7

INTEREST RATES AND BOND VALUATION

IN ITS MOST BASIC FORM, a bond is a pretty simple financial instrument. You lend a company some money, say $10,000. The company pays you interest regularly, and it repays the original loan amount of $10,000 at some point in the future. But bonds also can have unusual characteristics. For example, in 2002, Berkshire Hathaway, the company run by legendary investor Warren Buffett, issued some bonds with a surprising feature. Basically, bond buyers were required to *make* interest payments to Berkshire Hathaway for the privilege of owning the bonds,

Visit us at www.mhhe.com/rwj

DIGITAL STUDY TOOLS
- Self-Study Software
- Multiple-Choice Quizzes
- Flashcards for Testing and Key Terms

and the interest payments had to be made up front! Furthermore, if you paid $10,663.63 for one of these bonds, Berkshire Hathaway promised to pay you $10,000 in five years. Does this sound like a good deal? Investors must have thought it did; they bought $400 million worth!

This chapter shows how what we have learned about the time value of money can be used to value one of the most common of all financial assets: a bond. It then discusses bond features, bond types, and the operation of the bond market. What we will see is that bond prices depend critically on interest rates, so we will go on to discuss some fundamental issues regarding interest rates. Clearly, interest rates are important to everybody because they underlie what businesses of all types—small and large—must pay to borrow money.

Our goal in this chapter is to introduce you to bonds. We begin by showing how the techniques we developed in Chapters 5 and 6 can be applied to bond valuation. From there, we go on to discuss bond features and how bonds are bought and sold. One important thing we learn is that bond values depend, in large part, on interest rates. We therefore close the chapter with an examination of interest rates and their behavior.

Bonds and Bond Valuation

When a corporation or government wishes to borrow money from the public on a long-term basis, it usually does so by issuing or selling debt securities that are generically called *bonds*. In this section, we describe the various features of corporate bonds and some of the terminology associated with bonds. We then discuss the cash flows associated with a bond and how bonds can be valued using our discounted cash flow procedure.

BOND FEATURES AND PRICES

As we mentioned in our previous chapter, a bond is normally an interest-only loan, meaning that the borrower will pay the interest every period, but none of the principal will be repaid until the end of the loan. For example, suppose the Beck Corporation wants to borrow $1,000 for 30 years. The interest rate on similar debt issued by similar corporations is 12 percent. Beck will thus pay $.12 \times \$1,000 = \$120$ in interest every year for 30 years. At the end of 30 years, Beck will repay the $1,000. As this example suggests, a bond is a fairly simple financing arrangement. There is, however, a rich jargon associated with bonds, so we will use this example to define some of the more important terms.

In our example, the $120 regular interest payments that Beck promises to make are called the bond's **coupons**. Because the coupon is constant and paid every year, the type of bond we are describing is sometimes called a *level coupon bond.* The amount that will be repaid at the end of the loan is called the bond's **face value**, or **par value**. As in our example, this par value is usually $1,000 for corporate bonds, and a bond that sells for its par value is called a *par value bond.* Government bonds frequently have much larger face, or par, values. Finally, the annual coupon divided by the face value is called the **coupon rate** on the bond; in this case, because $\$120/1,000 = 12\%$, the bond has a 12 percent coupon rate.

The number of years until the face value is paid is called the bond's time to **maturity**. A corporate bond will frequently have a maturity of 30 years when it is originally issued, but this varies. Once the bond has been issued, the number of years to maturity declines as time goes by.

BOND VALUES AND YIELDS

As time passes, interest rates change in the marketplace. The cash flows from a bond, however, stay the same. As a result, the value of the bond will fluctuate. When interest rates rise, the present value of the bond's remaining cash flows declines, and the bond is worth less. When interest rates fall, the bond is worth more.

To determine the value of a bond at a particular point in time, we need to know the number of periods remaining until maturity, the face value, the coupon, and the market interest rate for bonds with similar features. This interest rate required in the market on a bond is called the bond's **yield to maturity (YTM)**. This rate is sometimes called the bond's *yield* for short. Given all this information, we can calculate the present value of the cash flows as an estimate of the bond's current market value.

For example, suppose the Xanth (pronounced "zanth") Co. were to issue a bond with 10 years to maturity. The Xanth bond has an annual coupon of $80. Similar bonds have a yield to maturity of 8 percent. Based on our preceding discussion, the Xanth bond will pay $80 per year for the next 10 years in coupon interest. In 10 years, Xanth will pay $1,000 to the owner of the bond. The cash flows from the bond are shown in Figure 7.1. What would this bond sell for?

coupon
The stated interest payment made on a bond.

face value
The principal amount of a bond that is repaid at the end of the term. Also called *par value*.

coupon rate
The annual coupon divided by the face value of a bond.

maturity
The specified date on which the principal amount of a bond is paid.

yield to maturity (YTM)
The rate required in the market on a bond.

FIGURE 7.1   Cash Flows for Xanth Co. Bond

Cash flows

Year	0	1	2	3	4	5	6	7	8	9	10
Coupon		$80	$80	$80	$80	$80	$80	$80	$80	$80	$ 80
Face value											1,000
		$80	$80	$80	$80	$80	$80	$80	$80	$80	$1,080

As shown, the Xanth bond has an annual coupon of $80 and a face, or par, value of $1,000 paid at maturity in 10 years.

As illustrated in Figure 7.1, the Xanth bond's cash flows have an annuity component (the coupons) and a lump sum (the face value paid at maturity). We thus estimate the market value of the bond by calculating the present value of these two components separately and adding the results together. First, at the going rate of 8 percent, the present value of the $1,000 paid in 10 years is:

Present value $= \$1,000/1.08^{10} = \$1,000/2.1589 = \$463.19$

Second, the bond offers $80 per year for 10 years; the present value of this annuity stream is:

$$\begin{aligned}
\text{Annuity present value} &= \$80 \times (1 - 1/1.08^{10})/.08 \\
&= \$80 \times (1 - 1/2.1589)/.08 \\
&= \$80 \times 6.7101 \\
&= \$536.81
\end{aligned}$$

We can now add the values for the two parts together to get the bond's value:

Total bond value $= \$463.19 + 536.81 = \$1,000$

This bond sells for exactly its face value. This is not a coincidence. The going interest rate in the market is 8 percent. Considered as an interest-only loan, what interest rate does this bond have? With an $80 coupon, this bond pays exactly 8 percent interest only when it sells for $1,000.

To illustrate what happens as interest rates change, suppose a year has gone by. The Xanth bond now has nine years to maturity. If the interest rate in the market has risen to 10 percent, what will the bond be worth? To find out, we repeat the present value calculations with 9 years instead of 10, and a 10 percent yield instead of an 8 percent yield. First, the present value of the $1,000 paid in nine years at 10 percent is:

Present value $= \$1,000/1.10^9 = \$1,000/2.3579 = \$424.10$

Second, the bond now offers $80 per year for nine years; the present value of this annuity stream at 10 percent is:

$$\begin{aligned}
\text{Annuity present value} &= \$80 \times (1 - 1/1.10^9)/.10 \\
&= \$80 \times (1 - 1/2.3579)/.10 \\
&= \$80 \times 5.7590 \\
&= \$460.72
\end{aligned}$$

We can now add the values for the two parts together to get the bond's value:

Total bond value $= \$424.10 + 460.72 = \$884.82$

Therefore, the bond should sell for about $885. In the vernacular, we say that this bond, with its 8 percent coupon, is priced to yield 10 percent at $885.

The Xanth Co. bond now sells for less than its $1,000 face value. Why? The market interest rate is 10 percent. Considered as an interest-only loan of $1,000, this bond pays only 8 percent, its coupon rate. Because this bond pays less than the going rate, investors are willing to lend only something less than the $1,000 promised repayment. Because the bond sells for less than face value, it is said to be a *discount bond.*

The only way to get the interest rate up to 10 percent is to lower the price to less than $1,000 so that the purchaser, in effect, has a built-in gain. For the Xanth bond, the price of $885 is $115 less than the face value, so an investor who purchased and kept the bond would get $80 per year and would have a $115 gain at maturity as well. This gain compensates the lender for the below-market coupon rate.

Another way to see why the bond is discounted by $115 is to note that the $80 coupon is $20 below the coupon on a newly issued par value bond, based on current market conditions. The bond would be worth $1,000 only if it had a coupon of $100 per year. In a sense, an investor who buys and keeps the bond gives up $20 per year for nine years. At 10 percent, this annuity stream is worth:

$$\text{Annuity present value} = \$20 \times (1 - 1/1.10^9)/.10$$
$$= \$20 \times 5.7590$$
$$= \$115.18$$

This is just the amount of the discount.

What would the Xanth bond sell for if interest rates had dropped by 2 percent instead of rising by 2 percent? As you might guess, the bond would sell for more than $1,000. Such a bond is said to sell at a *premium* and is called a *premium bond.*

This case is just the opposite of that of a discount bond. The Xanth bond now has a coupon rate of 8 percent when the market rate is only 6 percent. Investors are willing to pay a premium to get this extra coupon amount. In this case, the relevant discount rate is 6 percent, and there are nine years remaining. The present value of the $1,000 face amount is:

$$\text{Present value} = \$1,000/1.06^9 = \$1,000/1.6895 = \$591.89$$

The present value of the coupon stream is:

$$\text{Annuity present value} = \$80 \times (1 - 1/1.06^9)/.06$$
$$= \$80 \times (1 - 1/1.6895)/.06$$
$$= \$80 \times 6.8017$$
$$= \$544.14$$

We can now add the values for the two parts together to get the bond's value:

$$\text{Total bond value} = \$591.89 + 544.14 = \$1,136.03$$

Total bond value is therefore about $136 in excess of par value. Once again, we can verify this amount by noting that the coupon is now $20 too high, based on current market conditions. The present value of $20 per year for nine years at 6 percent is:

$$\text{Annuity present value} = \$20 \times (1 - 1/1.06^9)/.06$$
$$= \$20 \times 6.8017$$
$$= \$136.03$$

This is just as we calculated.

Based on our examples, we can now write the general expression for the value of a bond. If a bond has (1) a face value of F paid at maturity, (2) a coupon of C paid per period, (3) t periods to maturity, and (4) a yield of r per period, its value is:

$$\text{Bond value} = C \times [1 - 1/(1 + r)^t]/r \quad + \quad F/(1 + r)^t$$

$$\text{Bond value} = \underset{\text{of the coupons}}{\text{Present value}} \quad + \quad \underset{\text{of the face amount}}{\text{Present value}} \qquad \textbf{[7.1]}$$

EXAMPLE 7.1	**Semiannual Coupons**

In practice, bonds issued in the United States usually make coupon payments twice a year. So, if an ordinary bond has a coupon rate of 14 percent, then the owner will get a total of $140 per year, but this $140 will come in two payments of $70 each. Suppose we are examining such a bond. The yield to maturity is quoted at 16 percent.

Bond yields are quoted like APRs; the quoted rate is equal to the actual rate per period multiplied by the number of periods. In this case, with a 16 percent quoted yield and semiannual payments, the true yield is 8 percent per six months. The bond matures in seven years. What is the bond's price? What is the effective annual yield on this bond?

Based on our discussion, we know the bond will sell at a discount because it has a coupon rate of 7 percent every six months when the market requires 8 percent every six months. So, if our answer exceeds $1,000, we know we have made a mistake.

To get the exact price, we first calculate the present value of the bond's face value of $1,000 paid in seven years. This seven-year period has 14 periods of six months each. At 8 percent per period, the value is:

Present value = $1,000/1.08^{14} = $1,000/2.9372 = $340.46

The coupons can be viewed as a 14-period annuity of $70 per period. At an 8 percent discount rate, the present value of such an annuity is:

$$\begin{aligned}\text{Annuity present value} &= \$70 \times (1 - 1/1.08^{14})/.08 \\ &= \$70 \times (1 - .3405)/.08 \\ &= \$70 \times 8.2442 \\ &= \$577.10\end{aligned}$$

The total present value gives us what the bond should sell for:

Total present value = $340.46 + 577.10 = $917.56

To calculate the effective yield on this bond, note that 8 percent every six months is equivalent to:

Effective annual rate = $(1 + .08)^2 - 1 = 16.64\%$

The effective yield, therefore, is 16.64 percent.

As we have illustrated in this section, bond prices and interest rates always move in opposite directions. When interest rates rise, a bond's value, like any other present value, will decline. Similarly, when interest rates fall, bond values rise. Even if we are considering a bond that is riskless in the sense that the borrower is certain to make all the payments, there is still risk in owning a bond. We discuss this next.

INTEREST RATE RISK

The risk that arises for bond owners from fluctuating interest rates is called *interest rate risk*. How much interest rate risk a bond has depends on how sensitive its price is to interest rate changes. This sensitivity directly depends on two things: the time to maturity and the coupon rate. As we will see momentarily, you should keep the following in mind when looking at a bond:

1. All other things being equal, the longer the time to maturity, the greater the interest rate risk.
2. All other things being equal, the lower the coupon rate, the greater the interest rate risk.

We illustrate the first of these two points in Figure 7.2. As shown, we compute and plot prices under different interest rate scenarios for 10 percent coupon bonds with maturities of 1 year and 30 years. Notice how the slope of the line connecting the prices is much steeper for the 30-year maturity than it is for the 1-year maturity. This steepness tells us that a relatively small change in interest rates will lead to a substantial change in the bond's value. In comparison, the one-year bond's price is relatively insensitive to interest rate changes.

Intuitively, we can see that longer-term bonds have greater interest rate sensitivity because a large portion of a bond's value comes from the $1,000 face amount. The present value of this amount isn't greatly affected by a small change in interest rates if the amount is to be received in one year. Even a small change in the interest rate, however, once it is

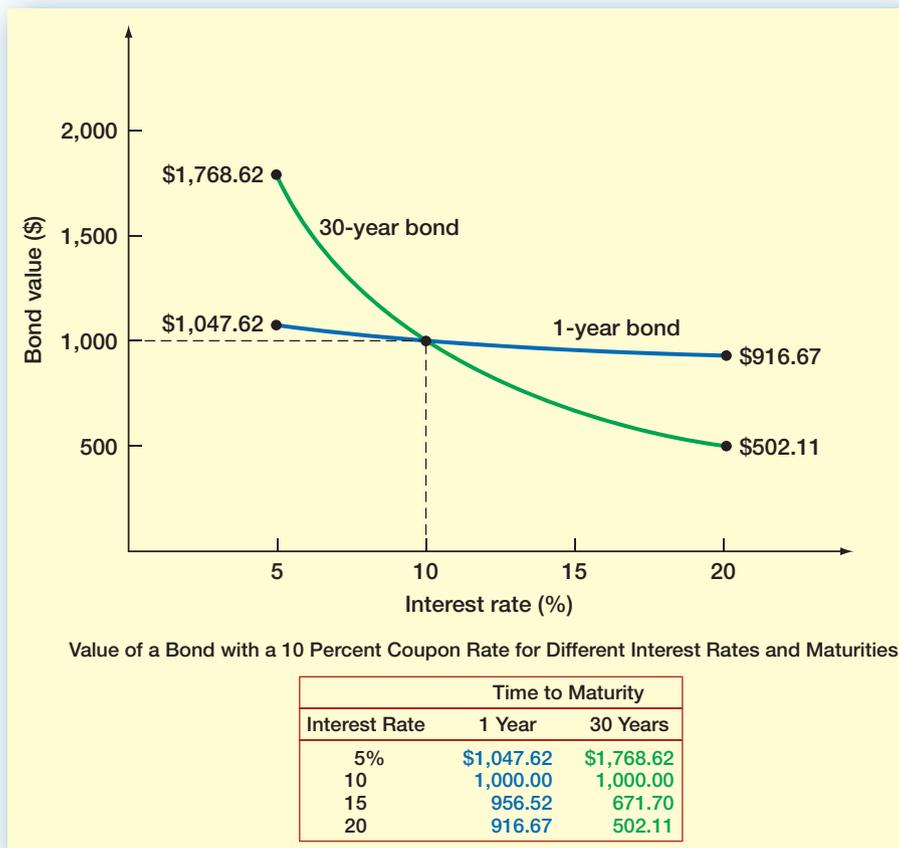Value of a Bond with a 10 Percent Coupon Rate for Different Interest Rates and Maturities

	Time to Maturity	
Interest Rate	1 Year	30 Years
5%	$1,047.62	$1,768.62
10	1,000.00	1,000.00
15	956.52	671.70
20	916.67	502.11

compounded for 30 years, can have a significant effect on the present value. As a result, the present value of the face amount will be much more volatile with a longer-term bond.

