CH:6

Interest Rates and Bond Valuation

What we will cover in this chapter

- **6.2: Corporate bonds**
  - Introduction of bonds
  - Bond Rating
  - Types of bond
  - Bond market
- **6.4: Bond valuation**
  - Yield to Maturity

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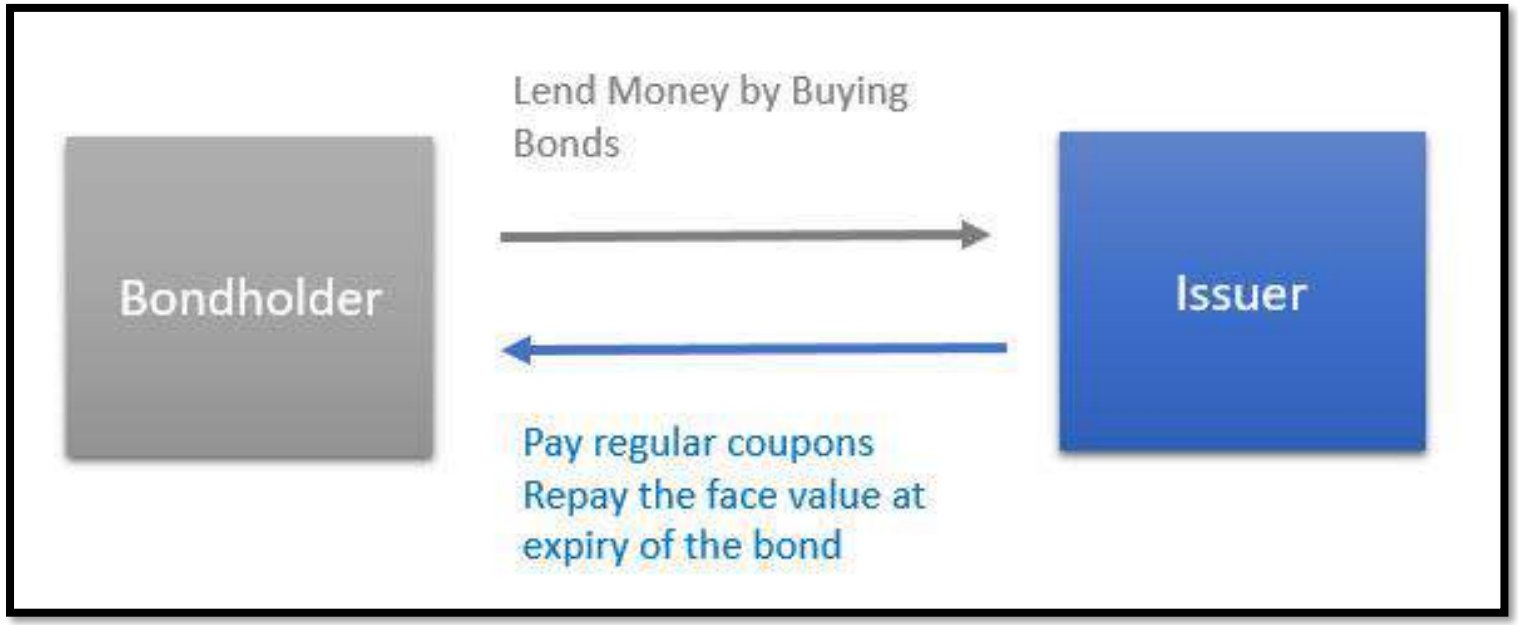
Introduction of bond

- A **corporate bond is a long-term debt instrument indicating that a corporation** has borrowed a certain amount of money and promises to repay it in the future under clearly defined terms.
- Most bonds are issued with maturities of 10 to 30 years and with a par value, or face value, of $1,000.

Characteristics of bond

- **Face Value –** par value
- **Maturity –** period of bond
- **Issuer-** company issuing the bond
- **Bondholder -** A person owning a bond/lenders
- **Coupon rate -** the percentage of the bond's par value that will be paid annually, typically in two equal semiannual payments, as interest.
- **Coupon-** annual interest payment that the bondholder receives from the bond's issue date until it matures.

Scenario


Lend Money by Buying Bonds
Bondholder
Issuer
Pay regular coupons
Repay the face value at expiry of the bond

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Bond Rating

- Independent agencies such as Moody's, Fitch, and Standard & Poor's assess **the riskiness of publicly traded bond issues**.
- These agencies derive their ratings by using **financial ratio and cash flow analyses** to assess the likely payment of bond interest and principal.
- Ratings affect **salability and cost.**

TABLE 6.3 Moody's and Standard & Poor's Bond Ratings[a]

Moody's	Interpretation	Standard & Poor's	Interpretation
Aaa	Prime quality	AAA	Investment grade
Aa	High grade	AA	
A	Upper medium grade	A	
Baa	Medium grade	BBB	
Ba	Lower medium grade	BB	Speculative
	or speculative	B	
B	Speculative		
Caa	From very speculative	CCC	
Ca	to near or in default	CC	
C	Lowest grade	C	Income bond
		D	In default

[a]Some ratings may be modified to show relative standing within a major rating category; for example, Moody's uses numerical modifiers (1, 2, 3), whereas Standard & Poor's uses plus (+) and minus (−) signs.

