Lecture 17

**Vocabulary – read the textbook Glossary to learn more about these words!**

- asset-backed security
- bearer bond
- bond
- bond rating
- capital gain
- catastrophe bond
- consol
- coupon rate
- debenture
- Federal National Mortgage Association
- high yield
- indenture
- mortgage-backed security
- municipal bond
- nominal rate
- par value
- rating service
- revenue bond
- securitization
- sinking fund
- yield-to-maturity
- zero-coupon bond

**Daily problems – after this lecture the problems you should master include:**

Exercises 7.2, p. 232, #2 – 11  Exercises 7.3, p. 239, #2 – 5

**Preliminaries**

Trading game: today only review timing of submissions & printouts

**Street-Bite**

Table 7.1, average daily trading volume

Visit www.nasdbondinfo.com and obtain price quotes

Asset-backed securities (from Chapter 9, Section 9.3.A1 p. 294 - 296)

- tremendous growth, from $35 billion in 1985 to more than $2,000 billion today
- ABS are the liabilities (securities) on right-hand-side balance sheet that receives the cash flows submitted by the financial assets on the left-hand-side; see securitization
- major assets with ABS include mortgages, consumer credit, manufactured homes, student loans, business accounts receivables

**Discussion**

Chapter 7: Time Value Application 2, Bond Valuation

Section 1. Bond basics: Notation, quotation, and cash flow

- obtain the cash flow stream from the description
  - formulas 7.1, 7.2, and 7.3

Section 2. Relation between price and yield-to-maturity

- The YTM: formula 7.4
  - Rule 7.1: the promised yield
- Components of the total rate of return
  - formula 7.5

Section 3. Bond price movements

- Rule 7.2: Discount versus premium bond prices
- 3A. Constant interest rates and scientific amortization
  - Figure 7.1

**Handouts**

Trading game
Practice Problems for Exam 3
### TABLE 7.1  Average daily trading volume of selected financial securities

**Asset-backed securities (from Chapter 9, Section 9.3.A1 p. 294 - 296)**

All “open market” securities mature in less than 270 days, and most mature in less than 60 days. Recall that according to one of the categorization schemes for financial markets in chapter 1 (table 1.2), the “money market” contains all securities with original maturity of 1-year or less. Securities with longer maturities are in the “capital markets.” All open market paper is in the money market.

Companies that issue open market securities realize an increase in a liability on the balance sheet. For issuing companies, open market securities are a financing source. The companies borrow cash for this very short-term because their intended use of the cash also is short-term. Generally speaking, companies obtain short-term financing for short-term uses, long-term financing for long-term uses. Figure 9.1 shows the types of companies that issue open market paper.

<table>
<thead>
<tr>
<th>Year</th>
<th>U.S. Treasury Securities</th>
<th>U.S. Agency Securities</th>
<th>Municipal Securities</th>
<th>Long-Term Corporate Securities</th>
<th>NYSE Stocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991</td>
<td>$128</td>
<td>$6</td>
<td>not available</td>
<td>not available</td>
<td>$6</td>
</tr>
<tr>
<td>1992</td>
<td>152</td>
<td>6</td>
<td></td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>1993</td>
<td>174</td>
<td>9</td>
<td></td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>1994</td>
<td>191</td>
<td>16</td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>1995</td>
<td>193</td>
<td>24</td>
<td></td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>1996</td>
<td>204</td>
<td>31</td>
<td></td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>1997</td>
<td>212</td>
<td>40</td>
<td></td>
<td></td>
<td>23</td>
</tr>
<tr>
<td>1998</td>
<td>227</td>
<td>48</td>
<td></td>
<td></td>
<td>29</td>
</tr>
<tr>
<td>1999</td>
<td>187</td>
<td>55</td>
<td></td>
<td></td>
<td>35</td>
</tr>
<tr>
<td>2000</td>
<td>207</td>
<td>73</td>
<td></td>
<td></td>
<td>43</td>
</tr>
<tr>
<td>2001</td>
<td>298</td>
<td>90</td>
<td>9</td>
<td></td>
<td>41</td>
</tr>
<tr>
<td>2002</td>
<td>366</td>
<td>82</td>
<td>9</td>
<td>19</td>
<td>40</td>
</tr>
<tr>
<td>2003</td>
<td>434</td>
<td>82</td>
<td>11</td>
<td>21</td>
<td>36</td>
</tr>
<tr>
<td>2004</td>
<td>501</td>
<td>77</td>
<td>12</td>
<td>21</td>
<td>46</td>
</tr>
</tbody>
</table>
“ABS” in figure 9.1 stands for short-term asset-backed securities and at year-end 2001 they represent 52% ($745 billion) of all commercial paper outstanding in the U.S.A. The balance sheet for the company creating the ABS provides key insight about this important security. The company issues (that is, sells) the asset backed security, the sale represents a source of financing, and there is an increase on the liability side for the line item “ABS”. Investors purchasing the ABS includes institutional players on the buy-side (pension funds, etc.). Companies creating open market ABS use the money to purchase Receivables from hundreds of different companies. The balance sheet’s asset side lists all the different Receivables on which the ABS have a claim. Ownership of an asset-backed security represents indirect ownership of revenues from a large pool of financial assets.