The other thing to know about interest rate risk is that, like most things in finance and economics, it increases at a decreasing rate. In other words, if we compared a 10-year bond to a 1-year bond, we would see that the 10-year bond has much greater interest rate risk. However, if you were to compare a 20-year bond to a 30-year bond, you would find that the 30-year bond has somewhat greater interest rate risk because it has a longer maturity, but the difference in the risk would be fairly small.

The reason that bonds with lower coupons have greater interest rate risk is essentially the same. As we discussed earlier, the value of a bond depends on the present value of its coupons and the present value of the face amount. If two bonds with different coupon rates have the same maturity, then the value of the one with the lower coupon is proportionately more dependent on the face amount to be received at maturity. As a result, all other things being equal, its value will fluctuate more as interest rates change. Put another way, the bond with the higher coupon has a larger cash flow early in its life, so its value is less sensitive to changes in the discount rate.

Bonds are rarely issued with maturities longer than 30 years. However, low interest rates in recent years have led to the issuance of much longer-term issues. In the 1990s, Walt Disney issued "Sleeping Beauty" bonds with a 100-year maturity. Similarly, BellSouth (which should be known as AT&T by the time you read this), Coca-Cola, and Dutch banking giant ABN AMRO all issued bonds with 100-year maturities. These companies evidently wanted to lock in the historical low interest rates for a *long* time. The current record holder for corporations looks to be Republic National Bank, which sold bonds with 1,000 years to maturity. Before these fairly recent issues, it appears the last time 100-year bonds were issued was in May 1954, by the Chicago and Eastern Railroad. If you are wondering when the next 100-year bonds will be issued, you might have a long wait. The IRS has warned companies about such long-term issues and threatened to disallow the interest payment deduction on these bonds.

We can illustrate the effect of interest rate risk using the 100-year BellSouth issue and one other BellSouth issue. The following table provides some basic information about the two issues, along with their prices on December 31, 1995, July 31, 1996, and March 23, 2005:

Maturity	Coupon Rate	Price on 12/31/95	Price on 7/31/96	Percentage Change in Price 1995–1996	Price on 3/23/05	Percentage Change in Price 1996–2005
2095	7.00%	$1,000.00	$800.00	−20.0%	$1,172.50	+46.6 %
2033	7.50	1,040.00	960.00	− 7.7	$1,033.30	+ 7.6

Several things emerge from this table. First, interest rates apparently rose between December 31, 1995, and July 31, 1996 (why?). After that, however, they fell (why?). Second, the longer-term bond's price first lost 20 percent and then gained 46.6 percent. These swings are much greater than those of the shorter-lived issue, which illustrates that longer-term bonds have greater interest rate risk.

FINDING THE YIELD TO MATURITY: MORE TRIAL AND ERROR

Frequently, we will know a bond's price, coupon rate, and maturity date, but not its yield to maturity. For example, suppose we are interested in a six-year, 8 percent coupon bond. A broker quotes a price of $955.14. What is the yield on this bond?

We've seen that the price of a bond can be written as the sum of its annuity and lump sum components. Knowing that there is an $80 coupon for six years and a $1,000 face value, we can say that the price is:

$$\$955.14 = \$80 \times [1 - 1/(1 + r)^6]/r + 1,000/(1 + r)^6$$

where r is the unknown discount rate, or yield to maturity. We have one equation here and one unknown, but we cannot solve it for r explicitly. The only way to find the answer is to use trial and error.

This problem is essentially identical to the one we examined in the last chapter when we tried to find the unknown interest rate on an annuity. However, finding the rate (or yield) on a bond is even more complicated because of the $1,000 face amount.

We can speed up the trial-and-error process by using what we know about bond prices and yields. In this case, the bond has an $80 coupon and is selling at a discount. We thus know that the yield is greater than 8 percent. If we compute the price at 10 percent:

$$\begin{aligned} \text{Bond value} &= \$80 \times (1 - 1/1.10^6)/.10 + 1,000/1.10^6 \\ &= \$80 \times 4.3553 + 1,000/1.7716 \\ &= \$912.89 \end{aligned}$$

At 10 percent, the value we calculate is lower than the actual price, so 10 percent is too high. The true yield must be somewhere between 8 and 10 percent. At this point, it's "plug and chug" to find the answer. You would probably want to try 9 percent next. If you did, you would see that this is in fact the bond's yield to maturity.

A bond's yield to maturity should not be confused with its **current yield,** which is simply a bond's annual coupon divided by its price. In the example we just worked, the bond's annual coupon was $80, and its price was $955.14. Given these numbers, we see that the current yield is $80/955.14 = 8.38$ percent, which is less than the yield to maturity of 9 percent. The reason the current yield is too low is that it considers only the coupon portion of your return; it doesn't consider the built-in gain from the price discount. For a premium bond, the reverse is true, meaning that current yield would be higher because it ignores the built-in loss.

Our discussion of bond valuation is summarized in Table 7.1.

Current market rates are available at www.bankrate.com.

current yield
A bond's annual coupon divided by its price.

I.	**Finding the Value of a Bond**
	Bond value = $C \times [1 - 1/(1 + r)^t]/r + F/(1 + r)^t$
	where
	C = Coupon paid each period
	r = Rate per period
	t = Number of periods
	F = Bond's face value
II.	**Finding the Yield on a Bond**
	Given a bond value, coupon, time to maturity, and face value, it is possible to find the implicit discount rate, or yield to maturity, by trial and error only. To do this, try different discount rates until the calculated bond value equals the given value (or let a financial calculator do it for you). Remember that increasing the rate *decreases* the bond value.

TABLE 7.1

Summary of Bond Valuation

EXAMPLE 7.2	**Current Events**

A bond has a quoted price of $1,080.42. It has a face value of $1,000, a semiannual coupon of $30, and a maturity of five years. What is its current yield? What is its yield to maturity? Which is bigger? Why?

Notice that this bond makes semiannual payments of $30, so the annual payment is $60. The current yield is thus $60/1,080.42 = 5.55 percent. To calculate the yield to maturity, refer back to Example 7.1. In this case, the bond pays $30 every six months and has 10 six-month periods until maturity. So, we need to find r as follows:

$$\$1,080.42 = \$30 \times [1 - 1/(1 + r)^{10}]/r + 1,000/(1 + r)^{10}$$

After some trial and error, we find that r is equal to 2.1 percent. But, the tricky part is that this 2.1 percent is the yield *per six months.* We have to double it to get the yield to maturity, so the yield to maturity is 4.2 percent, which is less than the current yield. The reason is that the current yield ignores the built-in loss of the premium between now and maturity.

EXAMPLE 7.3	**Bond Yields**

You're looking at two bonds identical in every way except for their coupons and, of course, their prices. Both have 12 years to maturity. The first bond has a 10 percent annual coupon rate and sells for $935.08. The second has a 12 percent annual coupon rate. What do you think it would sell for?

Because the two bonds are similar, they will be priced to yield about the same rate. We first need to calculate the yield on the 10 percent coupon bond. Proceeding as before, we know that the yield must be greater than 10 percent because the bond is selling at a discount. The bond has a fairly long maturity of 12 years. We've seen that long-term bond prices are relatively sensitive to interest rate changes, so the yield is probably close to 10 percent. A little trial and error reveals that the yield is actually 11 percent:

$$\text{Bond value} = \$100 \times (1 - 1/1.11^{12})/.11 + 1,000/1.11^{12}$$
$$= \$100 \times 6.4924 + 1,000/3.4985$$
$$= \$649.24 + 285.84$$
$$= \$935.08$$

With an 11 percent yield, the second bond will sell at a premium because of its $120 coupon. Its value is:

$$\text{Bond value} = \$120 \times (1 - 1/1.11^{12})/.11 + 1,000/1.11^{12}$$
$$= \$120 \times 6.4924 + 1,000/3.4985$$
$$= \$779.08 + 285.84$$
$$= \$1,064.92$$

CALCULATOR HINTS

How to Calculate Bond Prices and Yields Using a Financial Calculator

Many financial calculators have fairly sophisticated built-in bond valuation routines. However, these vary quite a lot in implementation, and not all financial calculators have them. As a result, we will illustrate a simple way to handle bond problems that will work on just about any financial calculator.

(continued)

To begin, of course, we first remember to clear out the calculator! Next, for Example 7.3, we have two bonds to consider, both with 12 years to maturity. The first one sells for $935.08 and has a 10 percent annual coupon rate. To find its yield, we can do the following:

Enter	12		100	−935.08	1,000
	N	**I/Y**	**PMT**	**PV**	**FV**
Solve for		11			

Notice that here we have entered both a future value of $1,000, representing the bond's face value, and a payment of 10 percent of $1,000, or $100, per year, representing the bond's annual coupon. Also, notice that we have a negative sign on the bond's price, which we have entered as the present value.

For the second bond, we now know that the relevant yield is 11 percent. It has a 12 percent annual coupon and 12 years to maturity, so what's the price? To answer, we just enter the relevant values and solve for the present value of the bond's cash flows:

Enter	12	11	120		1,000
	N	**I/Y**	**PMT**	**PV**	**FV**
Solve for				−1,064.92	

There is an important detail that comes up here. Suppose we have a bond with a price of $902.29, 10 years to maturity, and a coupon rate of 6 percent. As we mentioned earlier, most bonds actually make semiannual payments. Assuming that this is the case for the bond here, what's the bond's yield? To answer, we need to enter the relevant numbers like this:

Enter	20		30	−902.29	1,000
	N	**I/Y**	**PMT**	**PV**	**FV**
Solve for		3.7			

Notice that we entered $30 as the payment because the bond actually makes payments of $30 every six months. Similarly, we entered 20 for N because there are actually 20 six-month periods. When we solve for the yield, we get 3.7 percent. The tricky thing to remember is that this is the yield *per six months,* so we have to double it to get the right answer: $2 \times 3.7 = 7.4$ percent, which would be the bond's reported yield.

SPREADSHEET STRATEGIES

How to Calculate Bond Prices and Yields Using a Spreadsheet

Most spreadsheets have fairly elaborate routines available for calculating bond values and yields; many of these routines involve details we have not discussed. However, setting up a simple spreadsheet to calculate prices or

(continued)

yields is straightforward, as our next two spreadsheets show:

	A	B	C	D	E	F	G	H
1								
2	**Using a spreadsheet to calculate bond values**							
3								
4	Suppose we have a bond with 22 years to maturity, a coupon rate of 8 percent, and a yield to							
5	maturity of 9 percent. If the bond makes semiannual payments, what is its price today?							
6								
7	Settlement date:	1/1/00						
8	Maturity date:	1/1/22						
9	Annual coupon rate:	.08						
10	Yield to maturity:	.09						
11	Face value (% of par):	100						
12	Coupons per year:	2						
13	Bond price (% of par):	**90.49**						
14								
15	The formula entered in cell B13 is =PRICE(B7,B8,B9,B10,B11,B12); notice that face value and bond							
16	price are given as a percentage of face value.							

	A	B	C	D	E	F	G	H
1								
2	**Using a spreadsheet to calculate bond yields**							
3								
4	Suppose we have a bond with 22 years to maturity, a coupon rate of 8 percent, and a price of							
5	$960.17. If the bond makes semiannual payments, what is its yield to maturity?							
6								
7	Settlement date:	1/1/00						
8	Maturity date:	1/1/22						
9	Annual coupon rate:	.08						
10	Bond price (% of par):	96.017						
11	Face value (% of par):	100						
12	Coupons per year:	2						
13	Yield to maturity:	**.084**						
14								
15	The formula entered in cell B13 is =YIELD(B7,B8,B9,B10,B11,B12); notice that face value and bond							
16	price are entered as a percentage of face value.							
17								

In our spreadsheets, notice that we had to enter two dates: a settlement date and a maturity date. The settlement date is just the date you actually pay for the bond, and the maturity date is the day the bond actually matures. In most of our problems, we don't explicitly have these dates, so we have to make them up. For example, because our bond has 22 years to maturity, we just picked 1/1/2000 (January 1, 2000) as the settlement date and 1/1/2022 (January 1, 2022) as the maturity date. Any two dates would do as long as they are exactly 22 years apart, but these are particularly easy to work with. Finally, notice that we had to enter the coupon rate and yield to maturity in annual terms and then explicitly provide the number of coupon payments per year.

Concept Questions

7.1a What are the cash flows associated with a bond?

7.1b What is the general expression for the value of a bond?

7.1c Is it true that the only risk associated with owning a bond is that the issuer will not make all the payments? Explain.

More about Bond Features

7.2

In this section, we continue our discussion of corporate debt by describing in some detail the basic terms and features that make up a typical long-term corporate bond. We discuss additional issues associated with long-term debt in subsequent sections.

Securities issued by corporations may be classified roughly as *equity securities* and *debt securities.* At the crudest level, a debt represents something that must be repaid; it is the result of borrowing money. When corporations borrow, they generally promise to make regularly scheduled interest payments and to repay the original amount borrowed (that is, the principal). The person or firm making the loan is called the *creditor* or *lender.* The corporation borrowing the money is called the *debtor* or *borrower.*

From a financial point of view, the main differences between debt and equity are the following:

1. Debt is not an ownership interest in the firm. Creditors generally do not have voting power.
2. The corporation's payment of interest on debt is considered a cost of doing business and is fully tax deductible. Dividends paid to stockholders are *not* tax deductible.
3. Unpaid debt is a liability of the firm. If it is not paid, the creditors can legally claim the assets of the firm. This action can result in liquidation or reorganization, two of the possible consequences of bankruptcy. Thus, one of the costs of issuing debt is the possibility of financial failure. This possibility does not arise when equity is issued.

Information for bond investors can be found at www.investinginbonds.com.

IS IT DEBT OR EQUITY?

Sometimes it is not clear if a particular security is debt or equity. For example, suppose a corporation issues a perpetual bond with interest payable solely from corporate income if and only if earned. Whether this is really a debt is hard to say and is primarily a legal and semantic issue. Courts and taxing authorities would have the final say.

Corporations are adept at creating exotic, hybrid securities that have many features of equity but are treated as debt. Obviously, the distinction between debt and equity is important for tax purposes. So, one reason that corporations try to create a debt security that is really equity is to obtain the tax benefits of debt and the bankruptcy benefits of equity.

As a general rule, equity represents an ownership interest, and it is a residual claim. This means that equity holders are paid after debt holders. As a result of this, the risks and benefits associated with owning debt and equity are different. To give just one example, note that the maximum reward for owning a debt security is ultimately fixed by the amount of the loan, whereas there is no upper limit to the potential reward from owning an equity interest.

LONG-TERM DEBT: THE BASICS

Ultimately, all long-term debt securities are promises made by the issuing firm to pay principal when due and to make timely interest payments on the unpaid balance. Beyond this, a number of features distinguish these securities from one another. We discuss some of these features next.

The maturity of a long-term debt instrument is the length of time the debt remains outstanding with some unpaid balance. Debt securities can be *short-term* (with maturities of one year or less) or *long-term* (with maturities of more than one year).[1] Short-term debt is sometimes referred to as *unfunded debt.*[2]

Debt securities are typically called *notes, debentures,* or *bonds.* Strictly speaking, a bond is a secured debt. However, in common usage, the word *bond* refers to all kinds of secured and unsecured debt. We will therefore continue to use the term generically to refer to long-term debt. Also, usually the only difference between a note and a bond is the original maturity. Issues with an original maturity of 10 years or less are often called notes. Longer-term issues are called bonds.

The two major forms of long-term debt are public issue and privately placed. We concentrate on public-issue bonds. Most of what we say about them holds true for private-issue, long-term debt as well. The main difference between public-issue and privately placed debt is that the latter is directly placed with a lender and not offered to the public. Because this is a private transaction, the specific terms are up to the parties involved.

