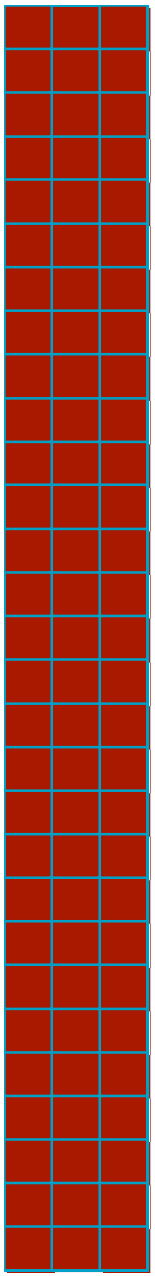


Interest Rates and Bond Valuation

Chapter Organization

- Bonds and Bond Valuation
- More on Bond Features
- Bond Ratings
- Some Different Types of Bonds

T7.1 Chapter Outline (concluded)

Interest Rates and Bond Valuation

Chapter Organization

- Bond Markets
- Inflation and Interest Rates
- Summary and Conclusions

Bond Features

- **Bond** - evidence of debt issued by a corporation or a governmental body. A bond represents a *loan* made by investors to the *issuer.* In return for his/her money, the investor receives a legal claim on future cash flows of the borrower. The issuer promises to:
- Make regular **coupon** payments every period until the bond matures, and
- Pay the **face/par/maturity value** of the bond when it matures.
- **Default** - since the above-mentioned promises are *contractual obligations*, an issuer who fails to keep them is subject to legal action on behalf of the lenders (bondholders).

Bond Features (concluded)

- If a bond has five years to maturity, an $80 annual coupon, and a $1000 face value, its cash flows would look like this:

Time	0	1	2	3	4	5
Coupons		$80	$80	$80	$80	$80
Face Value						$ 1000
						$_____

- How much is this bond worth? It depends on the level of current market interest rates. If the going rate on bonds like this one is 10%, then this bond is worth $924.18. Why? Stay tuned.

Bond Rates and Yields

- **Suppose a bond currently sells for $932.90. It pays an annual coupon of $70, and it matures in 10 years. It has a face value of $1000. What are its coupon rate, current yield, and yield to maturity (YTM)?**
  - **1. The *coupon rate* (or just "coupon") is the annual dollar coupon expressed as a percentage of the face value:**

    Coupon rate = $70 /$_____ = ___%

  - **2. The *current yield* is the annual coupon divided by the current market price of the bond:**

    Current yield = $___ /_____ = 7.5%

Under what conditions will the coupon rate and current yield be the same? Stay tuned.

Bond Rates and Yields (concluded)

- **3. The *yield to maturity* (or "YTM") is the rate that makes the price of the bond just equal to the present value of its future cash flows. It is the unknown r in:**

  $$\$932.90 = \$\_\_\_\_\_ \times[1 - 1/(1 + r)^{10}]/r + \$\_\_\_\_\_ /(1 + r)^{10}$$

  The only way to find the YTM is trial and error:

  a. Try 10%: $\$70 \times [(1 - 1/(1.10)^{10}]/.10 + \$1000/(1.10)^{10} = \$816$

  b. Try 9%: $\$70 \times [1 - 1/(1.09)^{10}]/.09 + \$1000/(1.09)^{10} = \$872$

  c. Try 8%: $\$70 \times [1 - 1/(1.08)^{10}]/.08 + \$1000/(1.08)^{10} = \$933$

  (∴) The yield to maturity is 8%

Valuing a Bond

- **Assume you have the following information.**

  Barnhart, Inc. bonds have a $1,000 face value
  The promised annual coupon is $100
  The bonds mature in 20 years
  The market's required return on similar bonds is 10%

  - **1. Calculate the present value of the face value**

    $= \$1{,}000 \times [1/1.10^{20}] = \$1{,}000 \times .14864 =$ **$148.64**

  - **2. Calculate the present value of the coupon payments**

    $= \$100 \times [1 - (1/1.10^{20})]/.10 = \$100 \times 8.5136 =$ **$851.36**

  - **3. The value of each bond = $148.64 + 851.36 = $1,000**

Example: A Discount Bond

- **Assume you have the following information.**

  Barnhart, Inc. bonds have a $1,000 face value
  The promised annual coupon is $100
  The bonds mature in 20 years
  The market's required return on similar bonds is 12%

