

FINANCIAL ASSETS

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CHAPTER 6

INTEREST RATES

Low Interest Rates Encourage Investment and Stimulate Consumer Spending

The U.S. economy has performed well since the early 1990s. Economic growth has been positive, unemployment fairly low, and inflation under control. One reason for the economy's steady performance has been the low level of interest rates over that period, especially the last few years. Since early 2001, the 10-year Treasury bond rate has generally been at or below 5 percent, a level not seen since the 1960s.

Low interest rates reduced the cost of capital for businesses, which has encouraged corporate investment, and they also stimulated consumer spending and the housing market. In the 1980s, 30-year fixed-rate mortgages cost 8 percent or more. At 8 percent, a homeowner who could afford a \$1,000 monthly payment for 30 years could borrow \$136,283. More recently, with mortgage rates at about 5.5 percent, the same homebuyer could handle a \$176,122 loan and thus a lot more house. Or, if this individual borrowed the same \$136,283, the monthly payment would decline from \$1,000 to \$773.80, leaving more funds available for other purchases. The drop in interest rates also led to a surge in mortgage refinancings, where high-rate loans are replaced with lower-rate and possibly larger loans, freeing up money for whatever the borrower chooses to spend it on.

The drop in interest rates was due to a number of factors—low inflation, foreign investors' purchases of U.S. securities (which drove their rates down), and effective management of the economy by the Federal Reserve and other government policy makers. While there are reasons for continued optimism, there are also reasons to think that low interest rates may not persist for much longer. Higher oil prices and a weakening dollar could lead to higher inflation, which, in turn, would push up interest rates. Likewise, the growing federal budget deficit and the weakening dollar could cause foreigners to sell U.S. bonds, which would also put upward pressure on rates. Because corporate treasurers—and individuals—are greatly affected by interest rates, this chapter takes a closer look at the major factors that determine rates in the market.

Putting Things In Perspective

Companies raise capital in two main forms: debt and equity. In a free economy, capital, like other items, is allocated through a market system, where funds are transferred and prices are established. The interest rate is the price lenders receive and borrowers pay for debt capital. Similarly, equity investors expect to receive dividends and capital gains, the sum of which represents the cost of equity. We will take up the cost of equity in later chapters, but our focus in this chapter is on the cost of debt. We begin by examining the factors that affect the supply of and demand for all investment capital, which, in turn, affects the overall cost of money. We will see that there is no one single interest rate—interest rates on different loans vary depending on the risk of the borrower, the use of the funds borrowed, the type of collateral used to back the loan, and the length of time the money is needed. In this chapter we concentrate mainly on how these various factors affect the cost of debt for individuals, but in later chapters we delve into the firm's cost of debt and its role in investment decisions. As you will see in Chapter 7, the cost of debt is a key determinant of bond prices, and it is also an important component of the cost of corporate capital, which we take up in Chapter 10.

6.1 THE COST OF MONEY

The four most fundamental factors affecting the cost of money are (1) **production opportunities**, (2) **time preferences for consumption**, (3) **risk**, and (4) **inflation**. To see how these factors operate, visualize an isolated island community where the people live on fish. They have a stock of fishing gear that permits them to survive reasonably well, but they would like to have more fish. Now suppose Mr. Crusoe had a bright idea for a new type of fishnet that would enable him to double his daily catch. However, it would take a year to perfect the design, build the net, and learn to use it efficiently, and Mr. Crusoe would probably starve before he could put his new net into operation. Therefore, he might suggest to Ms. Robinson, Mr. Friday, and several others that if they would give him one fish each day for a year, he would return two fish a day during all of the next year. If someone accepted the offer, then the fish that Ms. Robinson or one of the others gave to Mr. Crusoe would constitute *savings*; these savings would be *invested* in the fishnet; and the extra fish the net produced would constitute a *return on the investment*.

Obviously, the more productive Mr. Crusoe thought the new fishnet would be, the more he could afford to offer potential investors for their savings. In this example, we assume that Mr. Crusoe thought he would be able to pay, and thus he offered, a 100 percent rate of return—he offered to give back two fish for every one he received. He might have tried to attract savings for less—for example, he might have offered only 1.5 fish per day next year for every one he received this year, which would represent a 50 percent rate of return to Ms. Robinson and the other potential savers.

Production Opportunities

The investment opportunities in productive (cash-generating) assets.

Time Preferences for Consumption

The preferences of consumers for current consumption as opposed to saving for future consumption.

Risk

In a financial market context, the chance that an investment will provide a low or negative return.

Inflation

The amount by which prices increase over time.

How attractive Mr. Crusoe's offer appeared to a potential saver would depend in large part on the saver's *time preference for consumption*. For example, Ms. Robinson might be thinking of retirement, and she might be willing to trade fish today for fish in the future on a one-for-one basis. On the other hand, Mr. Friday might have a wife and several young children and need his current fish, so he might be unwilling to "lend" a fish today for anything less than three fish next year. Mr. Friday would be said to have a high time preference for current consumption and Ms. Robinson a low time preference. Note also that if the entire population were living right at the subsistence level, time preferences for current consumption would necessarily be high, aggregate savings would be low, interest rates would be high, and capital formation would be difficult.

The *risk* inherent in the fishnet project, and thus in Mr. Crusoe's ability to repay the loan, also affects the return investors require: the higher the perceived risk, the higher the required rate of return. Also, in a more complex society, there are many businesses like Mr. Crusoe's, many goods other than fish, and many savers like Ms. Robinson and Mr. Friday. Therefore, people use money as a medium of exchange rather than barter with fish. When money is used, its value in the future, which is affected by *inflation*, comes into play: the higher the expected rate of inflation, the larger the required dollar return. We discuss this point in detail later in the chapter.

Thus, we see that the interest rate paid to savers depends (1) on the rate of return producers expect to earn on invested capital, (2) on savers' time preferences for current versus future consumption, (3) on the riskiness of the loan, and (4) on the expected future rate of inflation. Producers' expected returns on their business investments set an upper limit to how much they can pay for savings, while consumers' time preferences for consumption establish how much consumption they are willing to defer, hence how much they will save at different interest rates.¹ Higher risk and higher inflation also lead to higher interest rates.



What is the price paid to borrow debt capital called?

What are the two items whose sum is the cost of equity?

What four fundamental factors affect the cost of money?

6.2 INTEREST RATE LEVELS

Borrowers bid for the available supply of debt capital using interest rates: The firms with the most profitable investment opportunities are willing and able to pay the most for capital, so they tend to attract it away from inefficient firms and firms whose products are not in demand. Of course, our economy is not completely free in the sense of being influenced only by market forces. For example, the federal government has agencies that help designated individuals or groups obtain credit on favorable terms. Among those eligible for this kind of assistance are small businesses, certain minorities, and firms willing to build plants in areas with high unemployment. Still, most capital in the United States is allocated through the price system, where interest is the price.

¹ The term "producers" is really too narrow. A better word might be "borrowers," which would include corporations, home purchasers, people borrowing to go to college, or even people borrowing to buy autos or to pay for vacations. Also, the wealth of a society and its demographics influence its people's ability to save and thus their time preferences for current versus future consumption.

FIGURE 6-1 Interest Rates as a Function of Supply and Demand for Funds

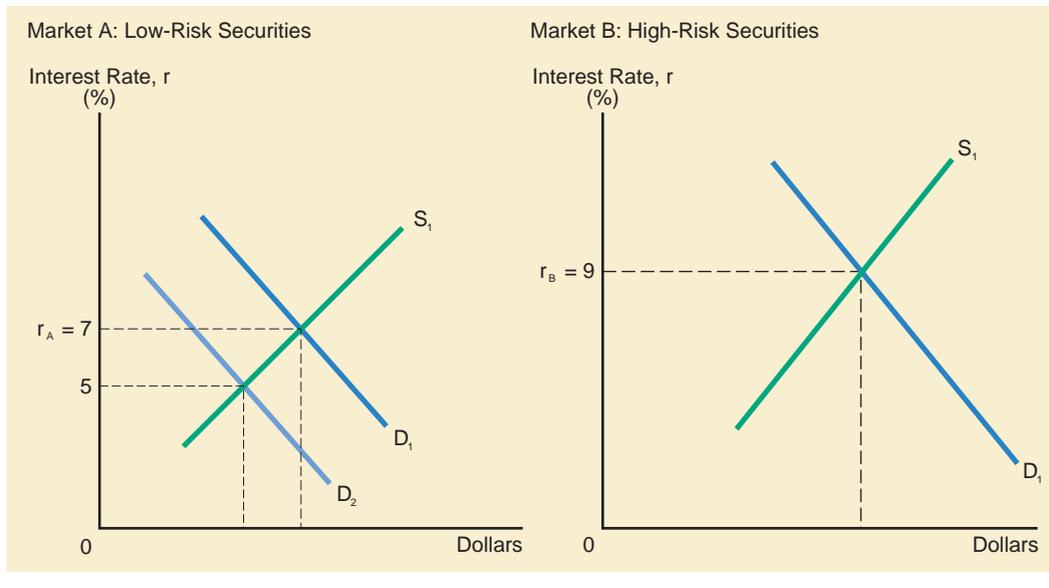


Figure 6-1 shows how supply and demand interact to determine interest rates in two capital markets. Markets A and B represent two of the many capital markets in existence. The going interest rate, designated as r , is initially 7 percent for the low-risk securities in Market A. Borrowers whose credit is strong enough to participate in this market can obtain funds at a cost of 7 percent, and investors who want to put their money to work without much risk can obtain a 7 percent return. Riskier borrowers must obtain higher-cost funds in Market B, where investors who are more willing to take risks expect to earn a 9 percent return but also realize that they might actually receive much less.

If the demand for funds declines, as it typically does during business recessions, the demand curves will shift to the left, as shown in curve D_2 in Market A. The market-clearing, or equilibrium, interest rate in this example declines to 5 percent. Similarly, you should be able to visualize what would happen if the Federal Reserve tightened credit: The supply curve, S_1 , would shift to the left, and this would raise interest rates and lower the amount of borrowing in the economy.

Capital markets are interdependent. For example, if Markets A and B were in equilibrium before the demand shift to D_2 in Market A, then investors were willing to accept the higher risk in Market B in exchange for a *risk premium* of $9\% - 7\% = 2\%$. After the shift to D_2 , the risk premium would initially increase to $9\% - 5\% = 4\%$. Immediately, though, this much larger premium would induce some of the lenders in Market A to shift to Market B, which would, in turn, cause the supply curve in Market A to shift to the left (or up) and that in Market B to shift to the right. The transfer of capital between markets would raise the interest rate in Market A and lower it in Market B, thus bringing the risk premium back closer to the original 2 percent.

There are many capital markets in the United States. U.S. firms also invest and raise capital throughout the world, and foreigners both borrow and lend in the United States. There are markets for home loans; farm loans; business loans; federal, state, and local government loans; and consumer loans. Within each category, there are regional markets as well as different types of submarkets. For example, in real estate there are separate markets for first and second mortgages

and for loans on single-family homes, apartments, office buildings, shopping centers, vacant land, and so on. Within the business sector there are dozens of types of debt securities, and there are also several different markets for common stocks.

There is a price for each type of capital, and these prices change over time as supply and demand conditions change. Figure 6-2 shows how long- and short-term interest rates to business borrowers have varied since the early 1970s. Notice that short-term interest rates are especially volatile, rising rapidly during booms and falling equally rapidly during recessions. (The shaded areas of the chart indicate recessions.) When the economy is expanding, firms need capital, and this demand for capital pushes up rates. Also, inflationary pressures are strongest during business booms, and that also exerts upward pressure on rates. Conditions are reversed during recessions. Slack business reduces the demand for credit, the rate of inflation falls, and interest rates drop. Furthermore, the Federal Reserve tends to increase the supply of funds during recessions to help stimulate the economy, and that also lowers rates.

