Chapter 9

Debt Valuation and Interest Rates

Chapter 9 Contents

• Learning Objectives
  1. Overview of Corporate Debt
     1. Identify the key features of bonds and describe differences between private and public debt markets.
  2. Valuing Corporate Debt
     1. Calculate the value of a bond and relate it to the yield to maturity on the bond.
  3. Bond Valuation: Four Key Relationships
     1. Describe the four key bond valuation relationships.
  4. Types of Bonds
     1. Identify the major types of corporate bonds.
  5. Determinants of Interest Rates
     1. Explain the effects of inflation on interest rates and describe the term structure of interest rates.
Principles Used in This Chapter

- **Principle 1: Money Has a Time Value.**
  - Debt securities require that the borrower repay the lender over time so cash flows have to be adjusted for time value of money.

- **Principle 2: There is a Risk-Return Tradeoff.**
  - The rate used to discount future cash flows depends on the risk of default by the borrower.

- **Principle 3: Cash Flows Are the Source of Value**
  - Debt securities provide value to the lender through the interest payments on the outstanding loan amount and the repayment of the loan balance itself.

Corporate Borrowings

- **Two main borrowing sources for a corporation:**
  1. Loan from a financial institution (known as private debt)
  2. Bonds (known as public debt since they can be traded in public financial markets)

- **Smaller firms** choose to raise money from banks in the form of loans because of the high costs associated with issuing bonds.

- **Larger firms** generally raise money from banks for short-term needs and depend on the bond market for long-term financing needs.
Borrowing Money in the Private Financial Market

• **Financial Institutions** are an important source of capital for corporations.
  - The loan might be used to finance firm’s day-to-day operations or it might be used for the purchase of equipment or property.
  - Such loans are considered **private market transactions** since it only involves the two parties to the loan.

• In the private financial market, loans are typically **floating rate loans** i.e. the interest rate is periodically adjusted based on a specific benchmark rate.
  - The most popular benchmark rate is the **London Interbank Offered Rate (LIBOR)**

Private Financial Market Borrowing

• **LIBOR** is the daily interest rate that is based on the interest rates at which banks offer to lend in the London wholesale or interbank market.
  - **Interbank market** is the market where banks loan each other money.

• Typical floating rate loan will specify following:
  - The **spread or margin** between the loan rate and the benchmark rate expressed as basis points.
  - A maximum and a minimum annual rate, to which the rate can adjust, called the **ceiling and floor**.
  - A **maturity date and Collateral**
    - For example, a corporation may get a 1-year loan with a rate of 300 basis points (or 3%) over LIBOR with a ceiling of 11% and a floor of 4%. 
Calculating Rate of Interest on a Floating Rate Loan

The Slinger Metal Fabricating Company entered into a loan agreement with its bank to finance the firm’s working capital.

The loan called for a **floating rate** that was 25 basis points (0.25%) over an index based on LIBOR. In addition, the loan adjusted weekly based on the closing value of the index for the previous week within the bounds of a maximum annual rate of 2.5% and a minimum of 1.75%. Calculate the rate of interest for the weeks 2 through 10.

<table>
<thead>
<tr>
<th>Week</th>
<th>LIBOR (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>1.98%</td>
</tr>
<tr>
<td>Week 2</td>
<td>1.66%</td>
</tr>
<tr>
<td>Week 3</td>
<td>1.52%</td>
</tr>
<tr>
<td>Week 4</td>
<td>1.35%</td>
</tr>
<tr>
<td>Week 5</td>
<td>1.60%</td>
</tr>
<tr>
<td>Week 6</td>
<td>1.63%</td>
</tr>
<tr>
<td>Week 7</td>
<td>1.67%</td>
</tr>
<tr>
<td>Week 8</td>
<td>1.88%</td>
</tr>
<tr>
<td>Week 9</td>
<td>1.93%</td>
</tr>
</tbody>
</table>
Calculating Rate of Interest on a Floating Rate Loan

**STEP 1: Picture the problem**

We can envision the problem solution by looking at a graph of the ceiling rate, the floor rate, and LIBOR plus the spread of 25 basis points. The rate of interest on the floating rate loan is based on LIBOR plus the spread but can never exceed the ceiling rate of 2.5%, nor can it ever drop below the floor rate of 1.75%.