  - 1. Calculate the present value of the face value

    $= \$1{,}000 \times [1/1.12^{20}] = \$1{,}000 \times .10366 = \$103.66$

  - 2. Calculate the present value of the coupon payments

    $= \$100 \times [1 - (1/1.10^{20})]/.10 = \$100 \times 7.4694 = \$746.94$

  - 3. The value of each bond = $103.66 + 746.94 = $850.60

Example: A Premium Bond

- **Assume you have the following information.**

  Barnhart, Inc. bonds have a $1,000 face value
  The promised annual coupon is $100
  The bonds mature in 20 years
  The market's required return on similar bonds is 8%

  - 1. Calculate the present value of the face value

    $= \$1{,}000 \times [1/1.08^{20}] = \$1{,}000 \times .21455 = \$214.55$

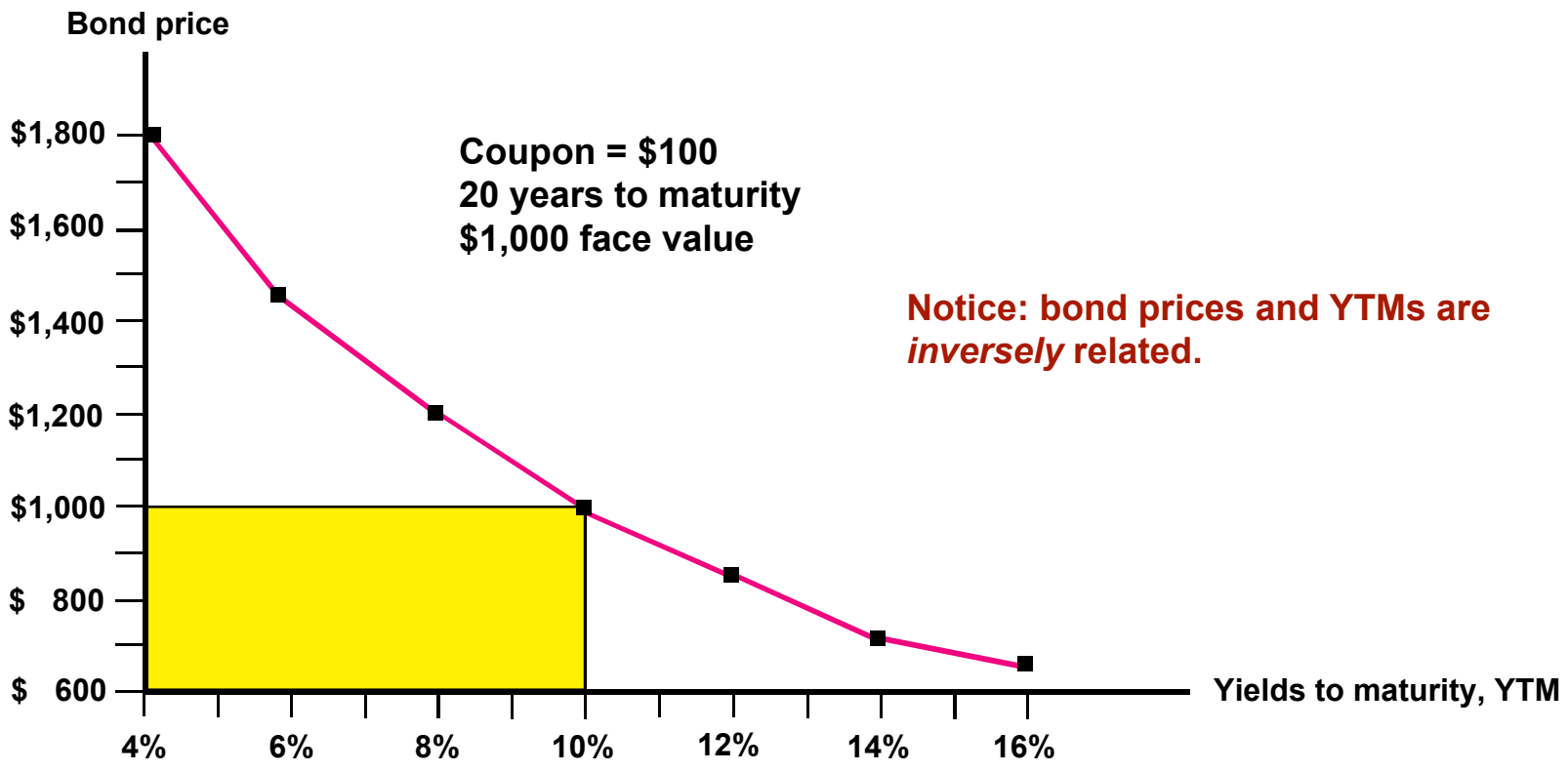
  - 2. Calculate the present value of the coupon payments