Information about individual bonds can be found at www.nasdbondinfo.com *and* www.bondresources.com.

There are many other dimensions to long-term debt, including such things as security, call features, sinking funds, ratings, and protective covenants. The following table illustrates these features for a bond issued by Cisco Systems. If some of these terms are unfamiliar, have no fear. We will discuss them all presently.

Features of a Cisco Systems Bond		
Term		**Explanation**
Amount of issue	$3 billion	The company issued $3 billion worth of bonds.
Date of issue	02/22/2006	The bonds were sold on 02/22/2006.
Maturity	02/22/2016	The bonds mature on 02/22/2016.
Face value	$1,000	The denomination of the bonds is $1,000.
Annual coupon	5.05	Each bondholder will receive $55 per bond per year (5.50% of face value).
Offer price	99.543	The offer price will be 99.543% of the $1,000 face value, or $995.43 per bond.
Coupon payment dates	2/22, 8/22	Coupons of $55/2 = $27.50 will be paid on these dates.
Security	None	The bonds are not secured by specific assets.
Sinking fund	None	The bonds have no sinking fund.
Call provision	At any time	The bonds do not have a deferred call.
Call price	Treasury rate plus 0.15%	The bonds have a "make-whole" call feature.
Rating	Moody's A1 S&P A+	The bonds are in the middle of the investment grade rating.

Many of these features will be detailed in the bond indenture, so we discuss this first.

---

[1]There is no universally agreed-upon distinction between short-term and long-term debt. In addition, people often refer to *intermediate-term debt,* which has a maturity of more than 1 year and less than 3 to 5, or even 10, years.

[2]The word *funding* is part of the jargon of finance. It generally refers to the long term. Thus, a firm planning to "fund" its debt requirements may be replacing short-term debt with long-term debt.

THE INDENTURE

The **indenture** is the written agreement between the corporation (the borrower) and its creditors. It is sometimes referred to as the *deed of trust*.[3] Usually, a trustee (a bank, perhaps) is appointed by the corporation to represent the bondholders. The trust company must (1) make sure the terms of the indenture are obeyed, (2) manage the sinking fund (described in the following pages), and (3) represent the bondholders in default—that is, if the company defaults on its payments to them.

The bond indenture is a legal document. It can run several hundred pages and generally makes for tedious reading. It is an important document, however, because it generally includes the following provisions:

1. The basic terms of the bonds.
2. The total amount of bonds issued.
3. A description of property used as security.
4. The repayment arrangements.
5. The call provisions.
6. Details of the protective covenants.

We discuss these features next.

Terms of a Bond Corporate bonds usually have a face value (that is, a denomination) of $1,000. This *principal value* is stated on the bond certificate. So, if a corporation wanted to borrow $1 million, 1,000 bonds would have to be sold. The par value (that is, initial accounting value) of a bond is almost always the same as the face value, and the terms are used interchangeably in practice.

Corporate bonds are usually in **registered form**. For example, the indenture might read as follows:

> **Interest is payable semiannually on July 1 and January 1 of each year to the person in whose name the bond is registered at the close of business on June 15 or December 15, respectively.**

This means that the company has a registrar who will record the ownership of each bond and record any changes in ownership. The company will pay the interest and principal by check mailed directly to the address of the owner of record. A corporate bond may be registered and have attached "coupons." To obtain an interest payment, the owner must separate a coupon from the bond certificate and send it to the company registrar (the paying agent).

Alternatively, the bond could be in **bearer form**. This means that the certificate is the basic evidence of ownership, and the corporation will "pay the bearer." Ownership is not otherwise recorded, and, as with a registered bond with attached coupons, the holder of the bond certificate detaches the coupons and sends them to the company to receive payment.

There are two drawbacks to bearer bonds. First, they are difficult to recover if they are lost or stolen. Second, because the company does not know who owns its bonds, it cannot notify bondholders of important events. Bearer bonds were once the dominant type, but they are now much less common (in the United States) than registered bonds.

---

[3]The words *loan agreement* or *loan contract* are usually used for privately placed debt and term loans.

indenture
The written agreement between the corporation and the lender detailing the terms of the debt issue.

registered form
The form of bond issue in which the registrar of the company records ownership of each bond; payment is made directly to the owner of record.

bearer form
The form of bond issue in which the bond is issued without record of the owner's name; payment is made to whomever holds the bond.

Security   Debt securities are classified according to the collateral and mortgages used to protect the bondholder.

Collateral is a general term that frequently means securities (for example, bonds and stocks) that are pledged as security for payment of debt. For example, collateral trust bonds often involve a pledge of common stock held by the corporation. However, the term *collateral* is commonly used to refer to any asset pledged on a debt.

Mortgage securities are secured by a mortgage on the real property of the borrower. The property involved is usually real estate—for example, land or buildings. The legal document that describes the mortgage is called a *mortgage trust indenture* or *trust deed.*

Sometimes mortgages are on specific property, such as a railroad car. More often, blanket mortgages are used. A *blanket mortgage* pledges all the real property owned by the company.[4]

debenture
An unsecured debt, usually with a maturity of 10 years or more.

note
An unsecured debt, usually with a maturity under 10 years.

Bonds frequently represent unsecured obligations of the company. A **debenture** is an unsecured bond, for which no specific pledge of property is made. The term **note** is generally used for such instruments if the maturity of the unsecured bond is less than 10 or so years when the bond is originally issued. Debenture holders have a claim only on property not otherwise pledged—in other words, the property that remains after mortgages and collateral trusts are taken into account. The Cisco bonds in the table are an example of such an issue.

The terminology that we use here and elsewhere in this chapter is standard in the United States. Outside the United States, these same terms can have different meanings. For example, bonds issued by the British government ("gilts") are called treasury "stock." Also, in the United Kingdom, a debenture is a *secured* obligation.

At the current time, public bonds issued in the United States by industrial and financial companies are typically debentures. However, most utility and railroad bonds are secured by a pledge of assets.

Seniority   In general terms, *seniority* indicates preference in position over other lenders, and debts are sometimes labeled as *senior* or *junior* to indicate seniority. Some debt is *subordinated,* as in, for example, a subordinated debenture.

In the event of default, holders of subordinated debt must give preference to other specified creditors. Usually, this means that the subordinated lenders will be paid off only after the specified creditors have been compensated. However, debt cannot be subordinated to equity.

Repayment   Bonds can be repaid at maturity, at which time the bondholder will receive the stated, or face, value of the bond; or they may be repaid in part or in entirety before maturity. Early repayment in some form is more typical and is often handled through a sinking fund.

sinking fund
An account managed by the bond trustee for early bond redemption.

A **sinking fund** is an account managed by the bond trustee for the purpose of repaying the bonds. The company makes annual payments to the trustee, who then uses the funds to retire a portion of the debt. The trustee does this by either buying up some of the bonds in the market or calling in a fraction of the outstanding bonds. This second option is discussed in the next section.

There are many different kinds of sinking fund arrangements, and the details would be spelled out in the indenture. For example:

1. Some sinking funds start about 10 years after the initial issuance.
2. Some sinking funds establish equal payments over the life of the bond.

---

[4]Real property includes land and things "affixed thereto." It does not include cash or inventories.

3. Some high-quality bond issues establish payments to the sinking fund that are not sufficient to redeem the entire issue. As a consequence, there is the possibility of a large "balloon payment" at maturity.

The Call Provision   A **call provision** allows the company to repurchase or "call" part or all of the bond issue at stated prices over a specific period. Corporate bonds are usually callable.

Generally, the call price is above the bond's stated value (that is, the par value). The difference between the call price and the stated value is the **call premium**. The amount of the call premium may become smaller over time. One arrangement is to initially set the call premium equal to the annual coupon payment and then make it decline to zero as the call date moves closer to the time of maturity.

Call provisions are often not operative during the first part of a bond's life. This makes the call provision less of a worry for bondholders in the bond's early years. For example, a company might be prohibited from calling its bonds for the first 10 years. This is a **deferred call provision**. During this period of prohibition, the bond is said to be **call protected**.

In just the last few years, a new type of call provision, a "make-whole" call, has become widespread in the corporate bond market. With such a feature, bondholders receive approximately what the bonds are worth if they are called. Because bondholders don't suffer a loss in the event of a call, they are "made whole."

To determine the make-whole call price, we calculate the present value of the remaining interest and principal payments at a rate specified in the indenture. For example, looking at our Cisco issue, we see that the discount rate is "Treasury rate plus 0.15%." What this means is that we determine the discount rate by first finding a U.S. Treasury issue with the same maturity. We calculate the yield to maturity on the Treasury issue and then add on 0.15 percent to get the discount rate we use.

Notice that with a make-whole call provision, the call price is higher when interest rates are lower and vice versa (why?). Also notice that, as is common with a make-whole call, the Cisco issue does not have a deferred call feature. Why might investors not be too concerned about the absence of this feature?

Protective Covenants   A **protective covenant** is that part of the indenture or loan agreement that limits certain actions a company might otherwise wish to take during the term of the loan. Protective covenants can be classified into two types: negative covenants and positive (or affirmative) covenants.

A *negative covenant* is a "thou shalt not" type of covenant. It limits or prohibits actions the company might take. Here are some typical examples:

1. The firm must limit the amount of dividends it pays according to some formula.
2. The firm cannot pledge any assets to other lenders.
3. The firm cannot merge with another firm.
4. The firm cannot sell or lease any major assets without approval by the lender.
5. The firm cannot issue additional long-term debt.

A *positive covenant* is a "thou shalt" type of covenant. It specifies an action the company agrees to take or a condition the company must abide by. Here are some examples:

1. The company must maintain its working capital at or above some specified minimum level.
2. The company must periodically furnish audited financial statements to the lender.
3. The firm must maintain any collateral or security in good condition.

call provision
An agreement giving the corporation the option to repurchase a bond at a specified price prior to maturity.

call premium
The amount by which the call price exceeds the par value of a bond.

deferred call provision
A call provision prohibiting the company from redeeming a bond prior to a certain date.

call-protected bond
A bond that, during a certain period, cannot be redeemed by the issuer.

protective covenant
A part of the indenture limiting certain actions that might be taken during the term of the loan, usually to protect the lender's interest.

Want detailed information about the amount and terms of the debt issued by a particular firm? Check out their latest financial statements by searching SEC filings at www.sec.gov.

This is only a partial list of covenants; a particular indenture may feature many different ones.

7.3 Bond Ratings

Firms frequently pay to have their debt rated. The two leading bond-rating firms are Moody's and Standard & Poor's (S&P). The debt ratings are an assessment of the creditworthiness of the corporate issuer. The definitions of creditworthiness used by Moody's and S&P are based on how likely the firm is to default and the protection creditors have in the event of a default.

It is important to recognize that bond ratings are concerned *only* with the possibility of default. Earlier, we discussed interest rate risk, which we defined as the risk of a change in the value of a bond resulting from a change in interest rates. Bond ratings do not address this issue. As a result, the price of a highly rated bond can still be quite volatile.

Bond ratings are constructed from information supplied by the corporation. The rating classes and some information concerning them are shown in the following table:

	Investment-Quality Bond Ratings				Low-Quality, Speculative, and/or "Junk" Bond Ratings					
	High Grade		**Medium Grade**		**Low Grade**		**Very Low Grade**			
Standard & Poor's	AAA	AA	A	BBB	BB	B	CCC	CC	C	D
Moody's	Aaa	Aa	A	Baa	Ba	B	Caa	Ca	C	D

Moody's	S&P	
Aaa	AAA	Debt rated Aaa and AAA has the highest rating. Capacity to pay interest and principal is extremely strong.
Aa	AA	Debt rated Aa and AA has a very strong capacity to pay interest and repay principal. Together with the highest rating, this group comprises the high-grade bond class.
A	A	Debt rated A has a strong capacity to pay interest and repay principal, although it is somewhat more susceptible to the adverse effects of changes in circumstances and economic conditions than debt in high-rated categories.
Baa	BBB	Debt rated Baa and BBB is regarded as having an adequate capacity to pay interest and repay principal. Whereas it normally exhibits adequate protection parameters, adverse economic conditions or changing circumstances are more likely to lead to a weakened capacity to pay interest and repay principal for debt in this category than in higher-rated categories. These bonds are medium-grade obligations.
Ba; B Caa Ca	BB; B CCC CC	Debt rated in these categories is regarded, on balance, as predominantly speculative with respect to capacity to pay interest and repay principal in accordance with the terms of the obligation. BB and Ba indicate the lowest degree of speculation, and CC and Ca the highest degree of speculation. Although such debt is likely to have some quality and protective characteristics, these are outweighed by large uncertainties or major risk exposures to adverse conditions. Some issues may be in default.
C	C	This rating is reserved for income bonds on which no interest is being paid.
D	D	Debt rated D is in default, and payment of interest and/or repayment of principal is in arrears.

Note: At times, both Moody's and S&P use adjustments (called notches) to these ratings. S&P uses plus and minus signs: A+ is the strongest A rating and A− the weakest. Moody's uses a 1, 2, or 3 designation, with 1 being the highest.

The highest rating a firm's debt can have is AAA or Aaa, and such debt is judged to be the best quality and to have the lowest degree of risk. For example, the 100-year Bell-South issue we discussed earlier was rated AAA. This rating is not awarded very often: As of 2006, only six U.S. companies had AAA ratings. AA or Aa ratings indicate very good quality debt and are much more common. The lowest rating is D for debt that is in default.

A large part of corporate borrowing takes the form of low-grade, or "junk," bonds. If these low-grade corporate bonds are rated at all, they are rated below investment grade by the major rating agencies. Investment-grade bonds are bonds rated at least BBB by S&P or Baa by Moody's.

Rating agencies don't always agree. To illustrate, some bonds are known as "crossover" or "5B" bonds. The reason is that they are rated triple-B (or Baa) by one rating agency and double-B (or Ba) by another, a "split rating." For example, in March 2004, Rogers Communication sold an issue of 10-year notes rated BBB– by S&P and Ba2 by Moody's.

A bond's credit rating can change as the issuer's financial strength improves or deteriorates. For example, in December 2005, Fitch (another major ratings agency) downgraded automaker Ford's long-term debt from investment grade to junk bond status. Bonds that drop into junk territory like this are called "fallen angels." Why was Ford downgraded? A lot of reasons, but Fitch was concerned that Ford, along with the rest of the North American auto industry, was in a period of restructuring that would result in large operating losses.

Credit ratings are important because defaults really do occur, and when they do, investors can lose heavily. For example, in 2000, AmeriServe Food Distribution, Inc., which supplied restaurants such as Burger King with everything from burgers to giveaway toys, defaulted on $200 million in junk bonds. After the default, the bonds traded at just 18 cents on the dollar, leaving investors with a loss of more than $160 million.

Even worse in AmeriServe's case, the bonds had been issued only four months earlier, thereby making AmeriServe an NCAA champion. Although that might be a good thing for a college basketball team such as the University of Kentucky Wildcats, in the bond market it means "No Coupon At All," and it's not a good thing for investors.

Want to know what criteria are commonly used to rate corporate and municipal bonds? Go to www.standardandpoors.com, www.moodys.com, *or* www.fitchinv.com.

If you're nervous about the level of debt piled up by the U.S. government, don't go to www.publicdebt.treas.gov *or to* www.brillig.com/debt_clock! *Learn all about government bonds at* www.ny.frb.org.

Concept Questions

7.3a What does a bond rating say about the risk of fluctuations in a bond's value resulting from interest rate changes?

7.3b What is a junk bond?

Some Different Types of Bonds   **7.4**

Thus far we have considered only "plain vanilla" corporate bonds. In this section, we briefly look at bonds issued by governments and also at bonds with unusual features.

GOVERNMENT BONDS

The biggest borrower in the world—by a wide margin—is everybody's favorite family member, Uncle Sam. In 2006, the total debt of the U.S. government was $8.4 *trillion,* or about $28,000 per citizen (and growing!). When the government wishes to borrow money for more than one year, it sells what are known as Treasury notes and bonds to the public (in fact, it does so every month). Currently, outstanding Treasury notes and bonds have original maturities ranging from 2 to 30 years.

