CHAPTER 7

BONDS AND THEIR VALUATION

Sizing Up Risk in the Bond Market

Many investors view Treasury securities as a safe but lackluster place to invest their funds. Treasuries are among the safest investments; nevertheless, in any given year, changing interest rates can cause significant changes in bond values, particularly for long-term bonds. For example, long-term Treasuries lost nearly 9 percent in 1999. More recently, Treasury bonds have performed quite well—indeed, they outperformed stocks in three of the five years between 2000 and 2004.

All bonds don't move in the same direction. Because of call and default risks, corporate bonds have higher yields than Treasuries. The yield spread between high-grade corporate and Treasury bonds is fairly small, but it is quite wide for companies with lower credit ratings and thus higher default risk. Indeed, changes in a firm's credit situation can cause dramatic shifts in its yield spreads. For example, amidst concerns about WorldCom's long-term viability, the spread on its five-year bonds that once had been just 1.67 percent jumped to over 20 percent in mid-2002. These bonds subsequently defaulted, which is what the huge spread predicted.

When all is going well in the economy, corporate bonds generally return more to investors than Treasuries. However, when the economy weakens and concerns about defaults rise, corporate bonds do worse than Treasuries. For example, from the beginning of 2000 to the end of 2002, a sluggish economy and the string of accounting scandals led to some major corporate defaults, which worried investors. Corporate bond prices declined relative to Treasury prices, and the result was an increase in the average yield spread. Since the beginning of 2003, though, the spread has declined as the economy rebounded.

To deal with these various risks, a recent *BusinessWeek Online* article gave investors the following useful advice:

> Take the same diversified approach to bonds as you do with stocks. Blend in U.S. government, corporate—both high-quality and high-yield—and perhaps even some foreign government debt. If you're investing taxable dollars, consider tax-exempt municipal bonds. And it doesn't hurt to layer in some inflation-indexed bonds.

Sources: Susan Scherreik, "Getting the Most Bang Out of Your Bonds," *BusinessWeek Online*, November 12, 2001; and *Stocks, Bonds, Bills, and Inflation: 2005 Yearbook (Valuation Edition)*, (Chicago: Ibbotson Associates, 2005).

Putting Things In Perspective

Bonds are one of the most important securities. If you skim through *The Wall Street Journal*, you will see references to a wide variety of bonds. This variety may seem confusing, but in actuality only a few characteristics distinguish the various types of bonds. In this chapter, we discuss the types of bonds companies and governments issue, the terms built into bond contracts, the procedures for determining bond prices and rates of return, and the types of risk bond investors and issuers face.

7.1 WHO ISSUES BONDS?

Bond
A long-term debt instrument.

A **bond** is a long-term contract under which a borrower agrees to make payments of interest and principal, on specific dates, to the holders of the bond. For example, on January 3, 2006, Allied Food Products borrowed $50 million by issuing $50 million of bonds. For convenience, we assume that Allied sold 50,000 individual bonds for $1,000 each. Actually, it could have sold one $50 million bond, 10 bonds each with a $5 million face value, or any other combination that totals to $50 million. In any event, Allied received the $50 million, and in exchange it promised to make annual interest payments and to repay the $50 million on a specified maturity date.

Until the 1970s, most bonds were beautifully engraved pieces of paper, and their key terms, including their face values, were spelled out on the bonds themselves. Today, though, virtually all bonds are represented by electronic data stored in secure computers, much like the "money" in a bank checking account.[1]

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[1] The Internal Revenue Service put pressure on corporations to move from paper bonds to "book entry" bonds for two reasons: (1) With paper bonds, there was no systematic record of who received interest payments, hence it was relatively easy for bondholders to cheat on their income taxes. (2) People could store unregistered paper bonds in safe-deposit boxes, and when they died, their heirs could simply remove them and thereby evade estate taxes. Book entry prevents these evasions.

Investors have many choices when investing in bonds, but bonds are classified into four main types: Treasury, corporate, municipal, and foreign. Each differs with respect to risk and consequently to its expected return.

Treasury bonds, generally called Treasuries and sometimes referred to as government bonds, are issued by the federal government.[2] It is reasonable to assume that the federal government will make good on its promised payments, so Treasuries have no default risk. However, these bonds' prices decline when interest rates rise, so they are not completely risk free.

Corporate bonds, as the name implies, are issued by corporations. Unlike Treasuries, corporate bonds are exposed to default risk—if the issuing company gets into trouble, it may be unable to make the promised interest and principal payments. Different corporate bonds have different levels of default risk, depending on the issuing company's characteristics and on the terms of the specific bond. Default risk is often referred to as "credit risk," and, as we saw in Chapter 6, the larger the default risk, the higher the interest rate investors demand.

Municipal bonds, or "munis," are issued by state and local governments. Like corporates, munis are exposed to some default risk. However, munis offer one major advantage over all other bonds: As we discussed in Chapter 3, the interest earned on most munis is exempt from federal taxes, and also from state taxes if the holder is a resident of the issuing state. Consequently, the interest rates on munis are considerably lower than on corporates of equivalent risk.

Foreign bonds are issued by foreign governments or foreign corporations. Foreign corporate bonds are, of course, exposed to default risk, and so are the bonds of some foreign governments. An additional risk exists if the bonds are denominated in a currency other than that of the investor's home currency. For example, if you purchase a corporate bond denominated in Japanese yen, even if the company does not default you still could lose money if the Japanese yen falls relative to the dollar.

Treasury Bonds
Bonds issued by the federal government, sometimes referred to as government bonds.

Corporate Bonds
Bonds issued by corporations.

Municipal Bonds
Bonds issued by state and local governments.

Foreign Bonds
Bonds issued by either foreign governments or foreign corporations.

SELF TEST

What is a bond?

What are the four main types of bonds?

Why are U.S. Treasury bonds not completely riskless?

In addition to default risk, what key risk do investors in foreign bonds face?

7.2 KEY CHARACTERISTICS OF BONDS

Although all bonds have some common characteristics, different bonds also have some different contractual features. For example, most corporate bonds have provisions for early repayment (call features), but the specific call provisions can vary widely among different bonds. Similarly, some bonds are backed by specific assets that must be turned over to the bondholders if the issuer defaults, while other bonds have no such collateral backup. Differences in contractual provisions, and in the fundamental, underlying financial strength of the

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[2] The U.S. Treasury actually calls its debt "bills," "notes," or "bonds." T-bills generally have maturities of 1 year or less at the time of issue, notes generally have original maturities of 2 to 7 years, and bonds mature in 8 to 30 years. There are technical differences between bills, notes, and bonds, but they are not important for our purposes, so we generally call all Treasury securities "bonds." Note too that a 30-year T-bond at the time of issue becomes a 29-year bond the next year, and it becomes a 1-year bond after 29 years.

companies backing the bonds, lead to differences in bonds' risks, prices, and expected returns. To understand bonds, it is essential that you understand the following terms.

Par Value

Par Value
The face value of a bond.

The **par value** is the stated face value of the bond; for illustrative purposes we generally assume a par value of $1,000, although any multiple of $1,000 (for example, $5,000 or $5 million) can be used. The par value generally represents the amount of money the firm borrows and promises to repay on the maturity date.

Coupon Interest Rate

Coupon Payment
The specified number of dollars of interest paid each year.

Coupon Interest Rate
The stated annual interest rate on a bond.

Allied Food Products' bonds require the company to pay a fixed number of dollars of interest each year. When this annual **coupon payment,** as it is called, is divided by the par value, the result is the **coupon interest rate.** For example, Allied's bonds have a $1,000 par value, and they pay $100 in interest each year. The bond's coupon payment is $100, so its coupon interest rate is $100/$1,000 = 10%. The $100 is the annual "rent" on the $1,000 loan. This payment, which is set at the time the bond is issued, remains in force during the bond's life.[3] Typically, at the time a bond is issued, its coupon payment is set at a level that will induce investors to buy the bond at or near its par value. Most of the examples and problems throughout this text will focus on bonds with fixed coupon rates.

Floating-Rate Bond
A bond whose interest rate fluctuates with shifts in the general level of interest rates.

In some cases, however, a bond's coupon payment will be allowed to vary over time. These **floating-rate bonds** work as follows. The coupon rate is set for an initial period, often six months, after which it is adjusted every six months based on some open market rate. For example, many corporate issues are tied to the 10-year Treasury bond rate. Other provisions can be included in these bonds. For example, some are convertible at the holders' option to fixed-rate debt, whereas others have upper and lower limits ("caps" and "floors") on how high or low the rate can go.

Zero Coupon Bond
A bond that pays no annual interest but is sold at a discount below par, thus providing compensation to investors in the form of capital appreciation.

Original Issue Discount (OID) Bond
Any bond originally offered at a price below its par value.

Some bonds pay no coupons at all, but are offered at a discount below their par values and hence provide capital appreciation rather than interest income. These securities are called **zero coupon bonds** (*zeros*). Other bonds pay some coupon interest, but not enough to allow them to be issued at par. In general, any bond originally offered at a price significantly below its par value is called an **original issue discount (OID) bond.** Some of the details associated with issuing or investing in zero coupon bonds are discussed more fully in Web Appendix 7A.

Maturity Date

Maturity Date
A specified date on which the par value of a bond must be repaid.

Bonds generally have a specified **maturity date** on which the par value must be repaid. Allied's bonds, which were issued on January 3, 2006, will mature on January 2, 2021; thus, they had a 15-year maturity at the time they were issued.

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[3] Back when bonds were pieces of paper, the "main bond" had a number of small (1/2- by 2-inch), dated, coupons attached to them, and on each interest payment date, the owner would "clip the coupon" for that date, send it to the company's paying agent, and receive a check for the interest. A 30-year, semiannual bond would start with 60 coupons, whereas a 5-year, annual payment, bond would start with only 5 coupons. Today, no physical coupons are involved, and interest checks are mailed automatically to the bonds' registered owners. Even so, people continue to use the terms *coupon* and *coupon interest rate* when discussing bonds.

Most bonds have **original maturities** (the maturity at the time the bond is issued) ranging from 10 to 40 years, but any maturity is legally permissible.[4] Of course, the effective maturity of a bond declines each year after it has been issued. Thus, Allied's bonds had a 15-year original maturity, but in 2007, a year later, they will have a 14-year maturity, and so on.

Original Maturity
The number of years to maturity at the time a bond is issued.

Call Provisions

Most corporate and municipal bonds, but not Treasury bonds, contain a **call provision,** which gives the issuer the right to call the bonds for redemption.[5] The call provision generally states that the issuer must pay the bondholders an amount greater than the par value if they are called. The additional sum, which is termed a *call premium*, is often set equal to one year's interest. For example, the call premium on a 10-year bond with a 10 percent annual coupon and a par value of $1,000 would be $100, which means that the issuer would have to pay investors $1,100 (the par value plus the call premium) if they wanted to call the bonds. In most cases the provisions in the bond contract are set so that the call premium declines over time as the bonds approach maturity. Also, while some bonds are immediately callable, in most cases bonds are often not callable until several years (generally 5 to 10) after issue. This is known as a *deferred call*, and the bonds are said to have *call protection*.

Call Provision
A provision in a bond contract that gives the issuer the right to redeem the bonds under specified terms prior to the normal maturity date.

Suppose a company sold bonds when interest rates were relatively high. Provided the issue is callable, the company could sell a new issue of low-yielding securities if and when interest rates drop, use the proceeds of the new issue to retire the high-rate issue, and thus reduce its interest expense. This process is called a *refunding operation*. Thus, the call privilege is valuable to the firm but detrimental to long-term investors, who will be forced to reinvest the amount they receive at the new and lower rates. Accordingly, the interest rate on new issues of callable bonds will exceed that on new noncallable bonds. For example, on August 30, 2005, Pacific Timber Company sold a bond issue yielding 8 percent; these bonds were callable immediately. On the same day, Northwest Milling Company sold an issue of similar risk and maturity that yielded only 7.5 percent; its bonds were noncallable for 10 years. Investors were willing to accept a 0.5 percent lower interest rate on Northwest's bonds for the assurance that the 7.5 percent interest rate would be earned for at least 10 years. Pacific, on the other hand, had to incur a 0.5 percent higher annual interest rate to obtain the option of calling the bonds in the event of a decline in rates.

Sinking Funds

Some bonds also include a **sinking fund provision** that facilitates the orderly retirement of the bond issue. Years ago, firms were required to deposit money with a trustee, which invested the funds and then used the accumulated sum to retire the bonds when they matured. Today, though, sinking fund provisions

Sinking Fund Provision
A provision in a bond contract that requires the issuer to retire a portion of the bond issue each year.

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[4] In July 1993, Walt Disney Co., attempting to lock in a low interest rate, issued the first 100-year bonds to be sold by any borrower in modern times. Soon after, Coca-Cola became the second company to stretch the meaning of "long-term bond" by selling $150 million worth of 100-year bonds.

