Chapter 12
The Bond Market

■ Answers to End-of-Chapter Questions

1. Investors use capital markets for long-term investment purposes. They use money markets, which have lower yields, primarily for temporary or transaction purposes.

2. The primary capital market securities are stocks and bonds. Most of these are purchased and owned by households.

3. The primary market is for securities being issued for the very first time, and the issuer receives the funds paid for the security. The secondary market is for securities that have been issued previously but are being traded among investors.

4. The three types of information that are most important to the investor made available of the bond certificate are the par value, coupon interest rate, and the maturity date of the bond. The par value is the amount the issuer will pay the holder of the bond when the bond matures. The coupon interest rate is multiplied by the par value to determine the interest payment the issuer must make to the bond holder in each period when the interest are scheduled to be paid. The maturity date is when the issuer must pay the bond holder the par value of the bond.

5. Bonds that are rated Baa or better by Moody's and BBB or better by S&P are considered investment grade bonds. Financial institutions are generally prohibited by state and federal law from purchasing anything but investment grade bonds. Bonds rated below Baa by Moody's and BBB by S&P are considered speculative grade bonds and are often termed as junk bonds, or high-yield bonds. In the junk bond market, there is a very real chance that the issuing firms would default on their bond payments. By comparison, the default risk of investment-grade bonds is negligible.

6. The risk that a bond's price will change due to changes in market interest rates is called interest rate risk.

7. Convertible bonds are bonds that may be exchanged for another security of the issuing firm (e.g. common stock) at the discretion of the bond holder. If the market value of the securities the bond holder receives with the conversion exceeds the market value of the bond, the bond holder will return the bonds to the issuer in exchange for the new securities and make a profit. As a result, conversion is an attractive feature to bond holders. It gives the bond holder an investment opportunity that is not available with nonconvertible bonds. As a result, the yield on a convertible bond is lower than a nonconvertible bond.

8. Firms like having the flexibility to adjust their capital structure by paying off debt they no longer need. They also need to pay off debt to remove restrictive covenants. Call provisions permit both these actions at the issuer's discretion.

9. A sinking fund contains funds set aside by the issuer of a bond to pay for the redemption of the bond when it matures. Because a sinking fund increases the likelihood that a firm will have the funds to pay off the bonds as required, investors like the feature. As a result, interest rates are lower on securities with sinking funds.

10. The list of terms of a bond is known as the indenture.

11. An investor would face the possibility of default risk if the company fails to make timely interest or principal payments and thus defaults on its bonds. The investor could also be exposed to interest rate risk which is the possible reduction in returns that is associated with changes in interest rates. Investors may be exposed to inflation risk where a general rise in prices of goods and services causes a decline in purchasing power. With inflation over time, the amount of money received on the bond's interest and principal payments will purchase fewer goods and services than before. In certain cases, bond holders may be exposed to call risk whereby the terms of the bond gives the company the right to buy back the bond before the maturity date. Lastly, bond holders may also face liquidity risk which is the risk that bond holders seeking to sell their bonds may not receive a price that reflects the true value of the bonds (based on the bond's interest rate and creditworthiness of the company).

■ Quantitative Problems

1. You are considering buying a bond that matures 10 years from today. The par value of the bond is $10,000 and the coupon rate is 7%. If the current market interest rates are 5%, what is the bond price today if the coupon is paid annually?

Solution:

$$P = \text{Coupon payment} \times \left[\frac{1}{r} - \frac{1}{r(1+r)^n}\right] + \frac{\text{Principal payment}}{(1+r)^n}$$

$$P = 700 \times \left[\frac{1}{0.05} - \frac{1}{0.05(1+0.05)^{10}}\right] + \frac{10{,}000}{(1+0.05)^{10}}$$

$$P = 700 \times [20 - 12.27826507] + 6{,}139.132535$$

$$P = 5{,}405.214451 + 6{,}139.132535 = \$11{,}544.35$$

2. A zero coupon bond has a par value of $1,000 and matures in 20 years. Investors require a 10% annual return on these bonds. For what price should the bond sell? (Note: Zero coupon bonds do not pay any interest.) (Review Chapter 3)?

