

## **Chapter 9 Bond Concepts and Pricing**

**Certificate in Risk Management**



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## Chapter – 9 Advanced Bond Concepts and Bond Pricing

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### Introduction

This session deals with the fundamental concepts of bonds. It covers the basics of the bonds, types of bonds, pricing of bonds, hedging bonds, valuation of bonds and factors affecting bond prices.

### Learning Objective

- Understand the basics of Bond
- Explain the difference between various types of bonds
- Understand the pricing of the bonds
- Explain the valuation of the bonds
- Explain the factors affecting the prices of the bonds
- Explain the hedging of the bonds



## 9.1 Bonds

A **bond** is a debt security issued by a borrower and subscribed/purchased by a lender/investor. A bond can also be defined as a contract between an investor and an issuer in which the issuer of the bond promises to pay some agreed returns to the investor. Bond is a usual form of a long-term financing used by firms which upon issuing a bond, promise to make certain cash flows in future in the form of interest and/or repayment under clearly defined terms and conditions..

The basic terms associated with bonds are:

**Par Value (or Face Value or Nominal Value):** The par value of a bond is the principal amount of a bond and is stated on the face of the bond security. The par value can be Rs. 100, Rs. 1,000 or any amount. The issue price, however, may be less than, equal to or more than the par value. Similarly, the redemption repayment may also be less than, equal to or more than the par value.



**Coupon Rate:** This is the rate at which interest on the par value of the bond is payable as per the payment schedule. The interest may be paid annually, semi-annually or even monthly. The coupon rate is generally given as % rate.

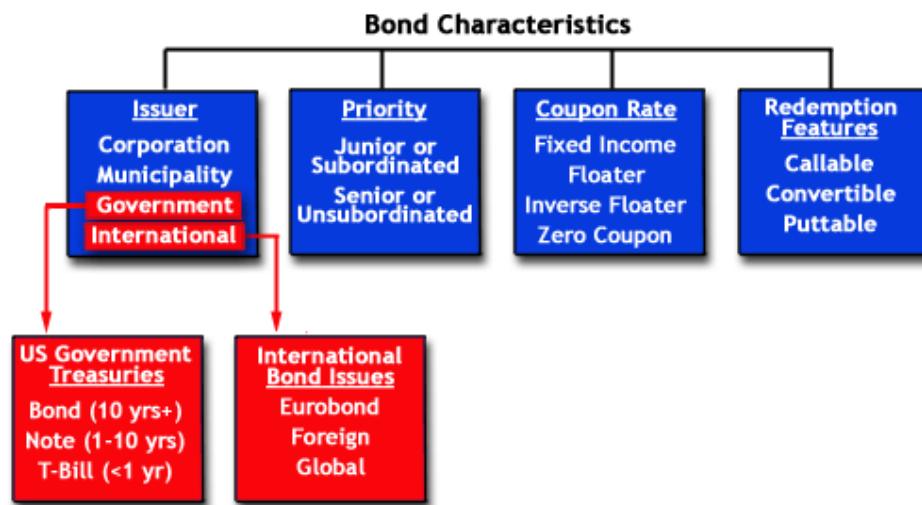
$$\text{Coupon} = \frac{\text{Coupon Rate} * \text{Face Value}}{\text{Number of Coupon Payments per Year}}$$

**Maturity:** the maturity of a bond refers to the period from the date of issue, after the expiry of which the redemption repayment will be made to the investor by the borrower firm.

For e.g., the Government of Canada issued a bond with a face value of \$1,000 in June 2002 which matures in June 2022. The stated annual interest rate is 8%:

- The face value is \$1000 (also called as Par value or Principal)
- The annual coupon is \$80
- The coupon rate is 8%
- The time to maturity is 20 years
- The maturity date is June 1, 2022

The classification of a bond can be done based upon its various characteristics like: the type of issuer, priority of the bond, based upon the coupon rate and redemption features of the bond. These categories have been shown in the chart below:



**Figure 9.1: Bond Types**

(Source Investopedia)

## Bond Types

### a) Based on Bond Issuers

The issuer is one of the most important characteristics of a bond. It determines the bond's credit quality. Bonds differ in their characteristics according to the issuers. Bonds issued by corporations differ from those issued by a state government/municipality or national government. Generally the securities issued by the government are considered to be having less risk of default than those issued by corporate bonds. But still there can be corporate bonds with better rating than those of the government bonds. There may be exceptions to the rule and like corporate bonds, there may be government bonds carrying various levels of risk. Bonds can be classified in several ways.

