

Bond Valuation

Learning Module

OUTLINE

- **Definition of Bond and Bond valuation**
- **Features of Bond**
- **Types of Bonds**
- **Reasons for Issuing Bonds**
- **Risk in Bonds**
- **Measuring Bond Yield**
- **Bond pricing theorems**

Definition of 'Bond'

- A debt investment in which an investor loans money to an entity (corporate or governmental) that borrows the funds for a defined period of time at a fixed interest rate. Bonds are used by companies, municipalities, states and foreign governments to finance a variety of projects and activities.

Definition of 'Bond Valuation'

- A technique for determining the fair value of a particular bond. Bond valuation includes calculating the present value of the bond's future interest payments, also known as its cash flow, and the bond's value upon maturity, also known as its face value or par value..

Definitions

■ Par or Face Value -

- The amount of money that is paid to the bondholders at maturity. For most bonds this amount is \$1,000. It also generally represents the amount of money borrowed by the bond issuer.

■ Coupon Rate -

- The coupon rate, which is generally fixed, determines the periodic coupon or interest payments. It is expressed as a percentage of the bond's face value. It also represents the interest cost of the bond to the issuer.

FEATURES OF BONDS

- A Sealed agreement
- Repayment of principles
- Specified time period
- Interest payment
- Call

TYPES OF BONDS

- **Government Bonds**
- **Municipal Bonds**
- **Corporate Bonds**
- **Zero-Coupon Bonds**

REASONS FOR ISSUING BOND

- Reduce the cost of capital
- Effective Tax saving
- Widen the sources of funds
- Preserve and control

RISK IN BONDS

- Interest rate risk
- Default risk
- Marketability Risk
- Callability Risk
- Reinvestment Risk

MEASURING BOND YIELD

- Current Yield
- Yield To Maturity
- Yield To Call
- Realized Yield To Maturity

CURRENT YIELD

- The current Yield relates the annual coupon interest to the market price. It is expressed as:

$$\text{Current Yield} = \frac{\text{Annual interest}}{\text{Price}}$$

EXAMPLE

- The Current Yield of a 10 Year, 12 % coupon Bond with a Par value of Rs.1000 and selling for Rs.950. what is current yield.

$$\begin{aligned} \text{Current yield} &= \frac{120}{950} \\ &= 12.63 \end{aligned}$$

YIELD TO MATURITY

- When you purchase a bond, you are not quoted a promised rate of return. Using the information on Bond price, maturity date, and coupon payments, you figure out the rate of return offered by the bond over its life.