Solution: $148.64

3. Suppose there are two bonds you are considering:

	Bond A	Bond B
Maturity (years)	20	30
Coupon rate (%) (paid semiannually)	12	8
Par value	$1,000	$1,000

a. If both bonds had a required rate of return of 10%, what would the bonds' prices be?

b. Explain what it means when a bond is selling at a discount, a premium, or at its face amount (par value). Based on results in (a) would you consider both bonds to be selling at a discount, premium, or at par?

c. Re-calculate the prices of the bonds if the required return falls to 9%?

Solution:

a. Bond A

$$\mathbf{P} = \text{Coupon payment} \times \left[\frac{1}{r} - \frac{1}{r(1+r)^n}\right] + \frac{\text{Principal payment}}{(1+r)^n}$$

$$\mathbf{P} = 60 \times \left[\frac{1}{0.05} - \frac{1}{0.05(1+0.05)^{40}}\right] + \frac{1{,}000}{(1+0.05)^{40}}$$

$$\mathbf{P} = 60 \times [20 - 2.840913646] + 142.0456823$$

$$\mathbf{P} = 1029.545181 + 142.0456823 = \$1{,}171.59$$

Bond B

$$\mathbf{P} = \text{Coupon payment} \times \left[\frac{1}{r} - \frac{1}{r(1+r)^n}\right] + \frac{\text{Principal payment}}{(1+r)^n}$$

$$\mathbf{P} = 40 \times \left[\frac{1}{0.05} - \frac{1}{0.05(1+0.05)^{60}}\right] + \frac{1{,}000}{(1+0.05)^{60}}$$

$$\mathbf{P} = 40 \times [20 - 1.070710475] + 53.53552375$$

$$\mathbf{P} = 757.171581 + 53.53552375 = \$810.71$$

b. Bond A is selling at a premium and Bond B is selling at a discount.

c. **Bond A**

$$\mathbf{P} = \text{Coupon payment} \times \left[\frac{1}{r} - \frac{1}{r(1+r)^n}\right] + \frac{\text{Principal payment}}{(1+r)^n}$$

$$\mathbf{P} = 60 \times \left[\frac{1}{0.045} - \frac{1}{0.045(1+0.045)^{40}}\right] + \frac{1{,}000}{(1+0.045)^{40}}$$

$$\mathbf{P} = 60 \times [20.22222222 - 3.820637802] + 171.9287011$$

$$\mathbf{P} = 984.0950651 + 171.9287011 = \$1{,}156.02$$

Bond B

$$\mathbf{P} = \text{Coupon payment} \times \left[\frac{1}{r} - \frac{1}{r(1+r)^n}\right] + \frac{\text{Principal payment}}{(1+r)^n}$$

$$\mathbf{P} = 40 \times \left[\frac{1}{0.045} - \frac{1}{0.045(1+0.045)^{60}}\right] + \frac{1{,}000}{(1+0.045)^{60}}$$

$$\mathbf{P} = 40 \times [20.22222222 - 1.584200184] + 171.9287011$$

$$\mathbf{P} = 745.5208814 + 71.28900828 = \$816.81$$

4. A 2-year $1,000 par zero-coupon bond is currently priced at $819.00. A 2-year $1,000 annuity is currently priced at $1,712.52. If you want to invest $10,000 in one of the two securities, which is a better buy? You can assume
   a. the pure expectations theory of interest rates holds,
   b. neither bond has any default risk, maturity premium, or liquidity premium, and
   c. you can purchase partial bonds.