![Graph of ceiling, floor, and LIBOR plus spread](image)

**Checkpoint 9.1**

**STEP 3: Solve**

The maximum rate of 2.5% is never reached, however the minimum rate of 1.75% was a limiting factor for week 5. Without the floor rate, the loan rate would have fallen to 1.66% for this week since LIBOR fell to 1.35% for week 4. Note that the loan rate is set based on the observed LIBOR rate for the prior week.

<table>
<thead>
<tr>
<th>Week (t)</th>
<th>LIBOR (t)</th>
<th>LIBOR (t-1) + Spread</th>
<th>Loan Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>1.98%</td>
<td></td>
<td>2.23%</td>
</tr>
<tr>
<td>Week 2</td>
<td>1.66%</td>
<td>2.23%</td>
<td></td>
</tr>
<tr>
<td>Week 3</td>
<td>1.52%</td>
<td>1.91%</td>
<td>1.91%</td>
</tr>
<tr>
<td>Week 4</td>
<td>1.35%</td>
<td>1.77%</td>
<td>1.77%</td>
</tr>
<tr>
<td>Week 5</td>
<td>1.60%</td>
<td>1.60%</td>
<td>1.75%</td>
</tr>
<tr>
<td>Week 6</td>
<td>1.63%</td>
<td>1.85%</td>
<td>1.85%</td>
</tr>
<tr>
<td>Week 7</td>
<td>1.67%</td>
<td>1.88%</td>
<td>1.88%</td>
</tr>
<tr>
<td>Week 8</td>
<td>1.88%</td>
<td>1.92%</td>
<td></td>
</tr>
<tr>
<td>Week 9</td>
<td>1.93%</td>
<td>2.13%</td>
<td>2.13%</td>
</tr>
<tr>
<td>Week 10</td>
<td></td>
<td>2.18%</td>
<td>2.18%</td>
</tr>
</tbody>
</table>
Public Financial Market Borrowing

• Firms also raise money by selling debt securities to individual investors and financial institutions such as mutual funds.
  – In order to sell debt securities to the public, the issuing firm must meet the legal requirements as specified by the securities laws.

• **Corporate bond** is a debt security issued by corporation that has promised future payments and a maturity date.
  – If the firm fails to pay the promised future payments of interest and principal, the bond trustee can classify the firm as insolvent and force the firm into bankruptcy.

Basic Bond Features

• The basic features of a bond include some or all of the following:
  – Bond Indenture (all bonds)
  – Claims on Assets and Income
  – Par or Face Value (all bonds)
  – Coupon Interest Rate (all bonds)
  – Maturity and Repayment of Principal (all bonds)
  – Call Provision and Conversion Features
### Table 9.2 Bond Terminology

Understanding the terminology used to describe bonds is essential to gaining a full understanding of the world of corporate bonds.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Issuer</td>
<td>The legal agreement between the firm issuing the bonds and the bond buyer who represents the bondholders. It lists the specific terms of the loan agreement, including a description of the bond, the rights of the bondholders, the rights of the issuing firm, and the responsibilities of the issuer.</td>
</tr>
<tr>
<td>Priority of claims on assets and income</td>
<td>In the event of insolvency, claims of debt in general, including bonds, are honored before those of common stock and preferred stock. In addition, interest payments hold priority over dividend payments for common and preferred stock.</td>
</tr>
<tr>
<td>Par value</td>
<td>The par value of a bond, also known as its face value, is the principal that must be repaid to the bondholder at maturity. In general, corporate bonds are issued with par values in increments of $1,000. Absent other bond price information, prices are generally expressed as a percentage of the bond’s par value.</td>
</tr>
<tr>
<td>Maturity and repayment of principal</td>
<td>The maturity date refers to the date on which the bond issuer must repay the principal or par value to the bondholder.</td>
</tr>
<tr>
<td>Coupon interest rate</td>
<td>The coupon rate on a bond indicates the percentage of the par value of the bond that will be paid out annually in the form of interest.</td>
</tr>
<tr>
<td>Current yield</td>
<td>The current yield on a bond refers to the ratio of the annual interest payment to the bond’s current market price. If, for example, we have a bond with an 8 percent coupon interest rate, a par value of $1,000, and a market price of $700, it would have a current yield of 11.4 percent, calculated as follows:</td>
</tr>
<tr>
<td>Conversion feature</td>
<td>In addition, some bonds have a conversion feature that allows bondholders to convert their bonds into a set number of shares of common stock.</td>
</tr>
</tbody>
</table>

