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 Private Financial Market

- **Advantages** of Private Debt Placement
  - Speed
  - Reduced costs
  - Financing flexibility

- **Disadvantages** of Private Debt Placement
  - Interest costs
  - Restrictive covenants
  - The possibility of future SEC registration

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%.

<table>
<thead>
<tr>
<th>Table 9.1</th>
<th>Types of Bank Debt</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>(Panel A) Types of Bank Loans—Classified by Intended Use</strong></td>
<td></td>
</tr>
<tr>
<td>Working capital loans</td>
<td>Typically, these loans set up a line of credit based on an open-ended credit agreement whereby the firm has prior approval to borrow up to a set limit. This type of credit agreement is similar to that of a personal credit card that provides a line of credit up to an agreed-upon limit. The credit is then used to provide cash needed to support the firm’s day-to-day business needs.</td>
</tr>
<tr>
<td>Transaction loans</td>
<td>Firms use this type of loan to finance a specific asset. These loans typically call for installment payments designed to repay the principal amount of the loan, plus interest, with fixed monthly or annual payments. Home mortgage and automobile loans are examples of transaction loans that require installment payments.</td>
</tr>
<tr>
<td><strong>(Panel B) Types of Bank Loans—Classified by the Collateral Used to Secure the Loan</strong></td>
<td></td>
</tr>
<tr>
<td>Secured debt</td>
<td>This type of debt acts as a promise to pay that is backed by granting the lender an interest in a specific piece of property, known as collateral. The property used to secure the loan can include virtually any tangible business asset and could include accounts receivable, inventory, plant and equipment, and real estate.</td>
</tr>
<tr>
<td>Unsecured debt</td>
<td>A promise to pay that is not supported by collateral so that the lender relies upon the creditworthiness and reputation of the borrower to repay the debt when due.</td>
</tr>
</tbody>
</table>
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 (.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 (t)</th>
<th>LIBOR (t)</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>
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<tr>
<td>Week 4</td>
<td>1.35%</td>
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<tr>
<td>Week 5</td>
<td>1.60%</td>
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<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%.

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Checkpoint 9.1

**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>
<thead>
<tr>
<th>Table 9.2</th>
<th>Bond Terminology</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indenture</strong></td>
<td>The legal agreement between the firm issuing the bonds and the bond trustee who represents the bondholders. It lists the specific terms of the loan agreement, including a description of the bonds, the rights of the bondholders, the rights of the issuing firm, and the responsibilities of the trustee.</td>
</tr>
<tr>
<td><strong>Priority of claim on assets and income</strong></td>
<td>In the case of insolvency, claims of debt in general, including bonds, are honored before those of both common stock and preferred stock. In addition, interest payments hold priority over dividend payments for common and preferred stock.</td>
</tr>
<tr>
<td><strong>Par value</strong></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. Also, when bond prices are quoted in the financial press, prices are generally expressed as a percentage of the bond’s par value.</td>
</tr>
<tr>
<td><strong>Maturity and repayment of principal</strong></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><strong>Coupon interest rate</strong></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>
</tbody>
</table>
| **Current yield** | 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 $780, it would have a current yield of 11.4 percent calculated as follows: \[
\text{Current Yield} = \frac{\text{Annual Interest Payment}}{\text{Current Market Price of the Bond}} = \frac{0.08 \times 1000}{780} = 11.4\% \] |
| **Call provision** | The call provision provides the issuer of the bond with the right to redeem or retire a bond before it matures. |
| **Conversion feature** | In addition, some bonds have a conversion feature that allows bondholders to convert their bonds into a set number of shares of common stock. |
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**.

### 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>Baa, Caa, 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>
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 × 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 × $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.

\[
\text{Bond Value} = \left( \frac{\text{Present Value of the Bond’s Coupon Interest Payments}}{} \right) + \left( \frac{\text{Present Value of the Principal Amount (par value)}}{} \right)
\]

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?
Valuing a Bond Issue – Annual 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 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 $1,065.

\[ i = 7.5\% \]

<table>
<thead>
<tr>
<th>Time Period</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<th>15</th>
<th>16</th>
<th>17</th>
<th>18</th>
<th>19</th>
<th>20</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Flow</td>
<td></td>
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<td>$85</td>
<td>$85</td>
<td>$85</td>
<td>$1,065</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 (9-2b). 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 Formulae:

\[
\text{Bond Value} = \text{Interest} \left( \frac{1}{(1 + \text{YTM}_{\text{market}})^t} \right) + \text{Principal} \left( \frac{1}{(1 + \text{YTM}_{\text{market}})^t} \right) 
\]

