 1
Yield curve shapes



Note: Curves are plotted by connecting U.S. Treasury constant-maturity yields for selected maturities.

steepen. This section shows how a worsening of the long-term inflation outlook affects the shape of the yield curve.

The Treasury yield curve

The yield curve shows how security yields vary as the term to maturity of the securities increases. For yield comparisons to be meaningful, the securities must have similar default risk and tax considerations. Economists typically focus on the yield curve for U.S. Treasury securities because Treasury bills, notes, and bonds are free of default risk. Moreover, yield data are readily available since Treasury securities are traded in active secondary markets.¹

The shape of the Treasury yield curve has varied substantially over time. Chart 1 illustrates some commonly observed shapes. Long-term

interest rates have been greater than short-term rates, on average, over long periods of U.S. history. And short-term interest rates typically have fluctuated over a wider range than long-term rates. This fluctuation has produced both upward-sloping yield curves, as in May 1981, and downward-sloping yield curves, as in April 1984. The yield curve has often sloped upward near business cycle troughs and downward in boom periods.

¹ The Treasury yields in this article are constant-maturity yields estimated by the U.S. Treasury. Daily yield curves are constructed from quotations reported by five leading government securities dealers. The yield curve is fitted by eye and based only on the most actively traded issues. Constant-maturity yields are read from the curve at specified maturities. This method permits estimation of the yield for a ten-year maturity, for example, even if no outstanding security has exactly ten years remaining to maturity.

The expectations theory

The expectations theory provides an explanation for the shape of the yield curve. This theory asserts that financial markets determine security yields so that the return from holding a multiyear security until maturity equals the expected average return from holding a series of one-year securities over the same period.

A numerical example helps illustrate the expectations theory. Suppose investors have only two options for investing over a three-year period. One option is to purchase a security maturing in one year, to reinvest the proceeds from this security at the end of the year in another one-year security, and to follow the same procedure at the end of the second year. The other option is to purchase a security maturing in three years and hold it to maturity. Suppose that a one-year security currently yields 4 percent and that one-year securities are expected to yield 5 percent and 6 percent in the following two years. A three-year security currently must provide a 5 percent annual return to match the expected average return from holding three successive one-year securities.² Investors will adjust their portfolios until the expected return over the three-year horizon is equalized. Investors will buy the three-year security only if it yields more than the currently available one-year security because they expect the proceeds from the one-year security to be reinvested later at higher short-term rates. That is, the yield curve will slope upward to reflect investors' expectations of future interest rates.

The expectations theory implies that the shape of the yield curve depends on the expected pat-

² This article uses arithmetic averages of interest rates to simplify the exposition. Geometric averages are appropriate, but the arithmetic averages provide close approximations in these examples. For further discussion of the expectations theory, see George G. Kaufman, *Money, the Financial System, and the Economy*, Third Edition, Houghton Mifflin, Boston, 1981.

tern of short-term interest rates. As the numerical example shows, long-term interest rates exceed current short-term rates if short-term rates are expected to rise. The yield curve thus slopes upward. In contrast, long-term interest rates are less than current short-term rates if short-term interest rates are expected to fall. In this case, the yield curve slopes downward.

The Fisher effect

How does expected inflation affect the shape of the yield curve? The link between market interest rates and expected inflation is called the Fisher effect.³ The Fisher effect implies that an increase in expected inflation could steepen the yield curve by raising the expected level of future short-term interest rates.

A market interest rate can be divided conceptually into a required real rate of return and the expected inflation rate over the relevant period. Market interest rates are nominal rates, measured in current dollars. But investors are concerned about their real, or inflation-adjusted, returns. As a result, investors demand nominal returns that are high enough to protect them against expected inflation and still yield a real return that makes lending attractive.⁴ If the expected inflation rate

³ The Fisher effect is named for Irving Fisher, a famous American economist. Fisher's work is summarized in George G. Kaufman, *Money, the Financial System, and the Economy*. This discussion of the Fisher effect neglects the role of income taxes. Income taxes are incorporated into the Fisher effect in Michael R. Darby, "The Financial and Tax Effects of Monetary Policy on Interest Rates," *Economic Inquiry*, June 1975, pp. 266-276.