These tendencies do not hold exactly, as demonstrated in the period after 1984. Oil prices fell dramatically in 1985 and 1986, reducing inflationary pressures on other prices and easing fears of serious long-term inflation. Earlier, these fears had pushed interest rates to record levels. The economy from 1984 to 1987 was strong, but the declining fears of inflation more than offset the normal

FIGURE 6-2 Long- and Short-Term Interest Rates, 1971–2005

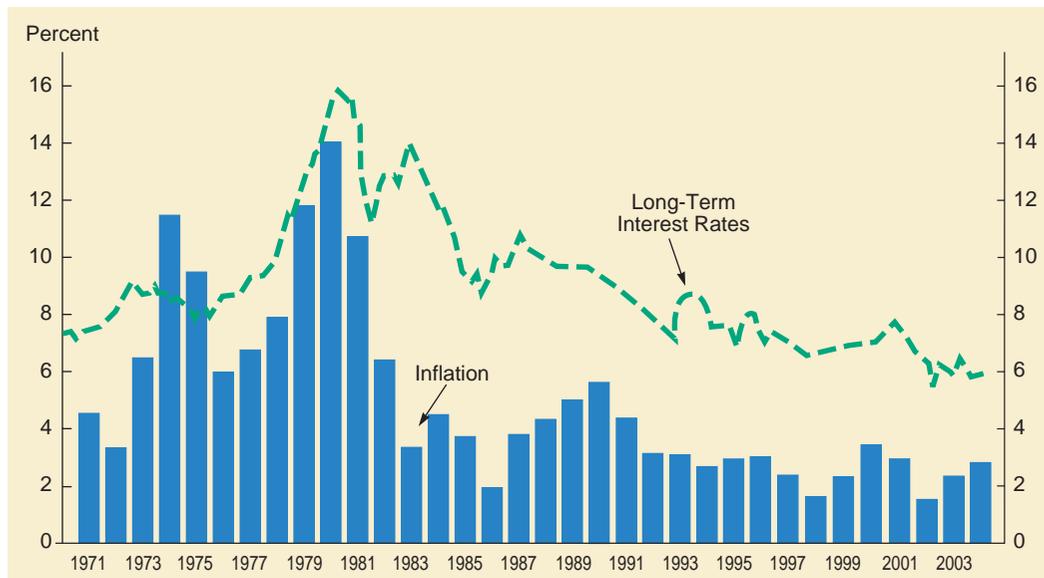


Notes:

- The shaded areas designate business recessions.
- Short-term rates are measured by 3- to 6-month loans to very large, strong corporations, and long-term rates are measured by AAA corporate bonds.

Source: St. Louis Federal Reserve Web site, FRED database, <http://research.stlouisfed.org/fred2>.

FIGURE 6-3 Relationship between Annual Inflation Rates and Long-Term Interest Rates, 1971–2005



Notes:

a. Interest rates are those on AAA long-term corporate bonds.

b. Inflation is measured as the annual rate of change in the Consumer Price Index (CPI).

Source: St. Louis Federal Reserve Web site, FRED database, <http://research.stlouisfed.org/fred2>.

tendency for interest rates to rise during good economic times, and the net result was lower interest rates.²

The relationship between inflation and long-term interest rates is highlighted in Figure 6-3, which plots inflation over time along with long-term interest rates. In the early 1960s, inflation averaged 1 percent per year, and interest rates on high-quality, long-term bonds averaged 4 percent. Then the Vietnam War heated up, leading to an increase in inflation, and interest rates began an upward climb. When the war ended in the early 1970s, inflation dipped a bit, but then the 1973 Arab oil embargo led to rising oil prices, much higher inflation rates, and sharply higher interest rates.

Inflation peaked at about 13 percent in 1980, but interest rates continued to increase into 1981 and 1982, and they remained quite high until 1985, because people feared another increase in inflation. Thus, the “inflationary psychology” created during the 1970s persisted until the mid-1980s. People gradually realized that the Federal Reserve was serious about keeping inflation down, that global competition was keeping U.S. auto producers and other corporations from raising prices as they had in the past, and that constraints on corporate price increases were diminishing labor unions’ ability to push through cost-increasing wage hikes. As these realizations set in, interest rates declined.

² Short-term rates are responsive to current economic conditions, whereas long-term rates primarily reflect long-run expectations for inflation. As a result, short-term rates are sometimes above and sometimes below long-term rates. The relationship between long-term and short-term rates is called the *term structure of interest rates*, and it is discussed later in this chapter.

The current interest rate minus the current inflation rate (which is also the gap between the inflation bars and the interest rate curve in Figure 6-3) is defined as the “current real rate of interest.” It is called a “real rate” because it shows how much investors really earned after taking out the effects of inflation. The real rate was extremely high during the mid-1980s, but it has generally been in the range of 3 to 4 percent since 1987.

In recent years inflation has been about 2.5 percent a year. However, long-term interest rates have been volatile because investors are not sure if inflation is truly under control or is about to jump back to the higher levels of the 1980s. In the years ahead, we can be sure of two things: (1) interest rates will vary, and (2) they will increase if inflation appears to be headed higher and decrease if inflation is expected to decline. We really don’t know where interest rates will go, but we do know that they will vary.



What role do interest rates play in allocating capital to different potential borrowers?

What happens to market-clearing, or equilibrium, interest rates in a capital market when the demand for funds declines? What happens when expected inflation increases or decreases?

How does the price of capital tend to change during a boom or a recession?

How does risk affect interest rates?

If inflation during the last 12 months was 2 percent and the interest rate during that period was 5 percent, what was the real rate of interest? If inflation is expected to average 4 percent during the next year and the real rate is 3 percent, what should the current rate of interest be? (3%; 7%)

6.3 THE DETERMINANTS OF MARKET INTEREST RATES

In general, the quoted (or nominal) interest rate on a debt security, r , is composed of a real risk-free rate of interest, r^* , plus several premiums that reflect inflation, the security’s risk, and its marketability (or liquidity). This relationship can be expressed as follows:

$$\text{Quoted interest rate} = r = r^* + IP + DRP + LP + MRP \quad (6-1)$$

Here

r = the quoted, or nominal, rate of interest on a given security.³
 r^* = the real risk-free rate of interest. r^* is pronounced “r-star,” and it is the rate that would exist on a riskless security in a world with no inflation.

³ The term *nominal* as it is used here means the *stated* rate as opposed to the *real* rate, which is adjusted to remove inflation’s effects. If you had bought a 10-year Treasury bond in February 2005, the quoted, or nominal, rate would have been about 4.2 percent, but if inflation averages 2.5 percent over the next 10 years, the real rate would turn out to be about $4.2\% - 2.5\% = 1.7\%$.

Also, note that in later chapters, when we discuss both debt and equity, we use the subscripts d and s to designate returns on debt and stock, that is, r_d and r_s .

- $r_{RF} = r^* + IP$, and it is the quoted rate on a risk-free security such as a U.S. Treasury bill, which is both very liquid and also free of most types of risk. Note that a premium for expected inflation, IP , is built into r_{RF} .
- IP = inflation premium. IP is equal to the average expected inflation rate over the life of the security. The expected future inflation rate is not necessarily equal to the current inflation rate, so IP is not necessarily equal to current inflation, as shown back in Figure 6-3.
- DRP = default risk premium. This premium reflects the possibility that the issuer will not pay interest or principal at the stated time and in the stated amount. DRP is zero for U.S. Treasury securities, but it rises as the riskiness of the issuer increases.
- LP = liquidity (or marketability) premium. This is a premium charged by lenders to reflect the fact that some securities cannot be converted to cash on short notice at a “reasonable” price. LP is very low for Treasury securities and for securities issued by large, strong firms, but it is relatively high on securities issued by small, privately held firms.
- MRP = maturity risk premium. As we will explain later, longer-term bonds, even Treasury bonds, are exposed to a significant risk of price declines due to increases in inflation and interest rates, and a maturity risk premium is charged by lenders to reflect this risk.

Because $r_{RF} = r^* + IP$, we can rewrite Equation 6-1 as follows:

$$\text{Nominal, or quoted, rate} = r = r_{RF} + DRP + LP + MRP$$

We discuss the components whose sum makes up the quoted, or nominal, rate on a given security in the following sections.

The Real Risk-Free Rate of Interest, r^*

The **real risk-free rate of interest, r^*** , is the interest rate that would exist on a riskless security if no inflation were expected, and it may be thought of as the rate of interest on *short-term* U.S. Treasury securities in an inflation-free world. The real risk-free rate is not static—it changes over time depending on economic conditions, especially (1) on the rate of return corporations and other borrowers expect to earn on productive assets and (2) on people’s time preferences for current versus future consumption. Borrowers’ expected returns on real asset investments set an upper limit on how much they can afford to pay for borrowed funds, while savers’ time preferences for consumption establish how much consumption they are willing to defer, hence the amount of funds they will lend at different interest rates. It is difficult to measure the real risk-free rate precisely, but most experts think that r^* has fluctuated in the range of 1 to 5 percent in recent years.⁴ The best estimate of r^* is the rate of return on indexed Treasury bonds, which are discussed in a box later in the chapter.

Real Risk-Free Rate of Interest, r^*

The rate of interest that would exist on default-free U.S. Treasury securities if no inflation were expected.

⁴ The real rate of interest as discussed here is different from the *current* real rate as discussed in connection with Figure 6-3. The current real rate is the current interest rate minus the current (or latest past) inflation rate, while the real rate, without the word “current,” is the current interest rate minus the *expected future* inflation rate over the life of the security. For example, suppose the current quoted rate for a one-year Treasury bill is 3 percent, inflation during the latest year was 2 percent, and inflation expected for the coming year is 2.5 percent. Then the *current* real rate would be $3\% - 2\% = 1\%$, but the *expected* real rate would be $3\% - 2.5\% = 0.5\%$. The rate on a 10-year bond would be related to the average expected inflation rate over the next 10 years, and so on. In the press, the term “real rate” generally means the current real rate, but in economics and finance, hence in this book unless otherwise noted, the real rate means the one based on *expected* inflation rates.

Nominal (Quoted) Risk-Free Rate, r_{RF}

The rate of interest on a security that is free of all risk; r_{RF} is proxied by the T-bill rate or the T-bond rate. r_{RF} includes an inflation premium.

The Nominal, or Quoted, Risk-Free Rate of Interest, r_{RF}

The **nominal, or quoted, risk-free rate, r_{RF}** is the real risk-free rate plus a premium for expected inflation: $r_{RF} = r^* + IP$. To be strictly correct, the risk-free rate should mean the interest rate on a totally risk-free security—one that has no default risk, no maturity risk, no liquidity risk, no risk of loss if inflation increases, and no risk of any other type. There is no such security; hence, there is no observable truly risk-free rate. However, there is one security that is free of most risks—an indexed U.S. Treasury security. These securities are free of default, maturity, and liquidity risks, and also of risk due to changes in the general level of interest rates. However, they are not free of changes in the real rate.⁵

If the term “risk-free rate” is used without either the modifiers “real” or “nominal,” people generally mean the quoted (nominal) rate, and we follow that convention in this book. Therefore, when we use the term risk-free rate, r_{RF} , we mean the nominal risk-free rate, which includes an inflation premium equal to the average expected inflation rate over the remaining life of the security. In general, we use the T-bill rate to approximate the short-term risk-free rate, and the T-bond rate to approximate the long-term risk-free rate. So, whenever you see the term “risk-free rate,” assume that we are referring either to the quoted U.S. T-bill rate or to the quoted T-bond rate.

Inflation Premium (IP)

Inflation has a major impact on interest rates because it erodes the dollar’s purchasing power and lowers real investment returns. To illustrate, suppose you saved \$1,000 and invested it in a Treasury bill that pays a 3 percent interest rate and matures in one year. At the end of the year, you will receive \$1,030—your original \$1,000 plus \$30 of interest. Now suppose the inflation rate during the year turned out to be 3.5 percent, and it affected all goods equally. If heating oil had cost \$1 per gallon at the beginning of the year, it would cost \$1.035 at the end of the year. Therefore, your \$1,000 would have bought $\$1,000/\$1 = 1,000$ gallons at the beginning of the year, but only $\$1,030/\$1.035 = 995$ gallons at the end. In *real terms*, you would be worse off—you would receive \$30 of interest, but it would not be sufficient to offset inflation. You would thus be better off buying 1,000 gallons of heating oil (or some other storable asset such as land, timber, apartment buildings, wheat, or gold) than buying the Treasury bill.

Investors are well aware of all this, so when they lend money, they build an **inflation premium (IP)** equal to the average expected inflation rate over the life of the security into the rate they charge. As discussed previously, the actual interest rate on a short-term, default-free U.S. Treasury bill, $r_{T\text{-bill}}$, would be the real risk-free rate, r^* , plus the inflation premium (IP):

$$r_{T\text{-bill}} = r_{RF} = r^* + IP$$

Therefore, if the real risk-free rate were $r^* = 1.7$ percent, and if inflation were expected to be 1.5 percent (and hence $IP = 1.5\%$) during the next year, then the quoted rate of interest on one-year T-bills would be $1.7\% + 1.5\% = 3.2\%$.