The following is a list of classes:

i) **Government (Treasury) Bonds** - The bonds issued by government; they include T-Bonds with maturities between 10 to 30 years, T-Notes with maturities between 1 to 10 years, and T-Bills with maturities between 3 to 12 months.

- T-Bills do not pay periodic interest; but they are purchased at a discount to their face values. At maturity they can be redeemed for their full face values. The others, however, have semi-annual interest (coupon) payments with their principals (face values) redeemable at maturity.
- The 30-year T-Bond, also known as the long bond, is used as the benchmark to assess the relative strength of the bond market. While most government bonds are marketable (i.e., they can be traded in the open market) some such as savings bonds are not. Government bonds are the safest types of bonds for investments. Though their yields are generally lower than other types of bonds having the same maturity time length.

ii) **Municipal Bonds (Munis)** - These are bonds issued and sold by local governments such as towns, counties, and states. These bonds are backed mostly by the future taxes received by the local governments. Munis are sometimes offered in \$5,000 units with varying maturities. Munis are as safe as the government bonds. But in some cases they may not be that safe as their quality varies depending on the issuing municipalities. The ratings of these bonds act as a great indicator of their safety levels. Some munis may be insured by private insurance companies to protect the investors from loss. This adds an extra level of safety to them, attracting more investors. These bonds are also exempt from state or local taxes if issued in the state of residence. There are two types of munis: general obligation and revenue bonds.

- General obligation bonds are backed by the credit and taxing authority of the issuer, such as states or towns,
- Revenue bonds are secured by revenues derived from a certain project, such as hospitals or toll bridges.

iii) **Corporate Bonds** - These bonds are issued by corporations to raise equity capital. They are rated riskier than government bonds and munis. The issuing party should be carefully assessed before investing in these bonds. These bonds range

from investment grade to junk grade depending on the rating of the issuing companies. For example, bonds issued by companies such as GE or IBM is considered very safe as the companies have established good track record of performing well. The bonds issued by less well known companies are mostly junk bonds. With the improvements in the credit quality of the company issuing bonds, their bonds gain quality and rise in price. The reverse is also true for high quality bonds going bad. The interest on corporate bonds is subject to government, state, and local taxes.

iv) **Savings bonds** - These are non-marketable securities for the investors who want a marginal return and these securities can be purchased with only a few dollars. Depending on their issued year these securities have different maturity periods/cycles. Interest on savings bonds is compounded semiannually and they can be redeemed at any time after the first six months of purchase. They continue collecting interest for a period for several years until reaching final maturity. At maturity they stop collecting interest.

v) **International bonds:** These types of bonds are issued in a market that is foreign to the issuer's home market, but some international bonds are issued in the currency of the foreign market and others are denominated in another currency. Here are some types of international bonds:

- Eurobond market: the euro is the currency used by participating European Union countries, eurobonds refer neither to the European currency nor to a European bond market. A Eurobond refers to any bond that is denominated in a currency other than that of the country in which it is issued. Bonds in the Eurobond market are categorized according to the currency in which they are issued. For example: a euro bond denominated in Japanese yen but issued in the U.S. will be classified as a euro yen bond.
- Foreign bonds are issued in the currency of the country in which a foreign entity issues the bond. Samurai bond is an example of foreign bond, which is a yen-denominated bond issued in Japan by an American company. Other popular foreign bonds include Yankee bonds and bulldog.
- Global bonds are structured such that they can be offered in both foreign and Eurobond markets. Global bonds are similar to eurobonds but can be offered

within the country whose currency is used to denominate the bond. A global bond denominated in yen could be sold to Japan or any other country throughout the Eurobond market.

#### b) Based on Priority

The priority of the bond is a determinant of the probability that the issuer will pay the investor his money back. The priority indicates the place of the investor in line if the company defaults on payments. Holders of an **unsubordinated** (senior) security will be first in line to receive payment from the liquidation proceeds of the company's assets. On the other hand, holder of a **subordinated** (junior) debt security will get paid only after the senior debt holders have received their share.

#### c) Based on Coupon Rate

Based upon the coupon payments made by bonds, bond issuers may choose from a variety of types of coupons, or interest payments to the investors.