    $= \$100 \times [1 - (1/1.08^{20})]/.08 = \$100 \times 9.8181 = \$981.81$

  - 3. The value of each bond = $214.55 + 981.81 = $1,196.36

- **Why do the bonds in this and the preceding example have prices that are different from par?**

Bond Price Sensitivity to YTM



The Bond Pricing Equation

- **Bond Value = Present Value of the Coupons**
  + Present Value of the Face Value

$$= C \times [1 - 1/(1 + r)^t]/r + F \times 1/(1 + r)^t$$

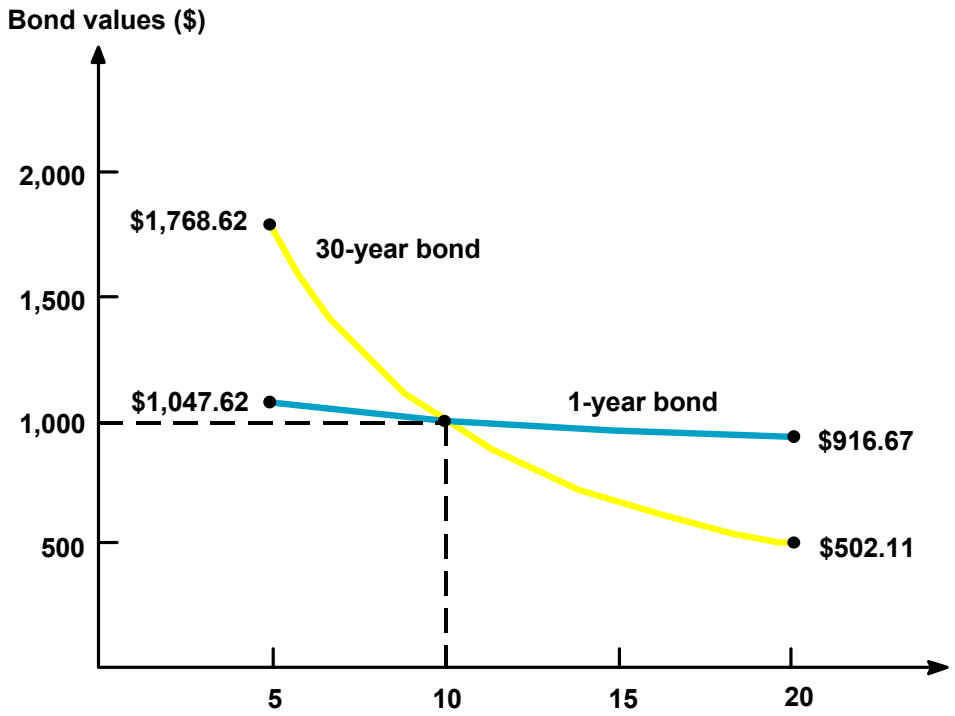
where: C = the promised coupon payment

F = the promised face value

t = number of periods until the bond matures

r = the market's required return, YTM

Interest Rate Risk and Time to Maturity (Figure 7.2)



	Time to Maturity	
Interest rate	1 year	30 years
5%	$1,047.62	$1,768.62
10	1,000.00	1,000.00
15	956.52	671.70
20	916.67	502.11

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

Bond Pricing Theorems

- **The following statements about bond pricing are *always* true.**
  - **1. Bond prices and market interest rates move in opposite directions.**
  - **2. When a bond's coupon rate is (greater than / equal to / less than) the market's required return, the bond's market value will be (greater than / equal to / less than) its par value.**
  - **3. Given two bonds identical but for maturity, the price of the longer-term bond will change more than that of the shorter-term bond, for a given change in market interest rates.**
  - **4. Given two bonds identical but for coupon, the price of the lower-coupon bond will change more than that of the higher-coupon bond, for a given change in market interest rates.**

Features of a May Department Stores Bond

Terms		Explanations
Amount of issue	$125 million	The company will issue $125 million worth of bonds.
Date of issue	2/28/86	The bonds were sold on 2/28/86.
Maturity	3/1/16	The principal will be paid in 30 years.
Annual coupon	9.25	The denomination of the bonds is $1,000. Each bondholder will receive $92.50 per bond per year (9.25% of the face value).
Offer price	100	The offer price will be 100% of the $1,000 face value per bond.