⁴ Required real interest rates are determined by the interaction of such macroeconomic factors as saving rates, investment opportunities, and government policies. Economists represent these factors with general equilibrium models of the economy. For example, see Joe Peek and James A. Wilcox, "The Postwar Stability of the Fisher Effect," *Journal of Finance*, September 1983, pp. 1111-1124.

TABLE 1
Inflation expectations and the yield spread

<u>Example 1</u>	<u>One-Year Rates</u>			<u>Three-Year Rate</u>	<u>Yield Spread</u>
	<u>First Year</u>	<u>Second Year</u>	<u>Third Year</u>		
Required real rate	2	2	2	2	—
Expected inflation	2	3	4	3	—
Nominal rate	4	5	6	5	1
<u>Example 2</u>					
Required real rate	2	2	2	2	—
Expected inflation	2	4	6	4	—
Nominal rate	4	6	8	6	2

Note: Numbers are annual percentage rates. Three-year rates are averages of the one-year rates. The yield spread is the difference between the three-year nominal rate and the first year one-year nominal rate.

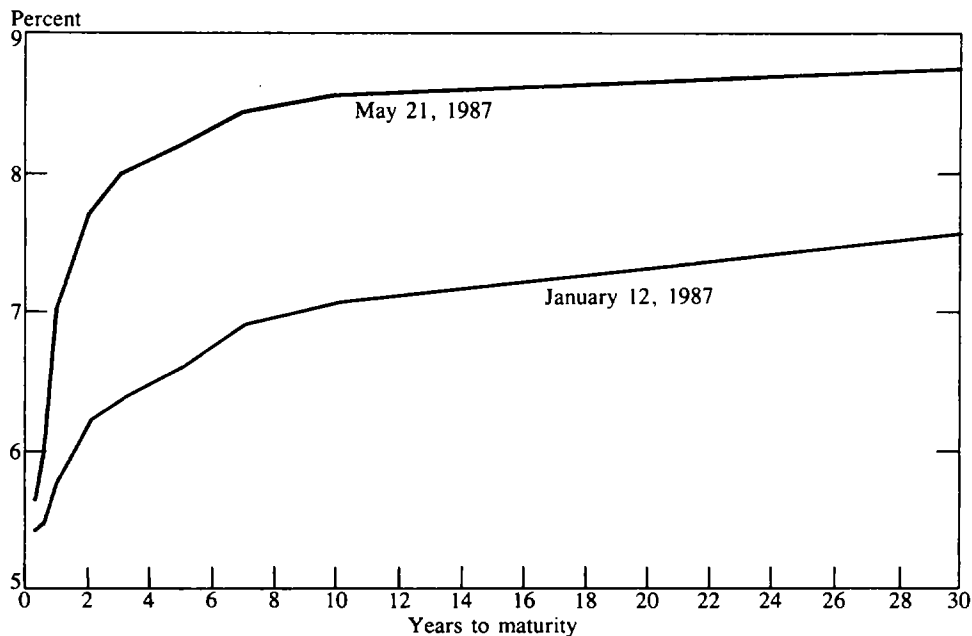
rises, the market interest rate must rise to preserve this required real return.

The Fisher effect is illustrated by the first example in Table 1. The required real rate of return is assumed to be 2 percent in all three periods. In the first year, the inflation rate is also expected to be 2 percent, implying that the nominal interest rate on a one-year security must be 4 percent to give investors the required real return. The expected inflation rate in the second year is 3 percent. The nominal interest rate on a one-year security over the second year must rise to 5 percent if the real return is to remain at the required 2 percent. Similarly, if the expected inflation rate is 4 percent in the third year, a one-year security must yield 6 percent to give investors a real return of 2 percent. Since the average of these one-year nominal rates is 5 percent, a three-year security must provide the same

5 percent return according to the expectations theory. This nominal return is the sum of the required real return of 2 percent and the expected average inflation rate of 3 percent over the three-year period.