- **Straight, plain vanilla or fixed-rate bonds** pay a specified coupon rate over a specified period of time. Upon maturity, the last coupon payment is made along with the principal amount of the bond to the investors.
- **Floating rate debt instruments** or floaters pay a coupon rate that varies in accordance with the movement of the underlying benchmark. These types of coupons can be fixed above or below or equal to the benchmark itself. These instruments follow benchmarks such as the three, six or nine-month T-bill rate or LIBOR.
- **Inverse floaters** pay a variable coupon rate that changes in direction opposite to that of short-term interest rates. An inverse floater subtracts the benchmark from a set coupon rate. An inverse floater that uses LIBOR as the underlying benchmark might pay a coupon rate of a certain percentage; let's say 4%, minus LIBOR.
- **Zero coupon** or accrual bonds do not pay any coupon. Instead, these types of bonds are issued at a discount and pay the full principal amount at maturity. It is also known as pure discount bonds.

#### d) Based on Redemption Features

Both investors and issuers are exposed to interest rate risk because they are locked into either receiving or paying a set coupon rate over a specified period of time. For this reason, some bonds have additional benefits to investors or in other words they have more flexibility for issuers:

- **Callable or a redeemable bond** feature gives a bond issuer the right, but not the obligation, to redeem his issue of bonds before the bond's maturity. The issuer in return pays the bond holders a premium. There are two categories of these types of bonds: American callable bonds and European callable bonds. American callable bonds can be called back by the issuer any time after the call protection period while European callable bonds can be called by the issuer only on pre-specified dates.
- The optimal time for issuers to call back their bonds is when the interest rate prevailing in the market is lower than the coupon rate they are paying on the bonds. The company could refinance its debt by reissuing bonds at a lower coupon rate after calling its bonds.
- **Convertible bonds** give investors the right but not the obligation to convert their bonds into a predetermined number of shares at predetermined dates. This can be done prior to the maturity of the bond.
- **Puttable bonds** give the investors the right but not the obligation to sell their bonds back to the issuer at a predetermined price and date. If the market prices of the bond are lower than the strike price of the bond (resulting from interest rates being higher than the bond's coupon rate), it would be good for investors to sell their bonds back to the issuer and reinvest their money at a higher interest rate. Thus these bonds protect investors from interest rate risk.

### e) Bond Categories

Bonds can be classified in several ways. In the last section we looked at the main bond types with regards to their issuers. However bonds have different features or characteristics depending on the specific issuing organizations or institutions. Here is a list of some of the better known features:

- **Secured Bonds** - These bonds are issued using specific properties or assets as collateral. Mortgage backed securities are the best known example of this type of bond where the bond is backed by a pool of mortgages. These bonds have a high degree of safety since the investors have the right to sell the pledged property in case of counterparty default. It is also known as asset-backed bonds.
- **Unsecured Bonds** — Also known as debenture bonds, these types of the bonds are backed only by the general credit-worthiness of the issuer. Corporate bonds are an example of unsecured bonds.
- **Bearer Bonds** - These are unregistered bonds which are assumed to be the property of their holders. If lost or stolen they cannot be replaced as they become the property of their holders.
- **Registered Bonds** —these bonds carry the owner's name for the principal or interest. Most bonds today are registered for principal only. If stolen or lost, registered bonds can be easily replaced.
- **Coupon Bonds** —this type of bonds comes with detachable coupons representing their interest payments. At the end of each interest period, the bondholder clips the corresponding coupon and presents it to the specified bank for collection.
- **Term Bonds** —these bonds have one maturity date for the entire bond issue.
- **Serial Bonds** — serial bonds mature in installments at different dates and they are thus different from term bonds.

### Benefits and Risks of Investing in Bond Market

One of the benefits of government securities is that some of them are exempted from state or local taxes and thus lead to higher return on these securities. Zero coupon bonds, US Treasury Notes, Bills and Bonds fall within this category. The main risk is the cost of opportunity. As the risk is low so is the return.

Government bonds are considered risk free (zero credit risk), because of the assumptions that the Government cannot default. It is assumed that if the government cannot pay the holders of the bonds, it will meet the requirement by printing more money.

Therefore the yield of the government bonds are used as benchmark rates, investors expect at least the return (yield) they get on government bonds of the same maturity when they invest in any non-government security. The logic is that all the other bonds are definitely (however slightly) more risky than the government issues. The investors demand more return for the additional risk that they bear.

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The governments of various countries raise debt through issuing bonds. Various credit rating agencies like Moody, S&P etc come out with ratings for the countries based mainly on the economic stability of the country. For investors in other countries investing in that country's issue, these rankings indicate the risk of the bonds (because these cross-country investments in bonds are also effected by the fluctuations in the foreign exchange market).