**FORMULA 7.1 Semiannual coupon**
The interest payment for a bond is paid semiannually and is called a coupon. The semiannual coupon is computed as

\[
coupon = \text{face value} \times \text{annual coupon rate} \div 2
\]

**FORMULA 7.2 Bond price**
Bond prices in the U.S.A. typically are quoted as a percent of par. The dollar price of the bond is computed as

\[
bond\ price = \text{face value} \times \text{quoted percentage price}
\]
FORMULA 7.3 Current yield

\[
\text{current yield} = \text{face value} \times \text{annual coupon rate} \div \text{bond price}
\]

FORMULA 7.4 Yield-to-maturity and bond cash flows

\[
bond\ price = \frac{\text{coupon}_1}{(1 + \frac{YTM}{2})^1} + \frac{\text{coupon}_2}{(1 + \frac{YTM}{2})^2} + \ldots + \frac{\text{coupon}_N}{(1 + \frac{YTM}{2})^N} + \frac{\text{face value}}{(1 + \frac{YTM}{2})^N}
\]

\[
= \text{coupon} \left[ \frac{1 - (1 + \frac{YTM}{2})^{-N}}{\frac{YTM}{2}} \right] + \frac{\text{face value}}{(1 + \frac{YTM}{2})^N}
\]

\(N\) is the number of expected coupons. The right-hand-side sums \(N + 1\) terms. The first \(N\) terms equal the present value of \(N\) expected coupons. They sum to the coupon multiplied by \(PVIFA_{YTM/2,\ N}\). The last term is the present value of the principal repayment (i.e., the face value). The investor receives the face value at the same time that the final coupon is paid so the two last terms on the right-hand-side are both discounted \(N\) periods. The yield-to-maturity is an annual percentage rate. The formula divides the yield-to-maturity by two because interest compounds semiannually.

EXERCISES 7.2

5. A 10-year bond with a 4.40\% coupon rate was issued with a 5.37\% yield to maturity. Find the bond price at time of issue. ©BD7a

6. A 20-year bond with a 7.80\% coupon rate was issued at a price of $1,130. Find the bond yield to maturity at time of issue. ©BD7b

7. Today is a day in June 2525 and a bond with annual coupon rate of 12.40\% just yesterday paid a coupon. The bond matures in June 2545 and its annual yield-to-maturity equals 8.80\% (semiannual compounding). Find the bond price. ©BD11a

10. Today is a day in November 2525 and a bond with annual coupon rate of 5.40\% just yesterday paid a coupon. The bond matures in May 2537 and its quoted bond price is 74.53 percent of par (semiannual compounding). You wish to make a bid such that your promised rate of return is 30 basis points greater than the quoted annual yield-to-maturity. Find the price as percent of par that you offer for the bond. ©BD13a

Lessons about the Structure of Finance. © 2005 by Thomas W. Downs. All rights reserved. Published by Pearson Custom Publishing, Boston.
11. A bond with a coupon rate of 7.30% has a price that today equals $868.92. The $1,000 bond pays coupons every 6 months, 30 coupons remain, and a coupon was paid yesterday. Suppose you buy this bond at today’s price and hold it so that you receive 20 coupons. You sell the bond upon receiving that last coupon. Find the selling price if the bond’s yield-to-maturity remains constant.