The second example in Table 1 shows how a worsening of inflation expectations steepens the yield curve. Suppose investors raise their estimates of future inflation to 4 percent for the second year and 6 percent for the third year, perhaps because of policy changes or economic disturbances. The Fisher effect implies that short-term nominal interest rates also must increase—to 6 percent the second year and 8 percent the third year—to maintain the required 2 percent real rate of return. As a result, the yield on a three-year security must rise to 6 percent, the average expected return from holding three successive one-year securities.

CHART 2
The steepening yield curve



Note: Curves are plotted by connecting U.S. Treasury constant-maturity yields for selected maturities.

The steepening of the yield curve in response to higher expected inflation can be seen in the widening spread between the nominal yields on one-year and three-year securities. The yield spread in Table 1 is the nominal interest rate on the three-year security minus the nominal rate on the first one-year security. The yield spread in the first example is one percentage point. The spread increases to two percentage points in the second example because of the higher nominal rate on three-year securities. Thus, an increase in expected future inflation rates can steepen the yield curve, reflecting a larger spread between the yields on long-term and short-term securities.

Recent steepening of the yield curve

Such an increase in expected inflation rates could presumably have contributed to the sharp

steepening of the yield curve for U.S. Treasury securities in the first half of 1987. Chart 2 shows yields on Treasury securities for two dates during this period. Yields on 30-year Treasury bonds rose from 7.4 percent in January to 8.8 percent in May. Three-month Treasury bill rates, in contrast, increased comparatively little, ranging from 5.4 percent to 5.7 percent over the period. The yield curve thus steepened dramatically as long-term rates rose relative to short-term rates.

Analysts disagreed about why the yield curve had steepened so sharply.⁵ Some felt the steepen-

⁵ See Bear Stearns and Company, *Analysts' Viewpoint*, May 5, 1987; William N. Griggs and Leonard J. Santow, *Griggs and Santow Report*, May 18, 1987; and Henry Kaufman, *Comments on Credit*, Salomon Brothers, May 15, 1987. The view that the bond market overreacted to the inflation threat is found in Maury N. Harris, *Update*, PaineWebber Inc., May 22, 1987.

ing reflected a sudden worsening of inflation expectations. These analysts noted that oil prices had firmed, that commodity prices had increased rapidly in both the spot and futures markets, and that the large depreciation of the dollar threatened to raise the U.S. inflation rate. Other analysts believed that the inflation outlook had not worsened substantially. These analysts felt the United States would not experience sharply higher inflation because of sluggish growth in domestic spending, low utilization rates for industrial capacity, and modest wage inflation.

Other factors affecting the yield curve

Those analysts who believed that the long-term inflation outlook had not worsened substantially attributed the steepening of the yield curve to factors other than rising long-term inflation expectations. For example, depreciation of the dollar may have increased the perceived risk of future exchange rate changes and discouraged purchases of long-term Treasury securities by Japanese and other foreign investors, forcing the yields on these securities higher. Such an explanation is not without foundation; a variety of macroeconomic and financial factors can cause the yield curve to steepen without changing long-term inflation expectations.

Macroeconomic factors

In addition to affecting expectations about long-term inflation rates, macroeconomic disturbances and policy changes can alter expectations about real interest rates and short-term inflation rates. Changes in investors' required real returns for future years can affect the shape of the yield curve even when inflation expectations are constant. And supply shocks, such as falling oil prices, can affect short-term inflation expectations without affecting the long-term inflation outlook appreciably. Thus, a steepening of the yield curve does

not necessarily imply higher long-term inflation expectations. Three possible economic scenarios help illustrate these points.

Saving and budget deficits. The yield curve can steepen even with unchanged inflation expectations if investors raise their required real interest rates for future years. The required real rate, which can be viewed as the price of credit, depends on the supply of and demand for funds. Funds are provided through private saving, growth of the domestic money supply, and capital inflows from abroad. Funds are demanded for private investment and government budget deficits. Lower private saving, declines in the real money supply, and reduced capital inflows decrease the supply of funds and raise the required real rate. A larger government deficit and stronger private investment raise the required real rate by increasing the demand for funds.