### Table 9.3 Interpreting Bond Ratings

Ratings are intended to reflect the likelihood of default by the issuing firm in the future.

<table>
<thead>
<tr>
<th>Bond Rating Category</th>
<th>Standard &amp; Poor’s</th>
<th>Moody’s</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Investment Grade:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prime or highest strong</td>
<td>AAA</td>
<td>Aaa</td>
<td>Highest quality, extremely strong capacity to pay.</td>
</tr>
<tr>
<td>High quality</td>
<td>AA</td>
<td>Aa</td>
<td>Very strong capacity to pay.</td>
</tr>
<tr>
<td>Upper medium</td>
<td>A</td>
<td>A-1, A</td>
<td>Upper medium quality. Strong capacity to pay.</td>
</tr>
<tr>
<td>Medium</td>
<td>BBB</td>
<td>Baa-1, Baa</td>
<td>Lower medium quality. Changing circumstances could impact the firm’s ability to pay.</td>
</tr>
<tr>
<td><strong>Not Investment Grade:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speculative</td>
<td>BB</td>
<td>Ba</td>
<td>Speculative elements, faces uncertainties.</td>
</tr>
<tr>
<td>Highly speculative</td>
<td>B, CCC, CC</td>
<td>B, Ca, Ca</td>
<td>Extremely speculative and highly vulnerable to nonpayment.</td>
</tr>
<tr>
<td>Default</td>
<td>D</td>
<td>C</td>
<td>Income bond, doesn’t pay interest.</td>
</tr>
</tbody>
</table>
Valuing Corporate Debt

- **Value** of corporate debt is equal to present value of contractually promised principal and interest payments (the cash flows) discounted back to the present using the **market’s required yield**.

Step-by-Step: Valuing Bonds by Discounting Future Cash Flows

- **Step 1**: Determine the amount and timing of bondholder cash flows. The total cash flows equal the promised interest (coupon) payments and principal payment.

- Annual Interest = Par value $\times$ coupon rate

- **Example 9.1**: The annual interest for a bond with coupon interest rate of 7% and a par value of $1,000 is equal to $70, (.07 \times $1,000 = $70).
Step-by-Step: Valuing Bonds by Discounting Future Cash Flows

• **Step 2:** Estimate the appropriate discount rate on a similar risk bond. Discount rate is the return the bond will yield if it is held to maturity and all bond payments are made.

• Discount rate can be either calculated or obtained from various sources (such as Yahoo! Finance).

Step-by-Step: Valuing Bonds by Discounting Future Cash Flows

• **Step 3:** Calculate the present value of the bond’s interest and principal payments from Step 1 using the discount rate estimated in step 2.

\[
\text{Bond Value} = \left( \frac{\text{Present Value of the Bond’s Coupon Interest Payments}}{\text{Present Value of the Principal Amount (par value) of the Bond Issue}} \right)
\]
Valuing a Bond Issue – Annual Coupons

Consider a $1,000 par value bond issued by AT&T (T) with a maturity date of 2026 and a stated coupon rate of 8.5%.

On January 1, 2007, the bond had 20 years left to maturity, and the market’s required yield to maturity for similar rated debt was 7.5%. If the market’s required yield to maturity on a comparable risk bond is 7.5%, what is the value of the bond?

