

Bond Terminology

Coupon rate: is the annual coupon amount expressed as a percentage of the face-value.

The **current yield** is the annual coupon divided by the current market price of the bond.

Yield to maturity (YTM) is the rate that makes the price of the bond just equal to the present value of its future cash flows. YTM is IRR of a bond

Realized Yield: The realized yield is an ex-post measure of the bond's returns. The realized yield is the average annual rate of return that was actually earned on the investment.

Bond Indenture: The bond indenture is a three party contract between the bond issuer, the bondholders, and the trustee

Bond Credit Ratings

- Credit rating is an assessment of the credit quality of the bond issue based on the issuer's financial condition.
- The primary question in bond rating analysis is whether the firm can service its debt in a timely manner over the life of a given issue.
- While deciding upon the credit rating of a particular issue factors related to the firm as well as the issue are considered.
- Split rating is obtained when there is disagreement among different bond rating agencies on credit quality of a particular issue.

Floating Rate Bonds/ Notes

- A Floating Rate Note (FRN) is a bond with a coupon that is adjusted periodically to a benchmark interest rate.
- Also known as floaters, variable rate notes, adjustable rate notes.
- A **floater cap** sets a limit to the amount of increase in coupon rate. The price of capped floater will be less than price of a regular floater.
- **Inverse Floater** is a bond whose coupon payment falls with increase in reference rate.

Bond Value in monetary terms:

Bond Value = Present Value of the coupons + Present Value of the Face Value

$$P = \sum_{t=1}^{2n} \frac{I/2}{(1 + r/2)^t} + \frac{M}{(1 + r/2)^{2n}}$$

For a **zero coupon bond**, price will be equal to present value of maturity cash flow as there are no intermediary cash flows on the bond.

$$P = \frac{M}{(1 + r)^n}$$

Price yield curve:

The relationship between the market yield on the bond and its price is referred to as the **price yield curve**.

The price – yield curve brings out three important points:

1. When the discount rate is below the coupon rate, bond is priced at premium to its par value.
2. When the discount rate is higher than the coupon rate, bond is priced at a discount to its par value.
3. The price- yield relationship is not a straight line but convex.

Different measures of bond yields:

Nominal Yield: is the coupon rate of a particular bond.

Current Yield: calculates current income from a bond as a percentage of the price. It is an equivalent of dividend yield for stocks

$$CY = \frac{I}{P}$$

Realized Yield: Measures the estimated rate of return for a bond likely to be sold prior to maturity.

$$P = \sum_{t=1}^{hp} \frac{I}{(1+r)^t} + \frac{P_{hp}}{(1+r)^{hp}}$$

Yield To Maturity

Yield to maturity (YTM) is the rate that makes the price of the bond just equal to the present value of its future cash flows. YTM is IRR of a bond.

$$P = \sum_{t=1}^{2T} \frac{I/2}{(1+r/2)^{2t}} + \frac{P_T}{(1+r/2)^{2T}}$$

Generally, market prices are observed in the bond market. Thus if a bond is priced higher than its par, it can be concluded that the current rate of interest is less than the stated coupon rate and is also true vice a versa.

YTM of a Zero Coupon Bond:

The YTM of a zero coupon bond is that discount rate which when used to discount the cash flow to be obtained at the end of maturity period will equate the value to its current market price.

$$P = \frac{M}{(1+r)^n}$$

Yield Curve

Yield Curve (term structure of interest rates): is a static function that relates the term to maturity to yield to maturity of a particular quality bond.

Types of yield curves:

Rising Yield Curve: is formed when the yields on short-term issues are low and rise consistently with longer maturities and flatten out at the extremes.

Declining yield curve: is formed when the yields on short-term issues are high and yields on subsequently longer maturities decline consistently.

Flat yield curve: is formed when short term yields are approximately equal to long term yields.

Humped yield curve is formed when yields on intermediate term issues are above those on short-term issues and the rates on long term issues decline to levels below those for the short term and then level out.

Spot Rate

- Spot rate is the discount rate for a cash flow at a specific maturity.
- Theoretical spot rate curve can be derived from the observable yield curve by process of **bootstrapping**.

Forward Rate

- Forward rate represents market's expectation of future short-term interest rates.
- Calculation of forward rates is based on the premise that investor will be indifferent between 1) investing in one year risk free security and 2) investing in six months risk free security and reinvesting the amount received in another six months risk free security, if they produce the same return for one-year investment horizon.
- The yield on six months risk free instrument that will be required six months from now to make investor indifferent is called six-month forward rate.

Bond Price Volatility

- There exists an inverse relationship between price of the bond and interest rates.
- Bond Price Volatility is measured as a percentage change in the price of the bond.

$$\text{Bond Price Volatility} = (\text{Ending Price of the Bond} / \text{Beginning Price of the Bond}) - 1$$

Characteristics of Bond Price Behavior

- Bond prices move inversely to interest rates.
- For a given change in interest rates, longer maturity bonds experience a larger price change.
- Bond price volatility increases at a diminishing rate as term to maturity increases.
- Bond price movements resulting from equal absolute increase and decrease in yield is not symmetrical.
- Higher coupon bonds show smaller percentage price fluctuations for a given change in yield.

