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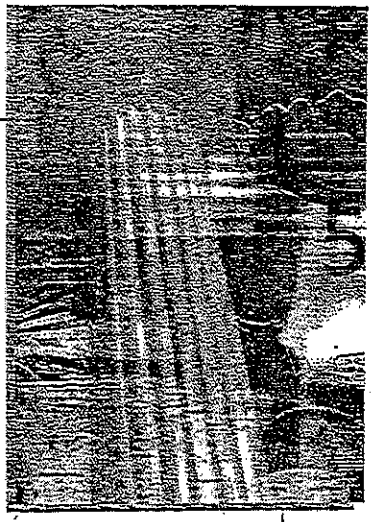
CHAPTER 5

Term Structure of Interest Rates



Whether interest rates go up or down often depends on which ones you focus on. Short-term interest rates can go up while long-term rates may stay put. Or vice versa. It's time to examine the details. After all, that's where the money is. The structure of yields on different maturities of the same class of securities is explored first. We then turn to the relationship among yields on different categories of securities (such as government bonds versus corporate bonds).

The Term Structure of Rates and the Yield Curve

The relationship among yields on different maturities of the same type of security is called the **term structure** of interest rates (from "term to maturity"). For government bonds, we might compare the yields on three-month Treasury bills, two-year notes, and 20-year bonds.

The relationship between yield and maturity is sometimes depicted graphically by a **yield curve**, as in Figure 5.1, where yield is measured on the vertical axis and term to maturity is on the horizontal axis. Often the yield curve is upward sloping—that is, short-term securities yield less than long-term securities (curve *A*). Sometimes it is rather flat—short-term yields equal long-term yields (curve *B*). And sometimes the yield curve is even downward sloping—short-term interest rates are *above* long-term rates (curve *C*).

What determines the shape of the yield curve? A number of analytical explanations have been proposed, ranging from the application of basic supply and demand to more complicated theories based on expectations and preferred maturity ranges of different investors. Each approach is aimed at explaining real-world observations, such as why yields on all maturities tend to move together, while at the same time there are distinct, divergent, pat-

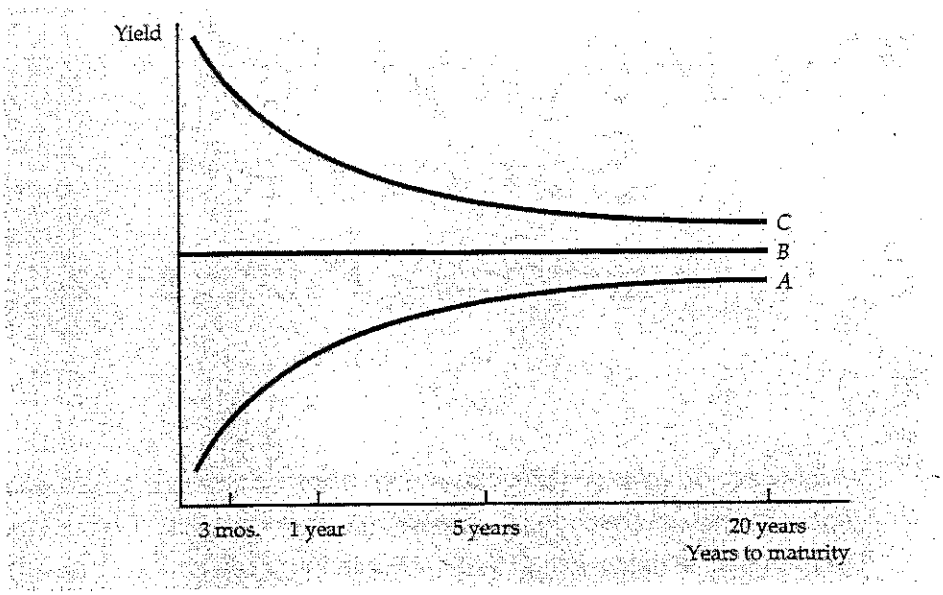


FIGURE 5.1 Three alternative yield curves.

terns between movements in short-term and long-term yields. First we will develop the alternative theories of the term structure, and then we will describe how they best explain actual events.