**STEP 1: Picture the problem**

The cash flows for the AT&T bond consist of the value of the bond today, which we are trying to estimate, the annual interest payments for years 1 through 20 of $85 each, and a final interest plus principal payment at the end of year 20 equal to $1,085.

\[ j = 7.5\% \]

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Cash Flow</th>
<th>Present Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-19</td>
<td>$85 per year</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>$1,085</td>
<td></td>
</tr>
</tbody>
</table>

**STEP 2: Decide on a solution strategy**

For this problem, we already know the market’s required yield to maturity is 7.5%, but we do not know the value of the bond, which we will find using Equation (8-2b). We know the annual interest and principal payments to the bondholder (stated in the bond indenture). The discount rate is equal to yield to maturity on a comparable risk bond, which we know to be 7.5%, so all we need to do to value the bond is discount the future interest and principal payments back to the present.
Valuing a Bond Issue – Annual Coupons

STEP 3: Solve

Estimation of the bond value requires that we substitute the appropriate values for the AT&T bond into the following equation and then solve it for bond value:

Using the Mathematical Formulas:

\[
\text{Bond Value} = \frac{\text{Interest}}{1 + \frac{YTM_{\text{market}}}{2}} + \frac{\text{Principal}}{1 + \frac{YTM_{\text{market}}}{2}}
\]

\[
\text{Bond Value} = \$95 \left( \frac{1 - \left(1 + \frac{0.07}{2}\right)^{-20}}{ \frac{0.07}{2}} \right) + \frac{\text{Principal}}{1 + \frac{0.07}{2}}
\]

Bond Value = \$95 \times \frac{1 - \left(1 + 0.035\right)^{-20}}{0.035} = \$1,101.94

Using a Financial Calculator:

Enter:

\[
\begin{align*}
\text{N} & = 20 \\
\text{I/Y} & = 7
\end{align*}
\]

\[
\begin{align*}
\text{PV} & = -1,101.94 \\
\text{FV} & = 1,000
\end{align*}
\]

Using an Excel Spreadsheet:

\[
=\text{PV}(-20, 0.0075, 0.007, 1,000)
\]

Thus, the present value of the interest plus principal payments to the bondholder is $1,101.94.

Semiannual Coupon Payments

- Corporate bonds typically pay interest to bondholders semiannually.
- Can adapt Equation (9-2a) from annual to semiannual payments as follows (if you need to show off with math) or you can follow the calculator approach (much easier):

\[
\text{Beta Value (semi-annual payments)} = \left( \text{Interest}/2 \right) \left[ 1 - \left( \frac{1}{1 + \frac{YTM_{\text{market}}}{2}} \right)^{2n} \right] + \frac{\text{Principal}}{ \left( \frac{1 + \frac{YTM_{\text{market}}}{2}}{2} \right)^{2n} }
\]
Valuing a Bond Issue That Pays Semiannual Coupons

Reconsider the bond issued by AT&T (T) with a maturity date of 2026 and a stated coupon rate of 8.5%.

- AT&T pays interest to bondholders on a semiannual basis on January 15 and July 15. On January 1, 2007, the bond had 20 years left to maturity. The market's required yield to maturity for a similarly rated debt was 7.5% per year or 3.75% for six months. What is the value of the bond?

Valuing a Bond Issue That Pays Semiannual Coupons

STEP 1: Picture the problem

The cash flows for the AT&T bond consist of the value of the bond today, which we are trying to estimate, the semiannual interest payments for periods 1 through 39 of $42.50 each, and a final interest plus principal payment at the end of year 20 or period 40 equal to $1,042.50.

\[
\begin{array}{cccccccccccccccccccccccc}
\text{Time Period} & 0 & 1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 & 9 & 10 & 11 & \cdots & 33 & 34 & 35 & 36 & 37 & 38 & 39 & 40 & \text{Years}
\end{array}
\]

\[
\begin{array}{ccc}
\text{Cash Flow} & $42.50 \text{ per year} & $1,042.50
\end{array}
\]

Present Value = 7

- Semi-annual interest payments of $850 = $42.50 every 6 months for 20 years or 40-six month periods.
- The $42.50 interest payment plus $1,000 return of principal at the end of year 20.
Valuing a Bond Issue That Pays Semiannual Coupons

**STEP 3: Solve**

Estimation of the bond value requires that we substitute the appropriate values for the AT&T bond into Equation (9-2c) and then solve for bond value.