Many economists believe that a low saving rate and large government budget deficits have put upward pressure on future real interest rates, contributing to the yield curve's upward slope. This upward-sloping yield curve would steepen further if a growing government deficit or further declines in private saving caused investors to raise their required real rates for future years even higher.

Table 2 illustrates how an increase in the future real returns required by investors could steepen the yield curve. The first example has a constant required real rate of 2 percent and is identical to the first example in Table 1. The yield spread between one-year and three-year securities is one percentage point. In the second example, required real rates rise from 2 percent for the first year to 3 percent for the second year and 4 percent for the third year. Expected inflation is the same in both examples. Short-term nominal rates increase more in the second example because of the higher real rates in the second and third years. The average expected return from three successive investments in one-year securities is 6 per-

TABLE 2
Real interest rates and the yield spread

	One-Year Rates			Three-Year Rate	Yield Spread
	First Year	Second Year	Third Year		
Example 1					
Required real rate	2	2	2	2	—
Expected inflation	2	3	4	3	—
Nominal rate	4	5	6	5	1
Example 2					
Required real rate	2	3	4	3	—
Expected inflation	2	3	4	3	—
Nominal rate	4	6	8	6	2

Note: Numbers are annual percentage rates. Three-year rates are averages of the one-year rates. The yield spread is the difference between the three-year nominal rate and the first year one-year nominal rate.

cent. According to the expectations theory, the three-year security must also yield 6 percent. As a result, the yield spread between one-year and three-year securities widens to two percentage points with no change in expected inflation.

Monetary policy. The yield curve also can steepen because of monetary policy changes. An easing of monetary policy when the economy is already producing near its capacity is one example. Such a policy would initially expand the real money supply, lowering required short-term real interest rates. With long-term real interest rates unchanged, the yield curve would steepen. Lower interest rates, in turn, would stimulate domestic spending, putting upward pressure on prices. Expected inflation would likely rise. As discussed previously, an increase in inflation expectations would cause long-term nominal interest rates to rise. Thus, both the initial decline in short-term

required real rates and the later rise in long-term nominal rates would steepen the yield curve.

Supply shocks. Supply shocks, such as changes in the price of oil or the exchange rate, can affect the shape of the yield curve by changing short-term inflation expectations much more than long-term inflation expectations. Changes in the price of oil, for example, have only a temporary effect on inflation and should not appreciably alter long-term inflation expectations. Over long time horizons, inflation depends primarily on such fundamental macroeconomic factors as the growth rates of the money supply and labor productivity. A change in the exchange rate also has temporary effects on inflation and should primarily affect short-term inflation expectations. Supply shocks can thus alter the shape of the yield curve by changing short-term inflation expectations much more than long-term inflation expectations, thus

changing the relationship between yields on short-term and long-term securities.

One supply shock that might have affected the yield curve was the sharp drop in crude oil prices in late 1985 and early 1986. Falling oil prices reduced the U.S. inflation rate substantially in 1986. Short-term inflation expectations also declined, causing short-term nominal interest rates to fall because of the Fisher effect. According to the expectations theory, long-term interest rates decline less than short-term rates under such circumstances. As a result, the yield curve temporarily steepened.

Financial factors

The shape of the yield curve also depends on financial factors that are unrelated to inflation expectations. Two such factors are liquidity premiums and relative asset supplies.

Liquidity premiums. Long-term interest rates incorporate an additional component, the liquidity premium, that is not explained by the expectations theory. A liquidity premium reflects the greater risk of long-term securities. Because liquidity premiums fluctuate over time, changes in the shape of the yield curve cannot be explained solely by changes in expected short-term interest rates.⁶

The size of the liquidity premium reflects investors' perceptions of interest rate risk.⁷ A sud-

den increase in interest rates could quickly reduce the market value of investors' long-term securities portfolios. As a result, investors demand a positive term premium before they will give up the relative safety of short-term financial assets and invest in riskier long-term securities.