Most U.S. Treasury issues are just ordinary coupon bonds. Some older issues are callable, and a few have some unusual features. There are two important things to keep in mind, however. First, U.S. Treasury issues, unlike essentially all other bonds, have no default risk because (we hope) the Treasury can always come up with the money to make the payments. Second, Treasury issues are exempt from state income taxes (though not federal income taxes). In other words, the coupons you receive on a Treasury note or bond are taxed only at the federal level.

State and local governments also borrow money by selling notes and bonds. Such issues are called *municipal* notes and bonds, or just "munis." Unlike Treasury issues, munis have varying degrees of default risk, and, in fact, they are rated much like corporate issues. Also, they are almost always callable. The most intriguing thing about munis is that their coupons are exempt from federal income taxes (though not necessarily state income taxes), which makes them very attractive to high-income, high–tax bracket investors.

Because of the enormous tax break they receive, the yields on municipal bonds are much lower than the yields on taxable bonds. For example, in May 2006, long-term Aa-rated corporate bonds were yielding about 6.46 percent. At the same time, long-term Aa munis were yielding about 4.35 percent. Suppose an investor was in a 30 percent tax bracket. All else being the same, would this investor prefer a Aa corporate bond or a Aa municipal bond?

Another good bond market site is money.cnn.com.

To answer, we need to compare the *aftertax* yields on the two bonds. Ignoring state and local taxes, the muni pays 4.35 percent on both a pretax and an aftertax basis. The corporate issue pays 6.46 percent before taxes, but it pays only $.0646 \times (1 - .30) = .045$, or 4.5 percent, once we account for the 30 percent tax bite. Given this, the muni has a better yield.

EXAMPLE 7.4	**Taxable versus Municipal Bonds**

Suppose taxable bonds are currently yielding 8 percent, while at the same time, munis of comparable risk and maturity are yielding 6 percent. Which is more attractive to an investor in a 40 percent bracket? What is the break-even tax rate? How do you interpret this rate?

For an investor in a 40 percent tax bracket, a taxable bond yields $8 \times (1 - .40) =$ 4.8 percent after taxes, so the muni is much more attractive. The break-even tax rate is the tax rate at which an investor would be indifferent between a taxable and a nontaxable issue. If we let t^* stand for the break-even tax rate, then we can solve for it as follows:

$$.08 \times (1 - t^*) = .06$$
$$1 - t^* = .06/.08 = .75$$
$$t^* = .25$$

Thus, an investor in a 25 percent tax bracket would make 6 percent after taxes from either bond.

ZERO COUPON BONDS

zero coupon bond
A bond that makes no coupon payments and is thus initially priced at a deep discount.

A bond that pays no coupons at all must be offered at a price that is much lower than its stated value. Such bonds are called **zero coupon bonds**, or just *zeroes*.[5]

---

[5]A bond issued with a very low coupon rate (as opposed to a zero coupon rate) is an *original-issue discount (OID) bond*.

Year	Beginning Value	Ending Value	Implicit Interest Expense	Straight-Line Interest Expense
1	$497	$ 572	$ 75	$100.60
2	572	658	86	100.60
3	658	756	98	100.60
4	756	870	114	100.60
5	870	1,000	130	100.60
Total			$503	$503.00

TABLE 7.2

Interest Expense for EIN's Zeroes

Suppose the Eight-Inch Nails (EIN) Company issues a $1,000 face value, five-year zero coupon bond. The initial price is set at $497. It is straightforward to verify that, at this price, the bond yields 15 percent to maturity. The total interest paid over the life of the bond is $1,000 − 497 = $503.

For tax purposes, the issuer of a zero coupon bond deducts interest every year even though no interest is actually paid. Similarly, the owner must pay taxes on interest accrued every year, even though no interest is actually received.

The way in which the yearly interest on a zero coupon bond is calculated is governed by tax law. Before 1982, corporations could calculate the interest deduction on a straight-line basis. For EIN, the annual interest deduction would have been $503/5 = $100.60 per year.

Under current tax law, the implicit interest is determined by amortizing the loan. We do this by first calculating the bond's value at the beginning of each year. For example, after one year, the bond will have four years until maturity, so it will be worth $1,000/1.15^4 = $572; the value in two years will be $1,000/1.15^3 = $658; and so on. The implicit interest each year is simply the change in the bond's value for the year. The values and interest expenses for the EIN bond are listed in Table 7.2.

Notice that under the old rules, zero coupon bonds were more attractive because the deductions for interest expense were larger in the early years (compare the implicit interest expense with the straight-line expense).

Under current tax law, EIN could deduct $75 in interest paid the first year and the owner of the bond would pay taxes on $75 in taxable income (even though no interest was actually received). This second tax feature makes taxable zero coupon bonds less attractive to individuals. However, they are still a very attractive investment for tax-exempt investors with long-term dollar-denominated liabilities, such as pension funds, because the future dollar value is known with relative certainty.

Some bonds are zero coupon bonds for only part of their lives. For example, General Motors has a debenture outstanding that matures on March 15, 2036. For the first 20 years of its life, no coupon payments will be made; but, after 20 years, it will begin paying coupons semiannually at a rate of 7.75 percent per year.

FLOATING-RATE BONDS

The conventional bonds we have talked about in this chapter have fixed-dollar obligations because the coupon rates are set as fixed percentages of the par values. Similarly, the principal amounts are set equal to the par values. Under these circumstances, the coupon payments and principal are completely fixed.

With *floating-rate bonds (floaters),* the coupon payments are adjustable. The adjustments are tied to an interest rate index such as the Treasury bill interest rate or the 30-year Treasury bond rate. The EE Savings Bonds we mentioned in Chapter 5 are a good example

of a floater. For EE bonds purchased after May 1, 1997, the interest rate is adjusted every six months. The rate that the bonds earn for a particular six-month period is determined by taking 90 percent of the average yield on ordinary five-year Treasury notes over the previous six months.

The value of a floating-rate bond depends on exactly how the coupon payment adjustments are defined. In most cases, the coupon adjusts with a lag to some base rate. For example, suppose a coupon rate adjustment is made on June 1. The adjustment might be based on the simple average of Treasury bond yields during the previous three months. In addition, the majority of floaters have the following features:

1. The holder has the right to redeem the note at par on the coupon payment date after some specified amount of time. This is called a *put* provision, and it is discussed in the following section.

2. The coupon rate has a floor and a ceiling, meaning that the coupon is subject to a minimum and a maximum. In this case, the coupon rate is said to be "capped," and the upper and lower rates are sometimes called the *collar*.

Official information about U.S. inflation-indexed bonds is at www.publicdebt.treas.gov/gsr/gsrlist.htm.

A particularly interesting type of floating-rate bond is an *inflation-linked* bond. Such bonds have coupons that are adjusted according to the rate of inflation (the principal amount may be adjusted as well). The U.S. Treasury began issuing such bonds in January of 1997. The issues are sometimes called "TIPS," or Treasury Inflation Protection Securities. Other countries, including Canada, Israel, and Britain, have issued similar securities.

OTHER TYPES OF BONDS

Many bonds have unusual or exotic features. So-called catastrophe, or cat, bonds provide an interesting example. To give an example of an unusual cat bond, the Fédération Internationale de Football Association (FIFA) issued $260 million worth of cat bonds to protect against the cancellation of the 2006 FIFA World Cup soccer tournament due to terrorism. Under the terms of the offer, the bondholders would lose up to 75 percent of their investment if the World Cup were to be cancelled.

Most cat bonds cover natural disasters. For example, in late 2005, catastrophe risk insurer PXRE issued several cat bonds that covered losses from European windstorms, U.S. hurricanes, and California earthquakes. At about the same time, Munich Re issued $131 million worth of "Aiolos" bonds. Named after the Greek god of the winds, the bond covers the company against losses from a European windstorm.

At this point, cat bonds probably seem pretty risky. It therefore might be surprising to learn that since cat bonds were first issued in 1997, only one has not been paid in full. Because of Hurricane Katrina, bondholders in that one issue lost $190 million.

An extra feature also explains why the Berkshire Hathaway bond we described at the beginning of the chapter actually had what amounts to a negative coupon rate. The buyers of these bonds also received the right to purchase shares of stock in Berkshire at a fixed price per share over the subsequent five years. Such a right, which is called a *warrant,* would be very valuable if the stock price climbed substantially (a later chapter discusses this subject in greater depth).

As these examples illustrate, bond features are really limited only by the imaginations of the parties involved. Unfortunately, there are far too many variations for us to cover in detail here. We therefore close this discussion by mentioning a few of the more common types.

Income bonds are similar to conventional bonds, except that coupon payments depend on company income. Specifically, coupons are paid to bondholders only if the firm's

Edward I. Altman on Junk Bonds

One of the most important developments in corporate finance over the last 20 years has been the reemergence of publicly owned and traded low-rated corporate debt. Originally offered to the public in the early 1900s to help finance some of our emerging growth industries, these high-yield, high-risk bonds virtually disappeared after the rash of bond defaults during the Depression. Recently, however, the junk bond market has been catapulted from being an insignificant element in the corporate fixed-income market to being one of the fastest-growing and most controversial types of financing mechanisms.

The term *junk* emanates from the dominant type of low-rated bond issues outstanding prior to 1977 when the "market" consisted almost exclusively of original-issue investment-grade bonds that fell from their lofty status to a higher–default risk, speculative-grade level. These so-called fallen angels amounted to about $8.5 billion in 1977. At the end of 2006, fallen angels comprised about 10 percent of the $1 trillion publicly owned junk bond market.

Beginning in 1977, issuers began to go directly to the public to raise capital for growth purposes. Early users of junk bonds were energy-related firms, cable TV companies, airlines, and assorted other industrial companies. The emerging growth company rationale coupled with relatively high returns to early investors helped legitimize this sector.

By far the most important and controversial aspect of junk bond financing was its role in the corporate restructuring movement from 1985 to 1989. High-leverage transactions and acquisitions, such as leveraged buyouts (LBOs), which occur when a firm is taken private, and leveraged recapitalizations (debt-for-equity swaps), transformed the face of corporate America, leading to a heated debate as to the economic and social consequences of firms' being transformed with debt-equity ratios of at least 6:1.

These transactions involved increasingly large companies, and the multibillion-dollar takeover became fairly common, finally capped by the huge $25+ billion RJR Nabisco LBO in 1989. LBOs were typically financed with about 60 percent senior bank and insurance company debt, about 25–30 percent subordinated public debt (junk bonds), and 10–15 percent equity. The junk bond segment is sometimes referred to as "mezzanine" financing because it lies between the "balcony" senior debt and the "basement" equity.

These restructurings resulted in huge fees to advisors and underwriters and huge premiums to the old shareholders who were bought out, and they continued as long as the market was willing to buy these new debt offerings at what appeared to be a favorable risk-return trade-off. The bottom fell out of the market in the last six months of 1989 due to a number of factors including a marked increase in defaults, government regulation against S&Ls' holding junk bonds, and a recession.

The default rate rose dramatically to 4 percent in 1989 and then skyrocketed in 1990 and 1991 to 10.1 percent and 10.3 percent, respectively, with about $19 billion of defaults in 1991. By the end of 1990, the pendulum of growth in new junk bond issues and returns to investors swung dramatically downward as prices plummeted and the new-issue market all but dried up. The year 1991 was a pivotal year in that, despite record defaults, bond prices and new issues rebounded strongly as the prospects for the future brightened.

In the early 1990s, the financial market was questioning the very survival of the junk bond market. The answer was a resounding "yes," as the amount of new issues soared to record annual levels of $40 billion in 1992 and almost $60 billion in 1993, and in 1997 reached an impressive $119 billion. Coupled with plummeting default rates (under 2.0 percent each year in the 1993–97 period) and attractive returns in these years, the risk-return characteristics have been extremely favorable.

The junk bond market in the late 1990s was a quieter one compared to that of the 1980s, but, in terms of growth and returns, it was healthier than ever before. While the low default rates in 1992–98 helped to fuel new investment funds and new issues, the market experienced its ups and downs in subsequent years. Indeed, default rates started to rise in 1999 and accelerated in 2000–2002. The latter year saw defaults reach record levels as the economy slipped into a recession and investors suffered from the excesses of lending in the late 1990s. Despite these highly volatile events and problems with liquidity, we are convinced that high-yield bonds, and its private debt companion, leveraged loans, will continue to be a major source of corporate debt financing and a legitimate asset class for investors.

Edward I. Altman is Max L. Heine Professor of Finance and vice director of the Salomon Center at the Stern School of Business of New York University. He is widely recognized as one of the world's experts on bankruptcy and credit analysis as well as the high-yield and distressed debt market.

213

income is sufficient. This would appear to be an attractive feature, but income bonds are not very common.

A *convertible bond* can be swapped for a fixed number of shares of stock anytime before maturity at the holder's option. Convertibles are relatively common, but the number has been decreasing in recent years.

A *put bond* allows the *holder* to force the issuer to buy back the bond at a stated price. For example, International Paper Co. has bonds outstanding that allow the holder to force International Paper to buy the bonds back at 100 percent of face value if certain "risk" events happen. One such event is a change in credit rating from investment grade to lower than investment grade by Moody's or S&P. The put feature is therefore just the reverse of the call provision.

A given bond may have many unusual features. Two of the most recent exotic bonds are CoCo bonds, which have a coupon payment, and NoNo bonds, which are zero coupon bonds. CoCo and NoNo bonds are contingent convertible, putable, callable, subordinated bonds. The contingent convertible clause is similar to the normal conversion feature, except the contingent feature must be met. For example, a contingent feature may require that the company stock trade at 110 percent of the conversion price for 20 out of the most recent 30 days. Valuing a bond of this sort can be quite complex, and the yield to maturity calculation is often meaningless. For example, in 2006, a NoNo issued by Merrill Lynch was selling at a price of $1,103.75, with a yield to maturity of negative 5.22 percent. At the same time, a NoNo issued by Countrywide Financial was selling for $1,640, which implied a yield to maturity of negative 59 percent!

Concept Questions

7.4a Why might an income bond be attractive to a corporation with volatile cash flows? Can you think of a reason why income bonds are not more popular?

7.4b What do you think would be the effect of a put feature on a bond's coupon? How about a convertibility feature? Why?

7.5 Bond Markets

Bonds are bought and sold in enormous quantities every day. You may be surprised to learn that the trading volume in bonds on a typical day is many, many times larger than the trading volume in stocks (by *trading volume* we simply mean the amount of money that changes hands). Here is a finance trivia question: What is the largest securities market in the world? Most people would guess the New York Stock Exchange. In fact, the largest securities market in the world in terms of trading volume is the U.S. Treasury market.

HOW BONDS ARE BOUGHT AND SOLD

As we mentioned all the way back in Chapter 1, most trading in bonds takes place over the counter, or OTC. Recall that this means there is no particular place where buying and selling occur. Instead, dealers around the country (and around the world) stand ready to buy and sell. The various dealers are connected electronically.