**Using the Mathematical Formulae,**

\[
\text{Bond Value (semi-annual payments)} = \frac{1}{\frac{1}{1 + \frac{YTM}{2}} - \frac{1}{(1 + \frac{YTM}{2})^n}} = \text{Principal} \left(1 + \frac{1}{YTM} \right)^{-n} = \text{Principal} \left(1 + \frac{1}{1.0375} \right)^{-n}
\]

**Using a Financial Calculator,**

\[
\begin{align*}
\text{FV} & = 0.5 \times 3.75\% \\
\text{i} & = 3.75\% \\
\text{N} & = 40 \\
\text{PV} & = -1,000.75 \\
\end{align*}
\]

**Using an Excel Spreadsheet,**

\[
\text{PV} = \text{PV}(3.75\%,40,40.5,1000) = 1,000.75
\]

Thus, the present value of the interest plus principal payments to the bondholder is $1,000.75.

Calculating a Bond’s Yield to Maturity (YTM)

- Think of YTM as the discount rate that makes the present value of the bond’s promised interest and principal equal to bond’s observed market price.

\[
\text{Bond Price} = \frac{\text{Interest}_{\text{year 1}}}{(1 + YTM)^1} + \frac{\text{Interest}_{\text{year 2}}}{(1 + YTM)^2} + \frac{\text{Interest}_{\text{year 3}}}{(1 + YTM)^3} + \frac{\text{Interest}_{\text{year 4}}}{(1 + YTM)^4} + \frac{\text{Interest}_{\text{year 5}}}{(1 + YTM)^5} + \frac{\text{Principal}}{(1 + YTM)^5}
\]

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Calculating the Yield to Maturity on a Corporate Bond

Calculate the yield to maturity for the following bond issued by Ford Motor Company (F) with a price of $744.80, where we assume that interest payments are made annually at the end of each year and the bond has a maturity of exactly 11 years.

**STEP 1: Picture the problem**

The cash flows for the Ford bond consist of the purchase price for the bond today of $744.80, annual interest payments for years 1 through 10 of $65, and a final interest plus principal payment of $1,000 at the end of year 11 equal to $1,065.

<table>
<thead>
<tr>
<th>Time Period</th>
<th>Cash Flow</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>-$744.80</td>
</tr>
<tr>
<td>1</td>
<td>$65</td>
</tr>
<tr>
<td>2</td>
<td>$65</td>
</tr>
<tr>
<td>3</td>
<td>$65</td>
</tr>
<tr>
<td>4</td>
<td>$65</td>
</tr>
<tr>
<td>5</td>
<td>$65</td>
</tr>
<tr>
<td>6</td>
<td>$65</td>
</tr>
<tr>
<td>7</td>
<td>$65</td>
</tr>
<tr>
<td>8</td>
<td>$65</td>
</tr>
<tr>
<td>9</td>
<td>$65</td>
</tr>
<tr>
<td>10</td>
<td>$65</td>
</tr>
<tr>
<td>11</td>
<td>$1,065</td>
</tr>
</tbody>
</table>

**STEP 2: Decide on a solution strategy**

To solve for the bond’s yield to maturity we must use Equation (9–2a) which is the rate of interest used to discount the cash flows paid to the bondholder in years 1 through 11 that makes the present value equal to the current market price of $744.80. We can do this the same three ways that we solved time value of money problems involving multiple cash flows in Chapter 6. That is, mathematically, using a calculator, and using a spreadsheet.