(9-2b)

\[
\text{Bond Value} = \frac{1}{(1 + 0.075)^t} + \frac{1}{(1 + 0.075)^t} \frac{85}{0.75}
\]

\[
\text{Bond Value} = 890.53 + 235.41 = 1,101.94
\]

Using a Financial Calculator:

<table>
<thead>
<tr>
<th>Enter</th>
<th>20</th>
<th>7.50%</th>
<th>85</th>
<th>1,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solve for</td>
<td>1,101.94</td>
<td></td>
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</tr>
</tbody>
</table>

Using an Excel Spreadsheet:

\[ =\text{PV}((\text{rate}, \text{per}, \text{pmt}, \text{fv}) \text{ or with values entered } =\text{PV}(0.075, 20, 85, 1,000)) \]

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):

  \[
  \text{Beta Value (semi-annual payments)} = \left( \frac{\text{Interest/2}}{1 + \frac{YTM_{\text{Market}}}{2}} \right)^{2n} \cdot \text{Principal} \left[ \frac{1}{1 + \frac{YTM_{\text{Market}}}{2}} \right]^{2n}
  \]

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.

\[ i = 3.75\% \text{ per period} \]

<table>
<thead>
<tr>
<th>Time Period</th>
<th>0</th>
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<th>2</th>
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<th>34</th>
<th>35</th>
<th>36</th>
<th>37</th>
<th>38</th>
<th>39</th>
<th>40</th>
<th>Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash Flow</td>
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<td>$42.50 per year</td>
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<tr>
<td>Present Value</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Semi-annual interest payments of $85/2 = $42.50 every 6 months for 20 years or 40 six-month periods.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>The $42.50 interest payment plus the $1,000 return of principal at the end of year 20.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**STEP 2: 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 Formulas.

Using the Mathematical Formulas,

- Bond Value (semi-annual payments) = Interest/2 \[ \left( 1 + \frac{1}{2} \frac{YTM_{6\%}}{2} \right)^{n} + \text{Principal} \left( 1 + \frac{1}{2} \frac{YTM_{6\%}}{2} \right)^{n} \]
- Bond Value (semi-annual payments) = $85/2 \[ \left( 1 + \frac{1}{2} \frac{0.0375}{2} \right)^{n} + \text{Principal} \left( 1 + \frac{1}{2} \frac{0.0375}{2} \right)^{n} \]
- Bond Value (semi-annual payments) = $873.42 + $299.94 = $1,173.36

Using a Financial Calculator,

- Enter 40, 3.75%, 42.5, 1,000
- Solve for $1,173.36

Using an Excel Spreadsheet,

=PV(rate, nper, pmt, FV) or with values entered =PV(0.0375, 40, 42.5, 1,000)

Thus, the present value of the interest plus principal payments to the bondholder is $1,173.36.
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.

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

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 $1,065 at the end of year 11 equal to $1,065.

\[
\text{YTM} \approx 1\%
\]