**Did You Know?** After the Peso Crisis in the late 1990s and early 2000s, Argentina defaulted on nearly 500,000 bonds, worth about \$81 billion. These bondholders in the US exchanged the bonds for bonds on the Dollar worth 35 cents.

#### 9.2 Spreads

Spread represents the difference between the bid and the ask price of a security or an asset. Practically speaking this is the price difference between the highest price that a buyer is willing to pay for an asset or an instrument and the lowest price for which a seller is willing to sell it.

## Types of Spreads

### i) Z-spreads

A Z-spread is also called a zero-volatility spread as it assumes that the interest rates do not change over the period it covers.

Corporate bonds are compared with the government bonds to see how much extra return they offer. The difference is called '**Nominal spread**'. It is the difference in yields at a certain point in time, for one fixed period of maturity.

Z-spreads are not very different from the nominal spreads for normal bonds; they are very useful for exotic bonds (with embedded options like amortizing bonds etc) and for Mortgage Backed Securities, where coupons are paid every month.

Z-spreads provide a measure over the whole of the spot treasury curve, representing the extra yield the investor will achieve if the non-treasury bond is kept till maturity. It gives how the yield of the corporate bond changes over the period, and it also gives the comparison with the government bond through out that period (till maturity).

The Z-spread when added to the treasury spot rate gives the total interest rate that is the discounting factor for all the future cash flows to find the present value of the bond. The present value of the bond is equal to the market value of the bond too. The steeper the Z-spread, the larger is the difference in the Z-spread and the nominal spread.

### ii) Inter market sector spread:

The yield spread between two fixed income securities in different sectors with the same maturity.

### iii) Credit Spread:

The spread between treasury securities and non-credit securities that is identical in all respect except quality rating.

**iv) Horizontal Spread:**

It's an option trading strategy involving the simultaneous purchase and sale of two same type options with same strike price but different expiration rates.

**v) Vertical spread:**

It's also an option trading strategy with a simultaneous purchase of two same type options having same expiration rate but different strike prices.

**vi) Future Spread:**

It's an arbitrage technique in which the trader buys and sells same commodities but in different markets to capitalize on a discrepancy in price.

### **The Factors Affecting the Spread of Bonds**

An 'On-The-Treasury' bond is a latest issue by the treasury of a country for a particular maturity. It is very liquid, often the most liquid in the market (partly because it is newly issued and would be traded more than the older issues).

Non-government bonds are compared with the on-the-treasury bonds to find their spread; the spread of a bond is the difference in the yield of the on-the-treasury bond and the maturity and the yield of the bond in question. It is in other words, the extra return that a particular bond offers when compared to a risk-free bond. Spreads are therefore indicators of the market's assessment of risk of the corporate bond.

**1. The credit rating** of the firm issuing the bonds has an impact on the spread of the bond. For a firm with a high credit rating, the probability that it will default is much lower than others and therefore the risk for the individual investors is much smaller. Therefore the spread of the bond is smaller for a very reliable firm (or issue by the firm). Bonds that have very low credit ratings (BB or lower) and offer big spreads are sometimes called Junk Bonds.

**2. The time to maturity** also affects the spread of the bonds. The longer the time to maturity, the higher will be the spread on the bond (because keeping the amount

invested for a long period is equivalent to subjecting it to all the risks that occur in that long period, therefore the risk is more for the investor).

### 9.3 Bond Pricing

Determining the price of a bond is very important to be understood before getting into any investment in them. Bond pricing helps in finding the losses, which the investor may suffer by investing in any investment. It also lets the investor know the gains, which he'll be getting by investing in any investment. There are simple calculations based on which the pricing of various types of bonds can be done. Effectively the bonds can be priced at a premium, discount, or at par. The bond is said to be selling at premium if its interest rate is higher than current prevailing rates. If its interest rate is lower than current prevailing interest rates then it is selling at a discount. Bond pricing lets the investor know the maximum price he should pay for any investment in bonds. Required rate of return is the interest rate that a security will need to offer in order to encourage investors to purchase it.

- At the time of issue a coupon bond is usually sold for a price which is close to its par value.
- After issue a bond is traded on the market at a price which reflects the current value of interest rates and the degree of risk associated with the bond.
- Calculate either the market price that a bond should sell for, given that the investor wants to obtain a particular yield or the effective yield (also known as yield to maturity), given the price at which the bond is trading.