One reason the bond markets are so big is that the number of bond issues far exceeds the number of stock issues. There are two reasons for this. First, a corporation would typically have only one common stock issue outstanding (there are exceptions to this that we discuss in our next chapter). However, a single large corporation could easily have a dozen or more

WORK THE WEB

Bond quotes have become more available with the rise of the Internet. One site where you can find current bond prices is www.nasdbondinfo.com. We went to the Web site and searched for bonds issued by ChevronTexaco. Here is a look at one of the bonds we found:

Issue: CVX.GP TEXACO CAPITAL INC. 7.50 03/01/2043   **Time and Sales**   **Descriptive Data**

In Portfolio	Rating Moody's/S&P/Fitch	----------- Last Sale -----------			----------- Most Recent -----------		
		Date	Price	Yield	Date	Price	Yield
☐	Aa2 / AA / AA	02/10/2006	116.11	5.273	02/10/2006	116.11	5.273

The bond has a coupon rate of 7.50 percent and matures on March 1, 2043. The last sale on this bond was at a price of 116.11 percent of par, which gives a yield to maturity of about 5.27 percent. After finding the quotes, we followed the Descriptive Data link for this bond. Here is the detailed information for this bond:

Detailed Bond Information

Symbol: CVX.GP
Issue: CVX 7.500 03/01/43 '13
Cusip: 881685BD2
Bond Type: DEBENTURE
Moody's/S&P/Fitch Rating Aa2 / AA / AA
Payment Frequency: Semiannually
Industry: FINANCIAL
Industry Subsector: Financial - Other
Coupon Type: Fixed:Plain Vanilla Fixed Coupon
Callable: Y
Other Features:

Call Schedule

Call Date	Call Price
03/01/2013	102.717
03/01/2014	102.536
03/01/2015	102.354
03/01/2016	102.173
03/01/2017	101.992
03/01/2018	101.811
03/01/2019	101.63
03/01/2020	101.449
03/01/2021	101.268
03/01/2022	101.087

Composite Trade Information

Last Sale						Most Recent			Net Change
Date	Price	Yield	High Price	Low Price	High Yield	Low Yield	Date	Price	Yield	Price
02/10/2006	116.11	5.273	116.11	116.11	5.273	5.273	02/10/2006	116.11	5.273	0.792

Not only does the site provide the most recent price and yield information, but it also provides important information about the bond. For instance, the fixed rate coupon is paid semiannually, and the bond is callable beginning March 1, 2013. The initial call price is 102.717 percent of par and declines each year. The bond also has a credit rating of Aa2 from Moody's and AA from S&P.

note and bond issues outstanding. Beyond this, federal, state, and local borrowing is simply enormous. For example, even a small city would usually have a wide variety of notes and bonds outstanding, representing money borrowed to pay for things like roads, sewers, and schools. When you think about how many small cities there are in the United States, you begin to get the picture!

Because the bond market is almost entirely OTC, it has historically had little or no transparency. A financial market is *transparent* if it is possible to easily observe its prices and trading volume. On the New York Stock Exchange, for example, it is possible to see the price and quantity for every single transaction. In contrast, in the bond market, it is often not possible to observe either. Transactions are privately negotiated between parties, and there is little or no centralized reporting of transactions.

Although the total volume of trading in bonds far exceeds that in stocks, only a small fraction of the total bond issues that exist actually trade on a given day. This fact, combined with the lack of transparency in the bond market, means that getting up-to-date prices on individual bonds can be difficult or impossible, particularly for smaller corporate or municipal issues. Instead, a variety of sources of estimated prices exist and are commonly used.

BOND PRICE REPORTING

In 2002, transparency in the corporate bond market began to improve dramatically. Under new regulations, corporate bond dealers are now required to report trade information through what is known as the Transactions Report and Compliance Engine (TRACE). As this is written, transaction prices are now reported on more than 4,000 bonds, amounting to approximately 75 percent of the investment grade market. More bonds will be added over time. Our nearby *Work the Web* box shows you how to get TRACE information.

To learn more about TRACE, visit www.nasd.com *and select Market Systems.*

As shown in Figure 7.3, *The Wall Street Journal* now provides a daily snapshot of the data from TRACE by reporting the 40 most active issues. The information reported is largely self-explanatory. The EST Spread is the estimated yield spread over a particular Treasury issue (a yield spread is just the difference in yields). The spread is reported in basis points, where 1 basis point is equal to .01 percent. The selected Treasury issue's maturity is given under UST, which is a standard abbreviation in the bond markets for U.S. Treasury. A "hot run" Treasury is the most recently issued of a particular maturity, better known as an on-the-run issue. Finally, the reported volume is the face value of bonds traded.

The Federal Reserve Bank of St. Louis maintains dozens of online files containing macroeconomic data as well as rates on U.S. Treasury issues. Go to www.stls.frb.org/fred/files.

As we mentioned before, the U.S. Treasury market is the largest securities market in the world. As with bond markets in general, it is an OTC market, so there is limited transparency. However, unlike the situation with bond markets in general, trading in Treasury issues, particularly recently issued ones, is very heavy. Each day, representative prices for outstanding Treasury issues are reported.

Figure 7.4 shows a portion of the daily Treasury note and bond listings from *The Wall Street Journal.* The entry that begins "8.000 Nov 21" is highlighted. Reading from left to right, the 8.000 is the bond's coupon rate, and the "Nov 21" tells us that the bond's maturity is November of 2021. Treasury bonds all make semiannual payments and have a face value of $1,000, so this bond will pay $40 per six months until it matures.

bid price
The price a dealer is willing to pay for a security.

The next two pieces of information are the **bid** and **asked prices**. In general, in any OTC or dealer market, the bid price represents what a dealer is willing to pay for a security, and the asked price (or just "ask" price) is what a dealer is willing to take for it. The difference between the two prices is called the **bid–ask spread** (or just "spread"), and it represents the dealer's profit.

asked price
The price a dealer is willing to take for a security.

bid–ask spread
The difference between the bid price and the asked price.

For historical reasons, Treasury prices are quoted in 32nds. Thus, the bid price on the 8.000 Nov 21 bond, 128:07, actually translates into 128 7/32, or 128.21875 percent of face value. With a $1,000 face value, this represents $1,282.1875. Because prices are quoted in 32nds, the smallest possible price change is 1/32. This is called the "tick" size.

FIGURE 7.3

Sample *Wall Street Journal* Bond Quotation

Corporate Bonds

Thursday, April 27, 2006

Forty most active fixed-coupon corporate bonds

COMPANY (TICKER)	COUPON	MATURITY	LAST PRICE	LAST YIELD	*EST SPREAD	UST†	EST $ VOL (000's)
Comcast Corp (CMCSA)	6.450	Mar 15, 2037	95.170	6.826	156	30	178,032
Wachovia Capital Trust III (WB)	5.800	Mar 15, 2011	97.976	5.930	97	5	121,500
Sprint Capital Corp (S)	8.375	Mar 15, 2012	112.281	5.869	92	5	84,227
Sprint Capital Corp (S)	6.875	Nov 15, 2028	102.428	6.665	140	30	81,530
CenturyTel Inc (CTL)	7.875	Aug 15, 2012	108.797	6.163	109	5	80,100
Omnicom Group Inc (OMC)	5.900	Apr 15, 2016	97.489	6.241	117	10	76,065
USB Capital IX (USB)	6.189	Apr 15, 2011	98.824	6.250	131	5	69,610
ArvinMeritor Inc (ARM)	8.125	Sep 15, 2015	97.375	8.535	347	10	68,600
Goldman Sachs Group Inc (GS)	5.350	Jan 15, 2016	95.481	5.969	89	10	66,057
Lehman Brothers Holdings Inc (LEH)	5.500	Apr 04, 2016	96.911	5.915	84	10	64,705
Sprint Capital Corp (S)	8.750	Mar 15, 2032	123.792	6.785	152	30	55,134
Time Warner Companies Inc (TWX)	9.150	Feb 01, 2023	119.020	7.178	192	30	54,762
BB&T Corp (BBT)	5.200	Dec 23, 2015	95.459	5.821	75	10	52,260
Southern Copper Corp (SOUPER)	7.500	Jul 27, 2035	97.061	7.754	246	30	52,100
AT&T Inc (T)	6.250	Mar 15, 2011	102.613	5.627	68	5	51,936
BellSouth Corp (BLS)	6.000	Nov 15, 2034	91.686	6.654	139	30	51,411
DaimlerChrysler North America Holding Corp (DCX)	6.500	Nov 15, 2013	101.289	6.282	121	10	50,727
Loews Corp (LTR)	5.250	Mar 15, 2016	93.490	6.138	107	10	50,700
BellSouth Capital Funding Corp (BLS)	7.875	Feb 15, 2030	113.161	6.754	149	30	49,230
Time Warner Inc (TWX)	6.750	Apr 15, 2011	103.588	5.903	95	5	48,900
CIT Group Inc (CIT)	7.375	Apr 02, 2007	101.805	5.318	n.a.	n.a.	48,300
COX Communications Inc (COXENT)	7.125	Oct 01, 2012	104.617	6.239	116	5	47,700
Comcast Cable Communications Inc (CMCSA)	7.125	Jun 15, 2013	105.461	6.164	109	10	47,670
Weyerhaeuser (WY)	6.750	Mar 15, 2012	103.336	6.064	111	5	47,269
Comcast Cable Communications Holdings Inc (CMCSA)	8.375	Mar 15, 2013	111.905	6.217	114	10	46,561
Verizon Global Funding Corp (VZ)	5.850	Sep 15, 2035	88.868	6.723	145	30	45,273
Home Depot Inc (HD)	5.400	Mar 01, 2016	97.280	5.766	67	10	44,000
General Electric Capital Corp (GE)	5.500	Apr 28, 2011	100.047	5.489	53	5	42,885
Morgan Stanley (MS)	5.800	Apr 01, 2007	100.423	5.314	n.a.	n.a.	41,997
Goldman Sachs Group Inc (GS)	5.700	Sep 01, 2012	99.666	5.762	68	5	41,343
Telefonica Europe (TELEFO)	8.250	Sep 15, 2013	114.929	6.967	170	30	41,250
Devon Energy Corp (DVN)	7.950	Apr 15, 2032	118.882	6.442	116	30	41,140
Cisco Systems Inc (CSCO)	5.500	Feb 22, 2016	97.607	5.822	75	10	39,746
Comcast Corp (CMCSA)	5.900	Mar 15, 2016	97.122	6.294	122	10	39,235
ConocoPhillips (COP)	4.750	Oct 15, 2012	95.218	5.644	55	5	39,184
WellPoint Inc (WLP)	5.850	Jan 15, 2036	91.974	6.460	120	30	38,050
Wachovia Corp (WB)	4.950	Nov 01, 2006	99.858	5.241	n.a.	n.a.	37,458
Wal-Mart Stores Inc (WMT)	5.250	Sep 01, 2035	88.102	6.128	87	30	37,335
Walt Disney Co (DIS)	6.375	Mar 01, 2012	103.269	5.706	74	5	37,200
Carolina Power & Light Co (PGN)	5.125	Sep 15, 2013	96.287	5.749	67	10	36,750
Goldman Sachs Capital I (GS)	6.345	Feb 15, 2034	95.937	6.667	140	30	36,554

Volume represents total volume for each issue; price/yield data are for trades of $1 million and greater. * Estimated spreads, in basis points (100 basis points is one percentage point), over the 2, 3, 5, 10 or 30-year hot run Treasury note/bond. 2-year: 4.625 03/08; 3-year: 4.500 02/09; 5-year: 4.750 03/11; 10-year: 4.500 02/16; 30-year: 5.375 02/31. †Comparable U.S. Treasury issue.

Source: MarketAxess Corporate BondTicker

The next number quoted is the change in the asked price from the previous day, measured in ticks (in 32nds), so this issue's asked price rose by 5/32 of 1 percent, or .15625 percent, of face value from the previous day. Finally, the last number reported is the yield to maturity, based on the asked price. Notice that this is a premium bond because it sells for more than its face value. Not surprisingly, its yield to maturity (5.31 percent) is less than its coupon rate (8 percent).

Some of the maturity dates in Figure 7.4 have an "n" after them. This just means that these issues are notes rather than bonds. The bonds with an "i" after them are the inflation-linked bonds, or TIPS, which we discussed in a previous section.

The very last ordinary bond listed, the 4.5 Feb 36, is often called the "bellwether" bond. This bond's yield is the one that is usually reported in the evening news. So, for example, when you hear that long-term interest rates rose, what is really being said is that the yield on this bond went up (and its price went down).

If you examine the yields on the various issues in Figure 7.4, you will clearly see that they vary by maturity. Why this occurs and what it might mean is one of the things we discuss in our next section.

Current and historical Treasury yield information is available at www.publicdebt.treas.gov/of/ofaucrt.htm.

FIGURE 7.4

Sample *Wall Street Journal* U.S. Treasury Note and Bond Prices

Treasury Bonds, Notes and Bills

Explanatory Notes

Representative Over-the-Counter quotation based on transactions of $1 million or more. Treasury bond, note and bill quotes are as of mid-afternoon. Colons in bid-and-asked quotes represent 32nds; 101:01 means 101 1/32. Net changes in 32nds. n-Treasury note. i-Inflation-Indexed issue. Treasury bill quotes in hundredths, quoted on terms of a rate of discount. Days to maturity calculated from settlement date. All yields are to maturity and based on the asked quote. Latest 13-week and 26-week bills are boldfaced. For bonds callable prior to maturity, yields are computed to the earliest call date for issues quoted above par and to the maturity date for issues below par. *When issued.

Source: eSpeed/Cantor Fitzgerald

U.S. Treasury strips as of 3 p.m. Eastern time, also based on transactions of $1 million or more. Colons in bid and asked quotes represent 32nds; 99:01 means 99 1/32. Net changes in 32nds. Yields calculated on the asked quotation. ci-stripped coupon interest. bp-Treasury bond, stripped principal. np-Treasury note, stripped principal. For bonds callable prior to maturity, yields are computed to the earliest call date for issues quoted above par and to the maturity date for issues below par.

Source: Bear, Stearns & Co. via Street Software Technology Inc.