Supply and Demand. Just about everything in economics is determined by supply and demand, and the term structure of interest rates should be no exception. In the previous chapter, we showed how the overall level of interest rates was determined by the supply of and demand for loanable funds or, alternatively, by the supply of and demand for securities as a whole. A simple extension of that approach suggests that the interest rates on different maturity categories of securities are determined by the relative supply of and demand for each maturity class. For example, the interest rate on three-month Treasury bills is determined by the supply of and demand for three-month Treasury bills, while the interest rate on 20-year bonds is determined by the supply of and demand for 20-year bonds. Thus when the supply of three-month bills goes up, the yield on bills rises to induce investors to buy the additional supply; when the supply of bills falls, the yield on bills falls to ration the smaller supply among eager investors.[1] If nothing happens to the supply of and demand for 20-year bonds, these shifts change the relationship between yields on securities of different maturity; that is, the term structure of interest rates changes.

[1]Do not be confused by the fact that a decrease in supply causes yields to fall; yields decline because the decrease in supply raises security *prices* and prices and yields are inversely related.

Although there is much to be said in favor of supply and demand in general, there are severe limitations to using that approach by itself to explain the term structure of interest rates. The problem is that supply and demand analysis focuses attention on the particular market in question, such as three-month Treasury bills, and deals with other markets, such as 20-year securities, as an afterthought. When there is a close relationship between two markets, as there is in the case of different maturities of the same security, it is perhaps more useful to focus on the interrelationships more directly. Thus instead of treating the maturity structure of interest rates from the vantage point of supply and demand in separate markets, we examine the relationships among securities within the framework of a single market.

The Pure Expectations Approach. There are many—and here financial analysts and economists often find much common ground—who argue that short-term securities and long-term securities are very good substitutes for each other in investor portfolios, not for every investor but for enough so that their decisions *collectively* make a significant impact on the market. For such investors the important feature of the security they buy is not the maturity date of the final payment, but rather what it *returns* over the period for which they want to invest (see the previous chapter for a definition of returns). This concern with returns implies that expectations of future short-term rates determine how long-term rates are related to short-term rates. Let's illustrate that with a particular example.

Say you are the portfolio manager of a bank and you want to invest funds for two years. Suppose you could buy a one-year Treasury security today yielding 8 percent, and you expect that next year the rate on one-year securities will be 10 percent. If you buy the one-year security today and reinvest in a one-year security next year, you expect an average return over the two years of about 9 percent. If you had the option of buying a *two-year* Treasury security today that yielded $9\frac{1}{2}$ percent, you'd jump at it (so would everyone else). On the other hand, if two-year Treasury securities were yielding only $8\frac{1}{2}$ percent, you wouldn't touch them (neither would anyone else). This means that unless the two-year security yielded exactly 9 percent (the average of the current and expected short-term rate), portfolio managers would try to buy it (if it yielded more) or sell it (if it yielded less). This buying and selling pressure by portfolio managers maintains the long-term (two year) rate as an average of the current short-term (one year) rate and the expected future short-term (one year) rate.

A somewhat more general statement is as follows: The relationship between the yield on a two-year (long-term) security and a one-year (short-term) security depends on the expected future short-term rate. If next year's *expected* short-term rate is above the current short-term rate, then the current long-term rate will be above the current short-term rate, and the yield curve will be upward sloping. On the other hand, if next year's expected short-term

rate is below the current short-term rate, the yield curve will be downward sloping.[2]

The key to this **expectations theory** of the term structure is that short-term securities and long-term securities are very good substitutes for each other in investor portfolios. In fact, they are perfect substitutes: If expected returns are the same, the portfolio manager is indifferent between "shorts" and "longs." Instead of separate markets for short-term and long-term securities, there is a single market. Note in this case that if the supply of long-term securities goes up and the supply of short-term securities goes down, it makes absolutely no difference as far as yields are concerned. Because investors are indifferent among maturity categories of the same security, they will happily exchange long-term securities for short-term securities, with no change in yields, as long as expected future short-term rates are unchanged.

The Liquidity Premium Modification. It is difficult to argue that investors are unconcerned about differences between short-term securities and long-term securities. It is simply a fact of life—embedded in the mathematics of bond prices—that the *prices* of long-term securities are more volatile than those of short-term securities (see Chapter 4 or, for a more rigorous discussion, the appendix to this chapter). If you have to sell a security before it reaches maturity and interest rates have increased, a long-term security will have fallen in price much more than a short-term one. If you might have to sell to raise cash, you'll prefer short-term securities. They are safer. Commercial banks, for example, prefer short-term securities precisely because their needs for cash are often unpredictable.

