CHAPTER-3

FIXED INCOME SECURITIES

By: Sabela A.

Classifying Securities

Basic Types	**Major Types**
Interest-bearing	➔ Money market instruments ➔ Fixed-income securities
Equities	➔ Common Stock ➔ Preferred Stock
Derivatives	➔ Future ➔ Option

Fixed Income Securities

- ➔ Fixed-income securities are long-term debt obligations of corporations or governments.
- ➔ These securities promise to make fixed payments according to a pre-set schedule.
- ➔ When they are issued, their lives exceed one year.
- ➔ They involve fixed coupon payments and final payment at maturity, except when the borrower defaults.
- ➔ There is a possibility of gain (loss) from fall (rise) in interest rates
- ➔ Depending on the debt issue, illiquidity can be a problem.

Examples: Treasury notes, Treasury bonds, and Corporate bonds

Bond

- Bond is a tradable instrument that represents a debt owed to the owner by the issuer.
- Most commonly, bonds pay interest periodically, and then return the principal at maturity.

Advantages of Bonds over Stocks

Bonds, while a more conservative investment than stocks, can offer certain investors some very attractive features:

   – Safety
   – Reliable income
   – Potential for capital gains
   – Diversification (especially for an otherwise all-equity portfolio)
   – Tax advantages

Basic terminology

- **Term to maturity** – date when debt ceases, with maturity being that exact date and term denoting the number of years till that date
- **Par value (maturity value, face value)** – amount issuer agrees to pay at maturity
- **Coupon** – periodic interest payment made to bondholders
- **Coupon rate** – rate of interest usually paid semiannually for U.S. issues; multiplied by par value yields dollar value of coupon
- **Zero-coupon bonds** – no periodic interest payments; principal and interest paid at term
- **Floating rate security** – coupon rate is reset periodically

Risks of Bonds

Bonds are generally less riskier than stocks, but they do suffer from several types of risk:

- ➔ **Credit risk** – Risk of default.
- ➔ **Price risk** – Risk of unexpected changes in rates, causing a capital loss.
- ➔ **Purchasing power risk** – Risk that inflation will be higher than expected.
- ➔ **Call risk** – Risk that the bond will be called because of lower rates.
- ➔ **Liquidity risk** – Risk that you will not be able to sell the bond at a price near its full value.
- ➔ **Foreign exchange risk** – Risk that a foreign currency will decline in value, causing a decline in the value of your interest payments and principal.

Bond Valuation

- The intrinsic value of a bond, like stocks, is the present value of its future cash flows.
- Bonds, however, have much more predictable cash flows and a finite life.
- The cash flows promised by a bond are:

➔ A series of (usually) constant interest payments

➔ The return of the face value of the bond at maturity

Bond Valuation (cont.)

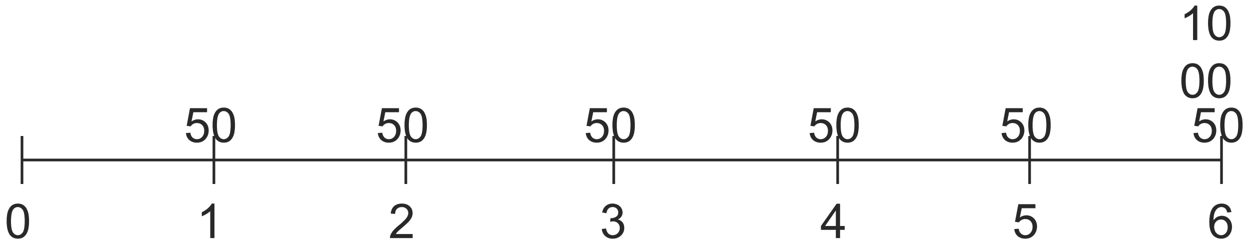
The value of a bond is determined by the following four variables:

1. **The Coupon Rate** – This is the promised annual rate of interest. It is normally fixed at issuance for the life of the bond.
2. **The Face Value** – This is nominally the amount of the loan owed by the issuer. It is to be paid back at maturity.
3. **Term to Maturity** – This is the remaining life of the bond, and is determined by today's date and the maturity date. Do not confuse this with the "original" maturity which was the life of the bond at issuance.
4. **Yield to Maturity** – This is the rate of return that will be earned on the bond if it is purchased at the current market price, held to maturity, and if all of the remaining coupons are reinvested at this same rate. This is the IRR of the bond.

Example

Suppose that you are interested in purchasing a 3-year bond with a 10% semiannual coupon rate and a face value of $1,000. If your required return is 7%, what is the intrinsic value of this bond?

Here is a timeline showing the cash flows:



Example (cont.)

Note that the cash flows of the bond consist of:

- ➔ An annuity, the interest payments - paid every six months. This is calculated as a lump sum which is the return of the face value of the bond at the end of its life.
- ➔ This payment is made at the same time as the last interest payment.

$$Pmt = \frac{CR \times FV}{2} = \frac{0.10 \times 1000}{2} = 50$$

Example (cont.)