Duration: Measure of Bond Price Volatility

- Duration is a measure of the sensitivity of the bond's price to interest rate movements.
- Bonds with higher duration have higher price volatility and thus are riskier than bonds with lower duration.

Macaulay Duration

Macaulay Duration is the total weighted average **time** for recovery of the payments and principal in relation to the current market price of the bond. It measures bond price volatility in terms of time period.

$$D = \frac{\sum_{t=1}^n \frac{C_t * t}{(1+i)^t}}{\sum_{t=1}^n \frac{C_t}{(1+i)^t}}$$

Characteristics of Macaulay Duration

1. Macaulay Duration for a zero coupon bond will be equal to its term to maturity.
2. The duration measure for a coupon bond will always be less than its term to maturity.
3. There is an inverse relation between coupon and duration.
4. There is positive relation between term to maturity and duration. However, duration increases at a decreasing rate with increased maturity.
5. There is an inverse relationship between yield to maturity and duration.

Modified Duration:

Modified duration is an adjusted measure that can be used as an approximate for interest rate sensitivity of an option free bond.

$$Duration_{Mod} = \frac{Duration_{Mac}}{(1 + i)}$$

Price change due to duration:

$$\frac{\Delta P}{P} * 100 = -D_{Mod} * \Delta i$$

Application of Duration: Bond trading strategies

- Longer duration implies larger price variation for a given change in yield. Portfolio manager can decide the bonds that should be comprised in his portfolio based on his expectations of direction of change of market yield.
- If he expects interest rates to move up he wants to protect his portfolio from deterioration in prices and thus would liquidate longer duration bonds and invest in shorter duration bonds.

Convexity

- Modified duration assumes that there exists linear relationship between price and yield for a bond.
- Convexity is a measure of the curvature of the price yield relationship.

- Convexity is a desired feature because presence of convexity implies that price will increase more in case interest rates fall and will decrease less in case interest rates rise.

$$Convexity = \frac{1}{(1+i)^2} \left[\sum_{t=1}^n \frac{CF_t}{(1+i)} * (t^2 + t) \right]$$

- The price yield relationship for a high coupon, short-term maturity bond will be almost straight line.
- Bond with low coupon and longer-term maturity will exhibit highly convex price- yield relationship.

Convertible Bonds

- A convertible bond is a hybrid instrument with features of both bond and equity.
- A convertible bond is exchangeable for a fixed number of shares of the issuing company's stock at the bondholder's discretion.
- Conversion Price can be calculated by following formula:

Conversion Price = Bond's par value / Conversion ratio

Conversion Ratio = Face value of bond / Conversion Price

*Conversion Value = Conversion Ratio * Market price per share at the time of conversion*

Premium over conversion value = Conversion value – Market price of a Convertible security

- The conversion price is usually adjusted for any stock splits or stock dividends to protect investors in convertible bonds from dilution. (**Anti-dilution clause**)

Advantages of convertible bonds: Issuing company

- Risky firms, which may find it difficult to raise money via conventional bonds except by offering a very high coupon rate may issue convertible bonds and lower the cost of debt.

- As value of convertible bond is equal to sum of values of an ordinary bond and value of conversion option, the value of ordinary bond will decrease with increased riskiness of firm's cash flows and the value of option will be higher.

Thus, it is beneficial for a firm with risky cash flows to issue convertible bonds.

- A convertible bond can be viewed as a deferred equity sale by a company at a premium over current prevailing market price.
- The restrictions in the form of bond indenture imposed by investors in convertibles may be less stringent as compared to the ones imposed by investors in ordinary bonds.

Advantages to buyers:

- Convertibles offer bondholders a chance to participate in the stock price appreciation.
- Convertibles offer a way to limit the risk associated with equity, which may result in big swings in either direction.

Warrants

- Warrants are securities that give the holders the right to buy shares of common stock directly from a company at a fixed price for a given period.
- Each warrant specifies the number of shares the holder can buy, the exercise price and the expiration date.
- Warrant is a right available to the holder, not an obligation.

Forced Convertibles: Callable Bonds

- The call feature gives the issuer of the bond the right to buy back the bond at a particular price.
- The option to call is available to the issuer thus callable feature is a disadvantage to the investor.

The **disadvantages** to the investor because of call feature is two fold:

- As the bond is callable at a particular price, investor cannot enjoy the appreciation in bond value that might be available due to declining interest rates.

- As bond will gain value when market interest rates are declining, and that is when call will be exercised, investor will be forced to reinvest the money received in low interest rate environment.

$$\text{Price of Callable bond} = \text{Price of Non-callable bond} - \text{Call value}$$

Putable Bond

- A Putable bond gives the holder the right to sell the bond back to the issuer at a specified exercise price, called Put Price.
- If the price of the bond decreases below the exercise price, then the bondholder can sell the bond back to the issuer at the exercise price.

$$\text{Price of Putable Bond} = \text{Price of non-putable bond} + \text{Price of put option}$$