<table>
<thead>
<tr>
<th>Time Period</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Years</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td>Cash Flow</td>
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<td>$65</td>
<td>$65</td>
<td>$65</td>
<td>$65</td>
<td>$65</td>
<td>$65</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 (9-1a) 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.
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>Maturity</th>
<th>1 yr</th>
<th>2 yr</th>
<th>3 yr</th>
<th>5 yr</th>
<th>7 yr</th>
<th>10 yr</th>
<th>30 yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aaa/AAA</td>
<td>14</td>
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<td>27</td>
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<td>Aa1/A+</td>
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<td>48</td>
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<td>77</td>
<td>99</td>
</tr>
<tr>
<td>Aa2/A+</td>
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<td>Aa3/A−</td>
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<td>A/1/A+</td>
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<td>67</td>
<td>81</td>
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<td>121</td>
</tr>
<tr>
<td>A/3/A−</td>
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<td>84</td>
<td>98</td>
<td>124</td>
</tr>
<tr>
<td>Baa1/BBB+</td>
<td>62</td>
<td>72</td>
<td>80</td>
<td>92</td>
<td>121</td>
<td>144</td>
<td>170</td>
</tr>
<tr>
<td>Baa2/BBB</td>
<td>65</td>
<td>80</td>
<td>88</td>
<td>97</td>
<td>128</td>
<td>155</td>
<td>177</td>
</tr>
<tr>
<td>Baa3/BBB−</td>
<td>72</td>
<td>85</td>
<td>90</td>
<td>102</td>
<td>134</td>
<td>159</td>
<td>181</td>
</tr>
<tr>
<td>Bb1/BB+</td>
<td>185</td>
<td>195</td>
<td>205</td>
<td>235</td>
<td>255</td>
<td>275</td>
<td></td>
</tr>
<tr>
<td>Bb2/BB</td>
<td>195</td>
<td>205</td>
<td>215</td>
<td>225</td>
<td>245</td>
<td>265</td>
<td>285</td>
</tr>
<tr>
<td>Bb3/BB−</td>
<td>205</td>
<td>215</td>
<td>225</td>
<td>235</td>
<td>255</td>
<td>275</td>
<td>295</td>
</tr>
<tr>
<td>B/1/B+</td>
<td>265</td>
<td>275</td>
<td>285</td>
<td>315</td>
<td>355</td>
<td>395</td>
<td>445</td>
</tr>
<tr>
<td>B/2/B</td>
<td>275</td>
<td>285</td>
<td>295</td>
<td>325</td>
<td>365</td>
<td>405</td>
<td>455</td>
</tr>
<tr>
<td>B/3/B</td>
<td>285</td>
<td>295</td>
<td>305</td>
<td>335</td>
<td>375</td>
<td>415</td>
<td>465</td>
</tr>
<tr>
<td>Caa/CCC+</td>
<td>450</td>
<td>460</td>
<td>470</td>
<td>495</td>
<td>505</td>
<td>515</td>
<td>545</td>
</tr>
<tr>
<td>US Treasury Yield</td>
<td>4.74%</td>
<td>4.71%</td>
<td>4.68%</td>
<td>4.63%</td>
<td>4.60%</td>
<td>5.90%</td>
<td>4.50%</td>
</tr>
</tbody>
</table>

Table 9.1 Corporate Bond Spread Tables

Corporate bonds offer different yields to maturity for different maturities and different credit risks. The following data reports the variation in yields to maturity for bonds across a wide range of default ratings categories and terms to maturity. The body of the table is reported in basis points or 1/100th of one percent. To get the yield to maturity for a particular bond rating and term to maturity, simply add the basis points in the spread table to the U.S. Treasury security with similar maturity. This sample data is for March 1, 2006. Spreads fluctuate daily.

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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.
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 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 rate that were five years up to the time the bond matures. Three interest rate or yield scenarios are considered: a par scenario in which case 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 15% but pays a coupon of only 12%, and finally a premium bond scenario in which case the market’s required yield to maturity only 5% but pays a coupon of 12%.

<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>
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 9.6: Bond Price Fluctuations for Bonds with Different Maturities

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.

<table>
<thead>
<tr>
<th>% Price decrease</th>
<th>% Price increase</th>
<th>12% (Base case)</th>
<th>9% (Decreased yield)</th>
<th>Years to Maturity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$1,000.00</td>
<td>$1,000.00</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$1,000.00</td>
<td>$1,000.00</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$1,000.00</td>
<td>$1,000.00</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$1,000.00</td>
<td>$1,000.00</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$1,000.00</td>
<td>$1,000.00</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$1,000.00</td>
<td>$1,000.00</td>
<td>30</td>
</tr>
<tr>
<td>15% (Increased yield)</td>
<td></td>
<td>$895.44</td>
<td>$849.44</td>
<td>5</td>
</tr>
<tr>
<td>% Decrease</td>
<td></td>
<td>$824.58</td>
<td>$812.22</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$806.08</td>
<td>$803.02</td>
<td>15</td>
</tr>
<tr>
<td>12% (Base case)</td>
<td></td>
<td>$1,000.00</td>
<td>$1,000.00</td>
<td>20</td>
</tr>
<tr>
<td>% Increase</td>
<td></td>
<td>11.7%</td>
<td>19.3%</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>24.2%</td>
<td>27.4%</td>
<td>30</td>
</tr>
<tr>
<td>9% (Decreased yield)</td>
<td></td>
<td>$1,116.69</td>
<td>$1,192.53</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$1,241.82</td>
<td>$1,273.86</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$1,294.68</td>
<td>$1,308.21</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$1,273.86</td>
<td>$1,308.21</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$1,294.68</td>
<td>$1,308.21</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$1,308.21</td>
<td>$1,308.21</td>
<td>30</td>
</tr>
</tbody>
</table>
Types of Bonds

• **Table 9-7** contains a listing of major types of long-term debt securities that are sold in the public financial market.