Sources: Moody's Investors Service, Inc., and Standard & Poor's Corporation.

Bond Quality and Rate of return

- Normally an inverse relationship exists between the quality of a bond and the rate of return that it must provide bondholders:

High-quality (high-rated) bonds provide lower returns than lower-quality (low-rated) bonds.

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Types of Bond

- Traditional bonds
- Contemporary bonds

TABLE 6.4 Characteristics and Priority of Lender's Claim of Traditional Types of Bonds

Bond type	Characteristics	Priority of lender's claim
Unsecured bonds		
Debentures	Unsecured bonds that only creditworthy firms can issue. Convertible bonds are normally debentures.	Claims are the same as those of any general creditor. May have other unsecured bonds subordinated to them.
Subordinated debentures	Claims are not satisfied until those of the creditors holding certain (senior) debts have been fully satisfied.	Claim is that of a general creditor but not as good as a senior debt claim.
Income bonds	Payment of interest is required only when earnings are available. Commonly issued in reorganization of a failing firm.	Claim is that of a general creditor. Are not in default when interest payments are missed, because they are contingent only on earnings being available.
Secured Bonds		
Mortgage bonds	Secured by real estate or buildings.	Claim is on proceeds from sale of mortgaged assets; if not fully satisfied, the lender becomes a general creditor. The *first-mortgage* claim must be fully satisfied before distribution of proceeds to *second-mortgage* holders, and so on. A number of mortgages can be issued against the same collateral.
Collateral trust bonds	Secured by stock and (or) bonds that are owned by the issuer. Collateral value is generally 25% to 35% greater than bond value.	Claim is on proceeds from stock and (or) bond collateral; if not fully satisfied, the lender becomes a general creditor.
Equipment trust certificates	Used to finance "rolling stock"—airplanes, trucks, boats, railroad cars. A trustee buys the asset with funds raised through the sale of trust certificates and then leases it to the firm; after making the final scheduled lease payment, the firm receives title to the asset. A type of leasing.	Claim is on proceeds from the sale of the asset; if proceeds do not satisfy outstanding debt, trust certificate lenders become general creditors.

TABLE 6.5 Characteristics of Contemporary Types of Bonds

Bond type	Characteristics[a]
Zero- (or low-) coupon bonds	Issued with no (zero) or a very low coupon (stated interest) rate and sold at a large discount from par. A significant portion (or all) of the investor's return comes from gain in value (that is, par value minus purchase price). Generally callable at par value. Because the issuer can annually deduct the current year's interest accrual without having to pay the interest until the bond matures (or is called), its cash flow each year is increased by the amount of the tax shield provided by the interest deduction.
Junk bonds	Debt rated Ba or lower by Moody's or BB or lower by Standard & Poor's. Commonly used by rapidly growing firms to obtain growth capital, most often as a way to finance mergers and takeovers. High-risk bonds with high yields—often yielding 2% to 3% more than the best-quality corporate debt.
Floating-rate bonds	Stated interest rate is adjusted periodically within stated limits in response to changes in specified money market or capital market rates. Popular when future inflation and interest rates are uncertain. Tend to sell at close to par because of the automatic adjustment to changing market conditions. Some issues provide for annual redemption at par at the option of the bondholder.
Extendible notes	Short maturities, typically 1 to 5 years, that can be renewed for a similar period at the option of holders. Similar to a floating-rate bond. An issue might be a series of 3-year renewable notes over a period of 15 years; every 3 years, the notes could be extended for another 3 years, at a new rate competitive with market interest rates at the time of renewal.
Putable bonds	Bonds that can be redeemed at par (typically, $1,000) at the option of their holder either at specific dates after the date of issue and every 1 to 5 years thereafter or when and if the firm takes specified actions, such as being acquired, acquiring another company, or issuing a large amount of additional debt. In return for its conferring the right to "put the bond" at specified times or when the firm takes certain actions, the bond's yield is lower than that of a nonputable bond.

[a]The claims of lenders (that is, bondholders) against issuers of each of these types of bonds vary, depending on the bonds' other features. Each of these bonds can be unsecured or secured.

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Bond Market

- The bond market broadly describes a **marketplace** where investors buy debt securities that are brought to the market by either governmental entities or publicly-traded corporations.