Liquidity premiums can fluctuate without accompanying changes in inflation expectations. The size of the premium reflects many factors affecting the degree of uncertainty about future interest rates. Uncertainty about future inflation rates is one such factor. Another is exchange rate uncertainty since foreign investors generally care about the value of their securities portfolios in terms of their own currencies. Other factors include changes in Federal Reserve operating procedures and deposit deregulation at commercial banks and thrift institutions. Changes in these factors might alter investors' perceptions of interest rate risk, causing liquidity premiums to vary without a change in expected inflation.

Relative asset supplies. Relative supplies of short-term and long-term securities also may affect the yield curve. Asset supplies do not affect the shape of the yield curve in the expectations theory. This theory assumes that many borrowers and lenders can easily shift from one maturity to another to obtain the most favorable yield. As a result, changing relative supplies of short-term and long-term securities would not affect the slope of the yield curve. A greater supply of long-term securities, for example, would not steepen the yield curve because investors can easily be attracted away from other maturities.

⁶ Studies finding evidence of changing term premiums include David S. Jones and V. Vance Roley, "Rational Expectations and the Expectations Model of the Term Structure," *Journal of Monetary Economics*, September 1983, pp. 453-465; Edward J. Kane, "Nested Tests of Alternative Term-Structure Theories," *Review of Economics and Statistics*, February 1983, pp. 115-123; and N. Gregory Mankiw, "The Term Structure of Interest Rates Revisited," *Brookings Papers on Economic Activity*, 1986:1, pp. 61-96.

⁷ Although theories of asset pricing imply that term premiums should reflect risk, the empirical evidence is mixed. Mankiw,

for example, finds little evidence that risk explains observed interest rate fluctuations. Engle, Liliien, and Robins conclude, however, that term premiums reflect the risk of unexpected interest rate changes. See Robert F. Engle, David M. Liliien, and Russell P. Robins, "Estimating Time Varying Risk Premia in the Term Structure: The ARCH-M Model," *Econometrica*, March 1987, pp. 391-407; and N. Gregory Mankiw, "The Term Structure of Interest Rates Revisited."

Some economists believe, however, that an increase in the supply of long-term securities raises long-term interest rates relative to short-term rates. This view is often called the market segmentation theory since the theory assumes securities markets are divided into distinct maturity segments with little movement by investors from one segment to another.⁸ An increase in the supply of long-term securities would depress the price of these securities because investors cannot shift easily from one maturity to another. The yields of long-term securities would rise because security prices and yields move inversely. A changing maturity structure for government debt could thus steepen the Treasury yield curve even when inflation expectations are stable.

In sum, the spread between long-term and short-term interest rates is an imperfect indicator of long-run inflation expectations. Various macroeconomic factors can steepen the yield curve by altering required real interest rates and short-term inflation expectations as well as long-term inflation expectations. Financial factors can alter the shape of the yield curve through changing liquidity premiums and changing relative asset supplies. The yield curve reflects many forces, long-term inflation expectations being just one.

The yield curve and inflation expectations in the 1980s

Because of the factors described in the previous section, the yield curve is not a perfectly reliable

⁸ The market segmentation view is stated in J.M. Culbertson, "The Term Structure of Interest Rates," *Quarterly Journal of Economics*, November 1957, pp. 485-517. Empirical evidence supporting asset supply effects is found in Benjamin M. Friedman, "Financial Flow Variables and the Short-Run Determination of Long-Term Interest Rates," *Journal of Political Economy*, August 1977, pp. 661-689; and V. Vance Roley, "The Determinants of the Treasury Security Yield Curve," *Journal of Finance*, December 1981, pp. 1103-1126.

indicator of inflation expectations. In practice, however, the yield curve might still be a good indicator of inflation expectations. Have changes in the shape of the yield curve been closely associated with changing inflation expectations in the 1980s?

Comparison with survey data

One way to see whether changes in the steepness of the yield curve have been a good indicator of changes in expected inflation is to compare the yield spread on securities with corresponding data on inflation expectations. No one measure of inflation expectations is generally accepted as being correct, and measures of long-term inflation expectations are especially scarce. However, surveys of inflation expectations have been used widely in economic research. Alternative measures of inflation expectations often are produced by statistical procedures involving arbitrary assumptions about the economic structure and the information available to forecasters. As a result, survey measures of expected inflation are probably as valid as any other measure currently available.