It is important to note that the inflation rate built into interest rates is the *inflation rate expected in the future*, not the rate experienced in the past. Thus, the latest

Inflation Premium (IP)

A premium equal to expected inflation that investors add to the real risk-free rate of return.

⁵ Indexed Treasury securities are the closest thing we have to a riskless security, but even they are not totally riskless, because r^* itself can change and cause a decline in the prices of these securities. For example, between its issue date in March 1998 and December 2004, the price of one long-term indexed Treasury bond first declined from 100 to 89, or by almost 10 percent, but then rose to 131. The cause of the initial price decline was an *increase* in the real rate on long-term securities from 3.625 to 4.4 percent, and the cause of the more recent price increase was a *decline* in real rates to 1.93 percent.

reported figures might show an annual inflation rate of 3 percent over the past 12 months, but that is for the *past* year. If people on average expect a 4 percent inflation rate in the future, then 4 percent would be built into the current interest rate. Note also that the inflation rate reflected in the quoted interest rate on any security is the *average inflation rate expected over the security's life*. Thus, the inflation rate built into a 1-year bond is the expected inflation rate for the next year, but the inflation rate built into a 30-year bond is the average inflation rate expected over the next 30 years.⁶

Expectations for future inflation are closely, but not perfectly, correlated with rates experienced in the recent past. Therefore, if the inflation rate reported for last month increased, people would tend to raise their expectations for future inflation, and this change in expectations would cause an increase in current rates.

Note that Germany, Japan, and Switzerland have over the past several years had lower inflation rates than the United States, hence their interest rates have generally been lower than ours. Italy and most South American countries have experienced higher inflation, and so their rates have been higher than ours.



Students should go to www.bloomberg.com/markets/rates to find current interest rates in the United States, as well as those in Australia, Brazil, Germany, Japan, and Great Britain.

Default Risk Premium (DRP)

The risk that a borrower will *default*, which means not make scheduled interest or principal payments, also affects the market interest rate on a bond: the greater the bond's risk of default, the higher the interest rate. Treasury securities have no default risk, hence they carry the lowest interest rates on taxable securities in the United States. For corporate bonds, the higher the bond's rating, the lower its default risk, and, consequently, the lower its interest rate.⁷ Here are some representative interest rates on long-term bonds during February 2005:

	Rate	DRP
U.S. Treasury	4.65%	—
AAA	5.45	0.80
AA	5.60	0.95
A	5.78	1.13
BBB	6.34	1.69

The difference between the quoted interest rate on a T-bond and that on a corporate bond with similar maturity, liquidity, and other features is the **default risk premium (DRP)**. Therefore, if the bonds listed above have the same maturity, liquidity, etc., then the default risk premium would be $DRP = 5.45\% - 4.65\% = 0.8$ percentage point for AAA corporate bonds, $5.60\% - 4.65\% = 0.95$ percentage point for AA, $5.78\% - 4.65\% = 1.13$ percentage points for A corporate bonds, and so forth. Default risk premiums vary somewhat over time, but the February 2005 figures are representative of levels in recent years.

Default Risk Premium (DRP)

The difference between the interest rate on a U.S. Treasury bond and a corporate bond of equal maturity and marketability.

⁶ To be theoretically precise, we should use a *geometric average*. Also, since millions of investors are active in the market, it is impossible to determine exactly the consensus expected inflation rate. Survey data are available, however, that give us a reasonably good idea of what investors expect over the next few years. For example, in 1980 the University of Michigan's Survey Research Center reported that people expected inflation during the next year to be 11.9 percent and that the average rate of inflation expected over the next 5 to 10 years was 10.5 percent. Those expectations led to record-high interest rates. However, the economy cooled thereafter and, as Figure 6-3 showed, actual inflation dropped sharply. This led to a gradual reduction in the *expected future* inflation rate, and as inflationary expectations dropped, so did quoted market interest rates.

⁷ Bond ratings, and bonds' riskiness in general, are discussed in detail in Chapter 7. For now, merely note that bonds rated AAA are judged to have less default risk than bonds rated AA, while AA bonds are less risky than A bonds, and so on. Ratings are designated AAA or Aaa, AA or Aa, and so forth, depending on the rating agency. In this book, the designations are used interchangeably.

An Almost Riskless Treasury Bond

Investors who purchase bonds must constantly worry about inflation. If inflation turns out to be greater than expected, bonds will provide a lower-than-expected real return. To protect themselves against expected increases in inflation, investors build an inflation risk premium into their required rate of return. This raises borrowers' costs.

To provide investors with an inflation-protected bond, and also to reduce the cost of debt to the government, on January 29, 1997, the U.S. Treasury issued \$7 billion of 10-year inflation-indexed bonds. These bonds pay an interest rate of 3.375 percent plus an additional amount that is just sufficient to offset inflation. At the end of each six-month period, the principal (originally set at par, or \$1,000) is adjusted by the inflation rate. For example, during the first six-month interest period, inflation (as measured by the CPI) was 1.085 percent. The inflation-adjusted principal was then calculated as $\$1,000(1 + \text{Inflation}) = \$1,000 \times 1.01085 = \$1,010.85$. So, on July 15, 1997, each bond paid interest of $0.03375/2 \times \$1,010.85 = \17.06 . Note that the interest rate is

divided by two because interest on these (and most other) bonds is paid twice a year.

By January 15, 1998, a bit more inflation had occurred, and the inflation-adjusted principal was up to \$1,019.69, so on January 15, 1998, each bond paid interest of $0.03375/2 \times \$1,019.69 = \17.21 . Thus, the total return during the first year consisted of $\$17.06 + \$17.21 = \$34.27$ of interest and $\$1,019.69 - \$1,000.00 = \$19.69$ of "capital gains," or $\$34.27 + \$19.69 = \$53.96$ in total. Thus, the total return was $\$53.96/\$1,000 = 5.396\%$.

This same adjustment process will continue each year until the bonds mature on January 15, 2007, at which time they will pay the adjusted maturity value. Thus, the cash income provided by the bonds rises by exactly enough to cover inflation, producing a real, inflation-adjusted rate of 3.375 percent. Further, since the principal also rises by the inflation rate, it too is protected from inflation. The accompanying table gives the inflation-adjusted principal and interest paid during the life of these $3\frac{3}{8}$ percent coupon, 10-year, inflation-indexed bonds:

Date	Inflation-Adjusted Principal	Interest Paid
7/15/97	\$1,010.85	\$17.06
1/15/98	1,019.69	17.21
7/15/98	1,026.51	17.32
1/15/99	1,035.12	17.47
7/15/99	1,049.01	17.70
1/15/00	1,061.92	17.92
7/15/00	1,080.85	18.24
1/15/01	1,098.52	18.54
7/15/01	1,118.82	18.88
1/15/02	1,120.74	18.91
7/15/02	1,134.85	19.15
1/15/03	1,144.31	19.31
7/15/03	1,159.24	19.56
1/15/04	1,166.24	19.68
7/15/04	1,189.74	20.08
1/15/05	1,205.19	20.34

Source: Bureau of the Public Debt's Online, Historical Reference CPI Numbers and Daily Index Ratios for $3\frac{3}{8}$ percent, 10-year note due January 15, 2007, <http://www.publicdebt.treas.gov/of/ofhispci.htm>.

The Treasury regularly conducts auctions to issue indexed bonds. The 3.375 percent rate was based on the relative supply and demand for the issue, and it will remain fixed over the life of the bond. However, new bonds are issued periodically, and their “coupon” real rates depend on the market at the time the bond is auctioned. In January 2005, 10-year indexed securities had a real rate of 1.625 percent.

Federal Reserve Board Chairman Greenspan lobbied in favor of the indexed bonds on the grounds that they would help him and the Fed make better estimates of investors’ expectations about inflation. He did not explain his reasoning (to our knowledge), but it might have gone something like this:

- We know that interest rates in general are determined as follows:

$$r = r^* + IP + MRP + DRP + LP$$

- For Treasury bonds, DRP and LP are essentially zero, so for a 10-year bond the rate is

$$r_{RF} = r^* + IP + MRP$$

The reason the MRP is not zero is that if inflation increases, interest rates will rise and the price of the bonds will decline. Therefore, “regular” 10-year bonds are exposed to maturity risk, hence a maturity risk premium is built into their market interest rate.

- The indexed bonds are protected against inflation—if inflation increases, then so will their dollar returns, and as a result, their price will not decline in real terms. Therefore, indexed bonds should have no MRP, hence their market return is

$$r_{RF} = r^* + 0 + 0 = r^*$$

In other words, the market rate on an indexed bond is the real rate.

- The difference between the yield on a regular 10-year bond and that on an indexed bond is the sum of the 10-year bonds’ IP and MRP. Regular 10-year bonds were yielding 6.80 percent when the first indexed bonds were issued in 1997 at a rate of 3.375 percent. The difference, 3.425 percent, was the average expected inflation rate over the next 10 years, plus an MRP for 10-year bonds.
- The 10-year MRP is about 1.0 percent, and it has been relatively stable in recent years. Therefore, the expected rate of inflation in January 1997 was $3.425\% - 1.00\% = 2.425\%$.

Both the annual interest received and the increase in principal are taxed each year as interest income, even though cash from the appreciation will not be received until the bond matures. Therefore, these bonds are not good for accounts subject to current income taxes but are excellent for individual retirement accounts [IRAs and 401(k) plans], which are not taxed until funds are withdrawn.

Keep in mind, though, that despite their protection against inflation, indexed bonds are not completely riskless. As we indicated earlier, the real rate can change, and if r^* rises, the prices of indexed bonds will decline. This just confirms one more time that there is no such thing as a free lunch or a riskless security!

Sources: “Inflation Notes Will Offer Fed Forecast Tool,” *The Wall Street Journal*, February 3, 1997, p. C1; and *The Wall Street Journal*, January 6, 2000, p. C21.

Liquidity Premium (LP)

A premium added to the equilibrium interest rate on a security if that security cannot be converted to cash on short notice and at close to its “fair market value.”

Interest Rate Risk

The risk of capital losses to which investors are exposed because of changing interest rates.

Maturity Risk Premium (MRP)

A premium that reflects interest rate risk.

Reinvestment Rate Risk

The risk that a decline in interest rates will lead to lower income when bonds mature and funds are reinvested.

Liquidity Premium (LP)

A “liquid” asset can be converted to cash quickly at a “fair market value.” Real assets are generally less liquid than financial assets, but different financial assets vary in their liquidity. Because liquidity is important, investors include a **liquidity premium (LP)** in the rates charged on different debt securities. Although it is difficult to accurately measure liquidity premiums, a differential of at least two and probably four or five percentage points exists between the least liquid and the most liquid financial assets of similar default risk and maturity.

Maturity Risk Premium (MRP)

U.S. Treasury securities are free of default risk in the sense that one can be virtually certain that the federal government will pay interest on its bonds and will also pay them off when they mature. Therefore, the default risk premium on Treasury securities is essentially zero. Further, active markets exist for Treasury securities, so their liquidity premiums are also close to zero. Thus, as a first approximation, the rate of interest on a Treasury security should be the risk-free rate, r_{RF} , which is equal to the real risk-free rate, r^* , plus an inflation premium, IP. However, the prices of long-term bonds decline whenever interest rates rise, and because interest rates can and do occasionally rise, all long-term bonds, even Treasury bonds, have an element of risk called **interest rate risk**. As a general rule, the bonds of any organization, from the U.S. government to Delta Airlines, have more interest rate risk the longer the maturity of the bond.⁸ Therefore, a **maturity risk premium (MRP)**, which is higher the greater the years to maturity, must be included in the required interest rate.

The effect of maturity risk premiums is to raise interest rates on long-term bonds relative to those on short-term bonds. This premium, like the others, is difficult to measure, but (1) it varies somewhat over time, rising when interest rates are more volatile and uncertain, then falling when interest rates are more stable, and (2) in recent years, the maturity risk premium on 20-year T-bonds has generally been in the range of one to two percentage points.⁹

We should also note that although long-term bonds are heavily exposed to interest rate risk, short-term bills are heavily exposed to **reinvestment rate risk**. When short-term bills mature and the principal must be reinvested, or “rolled over,” a decline in interest rates would necessitate reinvestment at a lower rate, and this would result in a decline in interest income. To illustrate, suppose you had \$100,000 invested in T-bills and you lived on the income. In 1981, short-term Treasury rates were about 15 percent, so your income would have been about \$15,000. However, your income would have declined to about \$9,000 by 1983, and to just \$2,900 by February 2005. Had you invested your money in long-term T-bonds, your income (but not the value of the principal) would have been stable.¹⁰ Thus, although “investing short” preserves one’s principal, the interest income provided by short-term T-bills is less stable than the interest income on long-term bonds.