- We can find the intrinsic value of these cash flows by finding the present value of the interest payments and then adding the present value of the face value:

$$V_B = Pmt\left[\frac{1-\frac{1}{(1+k_d)^N}}{k_d}\right]+\frac{FV}{(1+k_d)^N} = 50\left[\frac{1-\frac{1}{\left(1+\frac{0.07}{2}\right)^6}}{0.07/2}\right]+\frac{1000}{\left(1+0.07/2\right)}$$

$$\text{Price} = \frac{CPN_1}{(1+r)^1}+\frac{CPN_2}{(1+r)^2}+\frac{CPN_3}{(1+r)^3}+\ldots+\frac{CPN_n+FV}{(1+r)^n}$$

OR

$$\text{Price} = \sum_{t=1}^{n}\frac{CPN_t}{(1+i)^t}+\frac{FV}{(1+i)^n}$$

- Note that the first term is the present value of an annuity, and the second is the present value of a lump sum
- Do the math, and you'll find that the bond is worth $1,079.93. Note that this value must decline until it reaches $1,000 at maturity.

Example (cont.)

A few things of note with regard to the example above:

- ➔ The interest is paid semiannually, so we first calculated the annual interest and the divided it by two. If interest was paid, say, quarterly, we would have divided the annual amount by four.
- ➔ Similarly, we must convert the number of years to maturity (3) into the total number of periods (6).
- ➔ Finally, we also must adjust your annual required return (7%) to a semiannual return (3.5%).
- ➔ These three variables must always be stated on a per period basis.
- ➔ Nearly all bonds (in the U.S.) pay interest more often than annually. Most often this is semiannually, but it could also be quarterly or monthly.

Bond Return Measurement

- ➔ There are three ways in which the expected return of the bond is reported:

1. Current Yield (CY)
2. Yield to Maturity (YTM)
3. Yield to Call (YTC)

- ➔ The current yield is simple, but inaccurate. The yield to maturity (or yield to call) is much more representative of the return you will receive, but suffers from a problem of its own.

Current Yield

➔ The current yield on a bond is simply the annual interest payment divided by its current price.

$$CY = \frac{CR \times FV}{P_0}$$

➔ For our example bond, the current yield is:

$$CY = \frac{100}{1079.93} = 0.0926$$

➔ Note that the current yield is ignoring the capital loss that you will suffer over the remaining life of the bond (it must sell for $1,000 at maturity), so it overstates the expected return for bonds selling at a premium. For discount bonds, the expected return is understated.

Yield to Maturity

- ➔ Suppose that we didn't know that our required return was 7% per year, but we did know that the current bond price was \$1079.93.
- ➔ We could solve for the yield implied by that price (i.e., the YTM).
- Unfortunately, there is no closed-form solution to the bond valuation equation, so we need to use a trial and error algorithm to find the yield.

Yield to Maturity (cont.)

- Here is the bond valuation equation, slightly restated to make the point:

$$P_B = Pmt\left[\frac{1-\frac{1}{(1+YTM)^N}}{YTM}\right]+\frac{FV}{(1+YTM)^N}$$

- Note that I have replaced the bond's intrinsic value (V_B) with its price (P_B), and its required return (k_d) with its yield (YTM).
- Our problem now is to solve for that YTM given the price.

Yield to Maturity (cont.)

- ➔ To find the YTM, we first make a guess at the yield. Say that we choose 10%. That gives us a price of $1,000 which is lower than the actual price. To get the price to go up, we must lower our estimated yield.
- ➔ Suppose we now try 5%. The price now is $1,137.70 which is too high. We need to try a higher estimated yield.
- ➔ Now, we know that the YTM must be between 5% and 10%, so let's "split the difference" and try 7.5%. We get $1,066.06. Close, but not close enough.
- ➔ We now know the YTM is between 5% and 7.5%,
- ➔ And so on. Keep splitting the difference until you arrive at the correct price. The yield that achieves this is the YTM.
- ➔ This is the type of process that your calculator goes through when solving for the YTM (the "i" key). Eventually, you will find that the actual yield is 7%.

Yield to Call

- ➔ The yield to call (YTC) is exactly the same as the YTM, except that it assumes that the bond will be called at the next call date.
- ➔ The only differences from calculating the YTM are:
  - – We need to change the number of periods until maturity to the number of periods until it can be called.
  - – If a "call premium" is to be received, we must add that premium to the face value of the bond.

The Five Bond Pricing Theorems

1. Bond prices move inversely to changes in interest rates
2. Bonds with longer maturities are more price sensitive
3. Price sensitivity increases at a decreasing rate
4. Bonds with lower coupon rates are more price sensitive
5. A price increase caused by a decrease in interest rates is larger than a price decrease caused by an increase in interest rates of the same magnitude

Duration and Price Volatility

Duration as an Elasticity Measure:

➔ Maturity simply identifies how much time elapses until final payment; It ignores all information about the timing and magnitude of interim payments.