RATE	MATURITY MO/YR	BID	ASKED	CHG	ASK YLD	RATE	MATURITY MO/YR	BID	ASKED	CHG	ASK YLD
						1.875	Jul 13i	96:25	96:26	15	2.36
						4.250	Aug 13n	95:07	95:08	9	5.03
Government Bonds & Notes						12.000	Aug 13	115:09	115:10	3	4.88
2.250	Apr 06n	99:30	99:31	...	5.02	4.250	Nov 13n	95:01	95:02	8	5.04
2.000	May 06n	99:27	99:28	...	4.29	2.000	Jan 14i	97:06	97:07	13	2.39
4.625	May 06n	100:00	100:00	...	4.20	4.000	Feb 14n	93:09	93:10	8	5.05
6.875	May 06n	100:03	100:04	...	4.08	4.750	May 14n	98:00	98:00	7	5.05
2.500	May 06n	99:25	99:26	1	4.53	13.250	May 14	123:11	123:12	5	4.89
2.750	Jun 06n	99:20	99:21	...	4.61	2.000	Jul 14i	97:02	97:03	14	2.39
7.000	Jul 06n	100:13	100:14	...	4.78	4.250	Aug 14n	94:18	94:19	8	5.05
2.750	Jul 06n	99:14	99:15	...	4.73	12.500	Aug 14	122:27	122:28	5	4.90
2.375	Aug 06n	99:07	99:08	...	4.83	11.750	Nov 14	121:27	121:28	5	4.94
2.375	Aug 06n	99:04	99:05	1	4.83	4.250	Nov 14n	94:13	94:14	9	5.06
2.500	Sep 06n	98:30	98:31	...	4.94	1.625	Jan 15i	93:27	93:28	14	2.41
6.500	Oct 06n	100:21	100:22	...	4.94	4.000	Feb 15n	92:17	92:18	7	5.05
2.500	Oct 06n	98:24	98:25	1	4.94	11.250	Feb 15	143:08	143:09	8	5.08
2.625	Nov 06n	98:23	98:24	1	4.94	4.125	May 15n	93:07	93:08	7	5.06
3.500	Nov 06n	99:06	99:07	1	4.96	1.875	Jul 15i	95:18	95:19	15	2.41
2.875	Nov 06n	98:24	98:25	1	4.96	4.250	Aug 15n	93:29	93:30	7	5.07
3.000	Dec 06n	98:21	98:22	2	4.97	10.625	Aug 15	140:17	140:18	8	5.09
3.375	Jan 07i	101:05	101:06	1	1.70	4.500	Nov 15n	95:19	95:20	7	5.08
3.125	Jan 07n	98:19	98:20	2	4.96	9.875	Nov 15	135:23	135:24	8	5.10
2.250	Feb 07n	97:27	97:28	2	4.96	2.000	Jan 16i	96:07	96:08	15	2.44
6.250	Feb 07n	100:30	100:31	2	4.97	4.500	Feb 16n	95:16	95:17	6	5.08
3.375	Feb 07n	98:21	98:22	2	4.97	9.250	Feb 16	131:18	131:19	8	5.11
3.750	Mar 07n	98:28	98:29	2	4.97	7.250	May 16	116:15	116:16	7	5.13
3.625	Apr 07n	98:22	98:23	2	4.93	7.500	Nov 16	118:30	118:31	8	5.15
6.625	May 07n	101:22	101:23	3	4.92	8.750	May 17	129:25	129:26	8	5.17
4.375	May 07n	99:13	99:14	2	4.92	8.875	Aug 17	131:07	131:08	8	5.18
3.125	May 07n	98:04	98:05	2	4.94	9.125	May 18	134:21	134:22	9	5.21
3.500	May 07n	98:15	98:16	3	4.93	9.000	Nov 18	134:10	134:11	8	5.23
3.625	Jun 07n	98:15	98:16	2	4.94	8.875	Feb 19	133:15	133:16	8	5.25
3.875	Jul 07n	98:22	98:23	3	4.93	8.125	Aug 19	127:03	127:04	8	5.26
2.750	Aug 07n	97:08	97:09	3	4.93	8.500	Feb 20	131:09	131:10	7	5.27
3.250	Aug 07n	97:28	97:29	3	4.93	8.750	May 20	134:04	134:05	8	5.28
6.125	Aug 07n	101:14	101:15	3	4.93	8.750	Aug 20	134:13	134:14	7	5.29
4.000	Aug 07n	98:25	98:26	3	4.92	7.875	Feb 21	126:06	126:07	8	5.30
4.000	Sep 07n	98:23	98:24	4	4.92	8.125	May 21	129:00	129:01	6	5.30
4.250	Oct 07n	99:01	99:02	4	4.90	8.125	Aug 21	129:09	129:10	6	5.30
3.000	Nov 07n	97:04	97:05	3	4.92	8.000	Nov 21	128:07	128:08	5	5.31
4.250	Nov 07n	99:00	99:00	4	4.91	7.250	Aug 22	120:28	120:29	5	5.31
4.375	Dec 07n	99:03	99:04	4	4.91	7.625	Nov 22	125:06	125:07	5	5.31
3.625	Jan 08i	103:00	103:00	5	1.84	7.125	Feb 23	119:27	119:28	5	5.32
4.375	Jan 08n	99:02	99:03	4	4.91	6.250	Aug 23	110:13	110:14	5	5.32
3.000	Feb 08n	96:23	96:24	4	4.90	7.500	Nov 24	125:15	125:16	6	5.32
5.500	Feb 08n	101:01	101:02	4	4.86	2.375	Jan 25i	98:04	98:05	18	2.50
3.375	Feb 08n	97:11	97:12	4	4.90	7.625	Feb 25	127:02	127:03	4	5.32
4.625	Feb 08n	99:15	99:16	4	4.90	6.875	Aug 25	118:18	118:19	5	5.32
4.625	Mar 08n	99:15	99:16	6	4.90	2.000	Jan 26i	92:10	92:11	17	2.49
4.875	Apr 08n	99:29	99:30	5	4.90	6.000	Feb 26	108:06	108:07	4	5.32
2.625	May 08n	95:19	95:20	5	4.90	6.750	Aug 26	117:16	117:17	4	5.33
3.750	May 08n	97:24	97:25	4	4.89	6.500	Nov 26	114:18	114:19	5	5.32
5.625	May 08n	101:12	101:13	5	4.89	6.625	Feb 27	116:08	116:09	3	5.32
3.250	Aug 08n	96:13	96:14	4	4.90	6.375	Aug 27	113:08	113:09	3	5.32
4.125	Aug 08n	98:13	98:14	5	4.85	6.125	Nov 27	110:07	110:08	3	5.32
3.125	Sep 08n	96:01	96:02	5	4.90	3.625	Apr 28i	119:15	119:16	22	2.47
3.125	Oct 08n	95:29	95:30	6	4.89	5.500	Aug 28	102:12	102:13	2	5.31
3.375	Nov 08n	96:11	96:12	5	4.90	5.250	Nov 28	99:04	99:05	2	5.31
4.750	Nov 08n	99:20	99:21	6	4.89	5.250	Feb 29	99:04	99:05	2	5.31
4.375	Nov 08n	98:22	98:23	5	4.91	3.875	Apr 29i	124:21	124:22	24	2.46
3.375	Dec 08n	96:08	96:09	6	4.89	6.125	Aug 29	110:25	110:26	2	5.31
3.250	Jan 09n	95:26	95:27	6	4.90	6.250	May 30	112:28	112:29	...	5.29
3.875	Jan 09i	104:26	104:27	6	2.03	5.375	Feb 31	101:12	101:13	...	5.27
4.500	Feb 09n	98:28	98:29	6	4.91	3.375	Apr 32i	119:03	119:04	25	2.38
3.000	Feb 09n	95:01	95:02	6	4.91	4.500	Feb 36	89:22	89:23	...	5.18
2.625	Mar 09n	93:29	93:30	6	4.91						
3.125	Apr 09n	95:03	95:04	6	4.91						

218

A NOTE ABOUT BOND PRICE QUOTES

If you buy a bond between coupon payment dates, the price you pay is usually more than the price you are quoted. The reason is that standard convention in the bond market is to quote prices net of "accrued interest," meaning that accrued interest is deducted to arrive at the quoted price. This quoted price is called the **clean price**. The price you actually pay, however, includes the accrued interest. This price is the **dirty price**, also known as the "full" or "invoice" price.

An example is the easiest way to understand these issues. Suppose you buy a bond with a 12 percent annual coupon, payable semiannually. You actually pay $1,080 for this bond, so $1,080 is the dirty, or invoice, price. Further, on the day you buy it, the next coupon is due in four months, so you are between coupon dates. Notice that the next coupon will be $60.

The accrued interest on a bond is calculated by taking the fraction of the coupon period that has passed, in this case two months out of six, and multiplying this fraction by the next coupon, $60. So, the accrued interest in this example is $2/6 \times \$60 = \$20$. The bond's quoted price (that is, its clean price) would be $\$1,080 - \$20 = \$1,060$.[6]

> **clean price**
> The price of a bond net of accrued interest; this is the price that is typically quoted.

> **dirty price**
> The price of a bond including accrued interest, also known as the *full* or *invoice price.* This is the price the buyer actually pays.

> **Concept Questions**
>
> **7.5a** Why do we say bond markets may have little or no transparency?
>
> **7.5b** In general, what are bid and ask prices?
>
> **7.5c** What is the difference between a bond's clean price and dirty price?

Inflation and Interest Rates   7.6

So far, we haven't considered the role of inflation in our various discussions of interest rates, yields, and returns. Because this is an important consideration, we consider the impact of inflation next.

REAL VERSUS NOMINAL RATES

In examining interest rates, or any other financial market rates such as discount rates, bond yields, rates of return, and required returns, it is often necessary to distinguish between **real rates** and **nominal rates**. Nominal rates are called "nominal" because they have not been adjusted for inflation. Real rates are rates that have been adjusted for inflation.

To see the effect of inflation, suppose prices are currently rising by 5 percent per year. In other words, the rate of inflation is 5 percent. An investment is available that will be worth $115.50 in one year. It costs $100 today. Notice that with a present value of $100 and a future value in one year of $115.50, this investment has a 15.5 percent rate of return. In calculating this 15.5 percent return, we did not consider the effect of inflation, however, so this is the nominal return.

> **real rates**
> Interest rates or rates of return that have been adjusted for inflation.

> **nominal rates**
> Interest rates or rates of return that have not been adjusted for inflation.

---

[6]The way accrued interest is calculated actually depends on the type of bond being quoted—for example, Treasury or corporate. The difference has to do with exactly how the fractional coupon period is calculated. In our example here, we implicitly treated the months as having exactly the same length (30 days each, 360 days in a year), which is consistent with the way corporate bonds are quoted. In contrast, for Treasury bonds, actual day counts are used.

What is the impact of inflation here? To answer, suppose pizzas cost $5 apiece at the beginning of the year. With $100, we can buy 20 pizzas. Because the inflation rate is 5 percent, pizzas will cost 5 percent more, or $5.25, at the end of the year. If we take the investment, how many pizzas can we buy at the end of the year? Measured in pizzas, what is the rate of return on this investment?

Our $115.50 from the investment will buy us $115.50/5.25 = 22 pizzas. This is up from 20 pizzas, so our pizza rate of return is 10 percent. What this illustrates is that even though the nominal return on our investment is 15.5 percent, our buying power goes up by only 10 percent because of inflation. Put another way, we are really only 10 percent richer. In this case, we say that the real return is 10 percent.

Alternatively, we can say that with 5 percent inflation, each of the $115.50 nominal dollars we get is worth 5 percent less in real terms, so the real dollar value of our investment in a year is:

$115.50/1.05 = $110

What we have done is to *deflate* the $115.50 by 5 percent. Because we give up $100 in current buying power to get the equivalent of $110, our real return is again 10 percent. Because we have removed the effect of future inflation here, this $110 is said to be measured in current dollars.

The difference between nominal and real rates is important and bears repeating:

> **The nominal rate on an investment is the percentage change in the number of dollars you have.**
>
> **The real rate on an investment is the percentage change in how much you can buy with your dollars—in other words, the percentage change in your buying power.**

THE FISHER EFFECT

Fisher effect
The relationship between nominal returns, real returns, and inflation.

Our discussion of real and nominal returns illustrates a relationship often called the **Fisher effect** (after the great economist Irving Fisher). Because investors are ultimately concerned with what they can buy with their money, they require compensation for inflation. Let R stand for the nominal rate and r stand for the real rate. The Fisher effect tells us that the relationship between nominal rates, real rates, and inflation can be written as:

$$1 + R = (1 + r) \times (1 + h) \qquad\qquad [7.2]$$

where h is the inflation rate.

In the preceding example, the nominal rate was 15.50 percent and the inflation rate was 5 percent. What was the real rate? We can determine it by plugging in these numbers:

$$1 + .1550 = (1 + r) \times (1 + .05)$$
$$1 + r = 1.1550/1.05 = 1.10$$
$$r = 10\%$$

This real rate is the same as we found before. If we take another look at the Fisher effect, we can rearrange things a little as follows:

$$1 + R = (1 + r) \times (1 + h)$$
$$R = r + h + r \times h \qquad\qquad [7.3]$$

What this tells us is that the nominal rate has three components. First, there is the real rate on the investment, r. Next, there is the compensation for the decrease in the value of the

money originally invested because of inflation, h. The third component represents compensation for the fact that the dollars earned on the investment are also worth less because of the inflation.

This third component is usually small, so it is often dropped. The nominal rate is then approximately equal to the real rate plus the inflation rate:

$$R \approx r + h \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad \textbf{[7.4]}$$

The Fisher Effect	**EXAMPLE 7.5**

If investors require a 10 percent real rate of return, and the inflation rate is 8 percent, what must be the approximate nominal rate? The exact nominal rate?

The nominal rate is approximately equal to the sum of the real rate and the inflation rate: 10% + 8% = 18%. From the Fisher effect, we have:

$$1 + R = (1 + r) \times (1 + h)$$
$$= 1.10 \times 1.08$$
$$= 1.1880$$

Therefore, the nominal rate will actually be closer to 19 percent.

It is important to note that financial rates, such as interest rates, discount rates, and rates of return, are almost always quoted in nominal terms. To remind you of this, we will henceforth use the symbol R instead of r in most of our discussions about such rates.

INFLATION AND PRESENT VALUES

One question that often comes up is the effect of inflation on present value calculations. The basic principle is simple: Either discount nominal cash flows at a nominal rate or discount real cash flows at a real rate. As long as you are consistent, you will get the same answer.

To illustrate, suppose you want to withdraw money each year for the next three years, and you want each withdrawal to have $25,000 worth of purchasing power as measured in current dollars. If the inflation rate is 4 percent per year, then the withdrawals will simply have to increase by 4 percent each year to compensate. The withdrawals each year will thus be:

$$C_1 = \$25,000(1.04) \qquad = \$26,000$$
$$C_2 = \$25,000(1.04)^2 \qquad = \$27,040$$
$$C_3 = \$25,000(1.04)^3 \qquad = \$28,121.60$$

What is the present value of these cash flows if the appropriate nominal discount rate is 10 percent? This is a standard calculation, and the answer is:

$$PV = \$26,000 / 1.10 + \$27,040 / 1.10^2 + \$28,121.60 / 1.10^3 = \$67,111.75$$

Notice that we discounted the nominal cash flows at a nominal rate.

To calculate the present value using real cash flows, we need the real discount rate. Using the Fisher equation, the real discount rate is:

$$(1 + R) \qquad = (1 + r)(1 + h)$$
$$(1 + .10) \qquad = (1 + r)(1 + .04)$$
$$r \qquad = .0577$$

By design, the real cash flows are an annuity of $25,000 per year. So, the present value in real terms is :

$$PV = \$25,000[1 - (1/1.0577^3)]/.0577 = \$67,111.65$$

Thus, we get exactly the same answer (after allowing for a small rounding error in the real rate). Of course, you could also use the growing annuity equation we discussed in the previous chapter. The withdrawals are increasing at 4 percent per year; so using the growing annuity formula, the present value is:

$$PV = \$26,000\left[\frac{1 - \left(\frac{1 + .04}{1 + .10}\right)^3}{.10 - .04}\right] = \$26,000\,(2.58122) = \$67,111.75$$

This is exactly the same present value we calculated before.

Concept Questions

7.6a What is the difference between a nominal and a real return? Which is more important to a typical investor?

7.6b What is the Fisher effect?

7.7 Determinants of Bond Yields

We are now in a position to discuss the determinants of a bond's yield. As we will see, the yield on any particular bond reflects a variety of factors, some common to all bonds and some specific to the issue under consideration.

THE TERM STRUCTURE OF INTEREST RATES

At any point in time, short-term and long-term interest rates will generally be different. Sometimes short-term rates are higher, sometimes lower. Figure 7.5 gives us a long-range perspective on this by showing over two centuries of short- and long-term interest rates. As shown, through time, the difference between short- and long-term rates has ranged from essentially zero to up to several percentage points, both positive and negative.

term structure of interest rates
The relationship between nominal interest rates on default-free, pure discount securities and time to maturity; that is, the pure time value of money.

The relationship between short- and long-term interest rates is known as the **term structure of interest rates**. To be a little more precise, the term structure of interest rates tells us what *nominal* interest rates are on *default-free, pure discount* bonds of all maturities. These rates are, in essence, "pure" interest rates because they involve no risk of default and a single, lump sum future payment. In other words, the term structure tells us the pure time value of money for different lengths of time.

When long-term rates are higher than short-term rates, we say that the term structure is upward sloping; when short-term rates are higher, we say it is downward sloping. The term structure can also be "humped." When this occurs, it is usually because rates increase at first, but then begin to decline as we look at longer- and longer-term rates. The most common shape of the term structure, particularly in modern times, is upward sloping; but the degree of steepness has varied quite a bit.