⁸ For example, if someone had bought a 20-year Treasury bond for \$1,000 in October 1998, when the long-term interest rate was 5.3 percent, and sold it in May 2002, when long-term T-bond rates were about 5.8 percent, the value of the bond would have declined to about \$942. That would represent a loss of 5.8 percent, and it demonstrates that long-term bonds, even U.S. Treasury bonds, are not riskless. However, had the investor purchased short-term T-bills in 1998 and subsequently reinvested the principal each time the bills matured, he or she would still have had the original \$1,000. This point is discussed in detail in Chapter 7.

⁹ The MRP for long-term bonds has averaged 1.4 percent over the last 79 years. See *Stocks, Bonds, Bills, and Inflation: (Valuation Edition) 2005 Yearbook* (Chicago: Ibbotson Associates, 2005).

¹⁰ Long-term bonds also have some reinvestment rate risk. If one is saving and investing for some future purpose, say, to buy a house or for retirement, then to actually earn the quoted rate on a



Write out an equation for the nominal interest rate on any security.

Distinguish between the *real* risk-free rate of interest, r^* , and the *nominal*, or *quoted*, risk-free rate of interest, r_{RF} .

How do investors deal with inflation when they determine interest rates in the financial markets?

Does the interest rate on a T-bond include a default risk premium? Explain.

Distinguish between liquid and illiquid assets, and list some assets that are liquid and some that are illiquid.

Briefly explain the following statement: “Although long-term bonds are heavily exposed to interest rate risk, short-term T-bills are heavily exposed to reinvestment rate risk. The maturity risk premium reflects the net effects of these two opposing forces.”

Assume that the real risk-free rate is $r^* = 2\%$ and the average expected inflation rate is 3 percent for each future year. The DRP and LP for Bond X are each 1 percent, and the applicable MRP is 2 percent. What is Bond X’s interest rate? Is Bond X (1) a Treasury bond or a corporate bond and (2) more likely to have a 3-month or a 20-year maturity? (9 percent, corporate, 20-year)

6.4 THE TERM STRUCTURE OF INTEREST RATES

The **term structure of interest rates** describes the relationship between long- and short-term rates. The term structure is important both to corporate treasurers deciding whether to borrow by issuing long- or short-term debt and to investors who are deciding whether to buy long- or short-term bonds. Therefore, both borrowers and lenders should understand (1) how long- and short-term rates relate to each other and (2) what causes shifts in their relative levels.

Interest rates for bonds with different maturities can be found in a variety of publications, including *The Wall Street Journal* and the *Federal Reserve Bulletin*, and on a number of Web sites, including Bloomberg, Yahoo!, CNN Financial, and the Federal Reserve Board. Using interest rate data from these sources, we can determine the term structure at any given point in time. For example, the tabular section below Figure 6-4 presents interest rates for different maturities on three different dates. The set of data for a given date, when plotted on a graph such as Figure 6-4, is called the **yield curve** for that date.

As the figure shows, the yield curve changes both in position and in slope over time. In March 1980, all rates were quite high because high inflation was expected. However, the rate of inflation was expected to decline, so short-term rates were higher than long-term rates and the yield curve was thus *downward sloping*. By February 2000, inflation had indeed declined and thus all rates were lower, and the yield curve had become *humped*—medium-term rates were higher

Term Structure of Interest Rates

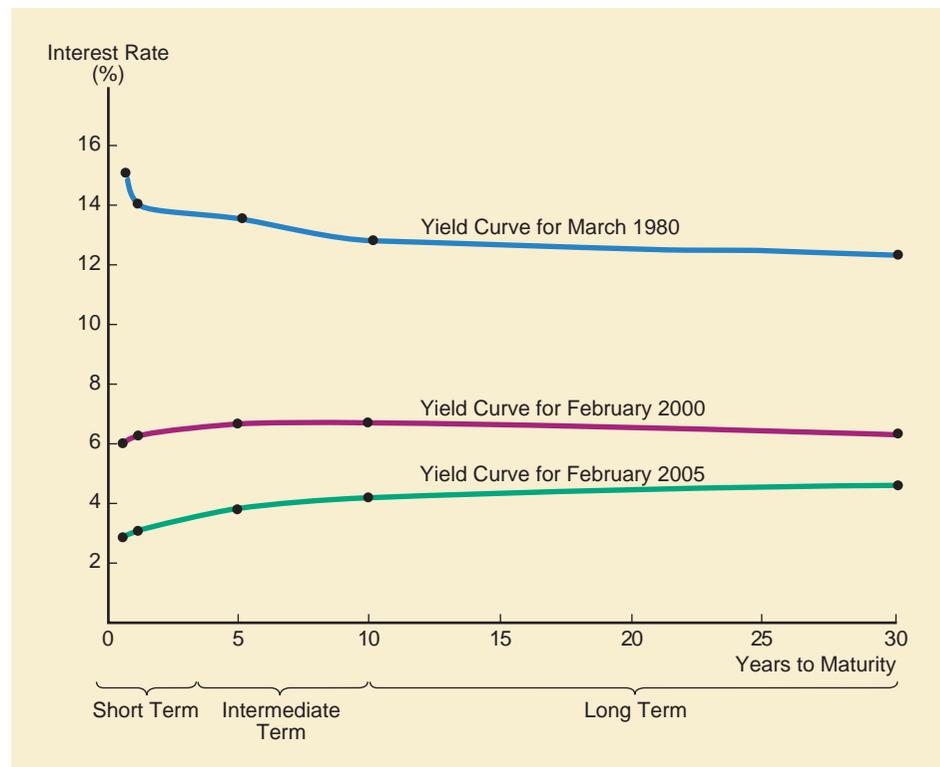
The relationship between bond yields and maturities.

Yield Curve

A graph showing the relationship between bond yields and maturities.

(Footnote 10, continued)

long-term bond, the interest payments must be reinvested at the quoted rate. However, if interest rates fall, the interest payments must be reinvested at a lower rate; thus, the realized return would be less than the quoted rate. Note, though, that reinvestment rate risk is lower on a long-term bond than on a short-term bond because only the interest payments (rather than interest plus principal) on the long-term bond are exposed to reinvestment rate risk. Zero coupon bonds, which are discussed in Chapter 7, are completely free of reinvestment rate risk during their lifetime.

FIGURE 6-4 U.S. Treasury Bond Interest Rates on Different Dates


Term to Maturity	INTEREST RATE		
	March 1980	February 2000	February 2005
6 months	15.0%	6.0%	2.9%
1 year	14.0	6.2	3.1
5 years	13.5	6.7	3.8
10 years	12.8	6.7	4.2
30 years	12.3	6.3	4.6

than either short- or long-term rates. By February 2005, all rates had fallen below the 2000 levels, and because short-term rates had dropped below long-term rates, the yield curve was *upward sloping*.

Figure 6-4 shows yield curves for U.S. Treasury securities, but we could have constructed curves for bonds issued by GE, IBM, Delta Airlines, or any other company that borrows money over a range of maturities. Had we constructed such corporate yield curves and plotted them on Figure 6-4, they would have been above those for Treasury securities because corporate yields include default risk premiums and somewhat higher liquidity premiums than Treasury bonds. However, the corporate yield curves would have had the same general shape as the Treasury curves. Also, the riskier the corporation, the higher its yield curve, so Delta, which was flirting with bankruptcy, would have a higher yield curve than GE or IBM.

Historically, long-term rates are generally above short-term rates because of the maturity premium, so the yield curve usually slopes upward. For this reason, people often call an upward-sloping yield curve a **“normal” yield curve** and a yield curve that slopes downward an **inverted**, or **“abnormal” curve**.

“Normal” Yield Curve

An upward-sloping yield curve.

Inverted (“Abnormal”) Yield Curve

A downward-sloping yield curve.

Thus, in Figure 6-4 the yield curve for March 1980 was inverted, while the yield curve in February 2005 was normal. However, the February 2000 curve was **humped**, which means that interest rates on medium-term maturities were higher than rates on both short- and long-term maturities. We explain in detail in the next section why an upward slope is the normal situation, but briefly, the reason is that short-term securities have less interest rate risk than longer-term securities, hence smaller MRPs. Therefore, short-term rates are normally lower than long-term rates.

Humped Yield Curve

A yield curve where interest rates on medium-term maturities are higher than rates on both short- and long-term maturities.



What is a yield curve, and what information would you need to draw this curve?

Distinguish among the shapes of a “normal” yield curve, an “abnormal” curve, and a “humped” curve.

If the interest rates on 1-, 5-, 10-, and 30-year bonds are 4, 5, 6, and 7 percent, respectively, how would you describe the yield curve? If the rates were reversed, how would you describe it?

6.5 WHAT DETERMINES THE SHAPE OF THE YIELD CURVE?

Because maturity risk premiums are positive, then if other things were held constant, long-term bonds would always have higher interest rates than short-term bonds. However, market interest rates also depend on expected inflation, default risk, and liquidity, and each of these factors can vary with maturity.

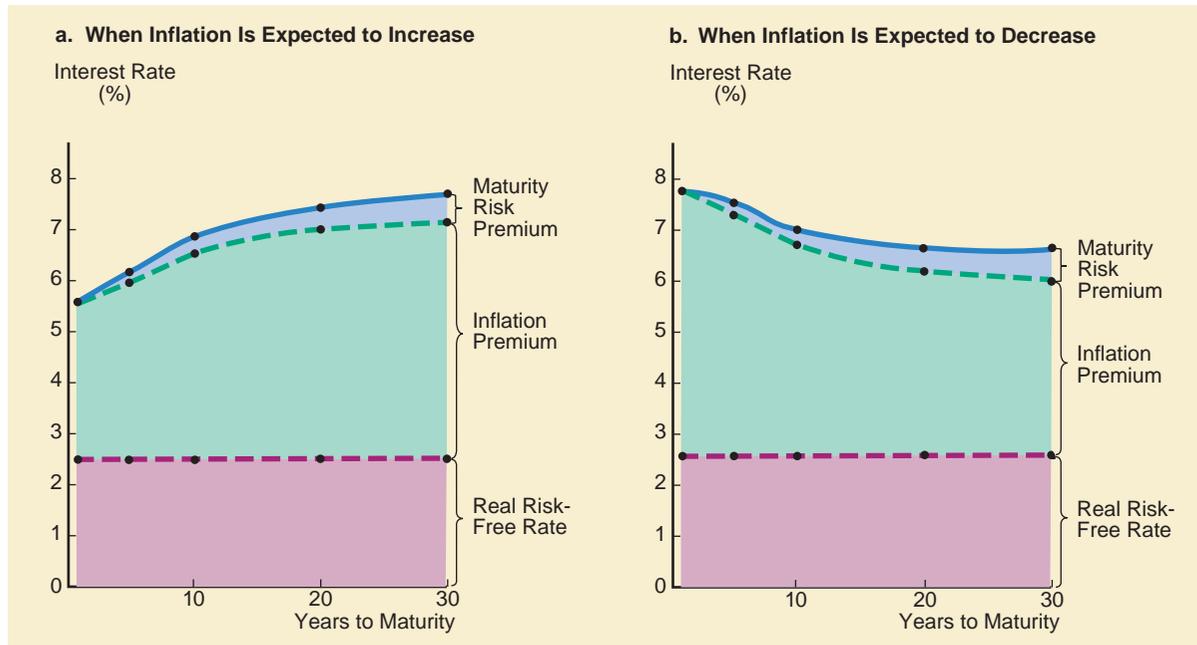
Expected inflation has an especially important effect on the yield curve’s shape, especially the curve for U.S. Treasury securities. Treasuries have essentially no default or liquidity risk, so the yield on a Treasury bond that matures in t years can be expressed as follows:

$$\text{T-bond yield} = r^*_t + IP_t + MRP_t$$

While the real risk-free rate, r^* , varies somewhat over time because of changes in the economy and demographics, these changes are random rather than predictable, so the best forecast for the future value of r^* is its current value. However, the inflation premium, IP , does vary significantly over time, and in a somewhat predictable manner. Recall that the inflation premium is simply the average level of expected inflation over the life of the bond. Thus, if the market expects inflation to increase in the future, say, from 3 to 4 to 5 percent over the next three years, the inflation premium will be higher on a three-year bond than on a one-year bond. On the other hand, if the market expects inflation to decline in the future, long-term bonds will have a smaller inflation premium than short-term bonds. Finally, since investors consider long-term bonds to be riskier than short-term bonds because of interest rate risk, the maturity risk premium always increases with maturity.