Bond market in Pakistan

- In Pakistan, the development of money market and bond market was initiated in late **1990s** after the liberalization reforms; however, Pakistan's bond market has developed at a **slow pace** as compared to other countries. Like other emerging markets, most of the debt financing is done through **bank borrowings**.

Bond Market in Pakistan

- Market Treasury Bills
- Pakistan Investment Bonds
- Federal Investment Bonds
- US Special Dollar Bonds
- Sukuks

- For details: https://www.slideshare.net/abubakartoor/bond-market-in-pakistan

International Bond market

- **Eurobond market**
  - A bond issued by an international borrower and sold to investors in countries with currencies other than the currency in which the bond is denominated.
    - **e:g GE issuing a dollar denominated bond in Pakistan**
- **Foreign bond market**
  - A bond that is issued by a foreign corporation or government and is denominated in the investor's home currency and sold in the investor's home market.
    - **e:g GE issuing a rupee denominated bond in Pakistan**

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Bond Valuation

The value of a bond is the present value of its interest payments plus the present value of its par value.

Basic Valuation Model…

$$V_0 = \frac{CF_1}{(1 + r)^1} + \frac{CF_2}{(1 + r)^2} + \cdots + \frac{CF_n}{(1 + r)^n} \qquad (6.4)$$

where

V_0 = value of the asset at time zero
CF_t = cash flow *expected* at the end of year t
r = appropriate required return (discount rate)
n = relevant time period

The value of any asset is the present value of all future cash flows it is expected to provide over the relevant time period.

Bond yields(rate of return)

- **Current yield:** A measure of a bond's cash return for the year; calculated *by dividing the bond's annual interest payment by its current price.*

- **Yield to maturity:** Yield to maturity is the rate of return investors earn if they buy a bond at a specific price and *hold it until maturity*.

- **Yield to call:** The yield to call represents the rate of return that investors earn if they buy a callable bond at a specific price and hold it until it is called back.

Basic Bond Valuation

$$B_0 = I \times \left[\sum_{t=1}^{n} \frac{1}{(1 + r_d)^t} \right] + M \times \left[\frac{1}{(1 + r_d)^n} \right] \quad (6.5)$$