• The **differences** among the various types of bond are based on the **following bond attributes**:
  - Secured versus Unsecured,
  - Priority of claim, Initial offering market,
  - Abnormal risk, Coupon level,
  - Amortizing or non-amortizing, and Convertibility.

• Differences in bond attributes lead to price differences across bonds

<table>
<thead>
<tr>
<th>Table 9-7</th>
<th>Types of Corporate Bonds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Debentures</td>
<td>Any form of unsecured long-term debt. Because they are unsecured, the earning ability of the issuing corporation is of great concern to the bondholder. They are rated like secured bonds and as a result must provide investors with a higher yield than secured bonds provide. Often, the issuing firm attempts to provide some protection to the holder of the bond by prohibiting the firm from issuing more secured long-term debt that would further tie up the firm’s assets and leave the bondholders less protected. To the issuing firm, the major advantage of debentures is that no property has to be secured by them. This allows the firm to issue debt and still preserve some future borrowing power.</td>
</tr>
<tr>
<td>Subordinated debentures</td>
<td>The claims of the subordinated debentures are honored only after the claims of secured debt and unsecured debentures have been satisfied.</td>
</tr>
<tr>
<td>Mortgage bonds</td>
<td>Bonds secured by a lien on real property. Typically, the value of the real property is greater than the amount of the bonds issued. This provides the mortgage bondholders with a margin of safety in the event the market value of the secured property declines. In the case of foreclosure, the bondholders get the proceeds from the sale of the secured property. If the proceeds from the sale do not cover the bonds, the bondholders become general creditors, similar to debenture bondholders, for the unpaid portion of the debt.</td>
</tr>
<tr>
<td>Eurobonds</td>
<td>Bonds issued in a country different from the one in whose currency the bond is denominated. For example, a bond that is issued in Europe or in Asia by an American company and that pays interest and principal in U.S. dollars would be considered a Eurobond. Thus, even if the bond is not issued in Europe, it merely needs to be sold in a country different from the one in whose currency it is denominated to be considered a Eurobond.</td>
</tr>
<tr>
<td>Zero coupon and very low coupon bonds</td>
<td>These bonds require either no coupon interest payments (these are called zeros) or very low interest payments. Consequently, the bondholder receives all or most of their return at maturity. Since these bonds pay little or no interest they must sell at a deep discount. For the investor, a zero coupon bond is like a U.S. savings bond. The obvious appeal of zero coupon bonds is to those investors who need a lump sum of money at some future date but don’t want to be concerned about reinvesting interest payments. Today, zero coupon bonds are infrequently issued by corporations. The dominant player in this market is the U.S. government, with the government’s zero coupon bonds called STRIPS.</td>
</tr>
<tr>
<td>Junk (high-yield) bonds</td>
<td>High-risk debt that has a below investment-grade bond rating (see the earlier discussion of bond ratings). Junk bonds are also called high-yield bonds because they pay interest rates that are 5 to 7% higher than those of the highest rated bonds.</td>
</tr>
<tr>
<td>Floating rate bonds</td>
<td>A floating- or variable-rate bond is simply one whose coupon rate fluctuates according to the level of current market interest rates. These bonds are quite popular with municipalities and foreign governments, but are far less common among corporations.</td>
</tr>
<tr>
<td>Convertible bonds</td>
<td>Convertible bonds are debt securities that can be converted into a firm’s stock at a pre-specified price.</td>
</tr>
</tbody>
</table>
Types of Bonds – Analysis of Features

- **Price and Yield Impact of Different Features**
  - If a bond contract **feature** (term) transfers **benefits to the firm** at the expense of the bondholder (lender) then the **price of the bond will be lower** as the investor will require a higher yield.
    - You will pay less for receiving less.

  - If a bond contract **feature** (term) transfers **benefits to the bondholder** (lender) at the expense of the firm then the **price of the bond will be higher** as the investor will require a lower yield.
    - You will pay more for receiving more.

Determinants of Interest Rates

- **Bond prices vary inversely with interest rates.**
  - To understand bond pricing, need to know determinants of interest rates.