Panel a of Figure 6-5 shows the yield curve when inflation is expected to increase. Here long-term bonds have higher yields for two reasons: (1) Inflation is expected to be higher in the future, and (2) there is a positive maturity risk premium. Panel b of the figure shows the yield curve when inflation is expected to decline. Such a downward sloping yield curve often foreshadows an economic

FIGURE 6-5 Illustrative Treasury Yield Curves



Maturity	WITH INFLATION EXPECTED TO INCREASE				WITH INFLATION EXPECTED TO DECREASE				
	r^*	IP	MRP	Yield	r^*	IP	MRP	Yield	
1 year	2.50%	3.00%	0.00%	5.50%	1 year	2.50%	5.00%	0.00%	7.50%
5 years	2.50	3.40	0.18	6.08	5 years	2.50	4.60	0.18	7.28
10 years	2.50	4.00	0.28	6.78	10 years	2.50	4.00	0.28	6.78
20 years	2.50	4.50	0.42	7.42	20 years	2.50	3.50	0.42	6.42
30 years	2.50	4.67	0.53	7.70	30 years	2.50	3.33	0.53	6.36

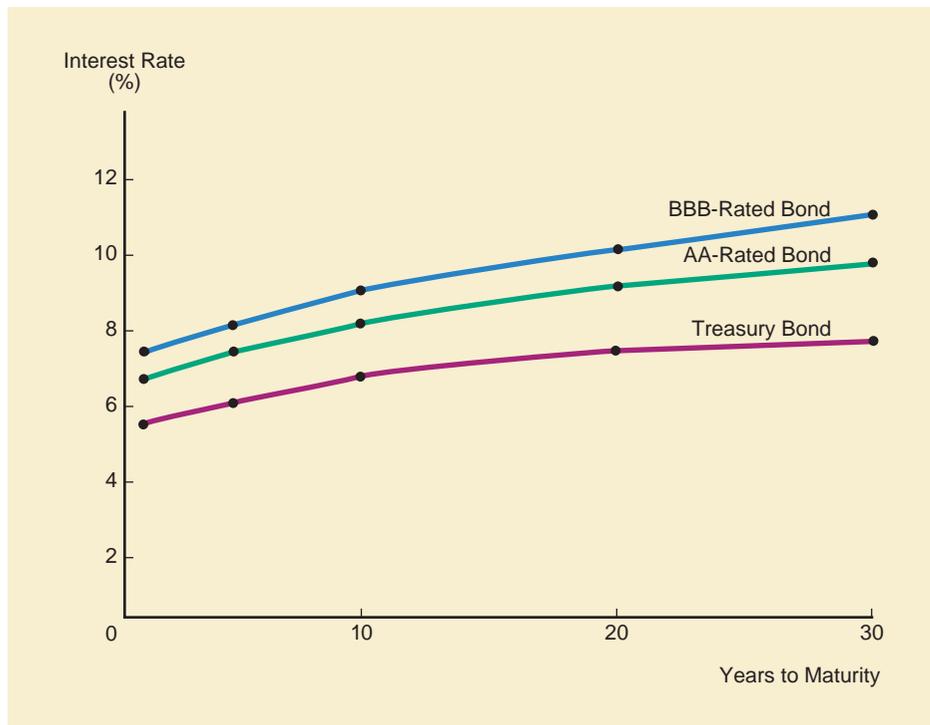
downturn, because weaker economic conditions generally lead to declining inflation, which, in turn, results in lower long-term rates.¹¹

Now let's consider the yield curve for corporate bonds. Recall that corporate bonds include a default risk premium (DRP) and a liquidity premium (LP). Therefore, the yield on a corporate bond that matures in t years can be expressed as follows:

$$\text{Corporate bond yield} = r^*_t + IP_t + MRP_t + DRP_t + LP_t$$

Corporate bonds' default and liquidity risks are affected by their maturities. For example, the default risk on Coca-Cola's short-term debt is very small, since there is almost no chance that Coca-Cola will go bankrupt over the next few years. However, Coke has some bonds that have a maturity of almost 100 years, and while the odds of Coke defaulting on these bonds still might not be very

¹¹ Note that yield curves tend to rise or fall relatively sharply for 5 to 10 years, and then flatten out. One reason this occurs is that when forecasting future interest rates people often predict varying changes in inflation for the next 5 to 10 years after which they assume a long-run constant inflation rate. Consequently, the short end of the yield curve tends to have more volatility because there are more variations in the year-to-year interest rate forecasts. By contrast, the long end of the yield curve tends to be more stable because of the assumption of constant inflation rates.

FIGURE 6-6 *Illustrative Corporate and Treasury Yield Curves*


Term to Maturity	INTEREST RATE		
	Treasury Bond	AA-Rated Bond	BBB-Rated Bond
1 year	5.5%	6.7%	7.4%
5 years	6.1	7.4	8.1
10 years	6.8	8.2	9.1
20 years	7.4	9.2	10.2
30 years	7.7	9.8	11.1

high, there is still a higher probability of default risk on Coke's long-term bonds than on its short-term ones.

Longer-term corporate bonds are also less liquid than shorter-term bonds. Since short-term debt has less default risk, someone can buy a short-term bond without as much credit checking as would be necessary before buying a long-term bond. Thus, people can move in and out of short-term corporate debt more rapidly than long-term debt. As a result, a corporation's short-term bonds are more liquid and thus have lower liquidity premiums than its long-term bonds.

Figure 6-6 shows yield curves for two hypothetical corporate bonds, an AA-rated bond with minimal default risk and a BBB-rated bond with more default risk, along with the yield curve for Treasury securities as taken from Panel a of Figure 6-5. Here we assume that inflation is expected to increase, so the Treasury yield curve is upward sloping. Because of their additional default and liquidity risk, corporate bonds always yield more than Treasury bonds with the same maturity, and BBB-rated bonds yield more than AA-rated bonds. Finally, note that the yield spread between corporate bonds and Treasury bonds is larger the longer the maturity. This occurs because longer-term corporate bonds have more default and liquidity risk than shorter-term bonds, and both of these premiums are absent in Treasury bonds.

The Links between Expected Inflation and Interest Rates: A Closer Look

Throughout the text, we use the following equation to describe the link between expected inflation and the nominal risk-free rate of interest, r_{RF} :

$$r_{RF} = r^* + IP$$

Recall that r^* is the real risk-free interest rate, and IP is the corresponding inflation premium. This equation suggests that there is a simple direct link between expected inflation and nominal interest rates.

It turns out, however, that this link is a bit more complex. To fully understand this relationship, first recognize that individuals get utility through the consumption of real goods and services such as bread, water, haircuts, pizza, and textbooks. When we save money we are giving up the opportunity to consume these goods today in return for being able to consume more in the future. Our gain in purchasing power is measured by the real rate of interest, r^* .

To illustrate this point consider the following example. Assume that a loaf of bread costs \$1.00 today. Also assume that the real rate of interest is 3 percent and that inflation is expected to be 5 percent over the next year. The 3 percent real rate indicates that the average consumer is willing to trade 100 loaves of bread today for 103 loaves next year. If there were a “bread bank,” consumers who wanted to defer consumption until next year could deposit 100 loaves today and withdraw 103 loaves next year. In practice, most of us do not directly trade real goods such as bread—instead we purchase these goods with money because in a well-functioning economy it is much more efficient to exchange money than goods. However, when we lend money over time we worry that borrowers might pay us back with dollars that aren’t worth as much due to inflation. To compensate for this risk, lenders build in a premium for expected inflation.

With these concerns in mind, let’s compare the dollar cost of 100 loaves of bread today to the cost of 103 loaves next year. Given the current price, 100 loaves of bread today would cost \$100. Since expected inflation is 5 percent, this means that a loaf of bread is expected to cost \$1.05 next year. Consequently, 103 loaves of bread are expected to cost \$108.15 next year ($103 \times \1.05). So, if consumers were to deposit \$100 in a bank today, they would need to earn 8.15 percent to realize a real return of 3 percent.

Putting this all together, we see that the one-year nominal interest rate can be calculated as follows:

$$\begin{aligned} r_{RF} &= (1 + r^*)(1 + I) - 1 \\ &= (1.03)(1.05) - 1 = 0.0815 = 8.15\% \end{aligned}$$

How does this expression compare with the original equation we used for the nominal risk-free rate of interest? Note that the above expression can be rewritten as

$$r_{RF} = r^* + I + (r^* \times I)$$

This equation is identical to our original expression for the nominal risk-free rate except it includes a “cross-term,” $r^* \times I$. When real interest rates and expected inflation are relatively low, the cross-term turns out to be quite small and thus it is often ignored. With this point in mind, in the text we will disregard the cross-term unless we state otherwise.

One last point—you should recognize that while it may be reasonable to ignore the cross-term when interest rates are low (as they are today), it is a mistake to do so when investing in a market where interest rates and inflation are quite high, as is often the case in many emerging markets. In these markets, the cross-term can be significant and thus should not be disregarded.



How do maturity risk premiums affect the yield curve?

If the inflation rate is expected to increase, would this increase or decrease the slope of the yield curve?

If the inflation rate is expected to remain constant at the current level in the future, would the yield curve slope up, down, or be horizontal? Consider all factors that affect the yield curve, not just inflation.

Explain why corporate bonds' default and liquidity premiums are likely to increase with their maturity.

Explain why corporate bonds always yield more than Treasury bonds and why BBB-rated bonds always yield more than AA-rated bonds.

6.6 USING THE YIELD CURVE TO ESTIMATE FUTURE INTEREST RATES¹²

In the last section we saw that the slope of the yield curve depends primarily on two factors: (1) expectations about future inflation and (2) the effects of maturity on bonds' risk. We also saw how to calculate the yield curve, given inflation and maturity-related risks. Note, though, that investors can reverse the process: They plot the yield curve and then use information embedded in it to estimate the market's expectations regarding future inflation and risk.

This process of using the yield curve to estimate future expected interest rates is straightforward, provided (1) we focus on Treasury bonds, and (2) we assume that all Treasury bonds have the same risk, that is, that there is no maturity risk premium. While this second assumption may not be reasonable, it enables us for the time being to take out the effects of risk and focus exclusively on how expectations about future interest rates affect the shape of the yield curve. Later on, we will show what happens when we once again assume that there is a maturity risk premium.

In fact, while most evidence suggests that there is a positive maturity risk premium, some academics and practitioners contend that this second assumption is reasonable, at least as an approximation. They argue that the market is dominated by large bond traders who buy and sell securities of different maturities each day, that these traders focus only on short-term returns, and that they are not concerned with maturity risk. According to this view, a bond trader is just as willing to buy a 20-year bond to pick up a short-term profit as he or she would be to buy a three-month security. Strict proponents of this view argue that the shape of the Treasury yield curve is therefore determined only by market expectations about future interest rates. This position has been called the *pure expectations theory* of the term structure of interest rates.

The **pure expectations theory** (often simply referred to as the "expectations theory") assumes that bond traders establish bond prices and interest rates strictly on the basis of expectations for future interest rates, and they are indifferent to maturity because they do not view long-term bonds as being riskier than short-term bonds. If this were true, then the maturity risk premium (MRP) would be zero, and long-term interest rates would simply be a weighted average of current and expected future short-term interest rates.

To illustrate this point, assume that one-year Treasury securities currently yield 5 percent, while two-year Treasury securities yield 5.5 percent. Investors with a two-year horizon have two primary options:

Option 1: Buy a two-year security and hold it for two years.

Option 2: Buy a one-year security, hold it for one year, and then at the end of the year reinvest the proceeds in another one-year security.

If they select Option 1, for every dollar they invest today, they will have accumulated \$1.113025 by the end of Year 2:

$$\text{Funds at end of Year 2} = \$1 \times (1.055)^2 = \$1.113025$$

Pure Expectations Theory

A theory that states that the shape of the yield curve depends on investors' expectations about future interest rates.

¹² This section is relatively technical, but instructors can omit it without loss of continuity.