   Solution: With PV = \$819; FV = \$1,000; PMT = 0; and N = 2, the yield to maturity on the two-year zero-coupon bonds is 10.5% for the two-year annuities. PV = \$1,712.52; PMT = 0; FV = \$2,000; and N = 2 gives a yield to maturity of 8.07%. The zero-coupon bonds are the better buy.

5. Consider the following cash flows. All market interest rates are 12%.

Year	0	1	2	3	4
Cash Flow		160	170	180	230

a. What price would you pay for these cash flows? What total wealth do you expect after 2½ years if you sell the rights to the remaining cash flows? Assume interest rates remain constant.
b. What is the duration of these cash flows?
c. Immediately after buying these cash flows, all market interest rates drop to 11%. What is the impact on your total wealth after 2½ years?

Solution:

a. $$\text{Price} = \frac{160}{1.12} + \frac{170}{1.12^2} + \frac{180}{1.12^3} + \frac{230}{1.12^4} = \$552.67$$

$$\text{Expected Wealth} = 160 \times (1.12)^{1.5} + 170 \times (1.12)^{.5} + \frac{180}{1.12^{.5}} + \frac{230}{1.12^{1.5}} = \$733.69$$

b. $$\text{Duration} = \frac{\frac{160}{1.12}(1) + \frac{170}{1.12^2}(2) + \frac{180}{1.12^3}(3) + \frac{230}{1.12^4}}{552.67} = 2.50$$

c. $$\text{Expected Wealth} = 160 \times (1.11)^{1.5} + 170 \times (1.11)^{.5} + \frac{180}{1.11^{.5}} + \frac{230}{1.11^{1.5}} = \$733.74$$

Since you are holding the cash flows for their duration, you are essentially immunized from interest rate changes (in this simplistic example).

6. An investor is considering two bonds. One is a corporate bond yielding 12%, and is currently selling at par. The marginal tax rate is 28%. The other is a municipal bond with a coupon rate of 9.50%. Which should the investor choose?

Solution:

$$\text{Net return after tax for corporate bond} = 0.12 \times (1 - 0.28) = 0.0864 \approx 8.64\%$$

Compared against municipal bond coupon of 9.50%

Since 8.64% < 9.50%, choose investor should choose the municipal bond over the corporate bond.

7. If the municipal bond rate is 4.25% and the corporate bond rate is 6.25%, what is the marginal tax rate assuming investors are indifferent between the two bonds?

Solution: The equivalent tax-free rate = taxable interest rate × (1 − marginal tax rate). In this case, $0.0425 = 0.0625 \times (1 - X)$, or $X = 32\%$.

8. M&E Inc. has an outstanding convertible bond. The bond can be converted into 20 shares of common equity (currently trading at $52/share). The bond has 5 years of remaining maturity, a $1,000 par value, and a 6% annual coupon. M&E's straight debt is currently trading to yield 5%. What is the minimum price of the bond?

Solution: The price must exceed the straight bond value or the value of conversion (you will see why in the next question).

If converted, the debt is worth $52 × 20 = $1,040.

Assuming a 5% YTM is correct, the price of straight debt is computed as:

$PMT = 60$; $N = 5$; $FV = 1000$; $I = 5$

Compute PV; $PV = 1{,}043.29$

The bond must be trading for at least $1,043.29.

9. Assume the debt in the previous question is trading at 1,035. How can you earn a riskless profit from this situation (arbitrage)?

Solution:

		Cash
a.	Short 20 shares of M&E at $52/share.	$1,0470 *
b.	Purchase a convertible bond.	($1,0.35)
		$5
c.	Convert the bond to shares, and use to close short position.	

Assuming these transactions are completed simultaneously, you make a riskless profit of $5.

*Typically, small investors cannot short stock and have use of the proceeds—the broker retains it as collateral. So, this doesn't quite work. But the idea is correct.