**STEP 3: Solve**

Using the Mathematical Formula:

It is cumbersome to solve for the yield to maturity by hand using a mathematical formula. For example, substituting the numbers for Ford’s bond into Equation (9–2a) where the term to maturity is 11 years we get the following result:

\[
\text{Bond Price} = \frac{\text{Interest}_{10}}{(1 + YTM)^{10}} + \frac{\text{Interest}_{9}}{(1 + YTM)^{9}} + \ldots + \frac{\text{Interest}_{1}}{(1 + YTM)} + \frac{\text{Principal}}{(1 + YTM)^{11}}
\]

\[
$744.80 = \frac{65}{(1 + YTM)^{10}} + \frac{65}{(1 + YTM)^{9}} + \ldots + \frac{65}{(1 + YTM)} + \frac{1000}{(1 + YTM)^{11}}
\]

Note that to keep from having to write out all 11 years of interest payments we have simply added “...” to reflect the omitted terms for years 4 through 10. This would be a tough equation to solve mathematically since the variable we are solving for, YTM, is raised to powers ranging from one to eleven. For this reason, investors and financial managers use either a financial calculator or Excel to calculate the yield to maturity.

Using a Financial Calculator:

Enter: 11, 744.80, 65, 1060

Solve for: 10.56%

Using an Excel Spreadsheet:

=RATE(nper, pmt, pv, 0) or with values entered: =RATE(11, 65, -744.80, 1000)

Thus, the yield to maturity on this bond is 10.56%. Notice, the value of the bond, PV, is input with a negative sign since the purchase price of the bond is seen by both the financial calculator and Excel as a cash outflow.
Using Market Yield to Maturity Data

- Market yield to maturity is regularly reported by a number of investor services and is quoted in terms of credit spreads or spreads to Treasury bonds.

- The spread values in table 9-4 represent basis points over a US Treasury security of the same maturity as the corporate bond. For example, a 30-year Ba1/BB+ corporate bond has a spread of 275 basis points over a similar 30-year US Treasury bond.
  - Thus this corporate bond should earn 2.75% over the 4.56% earned on treasury yield or 7.31%.
Bond Valuation: Four Key Relationships

- **First Relationship**: The value of bond is inversely related to changes in the yield to maturity.

<table>
<thead>
<tr>
<th></th>
<th>YTM = 12%</th>
<th>YTM rises to 15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Par value</td>
<td>$1,000</td>
<td>$1,000</td>
</tr>
<tr>
<td>Coupon rate</td>
<td>12%</td>
<td>12%</td>
</tr>
<tr>
<td>Maturity date</td>
<td>5 years</td>
<td>5 years</td>
</tr>
<tr>
<td>Bond Value</td>
<td>$1,000</td>
<td>$899.44</td>
</tr>
</tbody>
</table>

Bond Value Drops

**Figure 9.1**

Bond Value and the Market's Required Yield to Maturity (5-Year Bond, 12% Coupon Rate)

Bond prices and yields to maturity vary inversely. Since principal and interest payments are fixed, the price of the bond must adjust such that the bond yields the market’s current yield to maturity. For example, if the market yield to maturity were to increase from 12% to 15%, the price of the bond would have to fall from $1,000 to $899 in order for an investor who bought the bond today to earn 15%.
Bond Valuation: Four Key Relationships

- Since future interest rates cannot be predicted, a bond investor is exposed to the risk of changing values of bonds as interest rates change.

- The risk to the investor that the value of his or her investment will change is known as **interest rate risk**.

- **Second Relationship**: The market value of a bond will be less than its par value if the yield to maturity is above the coupon interest rate and will be valued above par value if the yield to maturity is below the coupon interest rate.

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Bond Valuation: Four Key Relationships

- Two sources of return from bond investment:
  - Periodic interest payments
  - Capital gain or loss when the bond is sold

- When a bond can be bought for less than its par value, it is called **discount bond**. For example, buying a $1,000 par value bond for $950.
  - Bonds will trade at a discount when the yield to maturity on the bond exceeds the coupon rate.