[5] The number of new corporate issues with call provisions attached has declined somewhat in recent years. In the 1980s, nearly 80 percent of new issues contained call provisions; however, in recent years this number has fallen to about 35 percent. The use of call provisions also varies with credit quality. Roughly 25 percent of investment-grade bonds issued in recent years have call provisions. By contrast, about 75 percent of recent non-investment-grade bond issues include a call provision. For more information on the use of callable bonds, see Levent Güntay, N. R. Prabhala, and Haluk Unal, "Callable Bonds and Hedging," a Wharton Financial Institutions Center working paper.

require the issuer to buy back a specified percentage of the issue each year. A failure to meet the sinking fund requirement constitutes a default, which may throw the company into bankruptcy. Therefore, a sinking fund puts a significant cash drain on the firm.

In most cases, the issuer can handle the sinking fund in either of two ways:

1. The company can call in for redemption (at par value) a certain percentage of the bonds each year; for example, it might call 5 percent of the total original amount of the issue at a price of $1,000 per bond. The bonds are numbered serially, and those called for redemption are determined by a lottery administered by the trustee.
2. Alternatively, the company can buy the required bonds on the open market.

The firm will choose the least-cost method. If interest rates have risen since the bond was issued, then the bond will sell at a price below its par value, so the firm will buy bonds in the open market at a discount. On the other hand, if interest rates have fallen and the bond's price has risen above par, it will use the call option. Note that a call for sinking fund purposes is quite different from a refunding call—a sinking fund call requires no call premium, but only a small percentage of the issue is normally callable in a given year.[6]

Although sinking funds are designed to protect investors by ensuring that the bonds are retired in an orderly fashion, you should recognize that sinking funds can work to the detriment of bondholders. For example, suppose the bond carries a 10 percent interest rate, but yields on similar bonds have fallen to 7.5 percent. A sinking fund call at par would require a long-term investor to give up a bond that pays $100 of interest and then to reinvest in a bond that pays only $75 per year. This is an obvious disadvantage to those bondholders whose bonds are called. On balance, however, bonds that have a sinking fund are regarded as being safer than those without such a provision, so at the time they are issued sinking fund bonds have lower coupon rates than otherwise similar bonds without sinking funds.

Other Features

Convertible Bond
A bond that is exchangeable, at the option of the holder, for the issuing firm's common stock.

Warrant
A long-term option to buy a stated number of shares of common stock at a specified price.

Putable Bond
A bond with provisions that allow its investor to sell it back to the company prior to maturity at a pre-arranged price.

Income Bond
A bond that pays interest only if it is earned.

Several other types of bonds are used sufficiently often to warrant mention.[7] First, **convertible bonds** are bonds that are exchangeable into shares of common stock, at a fixed price, at the option of the bondholder. Convertibles have lower coupon rates than nonconvertible debt with similar credit risk, but they offer investors the chance for capital gains as compensation for the lower coupon rate. Bonds issued with **warrants** are similar to convertibles. Warrants are options that permit the holder to buy stock for a stated price, thereby providing a capital gain if the stock's price rises. Bonds issued with warrants, like convertibles, carry lower coupon rates than regular bonds.

Unlike callable bonds that give the issuer the option to buy back their debt prior to maturity, **putable bonds** allow investors to sell the bonds back to the company prior to maturity at a specified price. If interest rates rise, then investors will put these bonds back to the company and reinvest in higher coupon bonds. Another variation is the **income bond,** which pays interest only if the interest is earned. Thus, income bonds cannot bankrupt a company, but from an investor's standpoint they are riskier than "regular" bonds. Yet another bond

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[6] Some sinking funds require the issuer to pay a call premium.

[7] A recent article by John D. Finnerty and Douglas R. Emery reviews new types of debt (and other) securities that have been created in recent years. See "Corporate Securities Innovations: An Update," *Journal of Applied Finance: Theory, Practice, Education*, Vol. 12, no. 1 (Spring/Summer 2002), pp. 21–47.

is the **indexed,** or **purchasing power, bond.** The interest rate is based on an inflation index such as the consumer price index, so the interest paid rises automatically when the inflation rate rises, thus protecting bondholders against inflation. The U.S. Treasury is the main issuer of indexed bonds, and today (2005) they generally pay from 1 to 2 percent, plus the rate of inflation during the past year.

Indexed (Purchasing Power) Bond
A bond that has interest payments based on an inflation index so as to protect the holder from inflation.

SELF TEST

Define floating-rate bonds, zero coupon bonds, putable bonds, income bonds, convertible bonds, and inflation indexed bonds.

How is the rate on a floating-rate bond determined? On an indexed bond?

What are the two ways sinking funds can be handled? Which alternative will be used if interest rates have risen? Which if interest rates have fallen?

7.3 BOND VALUATION

The value of any financial asset—a stock, a bond, a lease, or even physical assets such as apartment buildings or pieces of machinery—is simply the present value of the cash flows the asset is expected to produce.

The cash flows for a standard coupon-bearing bond, like those of Allied Foods', consist of interest payments during the bond's 15-year life plus the amount borrowed (generally the par value) when the bond matures. In the case of a floating-rate bond, the interest payments vary over time. For zero coupon bonds, there are no interest payments, so the only cash flow is the face amount when the bond matures. For a "regular" bond with a fixed coupon rate, like Allied's, here is the situation:
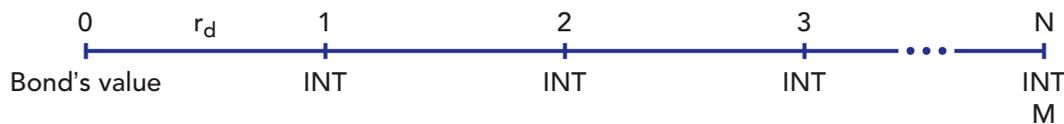
Here

> r_d = the bond's market rate of interest = 10 percent. This is the discount rate used to calculate the present value of the bond's cash flows, which is also its price. In Chapter 6 we discussed in detail the various factors that determine market interest rates. Note that r_d is *not* the coupon interest rate, and it is equal to the coupon rate if and only if (as in this case) the bond is selling at par.
>
> N = the number of years before the bond matures = 15. N declines each year after the bond has been issued, so a bond that had a maturity of 15 years when it was issued (original maturity = 15) will have N = 14 after one year, N = 13 after two years, and so on. At this point we assume that the bond pays interest once a year, or annually, so N is measured in years. Later on, we will analyze semiannual payment bonds, which pay interest each six months.
>
> INT = dollars of interest paid each year = Coupon rate × Par value = 0.10($1,000) = $100. In calculator terminology, INT = PMT = 100. If the

bond had been a semiannual payment bond, the payment would have been $50 each six months. The payment would be zero if Allied had issued zero coupon bonds, and it would vary if the bond had been a "floater."

M = the par, or maturity, value of the bond = $1,000. This amount must be paid at maturity.

We can now redraw the time line to show the numerical values for all variables except the bond's value, V_B:

0	10%	1	2	3	15
V_B		100	100	100	100
					1,000
					1,100

The following general equation can be solved to find the value of any bond:

$$\text{Bond's value, } V_B = \frac{INT}{(1 + r_d)^1} + \frac{INT}{(1 + r_d)^2} + \cdots + \frac{INT}{(1 + r_d)^N} + \frac{M}{(1 + r_d)^N}$$

$$= \sum_{t=1}^{N} \frac{INT}{(1 + r_d)^t} + \frac{M}{(1 + r_d)^N}$$

(7-1)

Inserting values for our particular bond, we have

$$V_B = \sum_{t=1}^{15} \frac{\$100}{(1.10)^t} + \frac{\$1,000}{(1.10)^{15}}$$

The cash flows consist of an annuity of N years plus a lump sum payment at the end of Year N, and this fact is reflected in Equation 7-1.

We could simply discount each cash flow back to the present and sum these PVs to find the bond's value; see Figure 7-1 for an example. However, this procedure is not very efficient, especially if the bond has many years to maturity. Therefore, we use a financial calculator to solve the problem. Here is the setup:

Inputs:	15	10		100	1000
	N	I/YR	PV	PMT	FV
Output:			= −1,000		

Simply input N = 15, r_d = I/YR = 10, INT = PMT = 100, M = FV = 1000, and then press the PV key to find the bond's value, $1,000.[8] Since the PV is an outflow to the investor, it is shown with a negative sign. The calculator is programmed to solve Equation 7-1: It finds the PV of an annuity of $100 per year for 15 years, discounted at 10 percent, then it finds the PV of the $1,000 maturity payment, and then it adds these two PVs to find the bond's value.

In this example the bond is selling at a price equal to its par value. Whenever the going rate of interest, r_d, is equal to the coupon rate, a *fixed-rate* bond

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[8] Spreadsheets can also be used to solve for the bond's value, as we show in the *Excel* model for this chapter.

FIGURE 7-1   *Time Line for Allied Food Products' Bonds, 10% Interest Rate*

	1/3/07	1/08	1/09	1/10	1/11	1/12	1/13	1/14	1/15	1/16	1/17	1/18	1/19	1/20	1/2/2021
Payments	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100 + 1,000

90.91
82.64
75.13
68.30
62.09
56.45
51.32
46.65
42.41
38.55
35.05
31.86
28.97
26.33
23.94
239.39

Present Value = **1,000.00** when r_d = 10%

will sell at its par value. Normally, the coupon rate is set at the going rate when a bond is issued, causing it to sell at par initially.

The coupon rate remains fixed after the bond is issued, but interest rates in the market move up and down. Looking at Equation 7-1, we see that an *increase* in the market interest rate (r_d) will cause the price of an outstanding bond to *fall*, whereas a *decrease* in rates will cause the bond's price to *rise*. For example, if the market interest rate on Allied's bond increased to 15 percent immediately after it was issued, we would recalculate the price with the new market interest rate as follows:

Inputs:	15	15		100	1000
	N	**I/YR**	**PV**	**PMT**	**FV**
Output:			= −707.63		

The price would fall to $707.63. Notice that the bond would then sell at a price below its par value. Whenever the going rate of interest *rises above* the coupon rate, a fixed-rate bond's price will fall *below* its par value, and it is called a **discount bond.**

On the other hand, bond prices rise when market interest rates fall. For example, if the market interest rate on Allied's bond decreased to 5 percent, we would once again recalculate its price:

Inputs:	15	5		100	1000
	N	**I/YR**	**PV**	**PMT**	**FV**
Output:			= −1,518.98		

Discount Bond
A bond that sells below its par value; occurs whenever the going rate of interest is above the coupon rate.

In this case the price rises to $1,518.98. In general, whenever the going interest rate *falls below* the coupon rate, a fixed-rate bond's price will rise *above* its par value, and it is called a **premium bond.**

Premium Bond
A bond that sells above its par value; occurs whenever the going rate of interest is below the coupon rate.

A bond that matures in eight years has a par value of $1,000, an annual coupon payment of $70, and a market interest rate of 9 percent. What is its price? ($889.30)

A bond that matures in 12 years has a par value of $1,000, an annual coupon of 10 percent, and a market interest rate of 8 percent. What is its price? ($1,150.72)

Which of these bonds is a "discount bond," and which is a "premium bond"?

7.4 BOND YIELDS

If you examine the bond market table of *The Wall Street Journal* or a price sheet put out by a bond dealer, you will typically see information regarding each bond's maturity date, price, and coupon interest rate. You will also see the bond's reported yield. Unlike the coupon interest rate, which is fixed, the bond's reported yield varies from day to day depending on current market conditions. Moreover, the yield can be calculated in three different ways, as we explain in the following sections.

Yield to Maturity

Yield to Maturity (YTM)
The rate of return earned on a bond if it is held to maturity.

Suppose you were offered a 14-year, 10 percent annual coupon, $1,000 par value bond at a price of $1,494.93. What rate of interest would you earn on your investment if you bought the bond and held it to maturity? This rate is called the bond's **yield to maturity (YTM),** and it is the interest rate generally discussed by investors when they talk about rates of return and the rate reported by *The Wall Street Journal*. To find the YTM, all you need to do is solve Equation 7-1 for r_d:

$$V_B = \$1,494.93 = \frac{\$100}{(1 + r_d)^1} + \cdots + \frac{\$100}{(1 + r_d)^{14}} + \frac{\$1,000}{(1 + r_d)^{14}}$$

You could substitute values for r_d until you find a value that "works" and forces the sum of the PVs on the right side of the equation to equal $1,494.93. However, finding r_d = YTM by trial and error would be a tedious, time-consuming process that is, as you might guess, easy with a financial calculator.[9] Here is the setup:

Inputs:	14		−1494.93	100	1000
	N	I/YR	PV	PMT	FV
Output:		= 5			

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[9] You could also find the YTM with a spreadsheet. In *Excel*, you would use the Rate function, inputting Nper = 14, Pmt = 100, Pv = −1494.93, Fv = 1000, 0 for Type, and leave Guess blank.

Simply enter N = 14, PV = −1494.93, PMT = 100, and FV = 1000, and then press the I/YR key. The answer, 5 percent, will then appear.