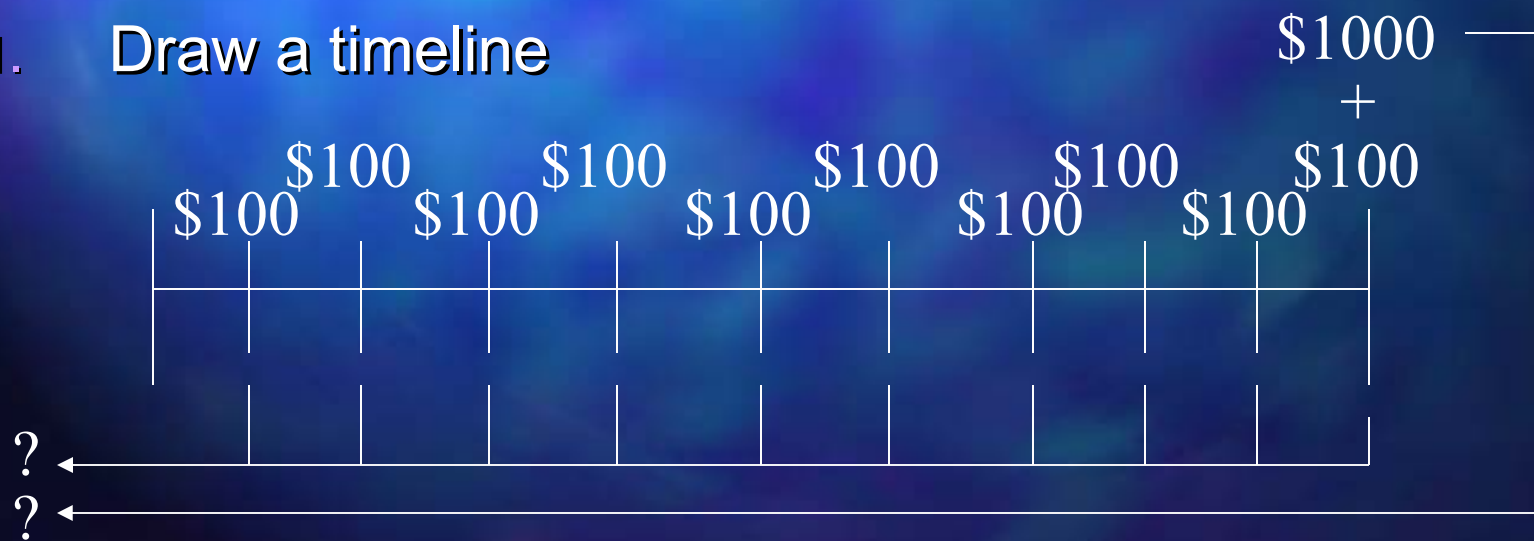
Formula

- $\frac{C}{(1+r)} + \frac{C}{(1+r)^2} + \frac{C}{(1+r)^n} + \frac{M}{(1+r)^n}$

Example

- Assume Hunter buys a 10-year bond from the KLM corporation on January 1, 2003. The bond has a face value of \$1000 and pays an annual 10% coupon. The current market rate of return is 12%. Calculate the price of this bond today.

1. Draw a timeline



Example

2. First, find the value of the coupon stream
 - Remember to follow the same approach you use in time value of money calculations.
 - You can find the PV of a cash flow stream
 - $PV = \$100/(1+.12)^1 + \$100/(1+.12)^2 + \$100/(1+.12)^3 + \$100/(1+.12)^4 + \$100/(1+.12)^5 + \$100/(1+.12)^6 + \$100/(1+.12)^7 + \$100/(1+.12)^8 + \$100/(1+.12)^9 + \$100/(1+.12)^{10}$
 - Or, you can find the PV of an annuity
 - $PVA = \$100 * \{[1-(1+.12)^{-10}]/.12\}$
 - $PV = \$565.02$

Example

3. Find the PV of the face value

- $PV = CF_t / (1+r)^t$
- $PV = \$1000 / (1+.12)^{10}$
- $PV = \$321.97$

3. Add the two values together to get the total PV

- $\$565.02 + \$321.97 = \$886.99$

YIELD TO CALL

- Some bonds carry a call feature that entitles the issuer to call(buy back) the bond prior to the stated maturity date in accordance with a call schedule for such bonds.

Realized Return

- Sometimes you will be asked to find the realized rate of return for a bond.
- This is the return that the investor actually realized from holding a bond.
- Using time value of money concepts, you are solving for the required rate of return instead of the value of the bond.

Example

- A purchased a bond for \$800 5-years ago and he sold the bond today for \$1200. The bond paid an annual 10% coupon. What is his realized rate of return?

- $$PV = \sum_{t=0}^n [CF_t / (1+r)^t]$$

- $$\$800 = [\$100/(1+r) + \$100/(1+r)^2 + \$100/(1+r)^3 + \$100/(1+r)^4 + \$100/(1+r)^5] + [\$1200/(1+r)^5]$$
- To solve, you need use a “trail and error” approach. You plug in numbers until you find the rate of return that solves the equation.
- The realized rate of return on this bond is 19.31%.

Example

- This is much easier to find using a financial calculator:
- $n = 5$
 $PV = -800$
 $FV = 1200$
 $PMT = 100$
 $i = ?$, this is the realized rate of return on this bond
- Note that if the payments had been semiannual, $n=10$, $PV=-800$, $FV=1200$, $PMT=50$, $i=?=9.47\%$. Thus, the realized return would have been $2 * 9.47\% = 18.94\%$.

BOND PRICING THEOREMS

- THEOREM 1:

Bond prices move inversely to interest rate changes.