The yield spread and a corresponding expected inflation spread are presented in Chart 3 for the 1980s. The yield spread is the difference between the yields on ten-year Treasury securities and on one-year Treasury securities. The expected inflation spread is the difference between the expected inflation rate over a ten-year horizon and the expected inflation rate over a one-year horizon. The expected inflation spread is measured by the difference between ten-year inflation expectations from the Decision-Makers Poll and the actual inflation rate one year ahead.⁹ The

⁹ Richard B. Hoey and Helen Hotchkiss, *Decision-Makers Poll*, Drexel Burnham Lambert Inc., June 4, 1987. This poll is the only available survey measure of long-term inflation expecta-

ten-year inflation forecast is compared with the actual one year ahead inflation rate because one-year survey expectations were not available over most of the 1980s. The one year ahead inflation rate is probably a good substitute for short-term inflation expectations because economic conditions and policies often change gradually. Therefore, forecasters have fairly accurate short-term expectations.¹⁰ According to the expectations theory, the yield spread should increase when the difference between ten-year and one-year inflation expectations widens.

The yield spread and the expected inflation spread have had a positive association over the 1980s. Chart 3 shows that an increase in the expected inflation spread was often accompanied

tions. The survey probably provides a reasonably good measure of the inflation rate expected by Treasury market participants because the survey includes many financial officers and portfolio managers who regularly make financial decisions. However, the accuracy of the long-term inflation expectations cannot be determined at this point because the survey has not been conducted long enough to permit a comparison of actual and expected values. The survey has been conducted intermittently since September 1978.

Box-Jenkins forecasts of the CPI also were computed for comparison with the Decision-Makers survey. Box-Jenkins statistical models, which predict inflation solely by extrapolating past changes in prices, neglect such other potentially useful information as money growth rates and real economic growth. The Box-Jenkins model was reestimated before each Decision-Makers survey date so that the statistical model used only information that was available to survey respondents at the time. The ten-year Box-Jenkins forecast and the ten-year survey measure of expected inflation have a correlation coefficient of 0.83. This correlation coefficient is statistically different from zero at the 1 percent significance level.

¹⁰ Using the actual one year ahead inflation rate as a substitute for the short-term inflation expectation can also be justified by the rational expectations hypothesis, which implies that the one-year inflation expectation differs from the actual one year ahead inflation rate by a random error with zero mean. This representation of expected inflation is employed in several empirical studies, including Benjamin M. Friedman and V. Vance Roley, "Investors' Portfolio Behavior Under Alternative Models of Long-Term Interest Rate Expectations: Unitary, Rational, or Autoregressive," *Econometrica*, November 1979, pp. 1475-1497.

by an increase in the yield spread, as in late 1981. However, the two variables moved in opposite directions in late 1984 and at other times. A positive relationship is confirmed by computing the correlation coefficient between the expected inflation spread and the yield spread. A correlation coefficient measures the degree of association between two variables. The correlation coefficient between the expected inflation spread and the yield spread is positive over the 1980s.¹¹ However, the correlation coefficient is smaller than one in value, which implies that the expected inflation spread and the yield spread did not always vary together. Therefore, the correlation coefficient is consistent with the view that the shape of the yield curve reflects expected inflation but is also affected by other factors.