If they select Option 2, they should end up with the same amount, but this equation is used to find the ending amount:

$$\text{Funds at end of Year 2} = \$1 \times (1.05) \times (1 + X)$$

Here X is the expected interest rate on a one-year Treasury security one year from now.

If the expectations theory is correct, each option must provide the same amount of cash at the end of two years, which implies that

$$(1.05)(1 + X) = (1.055)^2$$

We can rearrange this equation and then solve for X :

$$1 + X = (1.055)^2/1.05$$

$$X = (1.055)^2/1.05 - 1 = 0.0600238 = 6.00238\%$$

Thus, if the expectations theory is correct, the current yield curve would indicate that the market expects the one-year rate to be 6.00238 percent one year from now.

We can use yield curve data to help predict future short-term interest rates. In the absence of maturity risk premiums, an upward sloping Treasury yield curve implies that the market expects future short-term rates to increase. Also, notice that the two-year rate of 5.5 percent is a geometric average of the current and expected one-year rates.¹³ To understand the logic behind the averaging process, ask yourself what would happen if long-term yields were *not* an average of expected short-term yields. For example, suppose investors expected the one-year Treasury rate to be 6.00238 percent a year from now, but two-year bonds yielded only 5.25 percent. Bond traders would be able to earn a profit by adopting the following strategy:

1. Borrow money for two years at an annual cost of 5.25 percent.
2. Invest the money in a series of one-year securities. The annual expected return over the two-year period would be $[(1.05) \times (1.0600238)]^{1/2} - 1 = 5.5\%$.

Earning 5.5 percent when the cost is 5.25 percent is a good deal, so bond traders would rush to borrow money (demand funds) in the two-year market and invest (or supply funds) in the one-year market. Recall from Figure 6-1 that an increase in the demand for funds raises interest rates, whereas an increase in the supply of funds reduces interest rates. Therefore, bond traders would push up the two-year yield but reduce the yield on one-year bonds. The net effect would be a market equilibrium in which the two-year rate is a weighted average of expected future one-year rates.

The preceding analysis was based on the assumption that the maturity risk premium is zero, but most evidence suggests that there is a positive maturity risk premium. For example, assume once again that one- and two-year maturities yield 5.0 and 5.5 percent respectively, so we have a rising yield curve. However, now assume that the maturity risk premium on the two-year bond is

¹³ The geometric average of the current and expected one-year rates can be expressed as: $[(1.05) \times (1.0600238)]^{1/2} - 1 = 0.055$ or 5.50%. The arithmetic average of the two rates is $(5\% + 6.00238\%)/2 = 5.50119\%$. The geometric average is theoretically superior, but the difference is only 0.00119%. With interest rates at the levels they have been in the United States and most other nations in recent years, the geometric and arithmetic averages are so close that many people simply use the arithmetic average, especially given the other assumptions that underlie the estimation of future one-year rates.

0.2 percent versus zero for the one-year bond. This premium means that in equilibrium the expected annual return on a two-year bond (5.5 percent) must be 0.2 percent higher than the expected return on a series of two one-year bonds (5 percent and X percent), so the expected return on the series must be $5.5\% - 0.2\% = 5.3\%$:

$$\begin{aligned}\text{Expected return on 2-year series} &= \text{Rate on 2-year bond} - \text{MRP} \\ &= 0.055 - 0.002 = 0.053 = 5.3\%\end{aligned}$$

Now recall that the annual expected return from the series of two one-year securities can be expressed as follows, where X is the one-year rate next year:

$$\begin{aligned}(1.05)(1 + X) &= (1 + \text{Expected return on 2-year series})^2 = (1.053)^2 \\ 1.05X &= (1.053)^2 - 1.05 \\ X &= \frac{0.0588090}{1.05} = 0.0560086 = 5.60086\%\end{aligned}$$

Therefore, in this scenario market participants must expect the one-year rate next year to be 5.60086 percent.

Note that the yield curve rises by 0.5 percent when the years to maturity increases from one to two: $5.5\% - 5.0\% = 0.5\%$. Of this 0.5 percent increase, 0.2 percent is attributable to the MRP and the remaining 0.3 percent is due to the increase in expected one-year rates next year.

Putting all this together, we see that we can use the yield curve to predict the short-term rates that will exist for next year, but to do this we must have an estimate of the maturity risk premium. If our estimate of the MRP is incorrect, then so will be our yield-curve-based interest-rate forecast. Thus, while the yield curve can be used to obtain insights into the direction of future interest rates, we cannot back out expected interest rates with precision unless either the pure expectations theory holds exactly or else we know with certainty the exact maturity risk premium. As neither of these conditions holds, forecasts of future interest rates are only approximations, though they may be good approximations.



What key assumption underlies the pure expectations theory?

Assuming that the pure expectations theory is correct, how are expected short-term rates used to calculate expected long-term rates?

According to the pure expectations theory, what would happen if long-term rates were *not* an average of expected short-term rates?

Most evidence suggests that a positive maturity risk premium exists. How would this affect your calculations when determining interest rates?

Assume the interest rate on a one-year T-bond is currently 7 percent and the rate on a two-year bond is 9 percent. If the maturity risk premium is zero, what is a reasonable forecast of the rate on a one-year bond next year? What would the forecast be if the maturity risk premium on the two-year bond were 0.5 percent and it was zero for the one-year bond? (11.04 percent; 10.02 percent)

6.7 OTHER FACTORS THAT INFLUENCE INTEREST RATE LEVELS

Four additional factors that influence both the general level of interest rates and the shape of the yield curve are (1) the Federal Reserve policy; (2) the federal budget deficit or surplus; (3) international factors, including the foreign trade balance and interest rates in other countries; and (4) the level of business activity.

Federal Reserve Policy



The home page for the Board of Governors of the Federal Reserve System can be found at <http://www.federalreserve.gov/>. You can access general information about the Federal Reserve, including press releases, speeches, and monetary policy.

As you probably learned in your economics courses, (1) the money supply has a significant effect on the level of economic activity, inflation rate, and interest rates, and (2) in the United States, the Federal Reserve Board controls the money supply. If the Fed wants to stimulate the economy, it increases growth in the money supply. The initial effect of this action is to cause interest rates to decline. However, a larger money supply may also lead to an increase in the expected inflation rate, which could push up interest rates in spite of the Fed's desire to lower them. The reverse holds if the Fed tightens the money supply.

To illustrate, in 1981 inflation was extremely high, so the Fed tightened the money supply. The Fed deals primarily in the short-term end of the market, so its tightening had the direct effect of pushing up short-term rates sharply. At the same time, the very fact that the Fed was taking strong action to reduce inflation led to a decline in expectations for long-run inflation, which caused long-term bond yields to decline even as short-term rates rose.

The situation in 1991 was just the reverse. To combat the recession, the Fed took actions that caused short-term rates to fall sharply. These lower rates benefited companies that used debt—lower rates helped companies finance capital expenditures, which stimulated the economy. At the same time, lower rates led to home mortgage refinancings, which lowered mortgage payments and thus put additional dollars into consumers' pockets, which also stimulated the economy. Savers, of course, lost out, but the net effect of lower interest rates was a stronger economy.

Lower rates also cause foreigners who hold U.S. bonds to sell those bonds. These investors are paid dollars, which they then sell in order to buy other currencies. The sale of dollars and the purchase of other currencies lowers the value of the dollar relative to other currencies, and that makes U.S. goods less expensive, which helps our manufacturers and thus lowers the trade deficit. Note, though, that during periods when the Fed is actively intervening in the markets, the yield curve may be temporarily distorted. Short-term rates may be driven below the equilibrium level if the Fed is easing credit and above equilibrium if it is tightening credit. Long-term rates are not affected as much by Fed intervention. During 2004, in order to bring interest rates back to levels more consistent with inflation, the Federal Reserve increased short-term interest rates five times, causing short-term rates to rise by 1.25 percentage points. However, long-term rates (as measured by the 10-year Treasury note) remained level.

Federal Budget Deficits or Surpluses

If the federal government spends more than it takes in from taxes, it runs a deficit, and that deficit must be covered by additional borrowing or by printing money. If the government borrows, this increases the demand for funds and thus pushes up interest rates. If it prints money, investors believe that with "more money chasing a given amount of goods," the result will be increased inflation, which will also increase interest rates. So, the larger the federal deficit, other things held constant, the higher the level of interest rates.

Over the past several decades, the federal government has usually run large budget deficits. There were some surpluses in the late 1990s, but the September 11, 2001, terrorist attacks, the subsequent recession, and the Iraq war all boosted government spending and caused the deficits to return.

International Factors

Businesses and individuals in the United States buy from and sell to people and firms all around the globe. If we buy more than we sell (that is, if we import more than we export), we are said to be running a **foreign trade deficit**. When trade deficits occur, they must be financed, and this generally means borrowing from nations with export surpluses. In other words, if we import \$200 billion of goods but export only \$100 billion, we run a trade deficit of \$100 billion, while other countries would share in a \$100 billion trade surplus. We would probably borrow the \$100 billion from the surplus nations.¹⁴ At any rate, the larger our trade deficit, the more we must borrow. Foreigners will hold U.S. debt if and only if the rates on U.S. securities are competitive with rates in other countries. So, our interest rates are highly dependent on rates in other parts of the world.

This interdependency limits the ability of the Federal Reserve to use monetary policy to control economic activity in the United States. For example, if the Fed attempts to lower U.S. interest rates in the United States, and this causes our rates to fall below rates abroad, then foreigners will begin selling U.S. bonds. Those sales will depress bond prices, and that will push up rates in the U.S. Thus, a large trade deficit hinders the Fed's ability to combat a recession by lowering interest rates.

For 25 or so years following World War II the United States ran large trade surpluses, and the rest of the world owed us many billions of dollars. However, the situation changed, and we have been running trade deficits since the mid-1970s. The cumulative effect of these deficits has been to change the United States from being the largest creditor nation to being the largest debtor nation of all time. As a result, our interest rates are very much influenced by interest rates in other countries—higher or lower rates abroad lead to higher or lower U.S. rates. Because of all this, U.S. corporate treasurers and everyone else who is affected by interest rates should keep up with developments in the world economy.

Business Activity

Figure 6-2, presented in Section 6.2, can be examined to see how business conditions influence interest rates. Here are the key points revealed by the graph:

1. Because inflation increased from 1971 to 1981, the general tendency during that period was toward higher interest rates. However, since the 1981 peak, the trend has generally been downward.
2. The shaded areas in the graph represent recessions, during which (a) both the demand for money and the rate of inflation tend to fall and (b) the Federal Reserve tends to increase the money supply in an effort to stimulate the economy. As a result, there is a tendency for interest rates to decline during recessions. For example, the economy began to slow down in 2000, and we entered a mild recession in 2001. In response to this economic weakness, the Federal Reserve cut interest rates. However, in 2004 the economy began to rebound, so the Fed began to raise rates.
3. During recessions, short-term rates decline more sharply than long-term rates. This occurs because (a) the Fed operates mainly in the short-term sector, so its

¹⁴ The deficit could also be financed by selling assets, including gold, corporate stocks, entire companies, and real estate. The United States has financed its massive trade deficits by all of these means in recent years, but the primary method has been by borrowing from foreigners.

Foreign Trade Deficit

The situation that exists when a country imports more than it exports.

GLOBAL PERSPECTIVES

Measuring Country Risk

Various forecasting services measure the level of country risk in different countries and provide indexes that indicate factors such as each country's expected economic performance, access to world capital markets, political stability, and level of internal conflict. Country risk analysts use sophisticated models to measure risk, thus providing corporate managers and investors with a way to judge both the relative and absolute risk of investing in different countries. A sample of recent country risk estimates compiled by *Institutional Investor* is presented in the accompanying table. The higher the country's score, the lower its country risk. The maximum possible score is 100.

The countries with the least country risk all have strong, market-based economies, ready access to worldwide capital markets, relatively little social unrest, and a stable political climate. Switzerland's top ranking may surprise you, but that country's ranking is the result of its strong economic performance and political stability. You may also be surprised that the United States was ranked third, below both Switzerland and Luxembourg.

Arguably, there are fewer surprises when looking at the bottom five. Each of these countries has considerable social and political unrest and no market-based economic system. An investment in any of these countries is clearly a risky proposition.