The yield to maturity can also be viewed as the bond's *promised rate of return*, which is the return that investors will receive if all the promised payments are made. However, the yield to maturity equals the *expected rate of return* only if (1) the probability of default is zero and (2) the bond cannot be called. If there is some default risk, or if the bond may be called, then there is some probability that the promised payments to maturity will not be received, in which case the calculated yield to maturity will differ from the expected return.

Note also that a bond's yield to maturity changes whenever interest rates in the economy change, and this is almost daily. An investor who purchases a bond and holds it until it matures will receive the YTM that existed on the purchase date, but the bond's calculated YTM will change frequently between the purchase date and the maturity date.

Yield to Call

If you purchased a bond that was callable and the company called it, you would not have the option of holding it until it matured. Therefore, the yield to maturity would not be earned. For example, if Allied's 10 percent coupon bonds were callable, and if interest rates fell from 10 to 5 percent, then the company could call in the 10 percent bonds, replace them with 5 percent bonds, and save $100 − $50 = $50 interest per bond per year. This would be beneficial to the company, but not to its bondholders.

If current interest rates are well below an outstanding bond's coupon rate, then a callable bond is likely to be called, and investors will estimate its expected rate of return as the **yield to call (YTC)** rather than as the yield to maturity. To calculate the YTC, solve this equation for r_d:

<div align="right">Yield to Call (YTC)
The rate of return earned on a bond if it is called before its maturity date.</div>

$$\text{Price of callable bond} = \sum_{t=1}^{N} \frac{\text{INT}}{(1 + r_d)^t} + \frac{\text{Call price}}{(1 + r_d)^N} \qquad \textbf{(7-2)}$$

Here N is the number of years until the company can call the bond; call price is the price the company must pay in order to call the bond (it is often set equal to the par value plus one year's interest); and r_d is the YTC.

To illustrate, suppose Allied's bonds had a provision that permitted the company, if it desired, to call them 10 years after their issue date at a price of $1,100. Suppose further that interest rates had fallen, and one year after issuance the going interest rate had declined, causing their price to rise to $1,494.93. Here is the time line and the setup for finding the bonds' YTC with a financial calculator:

0	YTC = ?	1	2	8	9
−1,494.93		100	100	100	100
					1,100

Inputs:	9		−1494.93	100	1100
	N	I/YR	PV	PMT	FV
Output:		4.21 = YTC			
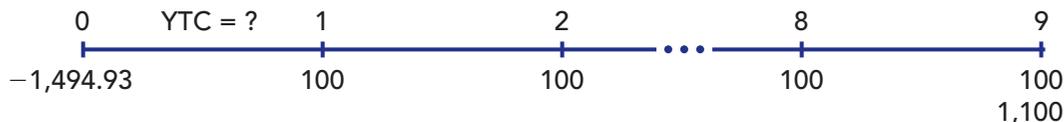
The YTC is 4.21 percent—this is the return you would earn if you bought an Allied bond at a price of $1,494.93 and it was called nine years from today. (It could not be called until 10 years after issuance, and 1 year has gone by, so there are 9 years left until the first call date.)

Do you think Allied *will* call its 10 percent bonds when they become callable? Allied's action will depend on what the going interest rate is when they become callable. If the going rate remains at $r_d = 5\%$, then Allied could save $10\% - 5\% = 5\%$, or $50 per bond per year, so it would call the 10 percent bonds and replace them with a new 5 percent issue. There would be some costs to the company to refund the bonds, but the interest savings would almost certainly be worth the cost, so Allied would almost certainly refund them. Therefore, you should expect to earn the YTC $= 4.21\%$ rather than the YTM $= 5\%$ if you bought the bond under the indicated conditions.

In the balance of this chapter, we assume that bonds are not callable unless otherwise noted, but some of the end-of-chapter problems deal with yield to call.

Current Yield

Current Yield
The annual interest payment on a bond divided by the bond's current price.

Brokerage house reports on bonds often refer to the **current yield,** which is defined as the annual interest payment divided by the bond's current price. For example, if Allied's 10 percent coupon bonds were currently selling for $985, the current yield would be $100/$985 = 10.15\%$.

Unlike the yield to maturity, the current yield *does not* represent the total return that investors should expect to receive from the bond because it does not take account of the capital gain or loss that will be realized if the bond is held until its maturity (or call). It does provide information regarding the amount of cash income that will be generated in a given year, but it does not provide an accurate measure of the total expected return. This point can be illustrated with a zero coupon bond. Because zeros pay no annual interest, they always have a zero current yield. However, zeros appreciate in value over time, so their total rate of return clearly exceeds zero.

SELF TEST

Explain the difference between yield to maturity and yield to call.

Halley Enterprises' bonds currently sell for $975. They have a seven-year maturity, an annual coupon of $90, and a par value of $1,000. What is their yield to maturity? Their current yield? (9.51%; 9.23%)

The Henderson Company's bonds currently sell for $1,275. They pay a $120 annual coupon and have a 20-year maturity, but they can be called in 5 years at $1,120. What is their YTM and their YTC, and which is "more relevant" in the sense that investors should expect to earn it? (8.99%; 7.31%; YTC)

7.5 CHANGES IN BOND VALUES OVER TIME

When a coupon bond is issued, the coupon is generally set at a level that causes the bond's market price to equal its par value. If a lower coupon were set, investors would not be willing to pay $1,000 for the bond, while if a higher coupon were set, investors would clamor for it and bid its price up over $1,000. Investment bankers can judge quite precisely the coupon rate that causes a bond to sell at its $1,000 par value.

A bond that has just been issued is known as a *new issue*. Once it has been issued, it is an *outstanding bond*, also called a *seasoned issue*. Newly issued bonds generally sell at prices very close to par, but the prices of outstanding bonds can vary widely from par. Except for floating-rate bonds, coupon payments are constant, so when economic conditions change, a bond with a $100 coupon that sold

at its $1,000 par value when it was issued will sell for more or less than $1,000 thereafter.

Among its outstanding bonds, Allied currently has three issues that will all mature in 15 years:

- As we have been discussing, Allied just issued 15-year bonds with a 10 percent coupon rate. These bonds were issued at par, which means that the market interest rate on the bonds was also 10 percent. Because the coupon rate equals the market interest rate, these bonds are trading at par, hence their price is $1,000.
- Five years ago, Allied issued 20-year bonds with a 7 percent coupon rate. These bonds currently have 15 years remaining until maturity. The bonds were originally issued at par, which means that 5 years ago when these bonds were issued, the market interest rate was 7 percent. For these bonds, the coupon rate is less than the market interest rate, so they sell at a discount. Using a financial calculator or spreadsheet, we can quickly find that they have a price of $771.82. (Set N = 15, I/YR = 10, PMT = 70, FV = 1000, and solve for the PV to get the price.)
- Ten years ago, Allied issued 25-year bonds with a 13 percent coupon rate. These bonds currently have 15 years remaining until maturity. They were originally issued at par, which means that 10 years ago the market interest rate must have been 13 percent. Because the coupon rate on these bonds is greater than the current market interest rate, they sell at a premium. Using a financial calculator or spreadsheet, we can find that their price is $1,228.18. (Set N = 15, I/YR = 10, PMT = 130, FV = 1000, and solve for the PV to get the price.)

Each of these three bonds has a 15-year maturity, each has the same credit risk, and thus each has the same market interest rate, 10 percent. However, the bonds have different prices because of their different coupon rates.

Now let's consider what would happen to the prices of these bonds over time, assuming that market interest rates remained constant at 10 percent and Allied does not default on its bonds. Table 7-1 demonstrates how the prices of each of these bonds will change over time if market interest rates remain at 10 percent. One year from now, each bond will have a maturity of 14 years—that is, N = 14. With a financial calculator, just override N = 15 with N = 14, press the PV key, and you find the value of each bond one year from now. Continuing, set N = 13, N = 12, and so forth, to see how the prices change over time.

Table 7-1 also shows the current yield, the capital gains yield, and the total return over time. For any given year, the *capital gains yield* is calculated as the bond's annual change in price divided by the beginning-of-year price. For example, if a bond were selling for $1,000 at the beginning of the year and $1,035 at the end of the year, its capital gains yield for the year would be $35/$1,000 = 3.5%. (If the bond were selling at a premium, then its price would decline over time, and the capital gains yield would be negative but offset by a high current yield.) A bond's total return is equal to the current yield plus the capital gains yield. In the absence of default risk, it is also equal to YTM and the market interest rate, which in our example is 10 percent.

Using the information from Table 7-1, Figure 7-2 plots the predicted changes in bond prices for the 7, 10, and 13 percent coupon bonds. Notice that the bonds have very different price paths over time, but at maturity all three bonds will sell at their par value of $1,000. Here are some points about the prices of the bonds over time:

- The price of the 10 percent coupon bond trading at par would remain at $1,000 if the market interest rate remains at 10 percent, so its current yield would remain at 10 percent and its capital gains yield would be zero each year.

TABLE 7-1   *Calculation of Current Yields, Capital Gains Yields, and Total Returns for 7%, 10%, and 13% Coupon Bonds When the Market Rate Remains Constant at 10%*

Number of Years until Maturity	7% COUPON BOND				10% COUPON BOND				13% COUPON BOND			
	Price[a]	Expected Current Yield[b]	Expected Capital Gains Yield[c]	Expected Total Return[d]	Price[a]	Expected Current Yield[b]	Expected Capital Gains Yield[c]	Expected Total Return[d]	Price[a]	Expected Current Yield[b]	Expected Capital Gains Yield[c]	Expected Total Return[d]
15	$ 771.82	9.1%	0.9%	10.0%	$1,000.00	10.0%	0.0%	10.0%	$1,228.18	10.6%	−0.6%	10.0%
14	779.00	9.0	1.0	10.0	1,000.00	10.0	0.0	10.0	1,221.00	10.6	−0.6	10.0
13	786.90	8.9	1.1	10.0	1,000.00	10.0	0.0	10.0	1,213.10	10.7	−0.7	10.0
12	795.59	8.8	1.2	10.0	1,000.00	10.0	0.0	10.0	1,204.41	10.8	−0.8	10.0
11	805.15	8.7	1.3	10.0	1,000.00	10.0	0.0	10.0	1,194.85	10.9	−0.9	10.0
10	815.66	8.6	1.4	10.0	1,000.00	10.0	0.0	10.0	1,184.34	11.0	−1.0	10.0
9	827.23	8.5	1.5	10.0	1,000.00	10.0	0.0	10.0	1,172.77	11.1	−1.1	10.0
8	839.95	8.3	1.7	10.0	1,000.00	10.0	0.0	10.0	1,160.05	11.2	−1.2	10.0
7	853.95	8.2	1.8	10.0	1,000.00	10.0	0.0	10.0	1,146.05	11.3	−1.3	10.0
6	869.34	8.1	1.9	10.0	1,000.00	10.0	0.0	10.0	1,130.66	11.5	−1.5	10.0
5	886.28	7.9	2.1	10.0	1,000.00	10.0	0.0	10.0	1,113.72	11.7	−1.7	10.0
4	904.90	7.7	2.3	10.0	1,000.00	10.0	0.0	10.0	1,095.10	11.9	−1.9	10.0
3	925.39	7.6	2.4	10.0	1,000.00	10.0	0.0	10.0	1,074.61	12.1	−2.1	10.0
2	947.93	7.4	2.6	10.0	1,000.00	10.0	0.0	10.0	1,052.07	12.4	−2.4	10.0
1	972.73	7.2	2.8	10.0	1,000.00	10.0	0.0	10.0	1,027.27	12.7	−2.7	10.0
0	1,000.00				1,000.00				1,000.00			

Notes:

[a] Using a financial calculator, the price of each bond is calculated by entering the data for N, I/YR, PMT, and FV, then solving for PV = the bond's value.

[b] The expected current yield is calculated as the annual interest divided by the price of the bond.

[c] The expected capital gains yield is calculated as the difference between the end-of-year bond price and the beginning-of-year bond price divided by the beginning-of-year price.

[d] The expected total return is the sum of the expected current yield and the expected capital gains yield.