Recognition of the greater capital uncertainty of long-term securities leads to the "liquidity premium" modification in the expectations theory of the term structure. If most investors are like commercial banks and prefer the capital certainty of short-term securities, while most bond issuers prefer to issue long-term securities, then investors on balance will demand a premium for holding long-term securities. This is often called a **liquidity premium,** but it is really a **risk premium**—a reward for exposure to the capital uncertainty of long-term securities. Thus in our previous numerical example a two-year security would have to yield more than the average of the current one-year rate and next year's expected one-year rate. Otherwise investors wouldn't want to hold the riskier two-year security.

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[2]The story of the downward-sloping yield curve is as follows. If the current one-year rate is 8 percent and investors expect next year's one-year rate to be 6 percent, portfolio managers could earn an average return of 7 percent by investing in two successive one-year securities. If the current rate on a two-year security were above 7 percent, all investors would buy it, forcing up the price and reducing the yield. If the current two-year rate were below 7 percent, no one would buy it, forcing down the price and raising the yield. Thus the two-year security must yield 7 percent when the current one-year security yields 8 percent and the expected one-year rate is 6 percent. Since the short-term (one-year) rate is 8 percent and the long-term (two-year) rate is 7 percent, we have exactly what we call a downward-sloping yield curve.

The Preferred Habitat Approach. It seems reasonable to suggest that many investors prefer short-term securities. But to leave it at that would be misleading, because some investors actually have a *preference* for long-term securities. Life insurance companies and pension funds, for example, don't worry that much about surprising needs for cash. Their liabilities are actuarially predictable. In fact, they want to make sure they earn at least 8 (or 10 or 12) percent on their assets over the next ten (or 20 or 30) years. That way they are sure of a profit, because they promise to pay pension holders something less than that. These institutions therefore prefer long-term securities.

Because some institutions prefer long-term securities while others prefer short-term issues (like members of the animal kingdom, they have **preferred habitats**), it would seem that the supply-demand emphasis in explaining the term structure could make a healthy comeback. For example, when the supply of five-year securities increases relative to other maturities, the yield on such issues will have to increase above the "expectations theory average" in order to induce investors to leave their preferred maturity ranges and to invest in the unfamiliar "five-year" territory. The same would be true for any increased supply of a particular maturity category. Thus the yields on various maturities would seem to have relatively little to do with expectations, and much more to do with relative supply and demand.

Not so fast, say the proponents of the expectations theory. While many institutions have preferred maturity ranges for their investments, they can also be induced rather easily to switch between short-term securities and long-term securities when yields get out of line with expectations. Commercial banks, for example, require only a "liquidity premium" to invest in longer-term securities. A large increase in the supply of five-year bonds may therefore initially push up their yield to a higher level than is warranted by the expectations theory alone. But commercial banks will then be lured away from their preferred one-year securities by the attractive yields on five-year bonds. And pension funds will be enticed as well. Both these actions mitigate the upward pressure on five-year bond yields caused by the increased supply of securities in that maturity category. In the process, the role of expectations is restored.

Real-World Observations. Each of the theories outlined previously is aimed at explaining the real world. We started with the pure expectations approach and then modified it to make the theory conform more closely to reality. A further step is to recognize that investors do not usually have precise numerical predictions of short-term rates for next year or the year after. More likely, investors form expectations of when the "level" of rates is in general relatively high and when the "level" of rates is in general relatively low. While this is a rather casual version of the expectations theory, it provides a powerful explanation of when the yield curve is likely to be upward sloping (curve *A* in Figure 5.1) or downward sloping (curve *C*).

When interest rates are high relative to what they have been, investors generally expect them to decline in the future. Falling interest rates mean

rising bond prices, and those investors who are holding long-term bonds in their portfolio will reap their just reward—big capital gains. Therefore, when all rates are relatively high, investors will prefer to hold long-term securities rather than short-term securities (because the potential capital gains on short-term securities are relatively low). This additional demand for long-term securities drives their prices up and their yields down relative to short-term securities. Thus long-term yields are below short-term yields (that is, the yield curve is downward sloping) when the overall level of rates is high.

Similarly, when the general level of rates is low and yields are expected to rise in the future, investors prefer not to hold long-term securities, because they are likely to incur large capital losses. This drives the price of long-term securities down (and the yield up), thereby producing long-term rates above short-term rates (an upward-sloping yield curve).