FIGURE 7.5   U.S. Interest Rates: 1800–2006
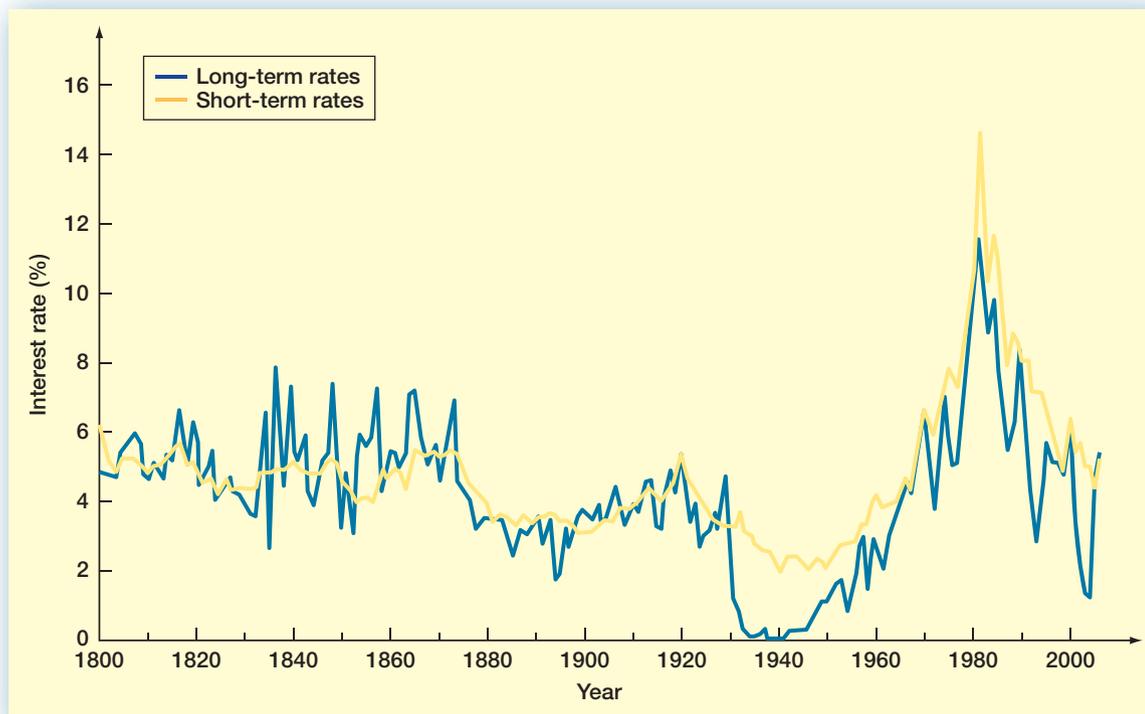
SOURCE: Jeremy J. Siegel, *Stocks for the Long Run,* 3rd edition, © McGraw-Hill, 2004; updated by the authors.

What determines the shape of the term structure? There are three basic components. The first two are the ones we discussed in our previous section: The real rate of interest and the rate of inflation. The real rate of interest is the compensation investors demand for forgoing the use of their money. You can think of it as the pure time value of money after adjusting for the effects of inflation.

The real rate of interest is the basic component underlying every interest rate, regardless of the time to maturity. When the real rate is high, all interest rates will tend to be higher, and vice versa. Thus, the real rate doesn't really determine the shape of the term structure; instead, it mostly influences the overall level of interest rates.

In contrast, the prospect of future inflation strongly influences the shape of the term structure. Investors thinking about lending money for various lengths of time recognize that future inflation erodes the value of the dollars that will be returned. As a result, investors demand compensation for this loss in the form of higher nominal rates. This extra compensation is called the **inflation premium**.

If investors believe the rate of inflation will be higher in the future, then long-term nominal interest rates will tend to be higher than short-term rates. Thus, an upward-sloping term structure may reflect anticipated increases in inflation. Similarly, a downward-sloping term structure probably reflects the belief that inflation will be falling in the future.
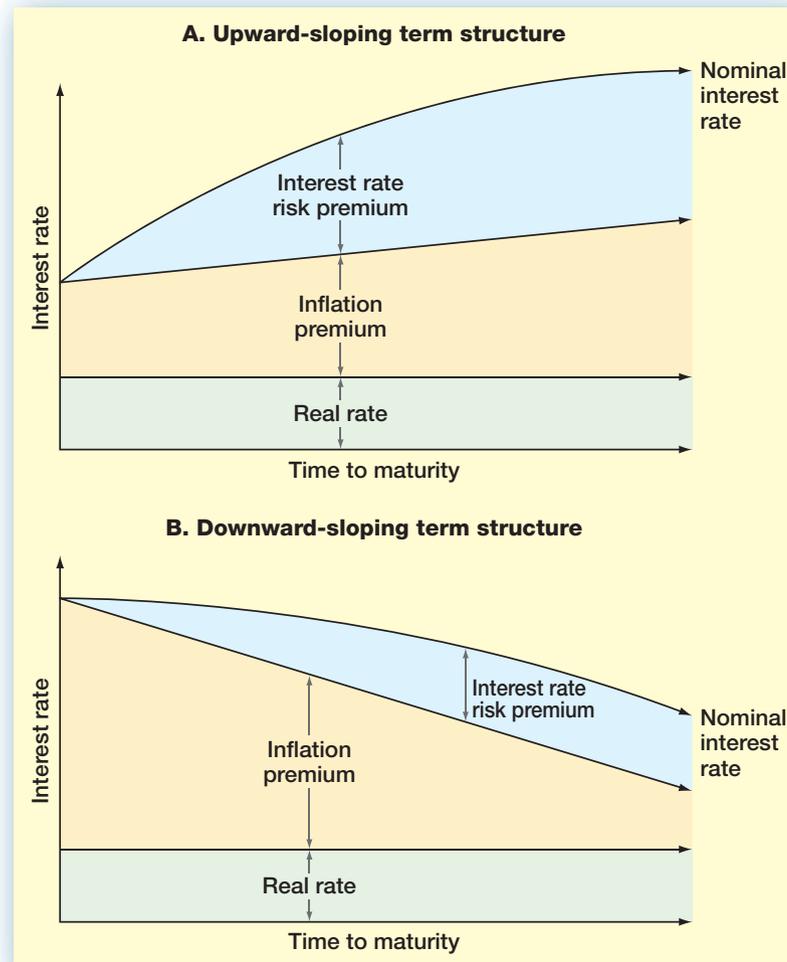
You can actually see the inflation premium in U.S. Treasury yields. Look back at Figure 7.4 and recall that the entries with an "i" after them are Treasury Inflation Protection Securities (TIPS). If you compare the yields on a TIPS to a regular note or bond with a

inflation premium
The portion of a nominal interest rate that represents compensation for expected future inflation.

A. Upward-sloping term structure

Interest rate

Nominal interest rate

Interest rate risk premium

Inflation premium

Real rate

Time to maturity

B. Downward-sloping term structure

Interest rate

Inflation premium

Interest rate risk premium

Nominal interest rate

Real rate

Time to maturity

similar maturity, the difference in the yields is the inflation premium. For the issues in Figure 7.4, check that the spread is about 2 to 3 percent, meaning that investors demand an extra 2 or 3 percent in yield as compensation for potential future inflation.

The third, and last, component of the term structure has to do with interest rate risk. As we discussed earlier in the chapter, longer-term bonds have much greater risk of loss resulting from changes in interest rates than do shorter-term bonds. Investors recognize this risk, and they demand extra compensation in the form of higher rates for bearing it. This extra compensation is called the **interest rate risk premium**. The longer is the term to maturity, the greater is the interest rate risk, so the interest rate risk premium increases with maturity. However, as we discussed earlier, interest rate risk increases at a decreasing rate, so the interest rate risk premium does as well.[7]

interest rate risk premium
The compensation investors demand for bearing interest rate risk.

[7]In days of old, the interest rate risk premium was called a "liquidity" premium. Today, the term *liquidity premium* has an altogether different meaning, which we explore in our next section. Also, the interest rate risk premium is sometimes called a *maturity risk premium*. Our terminology is consistent with the modern view of the term structure.

Putting the pieces together, we see that the term structure reflects the combined effect of the real rate of interest, the inflation premium, and the interest rate risk premium. Figure 7.6 shows how these can interact to produce an upward-sloping term structure (in the top part of Figure 7.6) or a downward-sloping term structure (in the bottom part).

In the top part of Figure 7.6, notice how the rate of inflation is expected to rise gradually. At the same time, the interest rate risk premium increases at a decreasing rate, so the combined effect is to produce a pronounced upward-sloping term structure. In the bottom part of Figure 7.6, the rate of inflation is expected to fall in the future, and the expected decline is enough to offset the interest rate risk premium and produce a downward-sloping term structure. Notice that if the rate of inflation was expected to decline by only a small amount, we could still get an upward-sloping term structure because of the interest rate risk premium.

We assumed in drawing Figure 7.6 that the real rate would remain the same. Actually, expected future real rates could be larger or smaller than the current real rate. Also, for simplicity, we used straight lines to show expected future inflation rates as rising or declining, but they do not necessarily have to look like this. They could, for example, rise and then fall, leading to a humped yield curve.

BOND YIELDS AND THE YIELD CURVE: PUTTING IT ALL TOGETHER

Going back to Figure 7.4, recall that we saw that the yields on Treasury notes and bonds of different maturities are not the same. Each day, in addition to the Treasury prices and yields shown in Figure 7.4, *The Wall Street Journal* provides a plot of Treasury yields relative to maturity. This plot is called the **Treasury yield curve** (or just the yield curve). Figure 7.7 shows the yield curve as of June 2006.

Treasury yield curve
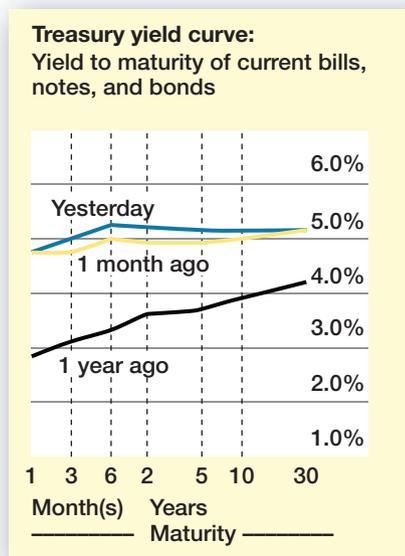A plot of the yields on Treasury notes and bonds relative to maturity.

FIGURE 7.7

The Treasury Yield Curve: June, 2006

Treasury yield curve:
Yield to maturity of current bills, notes, and bonds

Online yield curve information is available at www.bloomberg.com/markets.

As you probably now suspect, the shape of the yield curve reflects of the term structure of interest rates. In fact, the Treasury yield curve and the term structure of interest rates are almost the same thing. The only difference is that the term structure is based on pure discount bonds, whereas the yield curve is based on coupon bond yields. As a result, Treasury yields depend on the three components that underlie the term structure—the real rate, expected future inflation, and the interest rate risk premium.

Treasury notes and bonds have three important features that we need to remind you of: They are default-free, they are taxable, and they are highly liquid. This is not true of bonds in general, so we need to examine what additional factors come into play when we look at bonds issued by corporations or municipalities.

The first thing to consider is credit risk—that is, the possibility of default. Investors recognize that issuers other than the Treasury may or may not make all the promised payments on a bond, so they demand a higher yield as compensation for this risk. This extra compensation is called the **default risk premium**. Earlier in the chapter, we saw how bonds were rated based on their credit risk. What you will find if you start looking at bonds of different ratings is that lower-rated bonds have higher yields.

An important thing to recognize about a bond's yield is that it is calculated assuming that all the promised payments will be made. As a result, it is really a promised yield, and it may or may not be what you will earn. In particular, if the issuer defaults, your actual yield will be lower—probably much lower. This fact is particularly important when it comes to junk bonds. Thanks to a clever bit of marketing, such bonds are now commonly called high-yield bonds, which has a much nicer ring to it; but now you recognize that these are really high *promised* yield bonds.

Next, recall that we discussed earlier how municipal bonds are free from most taxes and, as a result, have much lower yields than taxable bonds. Investors demand the extra yield on a taxable bond as compensation for the unfavorable tax treatment. This extra compensation is the **taxability premium**.

Finally, bonds have varying degrees of liquidity. As we discussed earlier, there are an enormous number of bond issues, most of which do not trade regularly. As a result, if you wanted to sell quickly, you would probably not get as good a price as you could otherwise. Investors prefer liquid assets to illiquid ones, so they demand a **liquidity premium** on top of all the other premiums we have discussed. As a result, all else being the same, less liquid bonds will have higher yields than more liquid bonds.

default risk premium
The portion of a nominal interest rate or bond yield that represents compensation for the possibility of default.

taxability premium
The portion of a nominal interest rate or bond yield that represents compensation for unfavorable tax status.

liquidity premium
The portion of a nominal interest rate or bond yield that represents compensation for lack of liquidity.

CONCLUSION

If we combine all of the things we have discussed regarding bond yields, we find that bond yields represent the combined effect of no fewer than six things. The first is the real rate of interest. On top of the real rate are five premiums representing compensation for (1) expected future inflation, (2) interest rate risk, (3) default risk, (4) taxability, and (5) lack of liquidity. As a result, determining the appropriate yield on a bond requires careful analysis of each of these effects.

Concept Questions

7.7a What is the term structure of interest rates? What determines its shape?

7.7b What is the Treasury yield curve?

7.7c What six components make up a bond's yield?

Summary and Conclusions 7.8

This chapter has explored bonds, bond yields, and interest rates:

1. Determining bond prices and yields is an application of basic discounted cash flow principles.
2. Bond values move in the direction opposite that of interest rates, leading to potential gains or losses for bond investors.
3. Bonds have a variety of features spelled out in a document called the indenture.
4. Bonds are rated based on their default risk. Some bonds, such as Treasury bonds, have no risk of default, whereas so-called junk bonds have substantial default risk.
5. A wide variety of bonds exist, many of which contain exotic or unusual features.
6. Almost all bond trading is OTC, with little or no market transparency in many cases. As a result, bond price and volume information can be difficult to find for some types of bonds.
7. Bond yields and interest rates reflect the effect of six different things: the real interest rate and five premiums that investors demand as compensation for inflation, interest rate risk, default risk, taxability, and lack of liquidity.

In closing, we note that bonds are a vital source of financing to governments and corporations of all types. Bond prices and yields are a rich subject, and our one chapter, necessarily, touches on only the most important concepts and ideas. There is a great deal more we could say, but, instead, we will move on to stocks in our next chapter.

CHAPTER REVIEW AND SELF-TEST PROBLEMS

7.1 **Bond Values** A Microgates Industries bond has a 10 percent coupon rate and a $1,000 face value. Interest is paid semiannually, and the bond has 20 years to maturity. If investors require a 12 percent yield, what is the bond's value? What is the effective annual yield on the bond?

7.2 **Bond Yields** A Macrohard Corp. bond carries an 8 percent coupon, paid semiannually. The par value is $1,000, and the bond matures in six years. If the bond currently sells for $911.37, what is its yield to maturity? What is the effective annual yield?

ANSWERS TO CHAPTER REVIEW AND SELF-TEST PROBLEMS

7.1 Because the bond has a 10 percent coupon yield and investors require a 12 percent return, we know that the bond must sell at a discount. Notice that, because the bond pays interest semiannually, the coupons amount to $100/2 = $50 every six months. The required yield is 12%/2 = 6% every six months. Finally, the bond matures in 20 years, so there are a total of 40 six-month periods.

The bond's value is thus equal to the present value of $50 every six months for the next 40 six-month periods plus the present value of the $1,000 face amount:

$$\text{Bond value} = \$50 \times [(1 - 1/1.06^{40})/.06] + 1{,}000/1.06^{40}$$
$$= \$50 \times 15.04630 + 1{,}000/10.2857$$
$$= \$849.54$$

Notice that we discounted the $1,000 back 40 periods at 6 percent per period, rather than 20 years at 12 percent. The reason is that the effective annual yield on the bond is $1.06^2 - 1 = 12.36\%$, not 12 percent. We thus could have used 12.36 percent per year for 20 years when we calculated the present value of the $1,000 face amount, and the answer would have been the same.

7.2   The present value of the bond's cash flows is its current price, $911.37. The coupon is $40 every six months for 12 periods. The face value is $1,000. So the bond's yield is the unknown discount rate in the following:

$$\$911.37 = \$40 \times [1 - 1/(1 + r)^{12}]/r + 1,000/(1 + r)^{12}$$

The bond sells at a discount. Because the coupon rate is 8 percent, the yield must be something in excess of that.

If we were to solve this by trial and error, we might try 12 percent (or 6 percent per six months):

$$\text{Bond value} = \$40 \times (1 - 1/1.06^{12})/.06 + 1,000/1.06^{12}$$
$$= \$832.32$$

This is less than the actual value, so our discount rate is too high. We now know that the yield is somewhere between 8 and 12 percent. With further trial and error (or a little machine assistance), the yield works out to be 10 percent, or 5 percent every six months.

By convention, the bond's yield to maturity would be quoted as $2 \times 5\% = 10\%$. The effective yield is thus $1.05^2 - 1 = 10.25\%$.

CONCEPTS REVIEW AND CRITICAL THINKING QUESTIONS

1.   **Treasury Bonds**   Is it true that a U.S. Treasury security is risk-free?