FIGURE 7-2 — *Time Paths of 7%, 10%, and 13% Coupon Bonds When the Market Rate Remains Constant at 10%*
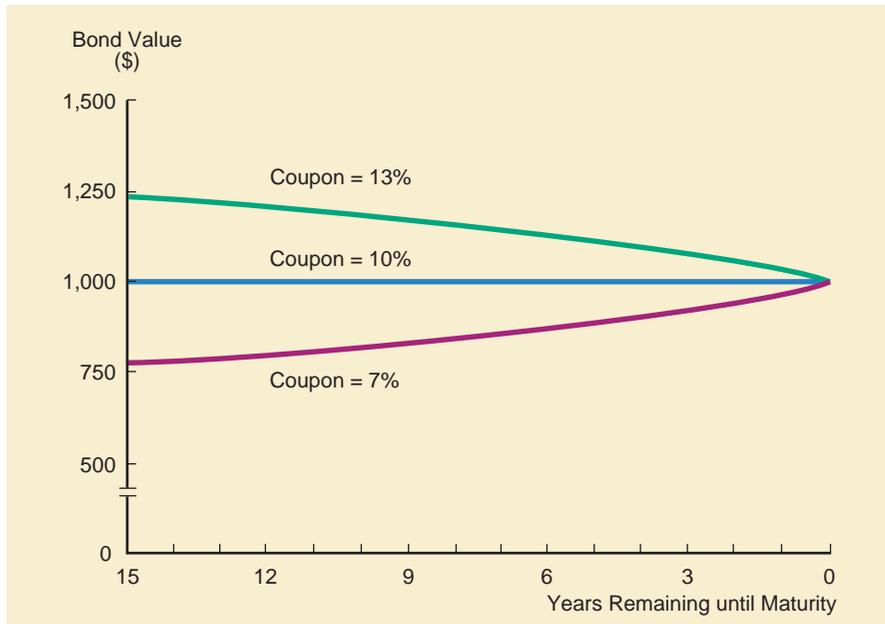
- The 7 percent bond trades at a discount, but its price must approach its par value as the maturity date approaches. At maturity it must sell for its par value, because that is the amount the company must give to its holders. So, its price must rise over time.
- The 13 percent coupon bond trades at a premium, but its price must be equal to its par value at maturity, so it must decline over time.

While the prices of the 7 and 13 percent coupon bonds move in opposite directions over time, each bond provides investors with the same total return, 10 percent, which is also the total return on the 10 percent coupon bond that sells at par. The discount bond has a lower coupon rate (and therefore a lower current yield), but it provides a capital gain each year. In contrast, the premium bond has a higher current yield, but it has an expected capital loss each year.[10]

SELF TEST

What is meant by the terms "new issue" and "seasoned issue"?

Last year a firm issued 20-year, 8 percent annual coupon bonds at a par value of $1,000.

(1) Suppose that one year later the going rate had dropped to 6 percent. What is the new price of the bonds, assuming that they now have 19 years to maturity? ($1,223.16)

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[10] In this example (and throughout the text) we ignore the tax effects associated with purchasing different types of bonds. For coupon bonds, under the current Tax Code, coupon payments are taxed as ordinary income, whereas capital gains are taxed at the capital gains tax rate. As we mentioned in Chapter 3, for most investors the capital gains tax rate is lower than the personal tax rate. Moreover, while coupon payments are taxed each year, capital gains taxes are deferred until the bond is sold or matures. Consequently, all else equal, investors would end up paying lower taxes on discount bonds, because a greater percentage of their total return comes in the form of capital gains. For details on the tax treatment of zero coupon bonds, see Web Appendix 7A.

(2) Suppose that one year after issue the going interest rate had been 10 percent (rather than 6 percent). What would the price have been? ($832.70)

Why do the prices of fixed-rate bonds fall if expectations for inflation rise?

7.6 BONDS WITH SEMIANNUAL COUPONS

Although some bonds pay interest annually, the vast majority actually make payments semiannually. To evaluate semiannual bonds, we must modify the valuation model (Equation 7-1) as follows:

1. Divide the annual coupon interest payment by 2 to determine the dollars of interest paid each six months.
2. Multiply the years to maturity, N, by 2 to determine the number of semiannual periods.
3. Divide the nominal (quoted) interest rate, r_d, by 2 to determine the periodic (semiannual) interest rate.

Making these changes results in the following equation for finding a semiannual bond's value:

$$V_B = \sum_{t=1}^{2N} \frac{INT/2}{(1 + r_d/2)^t} + \frac{M}{(1 + r_d/2)^{2N}} \qquad (7\text{-}1a)$$

To illustrate, now assume the Allied Food bonds discussed in Section 7.3 pay $50 of interest each six months rather than $100 at the end of each year. Thus, each interest payment is only half as large, but there are twice as many of them. The coupon rate is thus stated to be "10 percent with semiannual payments."[11]

When the going (nominal) rate of interest is r_d = 5% with semiannual compounding, the value of a 15-year, 10 percent semiannual coupon, bond that pays $50 interest every six months, is found as follows:

Inputs:	30	2.5		50	1000
	N	I/YR	PV	PMT	FV
Output:			=−1,523.26		

Enter N = 30, r_d = I/YR = 2.5, PMT = 50, FV = 1000, and then press the PV key to obtain the bond's value, $1,523.26. The value with semiannual interest payments is slightly larger than $1,518.98, the value when interest is paid annually

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[11] In this situation, the coupon rate of "10 percent paid semiannually," is the rate that bond dealers, corporate treasurers, and investors generally would discuss. Of course, if this bond were issued at par, its *effective annual rate* would be higher than 10 percent:

$$EAR = EFF\% = \left(1 + \frac{r_{NOM}}{M}\right)^M - 1 = \left(1 + \frac{0.10}{2}\right)^2 - 1 = (1.05)^2 - 1 = 10.25\%$$

Since 10 percent with annual payments is quite different from 10 percent with semiannual payments, we have assumed a change in effective rates in this section from the situation in Section 7.3, where we assumed 10 percent with annual payments.

as we calculated in Section 7.3. This higher value occurs because each interest payment is received somewhat faster under semiannual compounding.

SELF TEST

?

Describe how the annual payment bond valuation formula is changed to evaluate semiannual coupon bonds, and write out the revised formula.

Hartwell Corporation bonds have a 20-year maturity, an 8 percent semiannual coupon, and a face value of $1,000. The going interest rate (r_d) is 7 percent, based on semiannual compounding. What is the bond's price? ($1,106.78)

7.7 ASSESSING A BOND'S RISKINESS

Interest Rate Risk

As we saw in Chapter 6, interest rates fluctuate over time, and an increase in rates leads to a decline in the value of an outstanding bond. This risk of a decline in bond values due to an increase in interest rates is called **interest rate risk** (or **interest rate price risk**). To illustrate, refer back to Allied's bonds, assume once more that they have a 10 percent annual coupon, and assume that you bought one of these bonds at its par value, $1,000. Shortly after your purchase, the going interest rate rises from 10 to 15 percent.[12] As we saw in Section 7.3, this interest rate increase would cause the bond's price to fall from $1,000 to $707.63, so you would have a loss of $292.37 on the bond.[13] Interest rates can and do rise, and rising rates cause a loss of value for bondholders. Thus, people or firms who invest in bonds are exposed to risk from increasing interest rates.

Interest rate risk is higher on bonds with long maturities than on those maturing in the near future.[14] This follows because the longer the maturity, the longer before it is paid off and the bondholder can replace it with one with a higher coupon. This point can be demonstrated numerically by showing how the value of a 1-year bond with a 10 percent annual coupon fluctuates with changes in r_d, and then comparing these changes with those on a 15-year bond

Interest Rate (Price) Risk
The risk of a decline in a bond's price due to an increase in interest rates.

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[12] An immediate increase in rates from 10 to 15 percent would be quite unusual, and it would occur only if something quite bad were revealed about the company or happened in the economy. Smaller but still significant rate increases that adversely affect bondholders do occur fairly often.

[13] You would have an accounting (and tax) loss only if you sold the bond; if you held it to maturity, you would not have such a loss. However, even if you did not sell, you would still have suffered a real economic loss in an opportunity cost sense because you would have lost the opportunity to invest at 15 percent and would be stuck with a 10 percent bond in a 15 percent market. In an economic sense, "paper losses" are just as bad as realized accounting losses.

[14] Actually, a bond's maturity and coupon rate both affect interest rate risk. Low coupons mean that most of the bond's return will come from repayment of principal, whereas on a high-coupon bond with the same maturity, more of the cash flows will come in during the early years due to the relatively large coupon payments. A measurement called "duration," which finds the average number of years the bond's PV of cash flows remain outstanding, has been developed to combine maturity and coupons. A zero coupon bond, which has no interest payments and whose payments all come at maturity, has a duration equal to its maturity. Coupon bonds all have durations that are shorter than maturity, and the higher the coupon rate, the shorter the duration. Bonds with longer duration are exposed to more interest rate risk. A discussion of duration would go beyond the scope of this book, but see any investments text for a discussion of the concept.

as calculated previously. The one-year bond's values at different interest rates are shown here:

Value of a one-year bond at

$r_d = 5\%$:

	Inputs:	1	5		100	1000
		N	I/YR	PV	PMT	FV
	Output (Bond Value):			−1,047.62		

$r_d = 10\%$:

	Inputs:	1	10		100	1000
		N	I/YR	PV	PMT	FV
	Output (Bond Value):			−1,000.00		

$r_d = 15\%$:

	Inputs:	1	15		100	1000
		N	I/YR	PV	PMT	FV
	Output (Bond Value):			−956.52		

You would obtain the first value with a financial calculator by entering N = 1, I/YR = 5, PMT = 100, and FV = 1000, and then pressing PV to get $1,047.62. With everything still in your calculator, enter I/YR = 10 to override the old I/YR = 5, and press PV to find the bond's value at a 10 percent market rate; it drops to $1,000. Then enter I/YR = 15 and press the PV key to find the last bond value, $956.52.

The effects of increasing rates on the 15-year bond as found earlier can be compared with the just-calculated effects for the 1-year bond. This comparison is shown in Figure 7-3, where we show bond prices at several rates and then plot those prices in the graph. Note how much more sensitive the price of the 15-year bond is to changes in interest rates. At a 10 percent interest rate, both the 15-year and the 1-year bonds are valued at $1,000. When rates rise to 15 percent, the 15-year bond falls to $707.63, but the 1-year bond only falls to $956.52. The price decline for the 1-year bond is only 4.35 percent, while that for the 15-year bond is 29.24 percent.

For bonds with similar coupons, this differential interest rate sensitivity always holds true—the longer its maturity, the more its price changes in response to a given change in interest rates. Thus, even if the risk of default on two bonds is exactly the same, the one with the longer maturity is typically exposed to more risk from a rise in interest rates.[15]

The logical explanation for this difference in interest rate risk is simple. Suppose you bought a 15-year bond that yielded 10 percent, or $100 a year. Now suppose interest rates on comparable-risk bonds rose to 15 percent. You would be stuck with only $100 of interest for the next 15 years. On the other hand, had you bought a 1-year bond, you would have a low return for only 1 year. At the

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[15] If a 10-year bond were plotted in Figure 7-3, its curve would lie between those of the 15-year and the 1-year bonds. The curve of a one-month bond would be almost horizontal, indicating that its price would change very little in response to an interest rate change, but a 100-year bond would have a very steep slope, and the slope of a perpetuity would be even steeper. Also, a zero coupon bond's price is quite sensitive to interest rate changes, and the longer its maturity, the greater its price sensitivity. Therefore, a 30-year zero coupon bond would have a huge amount of interest rate risk.

FIGURE 7-3   *Values of Long- and Short-Term 10% Annual Coupon Bonds at Different Market Interest Rates*
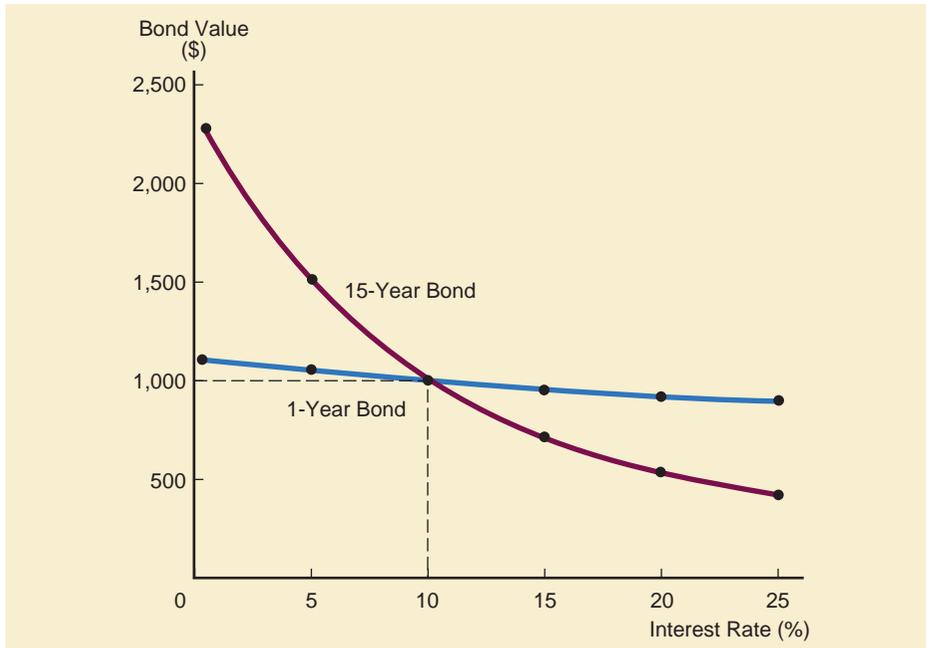
	VALUE OF	
Current Market Interest Rate, r_d	1-Year Bond	15-Year Bond
5%	$1,047.62	$1,518.98
10	1,000.00	1,000.00
15	956.52	707.63
20	916.67	532.45
25	880.00	421.11

Note: Bond values were calculated using a financial calculator assuming annual, or once-a-year, compounding.

end of the year, you would receive your $1,000 back, and you could then reinvest it and earn 15 percent, or $150 per year, for the next 14 years. Thus, interest rate risk reflects the length of time you are committed to a given investment.