Features of a May Department Stores Bond (concluded)

Terms		Explanations
Coupon payment dates	3/1, 9/31	Coupons of $92.50/2 = $46.25 will be paid on these dates.
Security	None	The bonds are debentures.
Sinking fund	Annual, beginning 3/1/97	The firm will make annual payments toward the sinking fund.
Call provision	Not callable before 2/28/93	The bonds have a deferred call feature.
Call price	106.48 initially, declining to 100	After 2/28/93, the company can buy back the bonds for $1,064.80 per bond, declining to $1,000 on 2/28/05.
Rating	Moody's A2	This is one of Moody's higher ratings. The bonds have a low probability of default.

The Bond Indenture

- The bond indenture is a *three-party contract* between the bond issuer, the bondholders, and the trustee. The trustee is hired by the issuer to protect the bondholders' interests. (What do you think would happen if an issuer refused to hire a trustee?)
- The indenture includes
  - The basic terms of the bond issue
  - The total amount of bonds issued
  - A description of the security (if any)
  - Repayment arrangements
  - Call provisions
  - Details of the protective covenants

Bond Ratings

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

Moody's	**S&P**	
Aaa	**AAA**	**Debt rated Aaa and AAA has the highest rating. Capacity to pay interest and principal is extremely strong.**
Aa	**AA**	**Debt rated Aa and AA has a very strong capacity to pay interest and repay principal. Together with the highest rating, this group comprises the high-grade bond class.**
A	**A**	**Debt rated A has a strong capacity to pay interest and repay principal, although it is somewhat more susceptible to the adverse effects of changes in circumstances and economic conditions than debt in high rated categories.**

Bond Ratings (concluded)

Baa	BBB	Debt rated Baa and BBB is regarded as having an adequate capacity to pay interest and repay principal. Whereas it normally exhibits adequate protection parameters, adverse economic conditions or changing circumstances are more likely to lead to a weakened capacity to pay interest and repay principal for debt in this category than in higher rated categories. These bonds are medium-grade obligations.
Ba, B Ca, C	BB, B CC, C	Debt rated in these categories is regarded, on balance, as predominantly speculative with respect to capacity to pay interest and repay principal in accordance with the terms of the obligation. BB and Ba indicate the lowest degree of speculation, and CC and Ca the highest degree of speculation. Although such debt will likely have some quality and protective characteristics, these are out-weighed by large uncertainties or major risk exposures to adverse conditions. Some issues may be in default.
D	D	Debt rated D is in default, and payment of interest and/or repayment of principal is in arrears

Sample Bond Quotations (Figure 7.3)

Bonds

Supplied by RBC Dominion Securities Inc./ International from Reuters

	Coupon	Mat. Date	Bid $	Yld%
Government				
Canada	6.500	Aug 01/99	101.36	5.23
Canada	7.750	Sep 01/99	102.87	5.25
Canada	10.500	Jul 01/00	109.96	5.27
Canada	7.250	Jun 01/07	113.80	5.29
OMHC	8.200	Jun 30/00	105.42	5.35
OMHC	5.100	Jun 02/03	99.04	5.32
Corporate				
Bank of Mont	6.900	Oct 16/01	104.16	5.51
Cdn Imp Bank	4.500	Dec 06/99	98.73	5.41
Imperial Oil	9.875	Dec 15/99	106.12	5.53
Loblaws Co.	6.650	Nov 08/27	107.69	6.08
Royal Bank	11.000	Jan 11/02	117.46	5.53
Union Gas	8.650	Nov 10/25	133.29	6.13

Source: *The Financial Post*, June 17, 1998, p.45. Used with permission.

Inflation and Returns

- **Key issues:**
  - **What is the difference between a *real* and a *nominal* return?**
  - **How can we convert from one to the other?**

- **Example:**

  Suppose we have $1,000, and Diet Coke costs $2.00 per six pack. We can buy 500 six packs. Now suppose the rate of inflation is 5%, so that the price rises to $2.10 in one year. We invest the $1,000 and it grows to $1,100 in one year. What's our return in *dollars*? In *six packs*?

Inflation and Returns (continued)

- **A.** ***Dollars.*** **Our <u>return</u> is**

  ($1100 - $1000)/$1000 = $100/$1000 = _____.

  (∴) The percentage increase in the amount of green stuff is 10%; our return is 10%.

- **B.** ***Six packs*****. We can buy $1100/$2.10 = _____ six packs, so our return is**

  (523.81 - 500)/500 = 23.81/500 = 4.76%

  (∴) The percentage increase in the amount of brown stuff is 4.76%; our return is 4.76%.