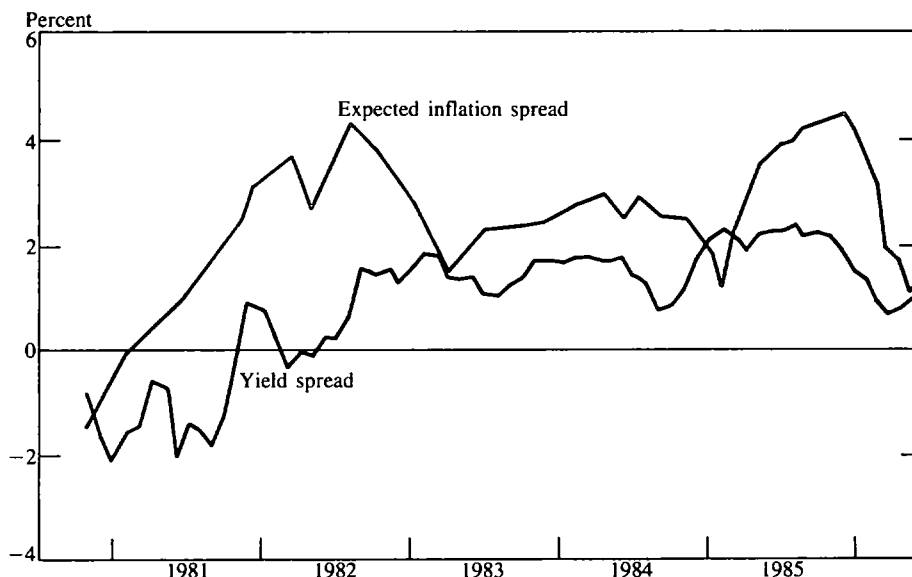
Some of these other factors in the 1980s were changing required real interest rates and changing liquidity premiums. Real interest rates were affected by large fluctuations in real economic growth, a mushrooming federal deficit, and changes in Federal Reserve operating procedures.¹² Moreover, interest rates were excep-

¹¹ The Pearson correlation coefficient between the expected inflation spread and the yield spread is 0.52 over the period from October 1980 to June 1986. This correlation coefficient is statistically different from zero at the 1 percent significance level.

The results are qualitatively similar when Box-Jenkins inflation forecasts are employed. If one-year Box-Jenkins forecasts are substituted for the actual one year ahead inflation rate in computing the expected inflation spread, the correlation coefficient between the yield spread and the expected inflation spread is 0.47 over the period from October 1980 to May 1987. This correlation coefficient is statistically significant at the 1 percent significance level. If the expected inflation spread equals the ten-year Box-Jenkins inflation forecast minus the one-year Box-Jenkins forecast, the correlation coefficient is 0.67 and is also significant at the 1 percent level.

¹² Another important influence on the yield curve in the 1980s may have been the large reductions in personal and corporate tax rates. The Treasury yield curve is plotted with pre-tax nominal interest rates, but investors care about their after-tax real returns. If investors expect their tax rates to fall in the years ahead, lower long-term nominal interest rates will provide the same after-tax

CHART 3
The yield spread and the expected inflation spread



Note: The yield spread is the difference between the ten-year and one-year constant-maturity yields on U.S. Treasury securities. The expected inflation spread is the ten-year inflation expectation from the Decision-Makers Poll minus the actual one year ahead inflation rate.

tionally volatile in the 1980-82 period. High interest rate volatility and other economic uncertainties may have caused increasing risk premiums for long-term securities in this period.

Evidence from the Decision-Makers Poll shows that the steepening of the Treasury yield curve in the first half of this year did not signal an increase in long-term inflation expectations. The dramatic steepening of the Treasury yield curve in April and May was accompanied by slightly lower long-term inflation expectations; the ten-year inflation expectation in the Decision-Makers Poll actually declined from 5.5 percent in March to 5.3 percent in May. Short-term inflation expect-

tations did increase, however, with the 12-month inflation forecast from the Decision-Makers Poll rising from 4.0 percent in March to 4.7 percent in May.¹³ The decrease in ten-year inflation expectations in tandem with the increase in 12-month inflation expectations should have flattened the yield curve under the expectations theory, contrary to what actually occurred. Comparisons between the yield spread and survey data show,

average real return. Expected tax rate changes could thus affect the steepness of the yield curve. This effect has received little attention in tests of the expectations theory and deserves further study.

¹³ Both 12-month and ten-year inflation expectations declined slightly from May to June. The 12-month inflation expectation declined to 4.57 percent in the June Decision-Makers Poll, and the ten-year inflation expectation declined to 5.25 percent. A widely quoted survey of business economists shows that forecasts of consumer price inflation in 1987 worsened from 4.1 percent in the March survey to 4.7 percent in the August survey. See Robert J. Eggert, *Blue Chip Economic Indicators*, March 10 and August 10, 1987.

therefore, that a steepening or flattening of the yield curve is not always due to changing inflation expectations.