Reinvestment Rate Risk

As we saw in the preceding section, an *increase* in interest rates will hurt bondholders because it will lead to a decline in the value of a bond portfolio. But can a *decrease* in interest rates also hurt bondholders? Actually, the answer is yes, because if interest rates fall, long-term bondholders will suffer a reduction in income. For example, consider a retiree who has a bond portfolio and lives off the income it produces. The bonds in the portfolio, on average, have coupon rates of 10 percent. Now suppose interest rates decline to 5 percent. Many of the bonds will be called, and as calls occur, the bondholder will have to replace

10 percent bonds with 5 percent bonds. Even bonds that are not callable will mature, and when they do, they too will have to be replaced with lower-yielding bonds. Thus, our retiree will suffer a reduction of income.

Reinvestment Rate Risk
The risk that a decline in interest rates will lead to a decline in income from a bond portfolio.

The risk of an income decline due to a drop in interest rates is called **reinvestment rate risk,** and its importance has been demonstrated to all bond-holders in recent years as a result of the sharp drop in rates since the mid-1980s. Reinvestment rate risk is obviously high on callable bonds. It is also high on short-term bonds, because the shorter the bond's maturity, the fewer the years before the relatively high old-coupon bonds will be replaced with the new low-coupon issues. Thus, retirees whose primary holdings are short-term bonds or other debt securities will be hurt badly by a decline in rates, but holders of noncallable long-term bonds will continue to enjoy the old high rates.

Comparing Interest Rate and Reinvestment Rate Risk

Note that interest rate risk relates to the *value* of the bond portfolio, while rein-vestment rate risk relates to the *income* the portfolio produces. If you hold long-term bonds, you will face significant interest rate risk because the value of your portfolio will decline if interest rates rise, but you will not face much reinvest-ment rate risk because your income will be stable. On the other hand, if you hold short-term bonds, you will not be exposed to much interest rate price risk, but you will be exposed to significant reinvestment rate risk.

Investment Horizon
The period of time an investor plans to hold a particular investment.

Which type of risk is "more relevant" to a given investor depends critically on how long the investor plans to hold the bonds—this is often referred to as the **investment horizon.** To illustrate, consider first an investor who has a relatively short, one-year investment horizon—say, the investor plans to go to graduate school a year from now and needs money for tuition and expenses. Reinvest-ment rate risk is of minimal concern to this investor, because there is little time for reinvestment. The investor could eliminate interest rate risk by buying a one-year Treasury security, since he or she would be assured of receiving the face value of the bond one year from now (the investment horizon). However, if this investor were to buy a long-term Treasury security, he or she would bear a con-siderable amount of interest rate risk because, as we have seen, long-term bond prices decline if interest rates rise. Consequently, investors with shorter invest-ment horizons should view long-term bonds as being especially risky.

By contrast, the reinvestment risk inherent in short-term bonds is especially relevant to investors with longer investment horizons. Consider a retiree who is living on income from his or her portfolio. If this investor buys one-year bonds, he or she will have to "roll them over" every year, and if rates fall, his or her income in subsequent years will likewise decline. A younger couple saving for something like their own retirement or their children's college costs would be affected similarly, because if they buy short-term bonds they too will have to roll their portfolio at possibly much lower rates. Since there is uncertainty today about the rates that will be earned on these reinvested cash flows, long-term investors should be especially concerned about the reinvestment rate risk inher-ent in short-term bonds.

One simple way to minimize both interest rate and reinvestment rate risk is to buy a zero coupon Treasury bond with a maturity that matches the investor's investment horizon. For example, assume your investment horizon is 10 years. If you buy a 10-year zero, you will receive a guaranteed payment in 10 years equal to the bond's face value, hence you face no interest rate price risk. More-over, as there are no coupons to reinvest, there is no reinvestment rate risk. This

feature explains why investors with specific goals often invest in zero coupon bonds.[16]

Recall from Chapter 6 that maturity risk premiums are generally positive. Moreover, a positive maturity risk premium implies that investors on average regard longer-term bonds as being riskier than shorter-term bonds. That, in turn, suggests that the average investor is most concerned with interest rate price risk. Still, it is appropriate for each individual investor to consider his or her situation, to recognize the risks inherent in bonds with different maturities, and to construct a portfolio that deals best with the investor's most relevant risk.

> Differentiate between interest rate risk and reinvestment rate risk.
>
> To which type of risk are holders of long-term bonds more exposed? Short-term bondholders?
>
> What type of security can be used to minimize both interest rate and reinvestment rate risk for an investor with a fixed investment horizon?

7.8 DEFAULT RISK

Potential default is another important risk faced by bondholders. If the issuer defaults, investors will receive less than the promised return. Recall from Chapter 6 that the quoted interest rate includes a default risk premium—the higher the probability of default, the higher the premium and thus the yield to maturity. Default risk on Treasuries is zero, but this risk is substantial for lower-grade corporate and municipal bonds.

To illustrate, suppose two bonds have the same promised cash flows—their coupon rates, maturities, liquidity, and inflation exposures are identical, but one has more default risk than the other. Investors will naturally pay more for the one with less chance of default. As a result, bonds with higher default risk will have higher market rates: $r_d = r^* + IP + DRP + LP + MRP$. If its default risk changes, this will affect r_d and thus the price. Thus, if the default risk on Allied's bonds increases, their price will fall and the yield to maturity (YTM = r_d) will increase.

In the next sections we consider some issues related to default risk. First, we show that corporations can influence default risk by changing the types of bonds they issue. Second, we discuss bond ratings, which are used to help judge default risk. Finally, we consider bankruptcy and reorganization, which affect how much an investor can expect to recover if a default occurs.

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[16] Two words of caution about zeros are in order. First, as we show in Web Appendix 7A, investors in zeros must pay taxes each year on their accrued gain in value, even though the bonds don't pay any cash until they mature. Second, buying a zero coupon with a maturity equal to your investment horizon enables you to lock in nominal cash flow, but the value of that cash flow will still depend on what happens to inflation during your investment horizon. What we need is an inflation-indexed zero coupon Treasury bond, but to date no such bond exists.

Also, the fact that maturity risk premiums are positive suggests that most investors have relatively short investment horizons. See *Stocks, Bonds, Bills, and Inflation: (Valuation Edition) 2005 Yearbook* (Chicago: Ibbotson Associates, 2005), which finds that the maturity risk premium for long-term bonds has averaged 1.4 percent over the past 79 years.

Various Types of Corporate Bonds

Default risk is influenced by both the financial strength of the issuer and the terms of the bond contract, including whether or not collateral has been pledged to secure the bond. Some types of bonds are described in this section.

Mortgage Bonds

Mortgage Bond
A bond backed by fixed assets. First mortgage bonds *are senior in priority to claims of* second mortgage bonds.

Under a **mortgage bond,** the corporation pledges specific assets as security for the bond. To illustrate, in 2005, Billingham Corporation needed $10 million to build a regional distribution center. Bonds in the amount of $4 million, secured by a *first mortgage* on the property, were issued. (The remaining $6 million was financed with equity capital.) If Billingham defaults on the bonds, the bondholders can foreclose on the property and sell it to satisfy their claims.

If Billingham had chosen to, it could have issued *second mortgage bonds* secured by the same $10 million of assets. In the event of liquidation, the holders of the second mortgage bonds would have a claim against the property, but only after the first mortgage bondholders had been paid off in full. Thus, second mortgages are sometimes called *junior mortgages* because they are junior in priority to the claims of *senior mortgages*, or *first mortgage bonds*.

Indenture
A formal agreement between the issuer and the bondholders.

All mortgage bonds are subject to an **indenture,** which is a legal document that spells out in detail the rights of both the bondholders and the corporation. The indentures of many major corporations were written 20, 30, 40, or more years ago. These indentures are generally "open ended," meaning that new bonds can be issued from time to time under the same indenture. However, the amount of new bonds that can be issued is virtually always limited to a specified percentage of the firm's total "bondable property," which generally includes all land, plant, and equipment.

For example, in the past Savannah Electric Company had provisions in its bond indenture that allowed it to issue first mortgage bonds totaling up to 60 percent of its net fixed assets. If its fixed assets totaled $1 billion, and if it had $500 million of first mortgage bonds outstanding, it could, by the property test, issue another $100 million of bonds (60 percent of $1 billion = $600 million).

At times, Savannah Electric was unable to issue any new first mortgage bonds because of another indenture provision: its times-interest-earned (TIE) ratio was required to be greater than 2.5, and at times earnings declined to the point where the minimum was violated. Thus, although Savannah Electric passed the property test, it failed the coverage test, so it could not issue any more first mortgage bonds. Savannah Electric then had to finance with junior bonds. Since its first mortgage bonds carried lower interest rates than its junior long-term debt, this restriction was costly.

Savannah Electric's neighbor, Georgia Power Company, had more flexibility under its indenture—its interest coverage requirement was only 2.0. In hearings before the Georgia Public Service Commission, it was suggested that Savannah Electric should change its indenture coverage to 2.0 so it could issue more first mortgage bonds. However, this was simply not possible—the holders of the outstanding bonds would have to approve the change, and it is inconceivable that they would vote for a change that would seriously weaken their position.

Debentures

Debenture
A long-term bond that is not secured by a mortgage on specific property.

A **debenture** is an unsecured bond, and as such it provides no specific collateral as security for the obligation. Debenture holders are, therefore, general creditors whose claims are protected by property not otherwise pledged. In practice, the use of debentures depends both on the nature of the firm's assets and on its general credit strength. Extremely strong companies such as General Electric and

ExxonMobil can use debentures because they simply do not need to put up property as security for their debt. Debentures are also issued by weak companies that have already pledged most of their assets as collateral for mortgage loans. In this latter case, the debentures are quite risky, and that risk will be reflected in their interest rates.

Subordinated Debentures

The term *subordinate* means "below," or "inferior to," and, in the event of bankruptcy, subordinated debt has a claim on assets only after senior debt has been paid in full. **Subordinated debentures** may be subordinated either to designated notes payable (usually bank loans) or to all other debt. In the event of liquidation or reorganization, holders of subordinated debentures receive nothing until all senior debt, as named in the debentures' indenture, has been paid. Precisely how subordination works, and how it strengthens the position of senior debtholders, is explained in detail in Web Appendix 7B.

Subordinated Debenture
A bond having a claim on assets only after the senior debt has been paid off in the event of liquidation.

Bond Ratings

Since the early 1900s, bonds have been assigned quality ratings that reflect their probability of going into default. The three major rating agencies are Moody's Investors Service (Moody's), Standard & Poor's Corporation (S&P), and Fitch Investor's Service. Moody's and S&P's rating designations are shown in Table 7-2.[17] The triple- and double-A bonds are extremely safe. Single-A and triple-B bonds are also strong enough to be called **investment-grade bonds,** and they are the lowest-rated bonds that many banks and other institutional investors are permitted by law to hold. Double-B and lower bonds are speculative, or **junk, bonds,** and they have a significant probability of going into default.

Investment-Grade Bonds
Bonds rated triple-B or higher; many banks and other institutional investors are permitted by law to hold only investment-grade bonds.

Bond Rating Criteria

Bond ratings are based on both qualitative and quantitative factors, some of which are listed below:

1. *Various ratios,* including the debt ratio and the times-interest-earned ratio. The better the ratios, the higher the rating.

Junk Bond
A high-risk, high-yield bond.

TABLE 7-2   *Moody's and S&P Bond Ratings*

	INVESTMENT GRADE				JUNK BONDS			
Moody's	Aaa	Aa	A	Baa	Ba	B	Caa	C
S&P	AAA	AA	A	BBB	BB	B	CCC	C

Note: Both Moody's and S&P use "modifiers" for bonds rated below triple-A. S&P uses a plus and minus system; thus, A+ designates the strongest A-rated bonds and A− the weakest. Moody's uses a 1, 2, or 3 designation, with 1 denoting the strongest and 3 the weakest; thus, within the double-A category, Aa1 is the best, Aa2 is average, and Aa3 is the weakest.

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[17] In the discussion to follow, reference to the S&P rating is intended to imply the Moody's and Fitch's ratings as well. Thus, triple-B bonds mean both BBB and Baa bonds; double-B bonds mean both BB and Ba bonds; and so on.