➔ Duration is a measure of the effective maturity of a security, meaning that:

1. It incorporates the timing and size of a security's cash flows.
2. It measures how price sensitive a security is to changes in interest rates.
3. The greater (shorter) the duration, the greater (lesser) the price sensitivity.

Duration and Price Volatility (cont'd)

- Duration is an approximate measure of the price elasticity of demand

$$\text{Duration} \cong -\frac{\frac{\Delta P}{P}}{\frac{\Delta i}{(1+i)}} \qquad \Delta P \cong -\text{Duration}\left[\frac{\Delta i}{(1+i)}\right]P$$

- The longer the duration, the larger the change in price for a given change in interest rates.

Duration and Price Volatility (cont'd)

Measuring Duration:

➔ Duration is a weighted average of the time until the expected cash flows from a security will be received, relative to the security's price

➔ Macaulay's Duration

$$D = \frac{\sum_{t=1}^{k} \frac{CF_t(t)}{(1+r)^t}}{\sum_{t=1}^{k} \frac{CF_t}{(1+r)^t}} = \frac{\sum_{t=1}^{n} \frac{CF_t(t)}{(1+r)^t}}{\text{Price of the Security}}$$

Duration and Price Volatility (cont'd)

Example:

What is the duration of a bond with a $1,000 face value, 10% coupon, 3 years to maturity and a 12% YTM?

$$D = \frac{\frac{100 \times 1}{(1.12)^1} + \frac{100 \times 2}{(1.12)^2} + \frac{100 \times 3}{(1.12)^3} + \frac{1{,}000 \times 3}{(1.12)^3}}{\sum_{t=1}^{3} \frac{100}{(1.12)^t} + \frac{1000}{(1.12)^3}} = \frac{2{,}597.6}{951.96} = 2.73 \text{ years}$$

Duration and Price Volatility (cont'd)

Example:

What is the duration of a bond with a $1,000 face value, 10% coupon, 3 years to maturity but the YTM is 20%?

$$D = \frac{\dfrac{100 * 1}{(1.20)^1} + \dfrac{100 * 2}{(1.20)^2} + \dfrac{100 * 3}{(1.20)^3} + \dfrac{1,000 * 3}{(1.20)^3}}{789.35} = \frac{2,131.95}{789.35} = 2.68 \text{ years}$$

Duration and Price Volatility (cont'd)

Example:

What is the duration of a zero coupon bond with a $1,000 face value, 3 years to maturity but the YTM is 12%?

$$D = \frac{\dfrac{1{,}000 * 3}{(1.12)^3}}{\dfrac{1{,}000}{(1.12)^3}} = \frac{2{,}135.34}{711.78} = 3 \text{ years}$$

By definition, the duration of a zero coupon bond is equal to its maturity

Bond Ratings

- ➔ Credit risk is the most important source of risk for owners of bonds.
- ➔ As a result, various rating agencies (S&P, Moody's, Fitch, and Dominion Bond) assign grades to indicate the credit quality of various bond issues.
- ➔ As you should guess, yields on lower rated bonds will be higher (more risk) than those on higher rated bonds (less risk).
- ➔ Bond ratings are a lot like grades: The agencies give A's, B's, C's, and D's with various schemes to differentiate within the category (i.e., AAA is better than AA).

Bond Ratings (cont'd)

Bond Ratings by Agency

Moody's	S&P	Fitch	DBRS	DCR	Definitions
Aaa	AAA	AAA	AAA	AAA	Prime. Maximum Safety
Aa1	AA+	AA+	AA+	AA+	High Grade High Quality
Aa2	AA	AA	AA	AA	
Aa3	AA-	AA-	AA-	AA-	
A1	A+	A+	A+	A+	Upper Medium Grade
A2	A	A	A	A	
A3	A-	A-	A-	A-	
Baa1	BBB+	BBB+	BBB+	BBB+	Lower Medium Grade
Baa2	BBB	BBB	BBB	BBB	
Baa3	BBB-	BBB-	BBB-	BBB-	
Ba1	BB+	BB+	BB+	BB+	Non Investment Grade
Ba2	BB	BB	BB	BB	Speculative
Ba3	BB-	BB-	BB-	BB-	
B1	B+	B+	B+	B+	Highly Speculative
B2	B	B	B	B	
B3	B-	B-	B-	B-	
Caa1	CCC+	CCC	CCC+	CCC	Substantial Risk
Caa2	CCC	-	CCC	-	In Poor Standing
Caa3	CCC-	-	CCC-	-	
Ca	-	-	-	-	Extremely Speculative
C	-	-	-	-	May be in Default
-	-	DDD	D	-	Default
-	-	DD	-	DD	
-	D	D	-	-	
-	-	-	-	DP	

Source: http://www.bondsonline.com/asp/research/bondratings.asp