- When a bond can be bought for more than its par value, it is called **premium bond**. For example, buying a $1,000 par value bond for $1,110.
  - Bonds will trade at a premium when the yield to maturity on the bond is less than the coupon rate.
Bond Valuation: Four Key Relationships

- Third Relationship: As maturity date approaches, market value of a bond approaches its par value.
  - Regardless of whether the bond was trading at a discount or at a premium, the price of bond will converge towards par value as the maturity date approaches.

<table>
<thead>
<tr>
<th>Table 9.5</th>
<th>Bond Prices Relative to Maturity Date</th>
</tr>
</thead>
</table>

Regardless of whether a bond is selling at a premium or discount, its price will approach its par value as the bond nears maturity. Bond prices are calculated for a $1,000 par value bond that pays a 12% coupon that spans the five years up to the time the bond matures. Three interest rate or yield scenarios are considered: a par scenario in which the market's required yield to maturity and coupon rate of the bond are equal, a discount bond scenario in which the market's required yield to maturity is 15% but pays a coupon of only 12%, and finally a premium bond scenario in which the market's required yield to maturity is only 9% but pays a coupon of 15%.

<table>
<thead>
<tr>
<th>Years to Maturity</th>
<th>5</th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td>12% Yield scenario</td>
<td>$1,000.00</td>
<td>$1,000.00</td>
<td>$1,000.00</td>
<td>$1,000.00</td>
<td>$1,000.00</td>
<td>$1,000.00</td>
</tr>
<tr>
<td>Discount bond</td>
<td>$899.44</td>
<td>$914.35</td>
<td>$931.50</td>
<td>$951.23</td>
<td>$973.91</td>
<td>$1,000.00</td>
</tr>
<tr>
<td>Premium bond</td>
<td>$1,116.69</td>
<td>$1,097.19</td>
<td>$1,075.94</td>
<td>$1,052.77</td>
<td>$1,027.52</td>
<td>$1,000.00</td>
</tr>
</tbody>
</table>

Figure 9.2
Value of a 12%-Percent Coupon Bond during the Life of the Bond
As a bond approaches its maturity, the price of the bond approaches the principal or par value of the bond.
Bond Valuation: Four Key Relationships

- **Fourth Relationship** Long term bonds have greater interest rate risk than short-term bonds.
  - While all bonds are affected by a change in interest rates, long-term bonds are exposed to greater volatility as interest rates change.

<table>
<thead>
<tr>
<th></th>
<th>Years to Maturity</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5</td>
<td>10</td>
<td>15</td>
<td>20</td>
<td>25</td>
<td>30</td>
</tr>
<tr>
<td>15% (Increased yield)</td>
<td>$899.44</td>
<td>$849.44</td>
<td>$824.58</td>
<td>$812.22</td>
<td>$806.08</td>
<td>$803.02</td>
</tr>
<tr>
<td>% Price decrease</td>
<td>−10.1%</td>
<td>−15.1%</td>
<td>−17.5%</td>
<td>−18.8%</td>
<td>−19.4%</td>
<td>−19.7%</td>
</tr>
<tr>
<td>12% (Base case)</td>
<td>$1,000.00</td>
<td>$1,000.00</td>
<td>$1,000.00</td>
<td>$1,000.00</td>
<td>$1,000.00</td>
<td>$1,000.00</td>
</tr>
<tr>
<td>% Price increase</td>
<td>11.7%</td>
<td>19.3%</td>
<td>24.2%</td>
<td>27.4%</td>
<td>29.5%</td>
<td>30.8%</td>
</tr>
<tr>
<td>9% (Decreased yield)</td>
<td>$1,116.69</td>
<td>$1,192.53</td>
<td>$1,241.82</td>
<td>$1,273.86</td>
<td>$1,294.68</td>
<td>$1,308.21</td>
</tr>
</tbody>
</table>

The longer the term to maturity, the greater will be the changes in bond prices in response to a given change in the market rate of interest.