   2. *Mortgage provisions:* Is the bond secured by a mortgage? If it is, and if the property has a high value relative to the amount of bonded debt, the rating is enhanced.
   3. *Subordination provisions:* Is the bond subordinated to other debt? If so, it will be rated at least one notch below the rating it would have if it were not subordinated. Conversely, a bond with other debt subordinated to it will have a somewhat higher rating.
   4. *Guarantee provisions:* Some bonds are guaranteed by other firms. If a weak company's debt is guaranteed by a strong company (usually the weak company's parent), the bond will be given the strong company's rating.
   5. *Sinking fund:* Does the bond have a sinking fund to ensure systematic repayment? This feature is a plus factor to the rating agencies.
   6. *Maturity:* Other things the same, a bond with a shorter maturity will be judged less risky than a longer-term bond, and this will be reflected in the ratings.
   7. *Stability:* Are the issuer's sales and earnings stable?
   8. *Regulation:* Is the issuer regulated, and could an adverse regulatory climate cause the company's economic position to decline? Regulation is especially important for utility, telephone, and insurance companies.
   9. *Antitrust:* Are any antitrust actions pending against the firm that could erode its position?
  10. *Overseas operations:* What percentage of the firm's sales, assets, and profits are from overseas operations, and what is the political climate in the host countries?
  11. *Environmental factors:* Is the firm likely to face heavy expenditures for pollution remediation?
  12. *Product liability:* Are the firm's products safe? The tobacco companies have for some time been under pressure, and so are their bond ratings.
  13. *Pension liabilities:* Does the firm have unfunded pension and/or employee health insurance liabilities that could pose a future problem?
  14. *Labor unrest:* Are there potential labor problems on the horizon that could weaken the firm's position? As we write this, a number of airlines face this problem, and it has caused their ratings to be lowered.
  15. *Accounting policies:* If a firm's accounting policies, and thus its reported earnings, are questionable, this will have a negative effect on its bond ratings. As we were working on this chapter, the policies of American International Group (AIG) came into question, and its bonds were downgraded shortly after its problems were revealed.

Representatives of the rating agencies have consistently stated that no precise formula is used to set a firm's rating: all the factors listed, plus others, are taken into account, but not in a mathematically precise manner. Statistical studies have borne out this contention, for researchers who have tried to predict bond ratings on the basis of quantitative data have had only limited success, indicating that the agencies use subjective judgment when establishing a firm's rating.[18]

Nevertheless, as we see in Table 7-3, there is a strong correlation between bond ratings and many of the ratios that we described in Chapter 4. Not surprisingly, companies with lower debt ratios, higher free cash flow to debt, higher returns on invested capital, higher EBITDA coverage ratios, and higher TIE ratios typically have higher bond ratings.

Importance of Bond Ratings

Bond ratings are important both to firms and to investors. First, because a bond's rating is an indicator of its default risk, the rating has a direct, measurable

[18] See Amed Belkaoui, *Industrial Bonds and the Rating Process* (London: Quorum Books, 1983).

TABLE 7-3   *Bond Rating Criteria; Three-Year (1998–2000) Median Financial Ratios for Different Bond Rating Classifications of Industrial Companies*[a]

	AAA	AA	A	BBB	BB	B	CCC
Times-interest-earned (EBIT/Interest)	21.4×	10.1×	6.1×	3.7×	2.1×	0.8×	0.1×
EBITDA interest coverage (EBITDA/Interest)	26.5	12.9	9.1	5.8	3.4	1.8	1.3
Net cash flow/Total debt	128.8%	55.4%	43.2%	30.8%	18.8%	7.8%	1.6%
Free cash flow/Total debt	84.2	25.2	15.0	8.5	2.6	(3.2)	(12.9)
Return on capital	34.9	21.7	19.4	13.6	11.6	6.6	1.0
Operating income/Sales[b]	27.0	22.1	18.6	15.4	15.9	11.9	11.9
Long-term debt/Total capital	13.3	28.2	33.9	42.5	57.2	69.7	68.8
Total debt/Total capital	22.9	37.7	42.5	48.2	62.6	74.8	87.7

Notes:
[a] Somewhat different criteria are applied to firms in different industries, such as utilities and financial corporations. This table pertains to industrial companies, which include manufacturers, retailers, and service firms.
[b] Operating income here is defined as sales minus cost of goods manufactured (before depreciation and amortization), selling, general and administrative, and research and development costs.

Source: Adapted from "Adjusted Key Industrial Financial Ratios," *Standard & Poor's 2002 Corporate Ratings Criteria,* July 21, 2003, p. 54.

influence on the bond's interest rate and the firm's cost of debt. Second, most bonds are purchased by institutional investors rather than individuals, and many institutions are restricted to investment-grade securities. Thus, if a firm's bonds fall below BBB, it will have a difficult time selling new bonds because many potential purchasers will not be allowed to buy them.

As a result of their higher risk and more restricted market, lower-grade bonds have higher required rates of return, r_d, than high-grade bonds. Figure 7-4 illustrates this point. In each of the years shown on the graph, U.S. government bonds have had the lowest yields, AAA bonds have been next, and BBB bonds have had the highest yields. The figure also shows that the gaps between yields on the three types of bonds vary over time, indicating that the cost differentials, or yield spreads, fluctuate from year to year. This point is highlighted in Figure 7-5, which gives the yields on the three types of bonds and the yield spreads for AAA and BBB bonds over Treasuries in May 2002 and January 2005.[19] Note first from Figure 7-5 that the risk-free rate, or vertical axis intercept, was lower in early 2005 than it was in May 2002, primarily reflecting the decline in

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[19] A yield spread is related to but not identical to risk premiums on corporate bonds. The true *risk premium* reflects only the difference in expected (and required) returns between two securities that results from differences in their risk. However, yield spreads reflect (1) a true risk premium; (2) a liquidity premium, which reflects the fact that U.S. Treasury bonds are more readily marketable than most corporate bonds; (3) a call premium, because most Treasury bonds are not callable whereas corporate bonds are; and (4) an expected loss differential, which reflects the probability of loss on the corporate bonds. As an example of the last point, suppose the yield to maturity on a BBB bond was 6.0 percent versus 4.8 percent on government bonds, but there was a 5 percent probability of total default loss on the corporate bond. In this case, the *expected* return on the BBB bond would be 0.95(6.0%) + 0.05(0%) = 5.7%, and the yield spread would be 0.9%, not the full 1.2 percentage points difference in "promised" yields to maturity.

FIGURE 7-4   *Yields on Selected Long-Term Bonds, 1994–2005*
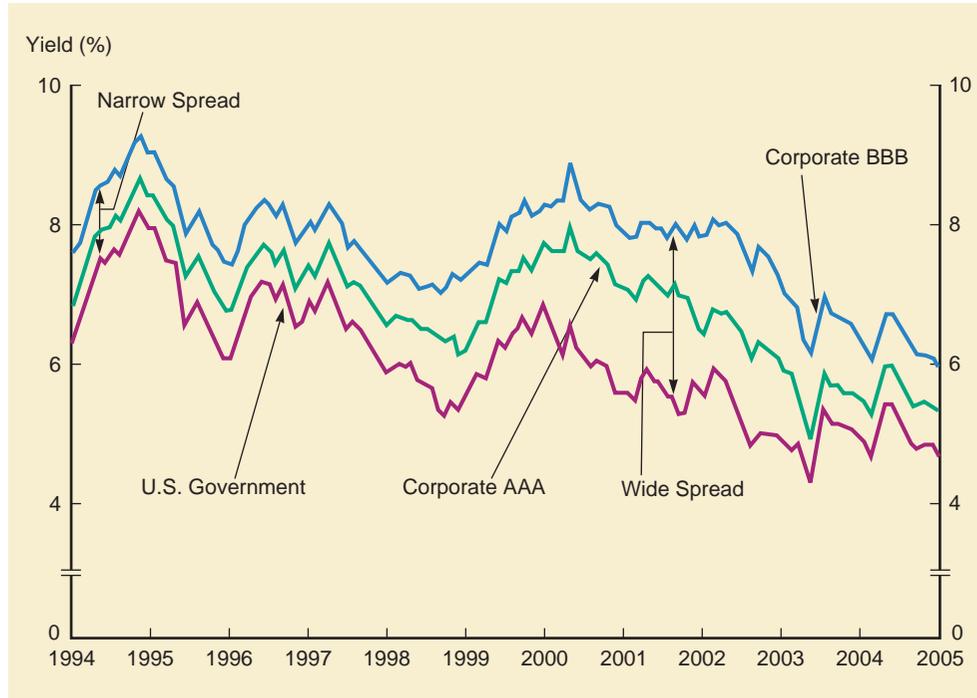
Source: Federal Reserve Statistical Release, Selected Interest Rates (Historical Data), **http://www
.federalreserve.gov/releases/H15/data.htm**.

both real rates and expected inflation over the past few years. Second, the slope
of the line has also decreased, indicating a decrease in investors' risk aversion.
Thus, the penalty for having a low credit rating varies over time. Occasionally,
as in 2002, the penalty is quite large, but at times like 1995 (shown in Figure
7-4) and in 2005 (shown in Figures 7-4 and 7-5) it is small. These spread differ-
ences reflect both investors' risk aversion and also their optimism or pessimism
regarding the economy and corporate profits. In 2002, as more and more corpo-
rate scandals were being revealed, investors were both pessimistic and risk
averse, so spreads were quite high.

Changes in Ratings

Changes in a firm's bond rating affect both the firm's ability to borrow funds
capital and its cost of that capital. Rating agencies review outstanding bonds on
a periodic basis, occasionally upgrading or downgrading a bond as a result of its
issuer's changed circumstances. For example, the February 10, 2005, issue of
Standard & Poor's CreditWeek Focus reported that Gap Inc.'s corporate credit rat-
ing was upgraded from BB+ to BBB−. The improved rating moved Gap's bonds
into the investment-grade category. The rating upgrade reflected Gap's improved
operating performance and its continued strong liquidity. On the other hand, a
little more than a week later, *CreditWeek Focus* warned that it might have to
downgrade the bonds of New York Times Co. The warning cited fears that the
Times may have taken on too much debt to finance a recent acquisition. In the

| FIGURE 7-5 | *Relationship between Bond Ratings and Bond Yields, 2002 and 2005* |

| | Long-Term Government Bonds (Default-Free) (1) | AAA Corporate Bonds (2) | BBB Corporate Bonds (3) | YIELD SPREADS | |
				AAA (4) = (2) − (1)	BBB (5) = (3) − (1)
May 2002	5.8%	6.8%	8.1%	1.0%	2.3%
January 2005	4.8	5.4	6.0	0.6	1.2
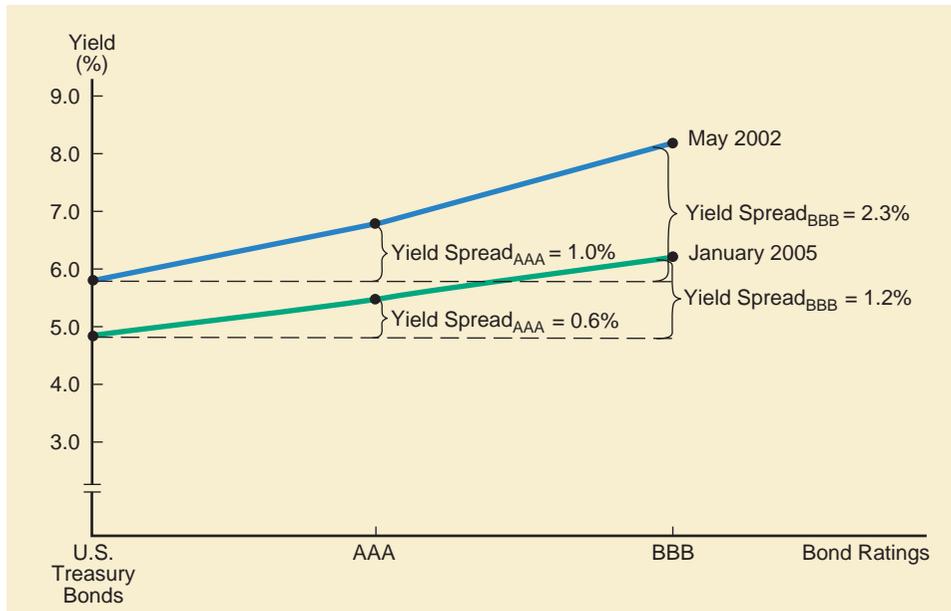
Source: Federal Reserve Statistical Release, Selected Interest Rates (Historical Data),
http://www.federalreserve.gov/releases/H15/data.htm.

months that follow, the company may choose to strengthen its balance sheet in order to avoid a downgrade.

On balance, it is fair to say that ratings agencies generally do a good job of measuring the average credit risk of bonds, and that they do their best to change ratings whenever they perceive a change in credit quality. At the same time, it is important to understand that ratings do not adjust immediately to changes in credit quality, and in some cases there can be a considerable lag between a change in credit quality and a change in rating. For example, the rating agencies were caught off guard by Enron's rapid decline. Enron declared bankruptcy on a Sunday in December 2001, and the preceding Friday its bonds still carried an investment-grade rating.