Top Five Countries (Least Amount of Country Risk)

Rank	Country	Total Score (Maximum Possible = 100)
1	Switzerland	95.2
2	Luxembourg	93.9
3*	United States	93.7
4*	Norway	93.7
5	United Kingdom	93.6

Bottom Five Countries (Greatest Amount of Country Risk)

Rank	Country	Total Score (Minimum Possible = 0)
169	Afghanistan	11.0
170	Liberia	9.4
171	Sierra Leone	9.3
172	North Korea	8.9
173	Somalia	8.2

*Ranking was determined before rounding total score.

Source: "Country Ratings by Region," *Institutional Investor*, www.institutionalinvestor.com, September 2004.

intervention has the strongest effect there, and (b) long-term rates reflect the average expected inflation rate over the next 20 to 30 years, and this expectation generally does not change much, even when the current inflation rate is low because of a recession or high because of a boom. So, short-term rates are more volatile than long-term rates. Taking another look at Figure 6-2, we indeed see that short-term rates have declined much more than long-term rates.



Other than inflationary expectations, name some additional factors that influence interest rates, and explain the effects of each.

How does the Fed stimulate the economy? How does the Fed affect interest rates? Does the Fed have complete control over U.S. interest rates; that is, can it set rates at any level it chooses? Why or why not?

6.8 INVESTING OVERSEAS

Investors should consider additional risk factors if they invest overseas. First, there is **country risk**, which refers to the risk that is attributable to investing in a particular country. This risk depends on the country's economic, political, and social environment. Some countries provide a safer investment climate, and therefore less country risk, than others. Examples of country risk include the risk that property will be expropriated without adequate compensation plus risks associated with changes in tax rates, regulations, and currency repatriation. Country risk also includes changes in host-country requirements regarding local production and employment, as well as the danger of damage due to internal strife.

It is especially important to keep in mind when investing overseas that securities are often denominated in a currency other than the dollar, which means that returns on the investment will depend on what happens to exchange rates. This is known as **exchange rate risk**. For example, if a U.S. investor purchases a Japanese bond, interest will probably be paid in yen, which must then be converted into dollars before the investor can spend his or her money in the United States. If the yen weakens relative to the dollar, then it will buy fewer dollars, hence fewer dollars will be received when funds are repatriated. However, if the yen strengthens, this will increase the effective investment return. It therefore follows that returns on a foreign investment depend on both the performance of the foreign security and on changes in exchange rates.

Country Risk

The risk that arises from investing or doing business in a particular country.

Exchange Rate Risk

The risk that exchange rate changes will reduce the number of dollars provided by a given amount of a foreign currency.



What is country risk?

What is exchange rate risk?

On what two factors does the return on a foreign investment depend?

6.9 INTEREST RATES AND BUSINESS DECISIONS

The yield curve for February 2005, shown earlier in Figure 6-4 in Section 6.4, indicates how much the U.S. government had to pay in February 2005 to borrow money for 1 year, 5 years, 10 years, and so on. A business borrower would have had to pay somewhat more, but assume for the moment that it is February 2005 and that the yield curve shown for that year applies to your company. Now suppose your company has decided to build a new plant with a 30-year life that will cost \$1 million, and to raise the \$1 million by borrowing rather than by issuing new stock. If you borrowed in February 2005 on a short-term basis—say, for one year—your interest cost would be only 3.1 percent, or \$31,000. On the other hand, if you used long-term financing, your cost would be 4.6 percent, or \$46,000. Therefore, at first glance, it would seem that you should use short-term debt.

However, this could prove to be a horrible mistake. If you use short-term debt, you will have to renew your loan every year, and the rate charged on each new loan will reflect the then-current short-term rate. Interest rates could return to their previous highs, in which case you would be paying 14 percent, or

\$140,000, per year. Those high interest payments would cut into and perhaps eliminate your profits. Your reduced profitability could increase your firm's risk to the point where your bond rating was lowered, causing lenders to increase the risk premium built into your interest rate. That would further increase your interest payments, which would further reduce your profitability, worry lenders still more, and make them reluctant to even renew your loan. If your lenders refused to renew the loan and demanded its repayment, as they would have every right to do, you might have to sell assets at a loss, which could result in bankruptcy.

On the other hand, if you used long-term financing in 2005, your interest costs would remain constant at \$46,000 per year, so an increase in interest rates in the economy would not hurt you. You might even be able to acquire some of your bankrupt competitors at bargain prices—bankruptcies increase dramatically when interest rates rise, primarily because many firms do use so much short-term debt.

Does all this suggest that firms should always avoid short-term debt? Not at all. If inflation falls over the next few years, so will interest rates. If you had borrowed on a long-term basis for 4.6 percent in February 2005, your company would be at a disadvantage if it were locked into 4.6 percent debt while its competitors (who used short-term debt in 2005) had a borrowing cost of only 3 percent or so.

Financing decisions would be easy if we could make accurate forecasts of future interest rates. Unfortunately, predicting interest rates with consistent accuracy is nearly impossible. However, even if it is difficult to predict future interest rate *levels*, it is easy to predict that interest rates will *fluctuate*—they always have, and they always will. This being the case, sound financial policy calls for using a mix of long- and short-term debt, as well as equity, to position the firm so that it can survive in any interest rate environment. Further, the optimal financial policy depends in an important way on the nature of the firm's assets—the easier it is to sell off assets to generate cash, the more feasible it is to use more short-term debt. This makes it more feasible for a firm to finance current assets like inventories and receivables with short-term debt than fixed assets like buildings. We will return to this issue later in the book, when we discuss working capital policy.

Changes in interest rates also have implications for savers. For example, if you had a 401(k) plan—and someday most of you will—you would probably want to invest some of your money in a bond mutual fund. You could choose a fund that had an average maturity of 25 years, 20 years, on down to only a few months (a money market fund). How would your choice affect your investment results, hence your retirement income? First, your annual interest income would be affected. For example, if the yield curve were upward sloping, as it normally is, you would earn more interest if you chose a fund that held long-term bonds. Note, though, that if you chose a long-term fund and interest rates then rose, the market value of the bonds in the fund would decline. For example, as we will see in Chapter 7, if you had \$100,000 in a fund whose average bond had a maturity of 25 years and a coupon rate of 6 percent, and if interest rates then rose from 6 to 10 percent, the market value of your fund would decline from \$100,000 to about \$64,000. On the other hand, if rates declined, your fund would increase in value. In any event, your choice of maturity would have a major effect on your investment performance, hence on your future income.



If short-term interest rates are lower than long-term rates, why might a borrower still choose to finance with long-term debt?

Explain the following statement: "The optimal financial policy depends in an important way on the nature of the firm's assets."

Tying It All Together

In this chapter, we discussed how interest rates are determined, the term structure of interest rates, and some of the ways interest rates affect business decisions. We saw that the interest rate on a given bond, r , is based on this equation:

$$r = r^* + IP + DRP + LP + MRP$$

where r^* is the real risk-free rate, IP is the premium for expected inflation, DRP is the premium for potential default risk, LP is the premium for lack of liquidity (or marketability), and MRP is the premium to compensate for the risk inherent in bonds with long maturities. Both r^* and the various premiums can and do change over time, depending on economic conditions, Federal Reserve actions, and the like. Since changes in these factors are difficult to predict, it is hard to forecast the future direction of interest rates.

The yield curve, which relates bonds' interest rates to their maturities, can slope up or down, and it changes in both slope and level over time. The main determinants of the slope of the curve are expectations for inflation in future years and the MRP. We can analyze yield curve data to estimate what market participants think future interest rates are likely to be.

We will use the insights gained from this chapter in later chapters, when we analyze the values of bonds and stocks and also when we examine various corporate investment and financing decisions.

SELF-TEST QUESTIONS AND PROBLEMS (Solutions Appear in Appendix A)

ST-1 **Key terms** Define each of the following terms:

- Production opportunities; time preferences for consumption; risk; inflation
- Real risk-free rate of interest, r^* ; nominal (quoted) risk-free rate of interest, r_{RF}
- Inflation premium (IP)
- Default risk premium (DRP)
- Liquidity premium (LP); maturity risk premium (MRP)
- Interest rate risk; reinvestment rate risk
- Term structure of interest rates; yield curve
- "Normal" yield curve; inverted ("abnormal") yield curve; humped yield curve
- Pure expectations theory
- Foreign trade deficit; country risk; exchange rate risk

ST-2 **Inflation and interest rates** The real risk-free rate of interest, r^* , is 3 percent, and it is expected to remain constant over time. Inflation is expected to be 2 percent per year for the next 3 years, and 4 percent per year for the next 5 years. The maturity risk premium is equal to $0.1(t - 1)\%$, where t = the bond's maturity. The default risk premium for a BBB-rated bond is 1.3 percent.

- What is the average expected inflation rate over the next 4 years?
- What is the yield on a 4-year Treasury bond?
- What is the yield on a 4-year BBB-rated corporate bond with a liquidity premium of 0.5 percent?

- d. What is the yield on an 8-year Treasury bond?
- e. What is the yield on an 8-year BBB-rated corporate bond with a liquidity premium of 0.5 percent?
- f. If the yield on a 9-year Treasury bond is 7.3 percent, what does that imply about expected inflation in 9 years?

- ST-3 Pure expectations theory** The yield on one-year Treasury securities is 6 percent, 2-year securities yield 6.2 percent, and three-year securities yield 6.3 percent. There is no maturity risk premium. Using expectations theory, forecast the yields on the following securities:
- a. A 1-year security, 1 year from now?
 - b. A 1-year security, 2 years from now?
 - c. A 2-year security, 1 year from now?

QUESTIONS

- 6-1** Suppose interest rates on residential mortgages of equal risk were 5.5 percent in California and 7.0 percent in New York. Could this differential persist? What forces might tend to equalize rates? Would differentials in borrowing costs for businesses of equal risk located in California and New York be more or less likely to exist than differentials in residential mortgage rates? Would differentials in the cost of money for New York and California firms be more likely to exist if the firms being compared were very large or if they were very small? What are the implications of all this with respect to nationwide branching?
- 6-2** Which fluctuate more, long-term or short-term interest rates? Why?
- 6-3** Suppose you believe that the economy is just entering a recession. Your firm must raise capital immediately, and debt will be used. Should you borrow on a long-term or a short-term basis? Why?
- 6-4** Suppose the population of Area Y is relatively young while that of Area O is relatively old, but everything else about the two areas is equal.
- a. Would interest rates likely be the same or different in the two areas? Explain.
 - b. Would a trend toward nationwide branching by banks and savings and loans, and the development of nationwide diversified financial corporations, affect your answer to part a?
- 6-5** Suppose a new process was developed that could be used to make oil out of seawater. The equipment required is quite expensive, but it would, in time, lead to very low prices for gasoline, electricity, and other types of energy. What effect would this have on interest rates?
- 6-6** Suppose a new and much more liberal Congress and administration were elected, and their first order of business was to take away the independence of the Federal Reserve System and to force the Fed to greatly expand the money supply. What effect would this have
- a. On the level and slope of the yield curve immediately after the announcement?
 - b. On the level and slope of the yield curve that would exist two or three years in the future?
- 6-7** It is a fact that the federal government (1) encouraged the development of the savings and loan industry; (2) virtually forced the industry to make long-term, fixed-interest-rate mortgages; and (3) forced the savings and loans to obtain most of their capital as deposits that were withdrawable on demand.
- a. Would the savings and loans have higher profits in a world with a “normal” or an inverted yield curve?
 - b. Would the savings and loan industry be better off if the individual institutions sold their mortgages to federal agencies and then collected servicing fees or if the institutions held the mortgages that they originated?
- 6-8** Suppose interest rates on Treasury bonds rose from 5 to 9 percent as a result of higher interest rates in Europe. What effect would this have on the price of an average company’s common stock?
- 6-9** What does it mean when it is said that the United States is running a trade deficit? What impact will a trade deficit have on interest rates?

PROBLEMS

Easy
Problems 1–7

- 6-1 Yield curves** The following yields on U.S. Treasury securities were taken from a recent financial publication:

Term	Rate
6 months	5.1%
1 year	5.5
2 years	5.6
3 years	5.7
4 years	5.8
5 years	6.0
10 years	6.1
20 years	6.5
30 years	6.3

- Plot a yield curve based on these data.
- What type of yield curve is shown?
- What information does this graph tell you?
- Based on this yield curve, if you needed to borrow money for longer than one year, would it make sense for you to borrow short term and renew the loan or borrow long term? Explain.