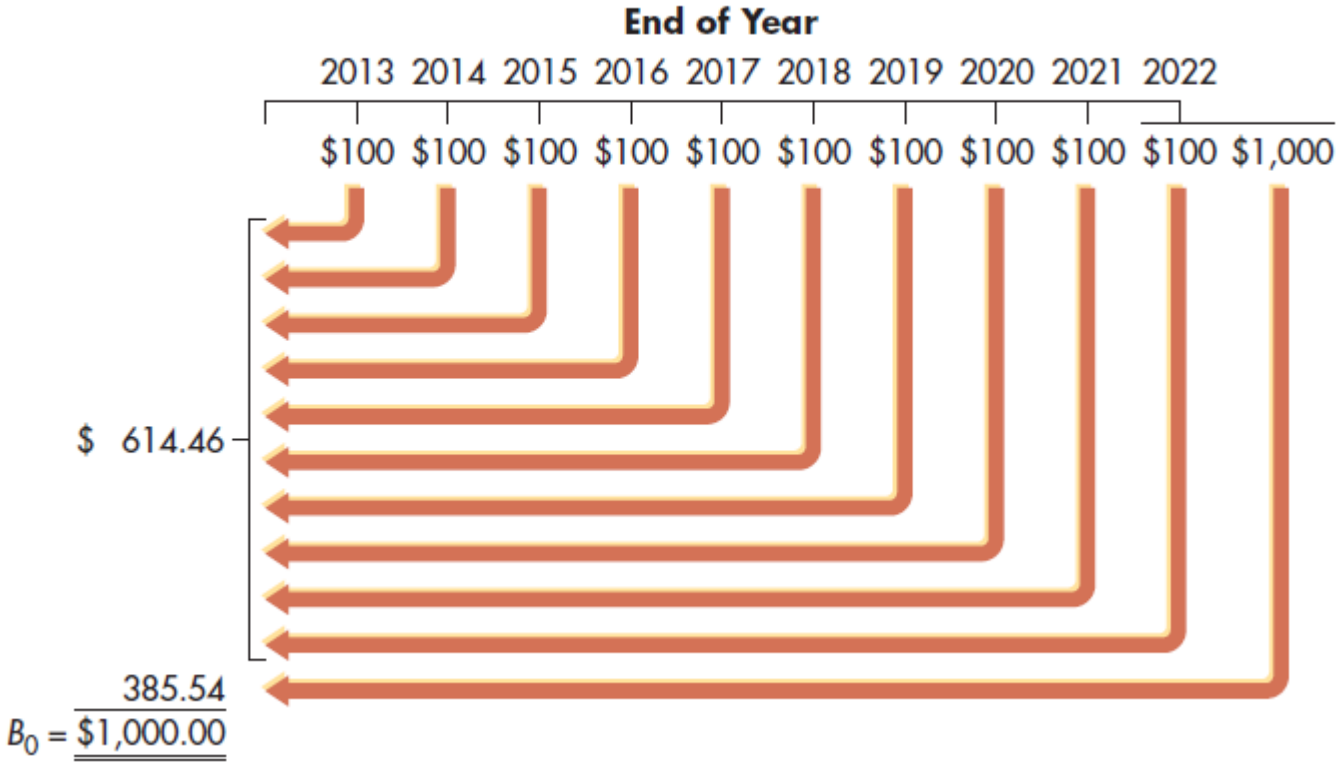
where

B_0 = value of the bond at time zero
I = *annual* interest paid in dollars
n = number of years to maturity
M = par value in dollars
r_d = required return on the bond

r_d or the required return on the bond is the discount rate used to determine bond value, which may differ from the bond's coupon interest rate.

Personal Finance Example 6.8 ▶ Tim Sanchez wishes to determine the current value of the Mills Company bond. *Assuming that interest on the Mills Company bond issue is paid annually* and that the required return is equal to the bond's coupon interest rate, $I = \$100$, $r_d = 10\%$, $M = \$1{,}000$, and $n = 10$ years.

The computations involved in finding the bond value are depicted graphically on the following time line.



Bond Value Behavior

- In practice, the value of a bond in the marketplace is rarely equal to its par value.
  - REASONS:
    - Variety of forces in the economy
    - Required return
    - Time to maturity

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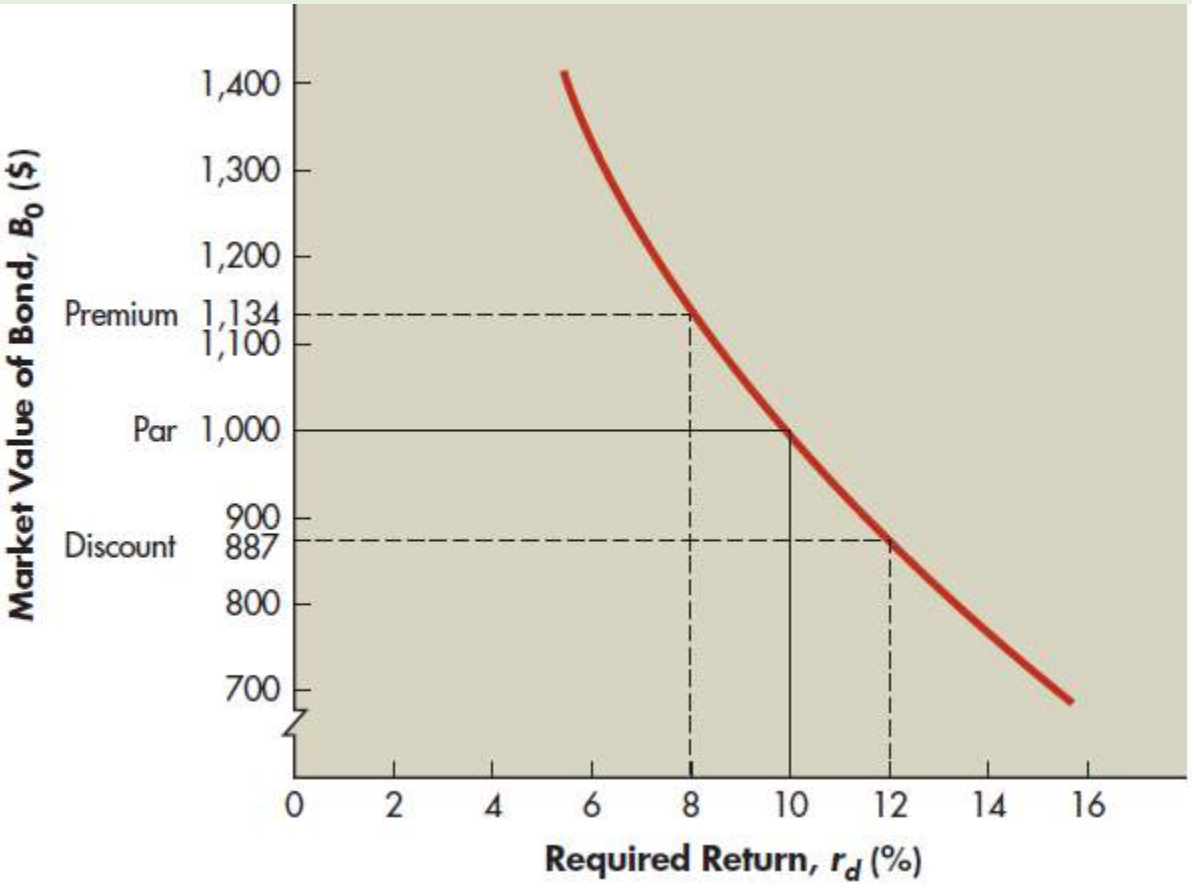
Bond Value Behavior…
Required return and bond values

A bond can sell at a discount, at par, or at a premium, depending on whether the required return is greater than, equal to, or less than its coupon interest rate.