Bankruptcy and Reorganization

When a business becomes *insolvent*, this means that it doesn't have enough cash to meet its interest and principal payments. A decision must then be made whether to dissolve the firm through *liquidation* or to permit it to *reorganize* and thus stay alive. These issues are addressed in Chapters 7 and 11 of the federal bankruptcy statutes, and the final decision is made by a federal bankruptcy court judge.

The decision to force a firm to liquidate versus permitting it to reorganize depends on whether the value of the reorganized firm is likely to be greater than the value of its assets if they were sold off piecemeal. In a reorganization, the firm's creditors negotiate with management on the terms of a potential reorganization. The reorganization plan may call for *restructuring* the debt, in which case the interest rate may be reduced, the term to maturity lengthened, or some of the debt may be exchanged for equity. The point of the restructuring is to reduce the financial charges to a level that is supportable by the firm's cash flows. Of course, the common stockholders also have to "take a haircut"—they generally see their position diluted as a result of additional shares being given to debtholders in exchange for accepting a reduced amount of debt principal and interest. A trustee may be appointed by the court to oversee the reorganization, but generally the existing management is allowed to retain control.

Liquidation occurs if the company is deemed to be worth more dead than alive. If the bankruptcy court orders a liquidation, assets are auctioned off and the cash obtained is distributed as specified in Chapter 7 of the Bankruptcy Act. Web Appendix 7B provides an illustration of how a firm's assets are distributed after liquidation. For now, you should know that (1) the federal bankruptcy statutes govern both reorganization and liquidation, (2) bankruptcies occur frequently, (3) a priority of the specified claims must be followed when distributing the assets of a liquidated firm, (4) bondholders' treatment depends on the terms of the bond, and (5) stockholders generally receive little in reorganizations and nothing in liquidations because the assets are generally worth less than the amount of debt outstanding.

SELF TEST

Differentiate between mortgage bonds and debentures.

Name the major rating agencies, and list some factors that affect bond ratings.

Why are bond ratings important both to firms and to investors?

Do bond ratings adjust immediately to changes in credit quality? Explain.

Differentiate between Chapter 7 liquidations and Chapter 11 reorganizations. When should each be used?

7.9 BOND MARKETS

Corporate bonds are traded primarily in the over-the-counter market. Most bonds are owned by and traded among large financial institutions (for example, life insurance companies, mutual funds, and pension funds, all of which deal in very large blocks of securities), and it is relatively easy for the over-the-counter bond dealers to arrange the transfer of large blocks of bonds among the relatively few holders of the bonds. It would be much more difficult to conduct similar operations in the stock market among the literally millions of large and small stockholders, so a higher percentage of stock trades occur on the exchanges.

Information on bond trades in the over-the-counter market is not published, but a representative group of bonds is listed and traded on the bond division of the NYSE. Table 7-4 reprints the "Corporate Bonds" section from *The Wall Street Journal* that shows the 40 most active issues that traded on March 11, 2005, in descending order of sales volume.

Text not available due to copyright restrictions

If you look at the first issue shown in Table 7-4, you will see that General Motors had the most actively traded issue on March 11, 2005. These bonds have an 8.375 percent coupon and will mature on July 15, 2033. On March 11, 2005, their price was 94.965 percent of par, or 0.94965 × $1,000 = $949.65, and their yield to maturity was 8.861 percent. (Thus, similarly rated bonds with a similar maturity would have required a coupon of roughly 8.86 percent on March 11 to sell at par.) Their estimated spread was 405 basis points over 30-year Treasuries. (If you looked at *The Wall Street Journal* for March 14, 2005, you would see that the 5.375 percent February 2031 Treasury issue's yield on March 11 was 4.81 percent, and 8.86% − 4.81% = 4.05%, which is the 405 basis points spread shown in Table 7-4.) The last column shows the estimated trading volume on March 11, which was $207,068,000.

If you examined the table closely, you would note that the GM bonds at the top of the list also have the highest yield and the largest yield spread over Treasuries. This reflects two things: First, the GM bonds at the top of the list have a very long maturity—2033—and when the yield curve is sharply upward sloping, long-term bonds have high yields. However, maturity doesn't explain the high yield spread over Treasuries—that is explained by the fact that GM is now (2005) in financial trouble, and its bonds were just downgraded to junk status. Seven other GM bonds are in the table, and they also have relatively high yields and yield spreads relative to their maturities. Ford also has several bonds in the table, and their yield spreads are second only to those of GM, reflecting its poor financial condition.

At the other end of the spectrum we see Time Warner, with a yield of only 3.239 percent and a yield spread so low that it is not even measurable. TW's bonds mature in only six weeks, and investors regard it as inconceivable that the company could go bankrupt in that short time. All the other data in the table have similar logical explanations.

As we noted earlier, coupon rates are generally set at levels that reflect the "going rate of interest" on the day the bonds are issued. If the rates were set lower, investors simply would not buy the bonds at the $1,000 par value, so the company could not borrow the money it needed. Thus, bonds generally sell at their par values on the day they are issued, but their prices fluctuate thereafter as interest rates change. Thus, the prices of the bonds in the table range from a low 93.804 (percent of par) for Ford to a high of 132.794 for Sprint, which issued bonds with a high yield but then gained strength (the opposite of GM) and saw its yields fall and its bond prices rise.

SELF TEST

Why do most bond trades occur in the over-the-counter market?

If a bond issue is to be sold at par, at what rate must its coupon rate be set? Explain.

Tying It All Together

This chapter described the different types of bonds governments and corporations issue, explained how bond prices are established, and discussed how investors estimate the rates of return on bonds. It also discussed the various types of risks that investors face when they buy bonds.

It is important to remember that when an investor purchases a company's bonds, the investor is providing the company with capital. Therefore, when a firm issues bonds, *the return that investors require on the bonds represents the cost of debt capital to the firm*. This point is extended in

Chapter 10, where the ideas developed in this chapter are used to help determine a company's overall cost of capital, which is a basic component in the capital budgeting process.

In recent years many companies have used zero coupon bonds to raise billions of dollars, while bankruptcy is an important consideration for both companies that issue debt and investors. Therefore, these two related issues are discussed in detail in Web Appendixes 7A and 7B. Please go to the ThomsonNOW Web site to access these appendixes.

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

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

a. Bond; treasury bond; corporate bond; municipal bond; foreign bond
b. Par value; maturity date; original maturity
c. Coupon payment; coupon interest rate
d. Floating-rate bond; zero coupon bond; original issue discount (OID) bond
e. Call provision; sinking fund provision; indenture
f. Convertible bond; warrant; putable bond; income bond; indexed, or purchasing power, bond
g. Discount bond; premium bond
h. Yield to maturity (YTM); yield to call (YTC); current yield; total return; yield spread
i. Interest rate risk; reinvestment rate risk; investment horizon
j. Default risk; credit risk
k. Mortgage bond; debenture; subordinated debenture
l. Investment-grade bond; junk bond

ST-2 **Bond valuation** The Pennington Corporation issued a new series of bonds on January 1, 1982. The bonds were sold at par ($1,000), had a 12 percent coupon, and matured in 30 years, on December 31, 2011. Coupon payments are made semiannually (on June 30 and December 31).

a. What was the YTM on January 1, 1982?
b. What was the price of the bonds on January 1, 1987, 5 years later, assuming that interest rates had fallen to 10 percent?
c. Find the current yield, capital gains yield, and total return on January 1, 1987, given the price as determined in part b.
d. On July 1, 2005, 6.5 years before maturity, Pennington's bonds sold for $916.42. What was the YTM, the current yield, the capital gains yield, and the total return at that time?
e. Now, assume that you plan to purchase an outstanding Pennington bond on March 1, 2005, when the going rate of interest given its risk was 15.5 percent. How large a check must you write to complete the transaction? This is a hard question.

ST-3 **Sinking fund** The Vancouver Development Company (VDC) is planning to sell a $100 million, 10-year, 12 percent, annual payment, bond issue. Provisions for a sinking fund to retire the issue over its life will be included in the indenture. Sinking fund payments will be made at the end of each year, and each payment must be sufficient to retire 10 percent of the original amount of the issue. The last sinking fund payment will retire the last of the bonds. The bonds to be retired each period can either be purchased on the open market or obtained by calling up to 5 percent of the original issue at par, at VDC's option.

a. How large must each sinking fund payment be if the company (1) uses the option to call bonds at par or (2) decides to buy bonds on the open market? For part (2), you can only answer in words.

b. What will happen to debt service requirements per year associated with this issue over its 10-year life?

c. Now consider an alternative plan, where VDC sets up its sinking fund so that *equal annual amounts* are paid into a sinking fund trust held by a bank, with the proceeds being used to buy government bonds that are expected to pay 7 percent annual interest. The payments, plus accumulated interest, must total to $100 million at the end of 10 years, when the proceeds will be used to retire the issue. How large must the annual sinking fund payments be? Is this amount known with certainty, or might it be higher or lower?

d. What are the annual cash requirements for covering bond service costs under the trusteeship arrangement described in part c? (Note: Interest must be paid on Vancouver's outstanding bonds but not on bonds that have been retired.) Assume level interest rates for purposes of answering this question.

e. What would have to happen to interest rates to cause the company to buy bonds on the open market rather than call them under the plan where some bonds are retired each year?

QUESTIONS

7-1 A sinking fund can be set up in one of two ways:

a. The corporation makes annual payments to the trustee, who invests the proceeds in securities (frequently government bonds) and uses the accumulated total to retire the bond issue at maturity.

b. The trustee uses the annual payments to retire a portion of the issue each year, either calling a given percentage of the issue by a lottery and paying a specified price per bond or buying bonds on the open market, whichever is cheaper.

What are the advantages and disadvantages of each procedure from the viewpoint of (a) the firm and (b) the bondholders?

7-2 Is it true that the following equation can be used to find the value of a bond with N years to maturity that pays interest once a year? Assume that the bond was issued several years ago.

$$V_B = \sum_{t=1}^{N} \frac{\text{Annual interest}}{(1 + r_d)^t} + \frac{\text{Par value}}{(1 + r_d)^N}$$

7-3 "The values of outstanding bonds change whenever the going rate of interest changes. In general, short-term interest rates are more volatile than long-term interest rates. Therefore, short-term bond prices are more sensitive to interest rate changes than are long-term bond prices." Is this statement true or false? Explain. (Hint: Make up a "reasonable" example based on a 1-year and a 20-year bond to help answer the question.)

7-4 If interest rates rise after a bond issue, what will happen to the bond's price and YTM? Does the time to maturity affect the extent to which interest rate changes affect the bond's price? (Again, an example might help you answer this question.)

7-5 If you buy a *callable* bond and interest rates decline, will the value of your bond rise by as much as it would have risen if the bond had not been callable? Explain.

7-6 Assume that you have a short investment horizon (less than 1 year). You are considering two investments: a 1-year Treasury security and a 20-year Treasury security. Which of the two investments would you view as being more risky? Explain.

7-7 Indicate whether each of the following actions will increase or decrease a bond's yield to maturity:

    a. The bond's price increases.
    b. The bond is downgraded by the rating agencies.
    c. A change in the bankruptcy code makes it more difficult for bondholders to receive payments in the event the firm declares bankruptcy.
    d. The economy seems to be shifting from a boom to a recession. Discuss the effects of the firm's credit strength in your answer.
    e. Investors learn that these bonds are subordinated to another debt issue.

7-8 Why is a call provision advantageous to a bond issuer? When would the issuer be likely to initiate a refunding call?

7-9 Are securities that provide for a sinking fund more or less risky from the bondholder's perspective than those without this type of provision? Explain.

7-10 What's the difference between a call for sinking fund purposes and a refunding call?

7-11 Why are convertibles and bonds with warrants typically offered with lower coupons than similarly rated straight bonds?

7-12 Explain whether the following statement is true or false: "Only weak companies issue debentures."

7-13 Would the yield spread on a corporate bond over a Treasury bond with the same maturity tend to become wider or narrower if the economy appeared to be heading into a recession? Would the change in the spread for a given company be affected by the firm's credit strength?

7-14 A bond's expected return is sometimes estimated by its YTM and sometimes by its YTC. Under what conditions would the YTM provide a better estimate, and when would the YTC be better?

PROBLEMS

Easy
Problems 1–4

7-1 **Bond valuation** Callaghan Motors' bonds have 10 years remaining to maturity. Interest is paid annually; they have a $1,000 par value; the coupon interest rate is 8 percent; and the yield to maturity is 9 percent. What is the bond's current market price?

7-2 **Current yield and yield to maturity** A bond has a $1,000 par value, 10 years to maturity, a 7 percent annual coupon, and sells for $985.

    a. What is its current yield?
    b. What is its yield to maturity (YTM)?
    c. Assume that the yield to maturity remains constant for the next 3 years. What will the price be 3 years from today?

7-3 **Bond valuation** Nungesser Corporation's outstanding bonds have a $1,000 par value, a 9 percent semiannual coupon, 8 years to maturity, and an 8.5 percent YTM. What is the bond's price?