Figure 5.2 demonstrates the accuracy of these conjectures with yield curves during the mid-1970s, a particularly illustrative period. The actual yield curve on August 30, 1974, was downward sloping, and that's when the overall "level" of rates was quite high by then-current historical standards. On the other hand, the most sharply upward-sloping curve is for January 23, 1976, when the "level" of rates was relatively low.

Figure 5.2 also emphasizes another empirical regularity: Short-term rates fluctuate more than long-term rates over the course of the business cycle. Indeed, over the 16-month period covered by the yield curves, short-term

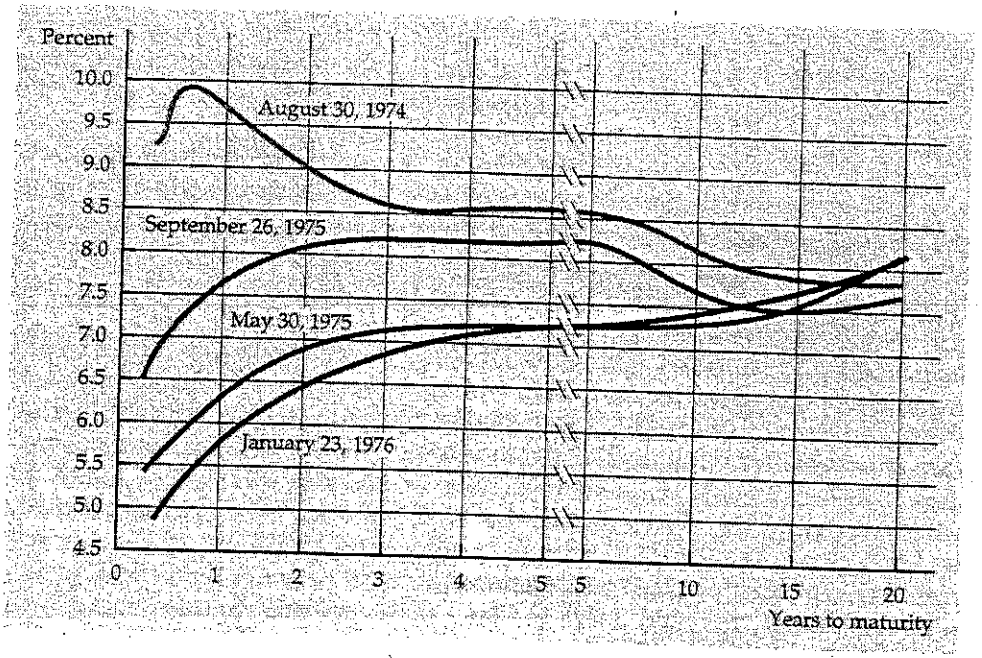

FIGURE 5.2 Yields on U.S. government securities.
Note: When the "level" of rates is high, the yield curve is likely to be downward sloping.

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rates fluctuated by about 5 percentage points, while 20-year bond yields hardly moved at all. Figure 5.3 confirms this relationship. Between October 1999 and October 2000, short-term rates rose by about $1\frac{1}{4}$ percentage points, while long-term rates actually *fell* by about $\frac{1}{2}$ a point. By October 2001, the Fed was lowering rates to counter a recession. Short-term rates fell about four points, while long-term rates fell by only $\frac{1}{2}$ a percentage point. The simple expectations theory provides the best explanation for this phenomenon: Since long-term rates are averages of current short-term rates and expected future short-term rates, as long as expectations are less volatile than actual short-term rate movements, long-term rates will move less than short-term rates.[3]

There is some empirical evidence lending credibility to the liquidity premium modification to the expectations theory of the term structure. In particular,