- Required rate > coupon interest rate
  - **Bond will be sold at discount**
- Required rate < coupon interest rate
  - **Bond will be sold at premium**

TABLE 6.6 Bond Values for Various Required Returns (Mills Company's 10% Coupon Interest Rate, 10-Year Maturity, $1,000 Par, January 1, 2013, Issue Date, Paying Annual Interest)

Required return, r_d	Bond value, B_0	Status
12%	$ 887.00	Discount
10	1,000.00	Par value
8	1,134.20	Premium



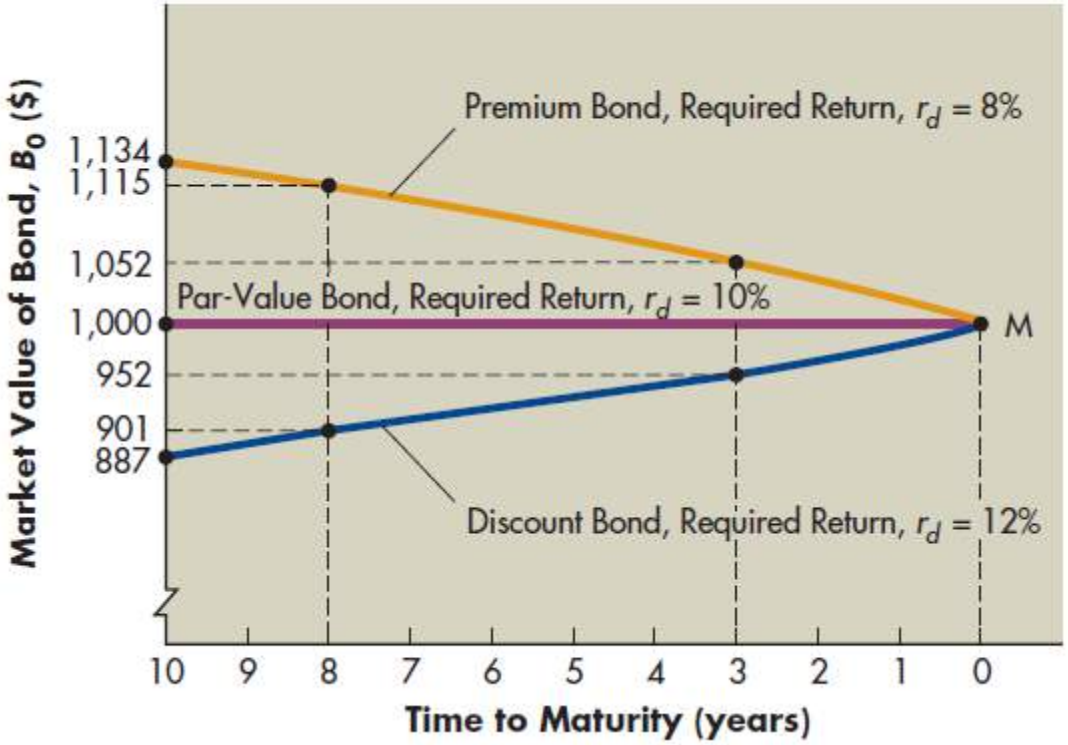
Bond Value Behavior…
Time to maturity and bond value

The amount of time to maturity affects bond values. The value of a bond will approach its par value as the bond moves closer to maturity.

Bond Value Behavior…
Time to maturity and bond value

- Constant Required Returns:
  - When the required return is different from the coupon interest rate and is *constant until maturity, the value of the bond will* approach its par value as the passage of time moves the bond's value closer to maturity.

Example 6.10 ▸ Figure 6.5 depicts the behavior of the bond values calculated earlier and presented in Table 6.6 for Mills Company's 10% coupon interest rate bond paying annual interest and having 10 years to maturity. Each of the three required returns—12%, 10%, and 8%—is assumed to remain constant over the 10 years to the bond's maturity. The bond's value at both 12% and 8% approaches and ultimately equals the bond's $1,000 par value at its maturity, as the discount (at 12%) or premium (at 8%) declines with the passage of time.