7-4 **Yield to maturity** A firm's bonds have a maturity of 10 years with a $1,000 face value, an 8 percent semiannual coupon, are callable in 5 years at $1,050, and currently sell at a price of $1,100. What are their yield to maturity and their yield to call? What return should investors expect to earn on this bond?

Intermediate
Problems 5–15

7-5 **Bond valuation** An investor has two bonds in his portfolio that both have a face value of $1,000 and pay a 10 percent annual coupon. Bond L matures in 15 years, while Bond S matures in 1 year.

a. What will the value of each bond be if the going interest rate is 5 percent, 8 percent, and 12 percent? Assume that there is only one more interest payment to be made on Bond S, at its maturity, and 15 more payments on Bond L.

b. Why does the longer-term bond's price vary more when interest rates change than does that of the shorter-term bond?

7-6 **Bond valuation** An investor has two bonds in his or her portfolio, Bond C and Bond Z. Each matures in 4 years, has a face value of $1,000, and has a yield to maturity of 9.6 percent. Bond C pays a 10 percent annual coupon, while Bond Z is a zero coupon bond.

a. Assuming that the yield to maturity of each bond remains at 9.6 percent over the next 4 years, calculate the price of the bonds at the following years to maturity and fill in the following table:

Years to Maturity	Price of Bond C	Price of Bond Z
4	_____	_____
3	_____	_____
2	_____	_____
1	_____	_____
0	_____	_____

b. Plot the time path of prices for each bond.

7-7 **Interest rate sensitivity** An investor purchased the following 5 bonds. Each of them had an 8 percent yield to maturity on the purchase day. Immediately after she purchased them, interest rates fell and each then had a new YTM of 7 percent. What is the percentage change in price for each bond after the decline in interest rates? Fill in the following table:

	Price @ 8%	Price @ 7%	Percentage Change
10-year, 10% annual coupon	_____	_____	_____
10-year zero	_____	_____	_____
5-year zero	_____	_____	_____
30-year zero	_____	_____	_____
$100 perpetuity	_____	_____	_____

7-8 **Yield to call** Six years ago, the Singleton Company issued 20-year bonds with a 14 percent annual coupon rate at their $1,000 par value. The bonds had a 9 percent call premium, with 5 years of call protection. Today, Singleton called the bonds. Compute the realized rate of return for an investor who purchased the bonds when they were issued and held them until they were called. Explain why the investor should or should not be happy that Singleton called them.

7-9 **Yield to maturity** Heymann Company bonds have 4 years left to maturity. Interest is paid annually, and the bonds have a $1,000 par value and a coupon rate of 9 percent.

a. What is the yield to maturity at a current market price of (1) $829 or (2) $1,104?

b. Would you pay $829 for each bond if you thought that a "fair" market interest rate for such bonds was 12 percent—that is, if r_d = 12 percent? Explain your answer.

7-10 **Current yield, capital gains yield, and yield to maturity** Hooper Printing Inc. has bonds outstanding with 9 years left to maturity. The bonds have an 8 percent annual coupon rate and were issued 1 year ago at their par value of $1,000, but due to changes in interest rates, the bond's market price has fallen to $901.40. The capital gains yield last year was −9.86 percent.

a. What is the yield to maturity?

b. For the coming year, what is the expected current yield and the expected capital gains yield?

c. Will the actual realized yields be equal to the expected yields if interest rates change? If not, how will they differ?

7-11 **Bond yields** Last year Clark Company issued a 10-year, 12 percent semiannual coupon bond at its par value of $1,000. The bond can be called in 4 years at a price of $1,060, and it now sells for $1,100.

a. What are the bond's yield to maturity and its yield to call? Would an investor be more likely to actually earn the YTM or the YTC?
b. What is the current yield? Is this yield affected by whether or not the bond is likely to be called?
c. What is the expected capital gains (or loss) yield for the coming year? Is this yield dependent on whether or not the bond is expected to be called?

7-12 **Yield to call** It is now January 1, 2006, and you are considering the purchase of an outstanding bond that was issued on January 1, 2004. It has a 9.5 percent annual coupon and had a 30-year original maturity. (It matures on December 31, 2033.) There was 5 years of call protection (until December 31, 2008), after which time it can be called at 109 (that is, at 109 percent of par, or $1,090). Interest rates have declined since it was issued, and it is now selling at 116.575 percent of par, or $1,165.75.

a. What is the yield to maturity? What is the yield to call?
b. If you bought this bond, which return do you think you would actually earn? Explain your reasoning.
c. Suppose the bond had been selling at a discount rather than a premium. Would the yield to maturity then have been the most likely actual return, or would the yield to call have been most likely?

7-13 **Price and yield** An 8 percent semiannual coupon bond matures in 5 years. The bond has a face value of $1,000 and a current yield of 8.21 percent. What are the bond's price and YTM?

7-14 **Current yield** A semiannual coupon bond that matures in 7 years sells for $1,020. It has a face value of $1,000 and a yield to maturity of 10.5883 percent. What is its current yield?

7-15 **Expected interest rate** Lloyd Corporation's 14 percent coupon rate, semiannual payment, $1,000 par value bonds, which mature in 30 years, are callable 5 years from today at $1,050. They sell at a price of $1,353.54, and the yield curve is flat. Assume interest rates are expected to remain at their current level.
a. What is the best estimate of these bonds' remaining life?
b. If Lloyd plans to raise additional capital and wants to use debt financing, what coupon rate would it have to set in order to issue new bonds at par?

Challenging Problems 16–20

7-16 **Bond valuation** Bond X is noncallable, has 20 years to maturity, a 9 percent annual coupon, and a $1,000 par value. Your required return on Bond X is 10 percent, and if you buy it you plan to hold it for 5 years. You, and the market, have expectations that in 5 years the yield to maturity on a 15-year bond with similar risk will be 8.5 percent. How much should you be willing to pay for Bond X today? (Hint: You will need to know how much the bond will be worth at the end of 5 years.)

7-17 **Bond valuation** You are considering a 10-year, $1,000 par value bond. Its coupon rate is 9 percent, and interest is paid semiannually. If you require an "effective" annual interest rate (not a nominal rate) of 8.16 percent, then how much should you be willing to pay for the bond?

7-18 **Bond returns** Last year, Joan purchased a $1,000 face value corporate bond with an 11 percent annual coupon rate and a 10-year maturity. At the time of the purchase, it had an expected yield to maturity of 9.79 percent. If Joan sold the bond today for $1,060.49, what rate of return would she have earned for the past year?

7-19 **Bond reporting** Look back at Table 7-4, and examine the Albertson's and Ford Motor Co. bonds that mature in 2031.
a. If these companies were to sell new $1,000 par value long-term bonds, approximately what coupon interest rate would they have to set if they wanted to bring them out at par?
b. If you had $10,000 and wanted to invest in the Ford bonds, what return would you expect to earn? What about the Albertson's bonds? Just based on the data in the table, would you have more confidence about earning your expected rate of return if you bought the Ford or Albertson's bonds? Explain.

7-20 **Yield to maturity and yield to call** Kaufman Enterprises has bonds outstanding with a $1,000 face value and 10 years left until maturity. They have an 11 percent annual coupon payment and their current price is $1,175. The bonds may be called in 5 years at 109 percent of face value (Call price = $1,090).

a. What is the yield to maturity?
b. What is the yield to call, if they are called in 5 years?
c. Which yield might investors expect to earn on these bonds, and why?
d. The bond's indenture indicates that the call provision gives the firm the right to call them at the end of each year beginning in Year 5. In Year 5, they may be called at 109 percent of face value, but in each of the next 4 years the call percentage will decline by 1 percent. Thus, in Year 6 they may be called at 108 percent of face value, in Year 7 they may be called at 107 percent of face value, and so on. If the yield curve is horizontal and interest rates remain at their current level, when is the latest that investors might expect the firm to call the bonds?

COMPREHENSIVE/SPREADSHEET PROBLEM

7-21   **Bond valuation** Clifford Clark is a recent retiree who is interested in investing some of his savings in corporate bonds. His financial planner has suggested the following bonds:
- Bond A has a 7 percent annual coupon, matures in 12 years, and has a $1,000 face value.
- Bond B has a 9 percent annual coupon, matures in 12 years, and has a $1,000 face value.
- Bond C has an 11 percent annual coupon, matures in 12 years, and has a $1,000 face value.

Each bond has a yield to maturity of 9 percent.

a. Before calculating the prices of the bonds, indicate whether each bond is trading at a premium, discount, or at par.
b. Calculate the price of each of the three bonds.
c. Calculate the current yield for each of the three bonds.
d. If the yield to maturity for each bond remains at 9 percent, what will be the price of each bond 1 year from now? What is the expected capital gains yield for each bond? What is the expected total return for each bond?
e. Mr. Clark is considering another bond, Bond D. It has an 8 percent semiannual coupon and a $1,000 face value (that is, it pays a $40 coupon every 6 months). Bond D is scheduled to mature in 9 years and has a price of $1,150. It is also callable in 5 years at a call price of $1,040.
    (1) What is the bond's nominal yield to maturity?
    (2) What is the bond's nominal yield to call?
    (3) If Mr. Clark were to purchase this bond, would he be more likely to receive the yield to maturity or yield to call? Explain your answer.
f. Explain briefly the difference between interest rate (or price) risk and reinvestment rate risk. Which of the following bonds has the most interest rate risk?

- A 5-year bond with a 9 percent annual coupon.
- A 5-year bond with a zero coupon.
- A 10-year bond with a 9 percent annual coupon.
- A 10-year bond with a zero coupon.

g. Only do this part if you are using a spreadsheet. Calculate the price of each bond (A, B, and C) at the end of each year until maturity, assuming interest rates remain constant. Create a graph showing the time path of each bond's value similar to Figure 7-2.
    (1) What is the expected interest yield for each bond in each year?
    (2) What is the expected capital gains yield for each bond in each year?
    (3) What is the total return for each bond in each year?

Integrated Case

Western Money Management Inc.

7-22 **Bond valuation** Robert Black and Carol Alvarez are vice presidents of Western Money Management and co-directors of the company's pension fund management division. A major new client, the California League of Cities, has requested that Western present an investment seminar to the mayors of the represented cities, and Black and Alvarez, who will make the actual presentation, have asked you to help them by answering the following questions.

a. What are a bond's key features?

b. What are call provisions and sinking fund provisions? Do these provisions make bonds more or less risky?

c. How is the value of any asset whose value is based on expected future cash flows determined?

d. How is a bond's value determined? What is the value of a 10-year, $1,000 par value bond with a 10 percent annual coupon if its required return is 10 percent?

e. (1) What is the value of a 13 percent coupon bond that is otherwise identical to the bond described in part d? Would we now have a discount or a premium bond?

  (2) What is the value of a 7 percent coupon bond with these characteristics? Would we now have a discount or a premium bond?

  (3) What would happen to the values of the 7 percent, 10 percent, and 13 percent coupon bonds over time if the required return remained at 10 percent? [Hint: With a financial calculator, enter PMT, I/YR, FV, and N, and then change (override) N to see what happens to the PV as it approaches maturity.]

f. (1) What is the yield to maturity on a 10-year, 9 percent, annual coupon, $1,000 par value bond that sells for $887.00? That sells for $1,134.20? What does the fact that it sells at a discount or at a premium tell you about the relationship between r_d and the coupon rate?

  (2) What are the total return, the current yield, and the capital gains yield for the discount bond? (Assume it is held to maturity and the company does not default on it.)

g. What is *interest rate* (or *price*) *risk*? Which has more interest rate risk, an annual payment 1-year bond or a 10-year bond? Why?

h. What is *reinvestment rate risk*? Which has more reinvestment rate risk, a 1-year bond or a 10-year bond?

i. How does the equation for valuing a bond change if semiannual payments are made? Find the value of a 10-year, semiannual payment, 10 percent coupon bond if nominal r_d = 13 percent.

j. Suppose you could buy, for $1,000, either a 10 percent, 10-year, annual payment bond or a 10 percent, 10-year, semiannual payment bond. They are equally risky. Which would you prefer? If $1,000 is the proper price for the semiannual bond, what is the equilibrium price for the annual payment bond?

k. Suppose a 10-year, 10 percent, semiannual coupon bond with a par value of $1,000 is currently selling for $1,135.90, producing a nominal yield to maturity of 8 percent. However, it can be called after 4 years for $1,050.

  (1) What is the bond's *nominal yield to call (YTC)*?

  (2) If you bought this bond, do you think you would be more likely to earn the YTM or the YTC? Why?

l. Does the yield to maturity represent the promised or expected return on the bond? Explain.

m. These bonds were rated AA− by S&P. Would you consider them investment-grade or junk bonds?

n. What factors determine a company's bond rating?

o. If this firm were to default on the bonds, would the company be immediately liquidated? Would the bondholders be assured of receiving all of their promised payments? Explain.

cyberproblem

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