Other indicators of inflation expectations

Despite the imperfect correlation between the yield spread and the expected inflation spread, the yield curve may still play a useful role as an indicator of inflation expectations if it is used in combination with other expectations indicators and fundamental economic analysis. Business forecasters and decisionmakers usually can have more confidence in the signals provided by a steepening or flattening yield curve if other indicators of inflation expectations give a similar message. Several market prices besides security yields may be useful in judging inflation expectations. The exchange rate of the dollar with other major currencies is one possible indicator since the dollar is likely to depreciate when market participants expect the U.S. inflation rate to rise relative to foreign inflation rates. Sensitive commodity prices also may rise when the general inflation rate is expected to worsen. Businesses may increase their stocks of storable commodities when higher inflation and stronger economic activity are expected. However, greater demand for commodities could push commodity prices higher before inflation is observed in more sluggish wages and prices. Rapid gains in the prices of gold and other precious metals are often viewed as a sign of increasing inflation expectations since these metals have served traditionally as inflation hedges.¹⁴

¹⁴ For more information about the relationship between auction-market prices and inflation expectations, see Brian R. Horrigan, "Monetary Indicators, Commodity Prices, and Inflation," Federal Reserve Bank of Philadelphia, Working Paper No. 86-7, April 1986; and Carl E. Walsh, "Interest Rates and Exchange Rates," *Weekly Letter*, Federal Reserve Bank of San Francisco, June 5, 1987.

Analysts, therefore, should monitor several market prices and yields that typically indicate changing inflation expectations. Focusing exclusively on the yield curve or any other expectations indicator could be misleading since many prices of financial instruments and commodities are highly volatile. This volatility reflects factors that are specific to the particular market as well as general economic news and policies. However, market-specific disturbances are unlikely to affect an entire set of indicators. The yield spread should be used, therefore, along with other information variables that quickly reflect market reactions to economic disturbances and policy changes.

Security yields and other expectations indicators should supplement rather than replace fundamental economic analysis, however. Analyzing fundamental determinants helps forecasters confirm or revise their previous views about the economic situation and gives better estimates of the factors driving inflation. Market prices and yields are useful primarily because they reflect new information about fundamental economic trends and policies. However, these indicators are affected by market-specific disturbances as well as a variety of macroeconomic influences. Also, at times, market expectations may simply be wrong. During the first half of 1987, for example, market prices and yields correctly reflected an increase in short-term inflation expectations, but a steepening yield curve erroneously indicated a rise in long-term inflation expectations.

Conclusion

The steepening of the Treasury yield curve during the first half of 1987 has been viewed as an indicator of rising inflation expectations. According to the expectations theory, expectations of higher inflation in the years ahead could steepen the yield curve since higher expected inflation should raise expected short-term nominal interest rates. However, a steepening of the yield curve

also could reflect an increase in future required real interest rates or bigger liquidity premiums on long-term securities. Real interest rates have been affected in the 1980s by such macroeconomic factors as wide swings in economic activity and a series of large federal budget deficits. Liquidity premiums have probably been influenced by interest rate volatility and uncertainty about the future foreign exchange value of the dollar.

To the extent that survey data give a reliable measure of long-term inflation expectations, evidence from the 1980s shows that the yield spread and inflation expectations have not always varied together. The steepening of the Treasury yield curve in the first half of 1987 is a case in point. The ten-year inflation expectation from the

Decision-Makers Poll actually decreased at the same time that long-term interest rates were rising. Although the cause of the sharp increase in long-term interest rates remains puzzling, an alternative explanation may be that Japanese and other foreign investors required higher long-term interest rates to compensate for a perceived rise in exchange rate risk. Twelve-month inflation expectations from the same survey did increase, however, which was consistent with rising commodity prices and such fundamental determinants as the falling dollar and firming oil prices. Business forecasters and decisionmakers, therefore, should examine a variety of expectations indicators and fundamental economic determinants rather than giving excessive weight to the shape of the yield curve.