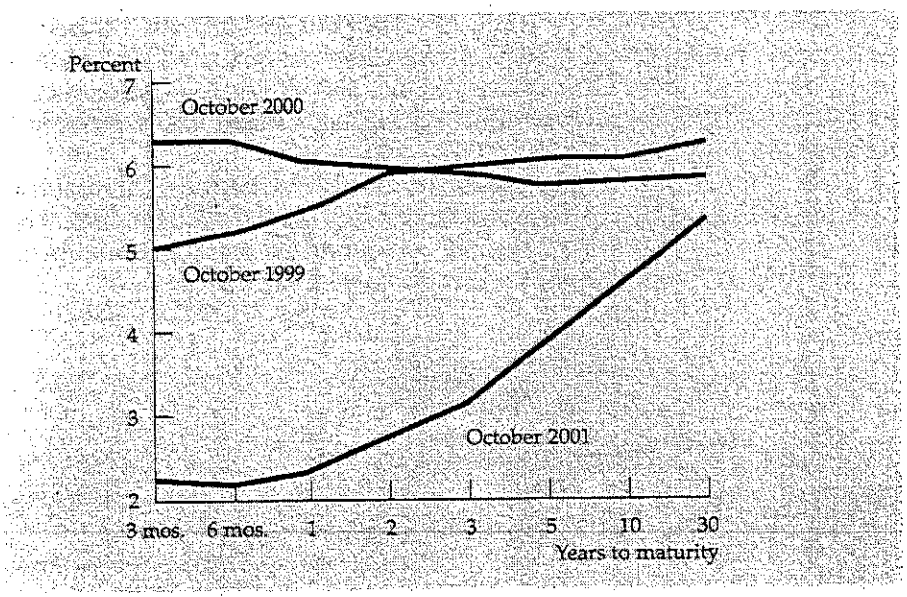

FIGURE 5.3 Short-term rates fluctuate more than long-term rates over the business cycle.

[3]Expected future short-term rates move less than current short-term rates as long as people view some of the influences on interest rates as temporary events—for example, a temporary slowdown in economic activity. The arithmetic of the rate movements is as follows: We saw earlier in the chapter that if the one-year rate were 8 percent and the expected one-year rate next year were 10 percent, then two-year rates would be 9 percent. If the one-year rate jumped to 12 percent and the expected one-year rate rose to 11 percent, then the equilibrium long-term rate would be $11\frac{1}{2}$ percent (the average of 12 and 11). Thus when the short-term rate jumped by 4 percentage points, the long-term rate rose by only $2\frac{1}{2}$ percentage points. And that is what we said in the text: Short-term rates fluctuate more than long-term rates.

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over long periods of time the yield curve tends to be upward sloping more often than it is downward sloping. Under the pure expectations theory this should not happen. After all, there is no reason to think that expected future short-term rates are usually above current short-term rates—and that's the only thing that would explain this phenomenon according to the pure expectations approach. But once a liquidity premium is added to the story, long-term rates exceed the average of the current short-term rate and expected future short-term rates. This implies an upward-sloping yield curve more of the time.

A final observation comes from market participants. Most practitioners would stress that over the very short run, large supplies in a specific maturity range would raise the interest rate on that particular category of security. Such anecdotal evidence supports the supply/demand or preferred habitat approach to the term structure of interest rates. In point of fact, in the very short run (such as over a week or two), there is little doubt that relative supplies of securities must be brought into the picture. After all, it takes time for the expectations-based substitution between short-term and long-term securities to occur. But after all is said and done, and all portfolio adjustments have been completed, the impact of relative supplies is swamped by expectations of future short-term rates.

To summarize, the best approach to the term structure is ecumenical. The expectations theory forms the foundation; liquidity premiums then enter as a permanent modification to the yield curve; and finally, over short periods of time, even relative supplies of securities have an impact.

GOING OUT ON A LIMB

Is the Shape of the Yield Curve a Crystal Ball?

Predicting the course of economic activity is serious business. Many corporations pay large sums for the forecasts generated by high-priced consultants. Perhaps they would be better off, and would save money, if they simply looked at the shape of the yield curve.

Figure 5.3 shows that short-term rates fluctuate more than long-term rates over the course of the business cycle. It also shows that in October 2000 (a few months *before* the official NBER business cycle peak), the yield curve was downward sloping, largely due to the anti-inflationary policy pursued by the Federal Reserve. This inverted yield curve was followed by a recession and then by a steep upward-sloping yield curve as the Fed aggressively cut short-term interest rates to help revive the weak economy.

Coincidence? The Federal Reserve Bank of Cleveland reports that negatively sloped segments of the yield curve preceded all but four of the 17 business-cycle downturns since 1910 (the exceptions were 1926, 1945, 1948, and 1953). Indeed, stock market forecasters (who make economic forecasters look like geniuses) have jettisoned many of their arcane charts in favor of the yield curve as the key predictor of stock price movements.

The message is clear. A negatively sloped yield curve is a danger sign for the economy and the stock market. If you see one, proceed with caution (sell first).