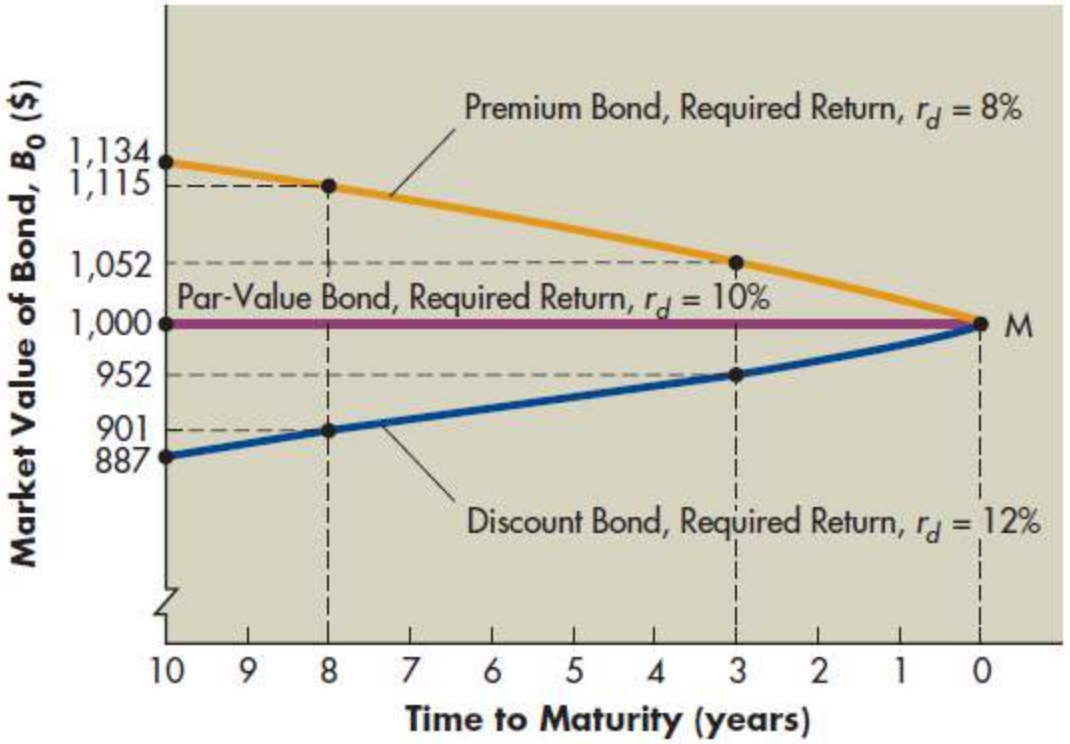


Bond Value Behavior…
Time to maturity and bond value

- Changing Required Returns:
  - *Short maturities have less interest rate risk than long maturities when all other features (coupon interest rate, par value, and interest payment frequency) are the same.*

The chance that interest rates will change and thereby change the required return and bond value is called interest rate risk.

Example 6.11 ▸ The effect of changing required returns on bonds with differing maturities can be illustrated by using Mills Company's bond and Figure 6.5. If the required return rises from 10% to 12% when the bond has 8 years to maturity (see the dashed line at 8 years), the bond's value decreases from $1,000 to $901—a 9.9% decrease. If the same change in required return had occurred with only 3 years to maturity (see the dashed line at 3 years), the bond's value would have dropped to just $952—only a 4.8% decrease. Similar types of responses can be seen for the change in bond value associated with decreases in required returns. The shorter the time to maturity, the less the impact on bond value caused by a given change in the required return.



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Yield to Maturity

- When investors evaluate bonds, they commonly consider yield to maturity (YTM).

- A bond's yield to maturity (YTM) is the **internal rate of return** required for the present value of all the future cash flows of the (coupon payments and face value) to equal the current price.

Yield to maturity vs current yield

- Current yield is the actual return one gets annually if one purchase that bond now.

- Yield to maturity is the yield one can expect annually if one holds on to the bond till maturity.

Personal Finance Example 6.12 ▸ Earl Washington wishes to find the YTM on Mills Company's bond. The bond currently sells for $1,080, has a 10% coupon interest rate and $1,000 par value, pays interest annually, and has 10 years to maturity.

$$B_0 = I \times \left[\sum_{t=1}^{n} \frac{1}{(1 + r_d)^t}\right] + M \times \left[\frac{1}{(1 + r_d)^n}\right]$$

$$PV_n = \left(\frac{CF}{r}\right) \times \left[1 - \frac{1}{(1 + r)^n}\right]$$

$$PV = \frac{FV_n}{(1 + r)^n}$$

- Required rate > coupon interest rate
  - **Bond will be sold at discount**
- Required rate < coupon interest rate
  - **Bond will be sold at premium**