- 6-2 Real risk-free rate** You read in *The Wall Street Journal* that 30-day T-bills are currently yielding 5.5 percent. Your brother-in-law, a broker at Safe and Sound Securities, has given you the following estimates of current interest rate premiums:

- Inflation premium = 3.25%
- Liquidity premium = 0.6%
- Maturity risk premium = 1.8%
- Default risk premium = 2.15%

On the basis of these data, what is the real risk-free rate of return?

- 6-3 Expected interest rate** The real risk-free rate is 3 percent. Inflation is expected to be 2 percent this year and 4 percent during the next 2 years. Assume that the maturity risk premium is zero. What is the yield on 2-year Treasury securities? What is the yield on 3-year Treasury securities?

- 6-4 Default risk premium** A Treasury bond that matures in 10 years has a yield of 6 percent. A 10-year corporate bond has a yield of 8 percent. Assume that the liquidity premium on the corporate bond is 0.5 percent. What is the default risk premium on the corporate bond?

- 6-5 Maturity risk premium** The real risk-free rate is 3 percent, and inflation is expected to be 3 percent for the next 2 years. A 2-year Treasury security yields 6.2 percent. What is the maturity risk premium for the 2-year security?

- 6-6 Inflation cross-product** An analyst is evaluating securities in a developing nation where the inflation rate is very high. As a result, the analyst has been warned not to ignore the cross-product between the real rate and inflation. If the real risk-free rate is 5 percent and inflation is expected to be 16 percent each of the next 4 years, what is the yield on a 4-year security with no maturity, default, or liquidity risk? (Hint: Refer to the box titled “The Links Between Expected Inflation and Interest Rates: A Closer Look.”)

- 6-7 Expectations theory** One-year Treasury securities yield 5 percent. The market anticipates that 1 year from now, 1-year Treasury securities will yield 6 percent. If the pure expectations theory is correct, what is the yield today for 2-year Treasury securities?

Intermediate
Problems 8–16

- 6-8 Expectations theory** Interest rates on 4-year Treasury securities are currently 7 percent, while 6-year Treasury securities yield 7.5 percent. If the pure expectations theory is correct, what does the market believe that 2-year securities will be yielding 4 years from now?

- 6-9 Expected interest rate** The real risk-free rate is 3 percent. Inflation is expected to be 3 percent this year, 4 percent next year, and then 3.5 percent thereafter. The maturity risk premium is estimated to be $0.05 \times (t - 1)\%$, where t = number of years to maturity. What is the yield on a 7-year Treasury note?

- 6-10 Inflation** Due to a recession, expected inflation this year is only 3 percent. However, the inflation rate in Year 2 and thereafter is expected to be constant at some level above 3 percent. Assume that the expectations theory holds and the real risk-free rate is $r^* = 2\%$. If the yield on 3-year Treasury bonds equals the 1-year yield plus 2 percent, what inflation rate is expected after Year 1?
- 6-11 Default risk premium** A company's 5-year bonds are yielding 7.75 percent per year. Treasury bonds with the same maturity are yielding 5.2 percent per year, and the real risk-free rate (r^*) is 2.3 percent. The average inflation premium is 2.5 percent, and the maturity risk premium is estimated to be $0.1 \times (t - 1)\%$, where t = number of years to maturity. If the liquidity premium is 1 percent, what is the default risk premium on the corporate bonds?
- 6-12 Maturity risk premium** An investor in Treasury securities expects inflation to be 2.5 percent in Year 1, 3.2 percent in Year 2, and 3.6 percent each year thereafter. Assume that the real risk-free rate is 2.75 percent, and that this rate will remain constant. Three-year Treasury securities yield 6.25 percent, while 5-year Treasury securities yield 6.80 percent. What is the difference in the maturity risk premiums (MRPs) on the two securities; that is, what is $MRP_5 - MRP_3$?
- 6-13 Default risk premium** The real risk-free rate, r^* , is 2.5 percent. Inflation is expected to average 2.8 percent a year for the next 4 years, after which time inflation is expected to average 3.75 percent a year. Assume that there is no maturity risk premium. An 8-year corporate bond has a yield of 8.3 percent, which includes a liquidity premium of 0.75 percent. What is its default risk premium?
- 6-14 Expectations theory and inflation** Suppose 2-year Treasury bonds yield 4.5 percent, while 1-year bonds yield 3 percent. r^* is 1 percent, and the maturity risk premium is zero.
- Using the expectations theory, what is the yield on a 1-year bond, 1 year from now?
 - What is the expected inflation rate in Year 1? Year 2?
- 6-15 Expectations theory** Assume that the real risk-free rate is 2 percent and that the maturity risk premium is zero. If the 1-year bond yield is 5 percent and a 2-year bond (of similar risk) yields 7 percent, what is the 1-year interest rate that is expected for Year 2? What inflation rate is expected during Year 2? Comment on why the average interest rate during the 2-year period differs from the 1-year interest rate expected for Year 2.
- 6-16 Inflation cross-product** An analyst is evaluating securities in a developing nation where the inflation rate is very high. As a result, the analyst has been warned not to ignore the cross-product between the real rate and inflation. A 6-year security with no maturity, default, or liquidity risk has a yield of 20.84 percent. If the real risk-free rate is 6 percent, what average rate of inflation is expected in this country over the next 6 years? (Hint: Refer to the box titled, "The Links Between Expected Inflation and Interest Rates: A Closer Look.")
- 6-17 Interest rate premiums** A 5-year Treasury bond has a 5.2 percent yield. A 10-year Treasury bond yields 6.4 percent, and a 10-year corporate bond yields 8.4 percent. The market expects that inflation will average 2.5 percent over the next 10 years ($IP_{10} = 2.5\%$). Assume that there is no maturity risk premium ($MRP = 0$), and that the annual real risk-free rate, r^* , will remain constant over the next 10 years. (Hint: Remember that the default risk premium and the liquidity premium are zero for Treasury securities: $DRP = LP = 0$.) A 5-year corporate bond has the same default risk premium and liquidity premium as the 10-year corporate bond described above. What is the yield on this 5-year corporate bond?
- 6-18 Yield curves** Suppose the inflation rate is expected to be 7 percent next year, 5 percent the following year, and 3 percent thereafter. Assume that the real risk-free rate, r^* , will remain at 2 percent and that maturity risk premiums on Treasury securities rise from zero on very short-term bonds (those that mature in a few days) to 0.2 percent for 1-year securities. Furthermore, maturity risk premiums increase 0.2 percent for each year to maturity, up to a limit of 1.0 percent on 5-year or longer-term T-bonds.
- Calculate the interest rate on 1-, 2-, 3-, 4-, 5-, 10-, and 20-year Treasury securities, and plot the yield curve.
 - Now suppose ExxonMobil, a AAA-rated company, had bonds with the same maturities as the Treasury bonds. As an approximation, plot an ExxonMobil yield curve on the same graph with the Treasury bond yield curve. (Hint: Think about the default risk premium on ExxonMobil's long-term versus its short-term bonds.)
 - Now plot the approximate yield curve of Exelon Corp., a risky nuclear utility.
- 6-19 Inflation and interest rates** In late 1980, the U.S. Commerce Department released new data showing inflation was 15 percent. At the time, the prime rate of interest was 21 percent, a record high. However, many investors expected the new Reagan administration to be more effective in controlling inflation than the Carter administration had been. Moreover, many observers believed that the extremely high interest rates and generally

tight credit, which resulted from the Federal Reserve System's attempts to curb the inflation rate, would lead to a recession, which, in turn, would lead to a decline in inflation and interest rates. Assume that at the beginning of 1981, the expected inflation rate for 1981 was 13 percent; for 1982, 9 percent; for 1983, 7 percent; and for 1984 and thereafter, 6 percent.

- What was the average expected inflation rate over the 5-year period 1981–1985? (Use the arithmetic average.)
- What average *nominal* interest rate would, over the 5-year period, be expected to produce a 2 percent real risk-free return on 5-year Treasury securities?
- Assuming a real risk-free rate of 2 percent and a maturity risk premium that equals $0.1 \times (t)\%$, where t is the number of years to maturity, estimate the interest rate in January 1981 on bonds that mature in 1, 2, 5, 10, and 20 years, and draw a yield curve based on these data.
- Describe the general economic conditions that could lead to an upward-sloping yield curve.
- If investors in early 1981 expected the inflation rate for every future year was 10 percent (that is, $I_t = I_{t+1} = 10\%$ for $t = 1$ to ∞), what would the yield curve have looked like? Consider all the factors that are likely to affect the curve. Does your answer here make you question the yield curve you drew in part c?

COMPREHENSIVE/SPREADSHEET PROBLEM

6-20 Interest rate determination and yield curves

- What effect would each of the following events likely have on the level of nominal interest rates?
 - Households dramatically increase their savings rate.
 - Corporations increase their demand for funds following an increase in investment opportunities.
 - The government runs a larger than expected budget deficit.
 - There is an increase in expected inflation.
- Suppose you are considering two possible investment opportunities: a 12-year Treasury bond and a 7-year, A-rated corporate bond. The current real risk-free rate is 4 percent, and inflation is expected to be 2 percent for the next 2 years, 3 percent for the following 4 years, and 4 percent thereafter. The maturity risk premium is estimated by this formula: $MRP = 0.1(t - 1)\%$. The liquidity premium for the corporate bond is estimated to be 0.7 percent. Finally, you may determine the default risk premium, given the company's bond rating, from the default risk premium table in the text. What yield would you predict for each of these two investments?
- Given the following Treasury bond yield information from a recent financial publication, construct a graph of the yield curve.

Maturity	Yield
1 year	5.37%
2 years	5.47
3 years	5.65
4 years	5.71
5 years	5.64
10 years	5.75
20 years	6.33
30 years	5.94

- Based on the information about the corporate bond that was given in part b, calculate yields and then construct a new yield curve graph that shows both the Treasury and the corporate bonds.
- Which part of the yield curve (the left side or right side) is likely to be the most volatile over time?
- Using the Treasury yield information above, calculate the following rates:
 - The 1-year rate, 1 year from now.
 - The 5-year rate, 5 years from now.
 - The 10-year rate, 10 years from now.
 - The 10-year rate, 20 years from now.

Integrated Case

Smyth Barry & Company, Part II

6-21 Interest rate determination In Part I of this case, presented in Chapter 5, you were asked to describe the U.S. financial system to Michelle Varga. Varga is a professional tennis player, and your firm (Smyth Barry) manages her money. Varga was impressed with your discussion and has asked you to give her more information about what determines the level of various interest rates. Once again, your boss has prepared some questions for you to consider.

- What are the four most fundamental factors that affect the cost of money, or the general level of interest rates, in the economy?
- What is the real risk-free rate of interest (r^*) and the nominal risk-free rate (r_{RF})? How are these two rates measured?
- Define the terms inflation premium (IP), default risk premium (DRP), liquidity premium (LP), and maturity risk premium (MRP). Which of these premiums is included when determining the interest rate on (1) short-term U.S. Treasury securities, (2) long-term U.S. Treasury securities, (3) short-term corporate securities, and (4) long-term corporate securities? Explain how the premiums would vary over time and among the different securities listed above.
- What is the term structure of interest rates? What is a yield curve?
- Suppose most investors expect the inflation rate to be 5 percent next year, 6 percent the following year, and 8 percent thereafter. The real risk-free rate is 3 percent. The maturity risk premium is zero for bonds that mature in 1 year or less, 0.1 percent for 2-year bonds, and then the MRP increases by 0.1 percent per year thereafter for 20 years, after which it is stable. What is the interest rate on 1-, 10-, and 20-year Treasury bonds? Draw a yield curve with these data. What factors can explain why this constructed yield curve is upward sloping?
- At any given time, how would the yield curve facing a AAA-rated company compare with the yield curve for U.S. Treasury securities? At any given time, how would the yield curve facing a BB-rated company compare with the yield curve for U.S. Treasury securities? Draw a graph to illustrate your answer.
- What is the pure expectations theory? What does the pure expectations theory imply about the term structure of interest rates?
- Suppose that you observe the following term structure for Treasury securities:

Maturity	Yield
1 year	6.0%
2 years	6.2
3 years	6.4
4 years	6.5
5 years	6.5

Assume that the pure expectations theory of the term structure is correct. (This implies that you can use the yield curve given above to “back out” the market’s expectations about future interest rates.) What does the market expect will be the interest rate on 1-year securities 1 year from now? What does the market expect will be the interest rate on 3-year securities 2 years from now?

- Finally, Varga is also interested in investing in countries other than the United States. Describe the various types of risks that arise when investing overseas.



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