2.   **Interest Rate Risk**   Which has greater interest rate risk, a 30-year Treasury bond or a 30-year BB corporate bond?

3.   **Treasury Pricing**   With regard to bid and ask prices on a Treasury bond, is it possible for the bid price to be higher? Why or why not?

4.   **Yield to Maturity**   Treasury bid and ask quotes are sometimes given in terms of yields, so there would be a bid yield and an ask yield. Which do you think would be larger? Explain.

5.   **Call Provisions**   A company is contemplating a long-term bond issue. It is debating whether to include a call provision. What are the benefits to the company from including a call provision? What are the costs? How do these answers change for a put provision?

6.   **Coupon Rate**   How does a bond issuer decide on the appropriate coupon rate to set on its bonds? Explain the difference between the coupon rate and the required return on a bond.

7.   **Real and Nominal Returns**   Are there any circumstances under which an investor might be more concerned about the nominal return on an investment than the real return?

8.   **Bond Ratings**   Companies pay rating agencies such as Moody's and S&P to rate their bonds, and the costs can be substantial. However, companies are not required to have their bonds rated; doing so is strictly voluntary. Why do you think they do it?

9.   **Bond Ratings**   U.S. Treasury bonds are not rated. Why? Often, junk bonds are not rated. Why?

10. **Term Structure**   What is the difference between the term structure of interest rates and the yield curve?

11. **Crossover Bonds** Looking back at the crossover bonds we discussed in the chapter, why do you think split ratings such as these occur?

12. **Municipal Bonds** Why is it that municipal bonds are not taxed at the federal level, but are taxable across state lines? Why are U.S. Treasury bonds not taxable at the state level? (You may need to dust off the history books for this one.)

13. **Bond Market** What are the implications for bond investors of the lack of transparency in the bond market?

14. **Treasury Market** All Treasury bonds are relatively liquid, but some are more liquid than others. Take a look back at Figure 7.4. Which issues appear to be the most liquid? The least liquid?

15. **Rating Agencies** A controversy erupted regarding bond-rating agencies when some agencies began to provide unsolicited bond ratings. Why do you think this is controversial?

16. **Bonds as Equity** The 100-year bonds we discussed in the chapter have something in common with junk bonds. Critics charge that, in both cases, the issuers are really selling equity in disguise. What are the issues here? Why would a company want to sell "equity in disguise"?

QUESTIONS AND PROBLEMS

1. **Interpreting Bond Yields** Is the yield to maturity on a bond the same thing as the required return? Is YTM the same thing as the coupon rate? Suppose today a 10 percent coupon bond sells at par. Two years from now, the required return on the same bond is 8 percent. What is the coupon rate on the bond then? The YTM?

BASIC
(Questions 1–14)

2. **Interpreting Bond Yields** Suppose you buy a 7 percent coupon, 20-year bond today when it's first issued. If interest rates suddenly rise to 15 percent, what happens to the value of your bond? Why?

3. **Bond Prices** Carpenter, Inc., has 8 percent coupon bonds on the market that have 10 years left to maturity. The bonds make annual payments. If the YTM on these bonds is 9 percent, what is the current bond price?

4. **Bond Yields** Linebacker Co. has 7 percent coupon bonds on the market with nine years left to maturity. The bonds make annual payments. If the bond currently sells for $1,080, what is its YTM?

5. **Coupon Rates** Hawk Enterprises has bonds on the market making annual payments, with 16 years to maturity, and selling for $870. At this price, the bonds yield 7.5 percent. What must the coupon rate be on the bonds?

6. **Bond Prices** Cutler Co. issued 11-year bonds a year ago at a coupon rate of 7.8 percent. The bonds make semiannual payments. If the YTM on these bonds is 8.6 percent, what is the current bond price?

7. **Bond Yields** Ngata Corp. issued 12-year bonds 2 years ago at a coupon rate of 9.2 percent. The bonds make semiannual payments. If these bonds currently sell for 104 percent of par value, what is the YTM?

8. **Coupon Rates** Wimbley Corporation has bonds on the market with 14.5 years to maturity, a YTM of 6.8 percent, and a current price of $1,136.50. The bonds make semiannual payments. What must the coupon rate be on these bonds?

9. **Calculating Real Rates of Return** If Treasury bills are currently paying 8 percent and the inflation rate is 4.5 percent, what is the approximate real rate of interest? The exact real rate?

10. **Inflation and Nominal Returns** Suppose the real rate is 4 percent and the inflation rate is 5.8 percent. What rate would you expect to see on a Treasury bill?

11. **Nominal and Real Returns** An investment offers a 15 percent total return over the coming year. Bill Bernanke thinks the total real return on this investment will be only 7 percent. What does Bill believe the inflation rate will be over the next year?

12. **Nominal versus Real Returns** Say you own an asset that had a total return last year of 14.2 percent. If the inflation rate last year was 5.3 percent, what was your real return?

13. **Using Treasury Quotes** Locate the Treasury issue in Figure 7.4 maturing in November 2027. Is this a note or a bond? What is its coupon rate? What is its bid price? What was the *previous* day's asked price?

14. **Using Treasury Quotes** Locate the Treasury bond in Figure 7.4 maturing in November 2024. Is this a premium or a discount bond? What is its current yield? What is its yield to maturity? What is the bid–ask spread?

INTERMEDIATE
(Questions 15–28)

15. **Bond Price Movements** Bond X is a premium bond making annual payments. The bond pays a 9 percent coupon, has a YTM of 7 percent, and has 13 years to maturity. Bond Y is a discount bond making annual payments. This bond pays a 7 percent coupon, has a YTM of 9 percent, and also has 13 years to maturity. If interest rates remain unchanged, what do you expect the price of these bonds to be one year from now? In three years? In eight years? In 12 years? In 13 years? What's going on here? Illustrate your answers by graphing bond prices versus time to maturity.

16. **Interest Rate Risk** Both Bond Sam and Bond Dave have 8 percent coupons, make semiannual payments, and are priced at par value. Bond Sam has 2 years to maturity, whereas Bond Dave has 15 years to maturity. If interest rates suddenly rise by 2 percent, what is the percentage change in the price of Bond Sam? Of Bond Dave? If rates were to suddenly fall by 2 percent instead, what would the percentage change in the price of Bond Sam be then? Of Bond Dave? Illustrate your answers by graphing bond prices versus YTM. What does this problem tell you about the interest rate risk of longer-term bonds?

17. **Interest Rate Risk** Bond J is a 4 percent coupon bond. Bond K is a 12 percent coupon bond. Both bonds have eight years to maturity, make semiannual payments, and have a YTM of 7 percent. If interest rates suddenly rise by 2 percent, what is the percentage price change of these bonds? What if rates suddenly fall by 2 percent instead? What does this problem tell you about the interest rate risk of lower-coupon bonds?

18. **Bond Yields** Caribbean Reef Software has 8.4 percent coupon bonds on the market with nine years to maturity. The bonds make semiannual payments and currently sell for 95.5 percent of par. What is the current yield on the bonds? The YTM? The effective annual yield?

19. **Bond Yields** Giles Co. wants to issue new 20-year bonds for some much-needed expansion projects. The company currently has 7 percent coupon bonds on the market that sell for $1,062, make semiannual payments, and mature in 20 years. What coupon rate should the company set on its new bonds if it wants them to sell at par?

20. **Accrued Interest** You purchase a bond with an invoice price of $1,090. The bond has a coupon rate of 8.6 percent, and there are five months to the next semiannual coupon date. What is the clean price of the bond?

21. **Accrued Interest** You purchase a bond with a coupon rate of 7.5 percent and a clean price of $865. If the next semiannual coupon payment is due in three months, what is the invoice price?

22. **Finding the Bond Maturity** Jude Corp. has 9 percent coupon bonds making annual payments with a YTM of 6.3 percent. The current yield on these bonds is 7.1 percent. How many years do these bonds have left until they mature?

23. **Using Bond Quotes** Suppose the following bond quotes for IOU Corporation appear in the financial page of today's newspaper. Assume the bond has a face value of $1,000 and the current date is April 15, 2007. What is the yield to maturity of the bond? What is the current yield? What is the yield to maturity on a comparable U.S. Treasury issue?

Company (Ticker)	Coupon	Maturity	Last Price	Last Yield	EST Spread	UST	EST Vol (000s)
IOU (IOU)	8.4	Apr 15, 2017	84.35	??	468	10	1,827

24. **Bond Prices versus Yields**
    a. What is the relationship between the price of a bond and its YTM?
    b. Explain why some bonds sell at a premium over par value while other bonds sell at a discount. What do you know about the relationship between the coupon rate and the YTM for premium bonds? What about for discount bonds? For bonds selling at par value?
    c. What is the relationship between the current yield and YTM for premium bonds? For discount bonds? For bonds selling at par value?

25. **Interest on Zeroes** Snowflake Corporation needs to raise funds to finance a plant expansion, and it has decided to issue 25-year zero coupon bonds to raise the money. The required return on the bonds will be 8 percent.
    a. What will these bonds sell for at issuance?
    b. Using the IRS amortization rule, what interest deduction can Snowflake Corporation take on these bonds in the first year? In the last year?
    c. Repeat part (b) using the straight-line method for the interest deduction.
    d. Based on your answers in (b) and (c), which interest deduction method would Snowflake Corporation prefer? Why?

26. **Zero Coupon Bonds** Suppose your company needs to raise $20 million and you want to issue 30-year bonds for this purpose. Assume the required return on your bond issue will be 7 percent, and you're evaluating two issue alternatives: a 7 percent annual coupon bond and a zero coupon bond. Your company's tax rate is 35 percent.
    a. How many of the coupon bonds would you need to issue to raise the $20 million? How many of the zeroes would you need to issue?
    b. In 30 years, what will your company's repayment be if you issue the coupon bonds? What if you issue the zeroes?
    c. Based on your answers in (a) and (b), why would you ever want to issue the zeroes? To answer, calculate the firm's aftertax cash outflows for the first year under the two different scenarios. Assume the IRS amortization rules apply for the zero coupon bonds.

27. **Finding the Maturity** You've just found a 10 percent coupon bond on the market that sells for par value. What is the maturity on this bond?

28. **Real Cash Flows** You want to have $1 million in real dollars in an account when you retire in 40 years. The nominal return on your investment is 11 percent and

the inflation rate is 4.5 percent. What real amount must you deposit each year to achieve your goal?

CHALLENGE
(Questions 29–35)

29. **Components of Bond Returns** Bond P is a premium bond with a 9 percent coupon. Bond D is a 5 percent coupon bond currently selling at a discount. Both bonds make annual payments, have a YTM of 7 percent, and have five years to maturity. What is the current yield for bond P? For bond D? If interest rates remain unchanged, what is the expected capital gains yield over the next year for bond P? For bond D? Explain your answers and the interrelationships among the various types of yields.

30. **Holding Period Yield** The YTM on a bond is the interest rate you earn on your investment if interest rates don't change. If you actually sell the bond before it matures, your realized return is known as the *holding period yield* (HPY).

   a. Suppose that today you buy an 8 percent annual coupon bond for $1,105. The bond has 10 years to maturity. What rate of return do you expect to earn on your investment?

   b. Two years from now, the YTM on your bond has declined by 1 percent, and you decide to sell. What price will your bond sell for? What is the HPY on your investment? Compare this yield to the YTM when you first bought the bond. Why are they different?

31. **Valuing Bonds** The Mangold Corporation has two different bonds currently outstanding. Bond M has a face value of $20,000 and matures in 20 years. The bond makes no payments for the first six years, then pays $1,100 every six months over the subsequent eight years, and finally pays $1,400 every six months over the last six years. Bond N also has a face value of $20,000 and a maturity of 20 years; it makes no coupon payments over the life of the bond. If the required return on both these bonds is 9 percent compounded semiannually, what is the current price of bond M? Of bond N?

32. **Valuing the Call Feature** Consider the prices in the following three Treasury issues as of May 15, 2007:

6.500	May 13n	106:10	106:12	−13	5.28
8.250	May 13	103:14	103:16	− 3	5.24
12.000	May 13	134:25	134:31	−15	5.32

   The bond in the middle is callable in February 2008. What is the implied value of the call feature? (*Hint:* Is there a way to combine the two noncallable issues to create an issue that has the same coupon as the callable bond?)

33. **Treasury Bonds** The following Treasury bond quote appeared in *The Wall Street Journal* on May 11, 2004:

9.125	May 09	100:03	100:04	. . .	−2.15

   Why would anyone buy this Treasury bond with a negative yield to maturity? How is this possible?

34. **Real Cash Flows** When Marilyn Monroe died, ex-husband Joe DiMaggio vowed to place fresh flowers on her grave every Sunday as long as he lived. The week after she died in 1962, a bunch of fresh flowers that the former baseball player thought appropriate for the star cost about $5. Based on actuarial tables, "Joltin' Joe" could expect to live for 30 years after the actress died. Assume that the EAR is 10.4 percent. Also, assume that the price of the flowers will increase at 3.9 percent per year, when expressed as an EAR. Assuming that each year has exactly 52 weeks, what is the present value of this commitment? Joe began purchasing flowers the week after Marilyn died.

35. **Real Cash Flows** You are planning to save for retirement over the next 30 years. To save for retirement, you will invest $700 a month in a stock account in real dollars and $300 a month in a bond account in real dollars. The effective annual return of the stock account is expected to be 11 percent, and the bond account will earn 7 percent. When you retire, you will combine your money into an account with a 9 percent effective return. The inflation rate over this period is expected to be 4 percent. How much can you withdraw each month from your account in real terms assuming a 25-year withdrawal period? What is the nominal dollar amount of your last withdrawal?

7.1 **Bond Quotes** You can find the current bond quotes for many companies at www.nasdbondinfo.com. Go to the site and find the bonds listed for Georgia Pacific. What is the shortest-maturity bond listed for Georgia Pacific? What is the longest-maturity bond? What are the credit ratings for each bond? Do each of the bonds have the same credit rating? Why do you think this is?

7.2 **Yield Curves** You can find information regarding the most current bond yields at money.cnn.com. Graph the yield curve for U.S. Treasury bonds. What is the general shape of the yield curve? What does this imply about the expected future inflation? Now graph the yield curve for AAA, AA, and A rated corporate bonds. Is the corporate yield curve the same shape as the Treasury yield curve? Why or why not?

7.3 **Default Premiums** The St. Louis Federal Reserve Board has files listing historical interest rates on their Web site: www.stls.frb.org. Find the link for "FRED II" data, then "Interest Rates." You will find listings for Moody's Seasoned Aaa Corporate Bond Yield and Moody's Seasoned Baa Corporate Bond Yield. A default premium can be calculated as the difference between the Aaa bond yield and the Baa bond yield. Calculate the default premium using these two bond indexes for the most recent 36 months. Is the default premium the same for every month? Why do you think this is?

Visit us at www.mhhe.com/rwj

MINICASE

Financing S&S Air's Expansion Plans with a Bond Issue

Mark Sexton and Todd Story, the owners of S&S Air, have decided to expand their operations. They instructed their newly hired financial analyst, Chris Guthrie, to enlist an underwriter to help sell $20 million in new 10-year bonds to finance construction. Chris has entered into discussions with Danielle Ralston, an underwriter from the firm of Raines and Warren, about which bond features S&S Air should consider and what coupon rate the issue will likely have.

Although Chris is aware of the bond features, he is uncertain about the costs and benefits of some features, so he isn't sure how each feature would affect the coupon rate of the bond issue. You are Danielle's assistant, and she has asked you to prepare a memo to Chris describing the effect of each of the following bond features on the coupon rate of the bond. She would also like you to list any advantages or disadvantages of each feature:

1. The security of the bond—that is, whether the bond has collateral.
2. The seniority of the bond.
3. The presence of a sinking fund.
4. A call provision with specified call dates and call prices.
5. A deferred call accompanying the call provision.
6. A make-whole call provision.
7. Any positive covenants. Also, discuss several possible positive covenants S&S Air might consider.
8. Any negative covenants. Also, discuss several possible negative covenants S&S Air might consider.
9. A conversion feature (note that S&S Air is not a publicly traded company).
10. A floating-rate coupon.