Solution:

$$B_0 = 100/r \times [\,1-(1/(1+r)^{10})] + 1{,}000\,[1/(1+r)^{10}]$$

1. $100/r \times [\,1-(1/(1+r)^{10})] + 1{,}000\,[1/(1+r)^{10}]$
   $= 100/0.09 \times [\,1-(1/(1+0.09)^{10})] + 1{,}000\,[1/(1+0.09)^{10}]$
   $=\$1{,}064.177$

or

2. $100/r \times [\,1-(1/(1+r)^{10})] + 1{,}000\,[1/(1+r)^{10}]$
   $= 100/0.08 \times [\,1-(1/(1+0.08)^{10})] + 1{,}000\,[1/(1+0.08)^{10}]$
   $=\$1{,}134.202$

***rd* lies between 8% and 9%.**

For practice

SELF-TEST PROBLEMS

ST6–1 **Bond valuation** Lahey Industries has outstanding a $1,000 par-value bond with an 8% coupon interest rate. The bond has 12 years remaining to its maturity date.

a. If interest is paid *annually*, find the value of the bond when the required return is (1) 7%, (2) 8%, and (3) 10%.

$$PV_n = \left(\frac{CF}{r}\right) \times \left[1 - \frac{1}{(1 + r)^n}\right]$$

$$PV = \frac{FV_n}{(1 + r)^n}$$

a. $B_0 = I/r_d \times [1 - 1/(1 + r_d)^n] + M \times 1/(1 + r_d)^n$

$I = 0.08 \times \$1{,}000 = \$80$

$M = \$1{,}000$

$n = 12$ yrs

1. $r_d = 7\%$

$B_0 = \$80/0.07 \times [1 - 1/(1 + 0.07)^{12}] + \$1{,}000 \times 1/(1 + 0.07)^{12}$

$= (\$1{,}142.86 \times 0.556) + (\$1{,}000 \times 0.444)$

$= \$635.43 + \$444.00 = \underline{\$1{,}079.43}$

(Calculator solution = $1,079.43)

2. $r_d = 8\%$

$B_0 = \$80/0.08 \times [1 - 1/(1 + 0.08)^{12}] + \$1{,}000 \times 1/(1 + 0.08)^{12}$

$= (\$1{,}000 \times 0.603) + (\$1{,}000 \times 0.397)$

$= \$603.00 + \$397.00 = \underline{\$1{,}000.00}$

(Calculator solution = $1,000.00)

3. $r_d = 10\%$

$B_0 = \$80/0.10 \times [1 - 1/(1 + 0.10)^{12}] + \$1{,}000 \times 1/(1 + 0.10)^{12}$

$= (\$800 \times 0.681) + (\$1{,}000 \times 0.319)$

$= \$544.80 + \$319.00 = \underline{\$863.80}$

(Calculator solution = $863.73)

ST6–1 **Bond valuation** Lahey Industries has outstanding a $1,000 par-value bond with an 8% coupon interest rate. The bond has 12 years remaining to its maturity date.

a. If interest is paid *annually*, find the value of the bond when the required return is (1) 7%, (2) 8%, and (3) 10%.

b. Indicate for each case in part a whether the bond is selling at a discount, at a premium, or at its par value.

b. 1. $r_d = 7\%$, $B_0 = \$1{,}079.43$; sells at a *premium*

2. $r_d = 8\%$, $B_0 = \$1{,}000.00$; sells at its *par value*

3. $r_d = 10\%$, $B_0 = \$863.80$; sells at a *discount*

ST6–1 Bond valuation Lahey Industries has outstanding a $1,000 par-value bond with an 8% coupon interest rate. The bond has 12 years remaining to its maturity date.

a. If interest is paid *annually*, find the value of the bond when the required return is (1) 7%, (2) 8%, and (3) 10%.

b. Indicate for each case in part a whether the bond is selling at a discount, at a premium, or at its par value.

c. Using the 10% required return, find the bond's value when interest is paid *semi-annually*.

c. $$B_0 = (I/2)/r_d \times [1 - 1/(1 + r_d/2)^{2n}] + M \times 1/(1 + r_d/2)^{2n}$$
$$= (\$80/2)/(0.10/2) \times [1 - 1/(1 + 0.10/2)^{24}]$$
$$+ \$1{,}000 \times 1/(1 + 0.10/2)^{24}$$
$$= \$800 \times 0.690 + \$1{,}000 \times 0.310$$
$$= \$552.00 + \$310.00 = \underline{\underline{\$862.00}}$$

ST6–1 **Bond valuation** Lahey Industries has outstanding a $1,000 par-value bond with an 8% coupon interest rate. The bond has 12 years remaining to its maturity date.

a. If interest is paid *annually*, find the value of the bond when the required return is (1) 7%, (2) 8%, and (3) 10%.

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c. Using the 10% required return, find the bond's value when interest is paid *semiannually*.