10. A 10-year, 1,000 par value bond with a 5% annual coupon is trading to yield 6%. What is the current yield?

Solution: The current price of the bond is computed as follows:

$PMT = 50$; $N = 10$; $FV = 1000$; $I = 6$

Compute PV; $PV = 926.40$

The current yield = 50/926.40 = 5.4%

11. A $1,000 par bond with an annual coupon has only one year until maturity. Its current yield is 7.621% and its yield to maturity is 12%. What is the price of the bond?

Solution:

$$\text{Current yield} = \frac{\text{Coupon}}{\text{Price}}$$

$$0.07621 = \frac{\text{Coupon}}{\text{Price}}$$

$$\text{Coupon} = 0.07621 \times \text{Price}$$

$$\text{Price} = \frac{\text{Coupon} + 1{,}000}{1.12}$$

$$\text{Price} = \frac{0.07621 \times \text{Price} + 1{,}000}{1.12}$$

$$1.12\text{Price} = 0.07621\text{Price} + 1{,}000$$

$$1.12\text{Price} - 0.07621\text{Price} = 1{,}000$$

$$1.04379\text{Price} = 1{,}000$$

$$\text{Price} = \frac{1{,}000}{1.04379} = \$958.05$$

12. A 1-year discount bond with a face value of $1,000 was purchased for $900. What is the yield to maturity? What is the yield on a discount basis?

    Solution: 900 = 1000/(1 + YTM), or YTM = 11.11%
    YDB = (1000 – 900)/1000 × (360/365) = 9.86%

13. A 7-year, $1,000 par bond has an 8% annual coupon and is currently yielding 7.5%. The bond can be called in 2 years at a call price of $1,010. What is the bond yielding, assuming it will be called (known as the yield to call)?

    Solution: The current price of the bond is computed as follows:
    $PMT = 80$; $N = 7$; $FV = 1000$; $I = 7.5$
    Compute PV; $PV = 1{,}026.48$
    Using this, the yield to call is calculated as follows:
    $PMT = 80$; $N = 2$; $FV = 1010$; $PV = 1{,}026.48$
    Compute I; $I = 7.018\%$

14. A 20-year $1,000 par value bond has a 7% annual coupon. The bond is callable after the 10th year for a call premium of $1,025. If the bond is trading with a yield to call of 6.25%, the bond's yield to maturity is what?

Solution: The current price of the bond is computed using the yield to call as follows:

$PMT = 70$; $N = 10$; $FV = 1025$; $I = 6.25$

Compute PV; $PV = 1{,}068.19$

Using this, the yield to maturity is calculated as follows:

$PMT = 70$; $N = 20$; $FV = 1000$; $PV = 1{,}068.19$

Compute I; $I = 6.39\%$

15. A 15-year $5,000 par value bond has a 12% semiannual coupon and a nominal yield to maturity of 8.5%. What is the price of the bond?

Solution:

$$P = \text{Coupon payment} \times \left[\frac{1}{r} - \frac{1}{r(1+r)^n}\right] + \frac{\text{Principal payment}}{(1+r)^n}$$

$$P = 300 \times \left[\frac{1}{0.0425} - \frac{1}{0.0425(1+0.0425)^{30}}\right] + \frac{5{,}000}{(1+0.0425)^{30}}$$

$$P = 300 \times [23.52941176 - 6.750394599] + 1{,}434.458852$$

$$P = 5{,}033.705148 + 1{,}434.458852 = \$6{,}468.16$$

16. Your company owns the following bonds:

Bond	Market Value	Duration
A	$13 million	2
B	$18 million	4
C	$20 million	3

If general interest rates rise from 8% to 8.5%, what is the approximate change in the value of the portfolio?

Solution: Portfolio duration = $2 \times (13/51) + 4 \times (18/51) + 3 \times (20/51) = 3.09$

Δ Value = $-$Duration $\times$ ($\Delta i/(1 + i)$) $\times$ Original Value

Δ Value = $-3.09 \times (0.005/1.08) \times \$51$ million = $729,583