Inflation and Returns (continued)

- **Real versus nominal returns:**

> **Your *nominal* return is the percentage change in the amount of money you have.**
>
> **Your *real* return is the percentage change in the amount of stuff you can actually buy.**

Inflation and Returns (concluded)

- The relationship between real and nominal returns is described by the Fisher Effect. Let:

R	=	the nominal return
r	=	the real return
h	=	the inflation rate

- According to the Fisher Effect:

$$1 + R = (1 + r) \times (1 + h)$$

  - From the example, the real return is 4.76%; the nominal return is 10%, and the inflation rate is 5%:

$$(1 + R) = 1.10$$

$$(1 + r) \times (1 + h) = 1.0476 \times 1.05 = 1.10$$

Factors Affecting Bond Yields

Key Issue:

What factors affect observed bond yields?

- **Real rate of interest**
- **Expected future inflation**
- **Interest rate risk**
- **Default risk premium**
- **Taxability premium**
- **Liquidity premium**

Quick Quiz

1. Under what conditions will the coupon rate, current yield, and yield-to-maturity be the same?

2. What does it mean when someone says a bond is selling "at par"? At "a discount"? At "a premium"?

3. What is a "transparent" market? Why is transparency important?

4. What is the "Fisher Effect"?

5. What is meant by the "term structure" of interest rates? How is the term structure of interest rates related to the yield curve?

Solution to Problem

- **Reznik Corporation has bonds on the market with 10.5 years to maturity, a yield-to-maturity of 8 percent, and a current price of $860. Coupon payments are semiannual. What must the coupon rate be on the bonds?**

  Total number of coupon payments = 10.5 × 2 = 21

  Yield-to-maturity per period = 8% / 2 = 4%

  Maturity value = F = $1,000

Solution to Problem (concluded)

- **Substituting the known values into the bond pricing equation:**

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

$$\$860 = C \times [1 - 1/(1 + .04)^{21}] / .04 + \$1{,}000/(1.04)^{21}$$

$$C = \$34.65$$

So the annual coupon must be $34.65 x 2 = $69.30

and the coupon rate is $69.30 / $1,000 = .0693 (6.93%)

Solution to Problem 7.13

- **Locate the Government of Canada issue in Figure 7.3 maturing on 1 FEB 04.**
  - **Is this a note or a bond?**
  - **What is its coupon rate?**
  - **What is its bid price?**

Solution to Problem 7.13 (concluded)

- Locate the CANADA issue in Fig. 7.3 maturing in 1 FEB 04.
- Is this a note or a bond?
- It's a bond, since there is no "n" following the maturity year.
- What is its coupon rate?
- The coupon rate is 10 1/4 percent.
- What is its bid price?
- The bid price is 123.95 percent of par.

Solution to Problem

- **Bond J has a 4% coupon and Bond K a 10% coupon. Both have 10 years to maturity, make semiannual payments, and have 9% YTMs. If market rates rise by 2%, what is the percentage price change of these bonds? If rates fall by 2%? What does this say about the risk of lower-coupon bonds?**

Current Prices:

Bond J:

$$PV = \$20 \times [1 - 1/(1.045)^{20}]/.045 + \$1{,}000/(1.045)^{20}$$

$$= \$\_\_\_\_\_$$

Bond K:

$$PV = \$50 \times [1 - 1/(1.045)^{20}]/.045 + \$1{,}000/(1.045)^{20}$$

$$= \$1065.04$$

Solution to Problem (continued)

Prices if market rates rise by 2%:

Bond J:

$$PV = \$20 \times [1 - 1/(1.055)^{20}]/.055 + \$1,000/(1.055)^{20}$$
$$= \$581.74$$

Bond K:

$$PV = \$50 \times [1 - 1/(1.055)^{20}]/.055 + \$1,000/(1.055)^{20}$$
$$= \$\_\_\_\_\_$$

Solution to Problem (continued)

Prices if market rates fall by 2%:

Bond J:

$$PV = \$20 \times [1 - 1/(1.035)^{20}]/.035 + \$1{,}000/(1.035)^{20}$$

$$= \$786.82$$

Bond K:

$$PV = \$50 \times [1 - 1/(1.035)^{20}]/.035 + \$1{,}000/(1.035)^{20}$$

$$= \$1213.19$$

Solution to Problem (concluded)

- **Percentage Changes in Bond Prices**

Bond Prices and Market Rates

	7%	9%	11%
Bond J	**$786.81**	**$674.80**	**$581.74**
% chg.	**(+16.60%)**		**(___%)**
Bond K	**$1,213.19**	**$1,065.04**	**$940.25**
% chg.	**(___%)**		**(-11.72%)**

The results above demonstrate that, all else equal, the price of the lower-coupon bond changes more (in percentage terms) than the price of the higher-coupon bond when market rates change.