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$$= (\$80/2)/(0.10/2) \times [1 - 1/(1 + 0.10/2)^{24}]$$
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$$= \$800 \times 0.690 + \$1{,}000 \times 0.310$$
$$= \$552.00 + \$310.00 = \underline{\underline{\$862.00}}$$

$$B_0 = I \times \left[\sum_{t=1}^{n} \frac{1}{(1 + r_d)^t}\right] + M \times \left[\frac{1}{(1 + r_d)^n}\right]$$

$$B_0 = \frac{I}{2} \times \left[\sum_{t=1}^{2n} \frac{1}{\left(1 + \frac{r_d}{2}\right)^t}\right] + M \times \left[\frac{1}{\left(1 + \frac{r_d}{2}\right)^{2n}}\right]$$

ST6–2 **Bond yields** Elliot Enterprises' bonds currently sell for $1,150, have an 11% coupon interest rate and a $1,000 par value, pay interest *annually*, and have 18 years to maturity.

a. Calculate the bonds' *current yield*.
b. Calculate the bonds' *yield to maturity (YTM)*.
c. Compare the YTM calculated in part b to the bonds' coupon interest rate and current yield (calculated in part a). Use a comparison of the bonds' current price and par value to explain these differences.

Solution:

a. $B_0 = \$1{,}150$

$I = 0.11 \times \$1{,}000 = \$110$

$M = \$1{,}000$

$n = 18 \text{ yrs}$

$$\text{Current yield} = \frac{\text{annual interest}}{\text{current price}}$$

$$= \frac{\$110}{\$1{,}150} = 9.57\%$$

ST-6.2

ST6–2 Bond yields Elliot Enterprises' bonds currently sell for $1,150, have an 11% coupon interest rate and a $1,000 par value, pay interest *annually*, and have 18 years to maturity.

a. Calculate the bonds' *current yield*.

b. Calculate the bonds' *yield to maturity (YTM)*.

c. Compare the YTM calculated in part b to the bonds' coupon interest rate and current yield (calculated in part a). Use a comparison of the bonds' current price and par value to explain these differences.

Solution:

b. $\$1{,}150 = \$110/r_d \times [1 - 1/(1 + r_d)^{18}] + \$1{,}000 \times 1/(1 + r_d)^{18}$

Because if $r_d = 11\%$, $B_0 = \$1{,}000 = M$, try $r_d = 10\%$.

$$B_0 = \$110/0.10 \times [1 - 1/(1 + 0.10)^{18}] + \$1{,}000 \times 1/(1 + 0.10)^{18}$$
$$= (\$1{,}100 \times 0.820) + (\$1{,}000 \times 0.180)$$
$$= \$902.00 + \$180.00 = \$1{,}082.00$$

Because $\$1{,}082.00 < \$1{,}150$, try $r_d = 9\%$.

$$B_0 = \$110/0.09 \times [1 - 1/(1 + 0.09)^{18}] + \$1{,}000 \times 1/(1 + 0.09)^{18}$$
$$= (\$1{,}222.22 \times 0.788) + (\$1{,}000 \times 0.212)$$
$$= \$963.11 + \$212.00 = \$1{,}175.11$$

Because the $1,175.11 value at 9% is higher than $1,150, and the $1,082.00 value at 10% rate is lower than $1,150, the bond's yield to maturity must be between 9% and 10%. Because the $1,175.11 value is closer to $1,150, rounding to the nearest whole percent, the YTM is 9%. (By using interpolation, the more precise YTM value is 9.27%.)

ST6–2 Bond yields Elliot Enterprises' bonds currently sell for $1,150, have an 11% coupon interest rate and a $1,000 par value, pay interest *annually*, and have 18 years to maturity.

a. Calculate the bonds' *current yield*.

b. Calculate the bonds' *yield to maturity (YTM)*.

c. Compare the YTM calculated in part b to the bonds' coupon interest rate and current yield (calculated in part a). Use a comparison of the bonds' current price and par value to explain these differences.

Solution:

c. The YTM of 9.27% is below both the bond's 11% coupon interest rate and its current yield of 9.57% calculated in part a, because the bond's market value of $1,150 is above its $1,000 par value. Whenever a bond's market value is above its par value (it sells at a *premium*), its YTM and current yield will be below its coupon interest rate; when a bond sells at *par*, the YTM and current yield will equal its coupon interest rate; and when the bond sells for less than par (at a *discount*), its YTM and current yield will be greater than its coupon interest rate. Observe also that the current yield measures the bond's coupon payment relative to its current price. When the bond sells at a premium, its YTM will be below its current yield because the YTM also takes into account that the bondholder will receive just $1,000 back at maturity, which represents a loss relative to the bond's current market price. In other words, the YTM is measuring both the value of the coupon payment that the investor receives (just like the current yield does) and the "loss" that the bondholder endures when the bond matures.

Problems

6.10, 6.11, 6.15, 6.16, 6.17, 6.18, 6.20, 6.21, 6.22, 6.24, 6.25.