When $y \uparrow \Rightarrow P \downarrow$

When $y \downarrow \Rightarrow P \uparrow$

Proof:

- $C = \text{Rs.}20\text{p.a.}$, $F = \text{Rs.}100$, $N = 1.5 \text{ years}$, $y = 10\% \text{ p.a.}$
- Price of the bond = ?
- From bond valuation model:
- $$P = \frac{10}{(1+0.05)} + \frac{10}{(1+0.05)^2} + \frac{110}{(1+0.05)^3}$$
- $P = \text{Rs.}113.616$
- Assume that interest rates rise and let $y = 20\% \text{ p.a.}$
- With higher interest rates, the price of the bond falls:
- $P = \text{Rs.}100.00$

THEOREM 2:

- The longer the maturity of the bond, the more sensitive it is to changes in interest rates.

Proof:

- Original annual YTM 10% for all bonds

| | BOND-A | BOND-B | BOND-C |
|------------------|--------|--------|--------|
| TERM TO MATURITY | 3 yrs | 6 yrs | 9 yrs |
| Annual Coupon | Rs.10 | Rs.10 | Rs.10 |
| Current price | Rs.100 | Rs.100 | Rs.100 |

Assume that interest rates fall by 2%, so that YTM becomes 8%.

| | BOND-A | BOND-B | BOND-C |
|---------------------------|-----------|-----------|------------|
| TERM TO MATURITY | 3 yrs | 6 yrs | 9 yrs |
| ■ Current price | Rs.105.24 | Rs.109.38 | Rs.112.66 |
| ■ Price sensitivity (in£) | +Rs.5.24 | +Rs.9.38 | + Rs.12.66 |

A 2% fall in YTM causes a higher price increase (+ Rs.12.66) for the 9 year bond.

Assume that interest rates increase by 2%, so that YTM becomes 12%.

| | <u>Bond A</u> | <u>Bond B</u> | <u>Bond C</u> |
|---------------------------|---------------|---------------|---------------|
| Term to maturity | 3 yrs | 6 yrs | 9 yrs |
| Current price | Rs.95.08 | Rs.91.62 | Rs.89.17 |
| Price sensitivity(in Rs.) | - Rs.4.92 | - Rs.8.38 | - Rs.10.83 |

A 2% increase in YTM causes a higher price fall (- Rs.12.66) for the 9 year bond.

THEOREM 3:

- The price changes resulting from equal absolute increases in YTM are not symmetrical.

Proof:

Bond A

Bond B

Bond C

Price changes (in Rs.)

YTM falls by 2% +Rs.5.24 + Rs.9.38 + Rs.12.66

YTM rises by 2 - Rs.4.92 - Rs.8.38 - Rs.10.83

For any given maturity, a $x\%$ decrease in YTM causes a price rise that is larger than the price

loss resulting from an equal $x\%$ increase in YTM.

THEOREM 4:

- The lower a bond's coupon, the more sensitive its price will be to given changes in interest rates.

Proof: Assume annual YTM 10% for all bonds

Bond A Bond B Bond C Z C B

Term to maturity 3 years

Annual Coupon Rs.30Rs. 15Rs. 5Rs. 0

Current price Rs.150.76 Rs.112.69 RS.87.31 Rs.74.62

Assume that interest rates increase by 2%, so that YTM becomes 12%.

Bond A Bond B Bond C Z C B

Term to maturity 3 years

| | | | | |
|---------------|-----------|-----------|----------|----------|
| Annual Coupon | Rs.30RS. | 15Rs. | 5Rs. | 0 |
| Current price | Rs.144.26 | Rs.107.38 | Rs.82.79 | RS.70.50 |

The change in the price of the bond as percentage of the initial price is:

| | Bond A | Bond B | Bond C | Zero Coupon Bond |
|-------------------|---------|---------|--------|------------------|
| Annual Coupon | Rs.30 | Rs.15 | Rs.5 | Rs.0 |
| % Change in Price | - 4.31% | - 4.71% | -5.18% | -5.52% |

**ANY
QUESTIONS**

THANK YOU