- **Quotes of interest rates in the financial press are commonly referred to as nominal (or quoted) interest rates.**

- **Real rate of interest** adjusts the nominal rate for the expected effects of inflation.
  - **Fisher Effect** equation makes formal the adjustment (model)
    
    $$(1+\text{Real Rate})(1+\text{Inflation Rate}) = (1+\text{Nominal Rate})$$
Components of the Nominal Rate of Interest

- The nominal return or interest rate (observed YTM) on a note or bond can be thought of including four basic components:

\[
\text{Nominal Rate of Interest} = \text{Real Rate of Interest}, \ r_{\text{real}} + \text{Inflation Premium} + \text{Default Premium} + \text{Maturity Premium}
\]

- Simplified Example with default only:

\[
E(YTM) = YTM_{\text{No Default}} \times (1 - \text{Probability of Default}) + YTM_{\text{Default}} \times (\text{Probability of Default})
\]

\[
= [37.5\% \times (1 - .50)] + [-3.75\% \times (1 - .50)] = 16.9\%
\]

Fisher Effect

- The relationship between the nominal rate of interest, \( r_{\text{nominal}} \), the anticipated rate of inflation, \( r_{\text{inflation}} \), and the real rate of interest is known as the Fisher effect.

\[
(1 + \text{Real Rate})(1 + \text{Inflation Rate}) = (1 + \text{Nominal Rate})
\]
Fisher Effect Example

• Compute the real rate of interest if the nominal rate of interest is 10% and the anticipated rate of inflation is 3%?

\[ r_{\text{real}} = \frac{(1 + r_{\text{nominal}})}{(1 + r_{\text{inflation}})} - 1 \]

\[ r_{\text{real}} = \{(1+.10) \div (1+.03)} - 1 \]

\[ = .0679 \text{ or } 6.79\% \]

Real Rates – Another Example

Assume that you expect that inflation will be 5% over the coming year. How much better off will you will (in purchasing power) if you place $10,000 savings in an account that also earns just 5%? (Real rate of return in this circumstance?)

<table>
<thead>
<tr>
<th></th>
<th>Year 0</th>
<th>Year 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savings Account Balance</td>
<td>$10,000.00</td>
<td>$10,500.00</td>
</tr>
<tr>
<td>Price Index (5% inflation)</td>
<td>$1.00</td>
<td>$1.05</td>
</tr>
<tr>
<td>Purchasing Power (units)</td>
<td>10,000.00</td>
<td>10,000.00</td>
</tr>
</tbody>
</table>
Solving for Nominal Rate of Interest

After considering a number of investment opportunities, you have decided that you should be able to earn a real return of 2% on your $10,000 in savings over the coming year. If the expected rate of inflation is expected to be 3.5% over the coming year, what nominal rate of return must you anticipate in order to earn the 2% real rate of return?

**STEP 3: Solve**

\[ r_{\text{nominal}} = (1 + r_{\text{real}})(1 + r_{\text{inflation}}) - 1 = r_{\text{real}} + r_{\text{inflation}} + r_{\text{real}} \times r_{\text{inflation}} \]  
\[ r_{\text{nominal}} = .02 + .035 + (.02 \times .035) \]
\[ r_{\text{nominal}} = 0.057 = 5.7\% \]

**STEP 4: Analyze**

In order to achieve a 2% increase in purchasing power in the face of a 3.5% rate of inflation you must earn a 5.7% return on your savings. Note that this total is greater than the sum of the real rate and the rate of inflation (i.e., 5.5%) since the price per unit rises over the year and you need a higher rate than 5.5% if you are to be able to increase your real purchasing power by the full 2%.

Example – Real and Nominal Rates

If you anticipate that the rate of inflation will now be 4% next year, holding all else the same, what rate of return will you need to earn on your savings in order to achieve a 2% increase in purchasing power?

**Step 1: Picture the Problem**

Assume that the prices of goods and services today is $1.00 per unit.

If the expected rate of inflation is 4% and you want to be able to purchase 2% more, you will need to earn a nominal rate of interest on your savings that will allow you to buy 10,200 units at $1.04 each.
### Step 3: Solve

\[ r_{\text{nominal}} = (1 + r_{\text{real}})(1 + r_{\text{inflation}}) - 1 \]

\[ = r_{\text{real}} + r_{\text{inflation}} + (r_{\text{real}} \times r_{\text{inflation}}) \]

\[ r_{\text{nominal}} = .02 + .04 + (.02 \times .04) \]

\[ = .0608 \text{ or } 6.08\% \]
Interest-Rate Determinants – Breaking It Down

The nominal return or interest rate on a note or bond can be thought of including five basic components:

\[ r_{\text{nominal}} = r_{\text{real risk-free}} + \text{Inflation Premium} + \text{Default-risk Premium} + \text{Maturity-risk Premium} + \text{Liquidity-risk Premium} \]

Interest Rate Determinants (cont.)