FORMULA 7.5 Components for bonds of the promised yield-to-maturity

\[
yield \ - \ to \ - \ maturity = \frac{coupon}{bond \ price} + \%\Delta(bond \ price) = \left( current \ yield \right) + \left( capital \ gains \ yield \right)
\]

The total return from a bond investment has two sources. A current income component provides immediate cash flow in the form of coupons while a changing price component causes capital gains or losses. Table 7.2 contrasts characteristics for these two components.

<table>
<thead>
<tr>
<th>Current yield</th>
<th>Capital gains yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>(coupon / price)</td>
<td>(%Δprice)</td>
</tr>
<tr>
<td>realized cash flow</td>
<td>accrued cash flow</td>
</tr>
<tr>
<td>immediately taxable</td>
<td>taxes are deferred</td>
</tr>
<tr>
<td>relatively predictable &amp; more certain</td>
<td>very unpredictable &amp; more uncertain</td>
</tr>
<tr>
<td>relatively large and usually the main reason for buying the bond</td>
<td>relatively small and not a significant decision variable (except for zero coupon bonds)</td>
</tr>
</tbody>
</table>

TABLE 7.2 Component characteristics for the total rate of return

RULE 7.1 Determination of premium and discount bonds

The bond price is 100 percent of face value, and the bond is said to sell at par, when the coupon rate equals the yield to maturity.

The bond price is less than face value, and the bond is said to sell at a discount, when the coupon rate is less than the yield to maturity.

Lessons about the Structure of Finance. © 2005 by Thomas W. Downs. All rights reserved. Published by Pearson Custom Publishing, Boston.
The bond price exceeds face value, and the bond is said to sell at a *premium*, when the coupon rate is greater than the yield to maturity.

**RULE 7.2** Relation between yield-to-maturity, coupon rate, and bond price

**Bond price**

\[
\begin{align*}
&< 1,000 \text{ when coupon rate } < \text{YTM.} \\
&= 1,000 \text{ when coupon rate } = \text{YTM.} \\
&> 1,000 \text{ when coupon rate } > \text{YTM.}
\end{align*}
\]

The bond price exceeds face value and the bond is said to sell at a *premium* when coupon rate > yield-to-maturity. Conversely, bond price is less than face value and the bond is said to sell at a *discount* when the coupon rate < YTM. When coupon rate and yield to maturity are equal the bond price equals face value and the bond is said to sell at *par*.

Borrowers usually set coupon rates so that the bonds sell in the primary market at a price near face value. The coupon rate is printed on the bond and is unchanging. The overall level of interest rates, on the other hand, rises and falls with economic factors such as inflation. Yield-to-maturity for any particular bond correlates highly with the overall level of rates.

**RULE 7.3** Inverse relation between bond price and interest rate movements

**Existing bond prices**

\[
\begin{align*}
\text{rise} \quad \Rightarrow \quad \text{fall}
\end{align*}
\]

when subsequent interest rates

\[
\begin{align*}
\text{fall} \quad \Rightarrow \quad \text{rise}
\end{align*}
\]

Rule 7.3 is strictly true for exclusively the relation between a particular bond’s price and yield-to-maturity. Because a particular YTM generally rises or falls with the overall level of interest rates, though, the rule is generally true.
FIGURE 7.1 Evolution of bond price over time given constant yield-to-maturity

**Notes** The premium bond with $1,100 price today converges by the maturity date to its face value of $1,000. The discount bond with price of $900 also converges to face value.

*Scientific amortization* refers to the evolutionary path of bond price from its current price toward face value given yield-to-maturity remains constant.

**EXERCISES 7.3B**

5. Today is a day in June 2525 and a bond with annual yield-to-maturity of 11.20% just yesterday paid a coupon. The bond matures in June 2540 and its quoted bond price today is 77.72 percent of par (semiannual compounding). Contrast the annual capital gains yield today with the annual capital gains yield for the six months that conclude with June 2540 (assume scientific amortization and constant *YTM*). ©BD17b .