- The inflation premium
- Default-risk premium
- Maturity-risk premium
- Liquidity-risk premium
Default Premium

- In addition to accounting for the time value of money and inflation, the interest rate that a firm’s bonds pay must also offer a default premium i.e. risk that the issuer will fail to repay interest and principal in a timely manner.

Maturity Premium – The Term Structure of Interest Rates

- Long-term bonds are more sensitive to interest rate changes.
  - **Maturity premium** is the compensation that investors demand for bearing interest rate risk on long-term bonds.
- The relationship between interest rates and time to maturity with risk held constant is known as the **term structure of interest rates or the yield curve**.
  - Figure 9-3 illustrates a hypothetical yield curve of US Treasury Bonds.
Figure 9.3
The Term Structure of Interest Rates or Yield Curve
The yield curve shows the relationship between yield to maturity and maturity dates for a set of similar bonds (typically U.S. Government or Treasury securities). In this example the 20-year bond has a yield to maturity of 13% while the 5-year security yields only 11.5%. Thus, the yield curve is said to be upward sloping. The upward sloping yield curve is the most typical; however, flat and inverted (downward sloping) yield curves are sometimes observed.

Figure 9.4
Treasury Yield Curve during Period of Increasing Inflation

<table>
<thead>
<tr>
<th>Maturity</th>
<th>Real Risk-Free Rate</th>
<th>Inflation Premium</th>
<th>Maturity-Risk Premium</th>
<th>Yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>90 days</td>
<td>1.00%</td>
<td>1.75%</td>
<td>0.01%</td>
<td>2.76%</td>
</tr>
<tr>
<td>2 years</td>
<td>1.00%</td>
<td>2.15%</td>
<td>0.11%</td>
<td>3.26%</td>
</tr>
<tr>
<td>5 years</td>
<td>1.00%</td>
<td>2.56%</td>
<td>0.57%</td>
<td>4.13%</td>
</tr>
<tr>
<td>10 years</td>
<td>1.00%</td>
<td>3.05%</td>
<td>0.97%</td>
<td>5.02%</td>
</tr>
<tr>
<td>20 years</td>
<td>1.00%</td>
<td>3.42%</td>
<td>1.32%</td>
<td>5.74%</td>
</tr>
<tr>
<td>30 years</td>
<td>1.00%</td>
<td>3.60%</td>
<td>1.50%</td>
<td>6.10%</td>
</tr>
</tbody>
</table>
Shifts in the Yield Curve

- The term structure of interest rates changes over time as expectations regarding each of the three factors that underlie interest rates change.
  - Figure 9-4 shows the yield curve one day before 9/11 attack and again two weeks later.

- We observe a significant shift in the yield curve in figure 9-4 for short-term interest rates.

- Investors shifted their funds to the safety of Treasury securities, pushing up the prices and bringing down the yields.

---

**Figure 9.4**
Changes in the Term Structure of Interest Rates around September 11th, 2001

Important economic events often lead to shifts in the shape and location of the term structure of interest rates as investors rebalance their portfolios to reduce risk. Such an event occurred on September 11, 2001.
Shifts and Shapes of the Yield Curve

- The yield curve is generally upward sloping but it can assume different shapes i.e. downward sloping or flat.

- Figure 9-5 illustrates different shapes of yield curves at different dates.
Key Terms

- Amortizing bond
- Basis point
- Bond rating
- Bond indenture
- Call provision
- Collateral
- Conversion feature

Key Terms (cont.)

- Convertible bond
- Corporate bond
- Coupon interest rate
- Credit spread
- Current yield
- Debenture
- Default-risk premium
Key Terms (cont.)

- Discount bond
- Eurobonds
- Fisher effect
- Floating rate
- Floating rate bonds
- Inflation premium
- Interest rate risk
Key Terms (cont.)

- Junk (high-yield) bond
- LIBOR
- Liquidity-risk premium
- Maturity-risk premium
- Mortgage bond
- Nominal (or quoted) interest rate
- Non-amortizing bond

Key Terms (cont.)

- Par or face value of a bond
- Private market transaction
- Premium bond
- Real rate of interest
- Recovery rate
- Secured bond
- Spread to Treasury bonds
Key Terms (cont.)

- Subordinated debentures
- Syndicate
- Term structure of interest rates
- Transaction loan
- Unsubordinated debentures
- Yield curve
- Yield to maturity
- Zero coupon bond