The price of a bond is the sum of the present values of all expected interest payments plus the present value of the initial investment at maturity. Calculating bond price is simple: all that is required to be done for pricing is simple discounting of the known future cash flows. To calculate present value (PV) we need to know the interest rate that would earn a known future cash flow. Following is the formula for calculating a bond's price, which uses the present value (PV) formula:

$$\text{Bond Price} = \{C / (1 + i)\} + \{C / (1 + i)^2\} + \dots + \{C / (1 + i)^n\} + \{M / (1 + i)^n\}$$

C = coupon payment

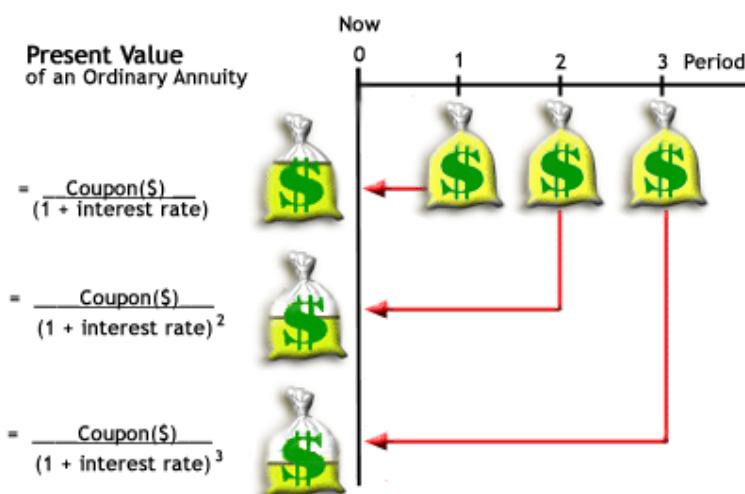
n = number of payments

i = interest rate, or required yield

M = value at maturity, or par value

We can also use the ordinary annuity formula if the expected future cash flows or coupons are fixed or are same. The following diagram describes how present value is calculated for an ordinary annuity:

The series of coupon payments, which will be received in the future, is referred to as an ordinary annuity, (simply put annuity is a series of fixed payments at set intervals over a fixed period of time). The first payment of an ordinary annuity will occur after a particular interval from the time at which the debt security has been acquired. The calculation will assume this time to be the present.



Sum of the above equals the present value of an annuity formula:

$$PV = PMT \times \left[ \frac{1 - (1 + i)^{-n}}{i} \right]$$

Where: PV = Present Value  
PMT = Coupon Payment  
i = Interest rate  
n = Number of periods

**Figure 9.2 Ordinary Annuity**  
(Source [www.investopedia.com](http://www.investopedia.com))

In the diagram given above the present value for all future cash flows has been calculated by using a single calculation unlike using the summation to be done for all present values (it actually calculates the sum of the present values of all future cash flows, but unlike the bond-pricing formula we saw earlier, it doesn't require that we add the value of each coupon payment).

So simply by using the annuity model into the bond pricing formula we arrive at the following formula for bond pricing:

$$\text{Bond Price} = C * \left\{ \frac{1 - \frac{1}{(1 + i)^n}}{i} \right\} + \frac{M}{(1 + i)^n}$$

#### **Bond Pricing example:**

Calculate the price of a bond with a par value of Rs.1000/- to be paid in 10 years, a coupon rate of 10%, and a required yield of 12%. The coupon payments are made semi-annually to bond holders.

Since the coupon payments are made semi annually there would be a total of 20 coupon payments. Half the coupon rate is applicable for semi annual payments i.e. 5%. The coupon payment is Rs. 50/- ( $0.05 * 1000 = 50$ ).

Similar to coupon rate, the applicable or the required yield will be halved to 6%.

Now with semi-annual coupon and yield rates in place, apply the formula to calculate the bond price:

$$\text{Bond Price} = 50 * \left\{ \frac{1 - \frac{1}{(1 + 0.06)^{20}}}{0.06} \right\} + \frac{1000}{(1 + 0.06)^{20}}$$

$$= \text{Rs. } 885.32$$

#### **Relationship between Coupon Bond Prices and Interest Rates**

- When interest rate rise, market prices of bond fall and vice versa( the longer the time until maturity , the more sensitive the bond price is to changes in interest rate)
- If price < par value, a bond is said to sell at a Discount
- If price > par value, a bond is said to sell at a Premium
- If price = par value, a bond is said to sell at a Par

### For a Zero-Coupon bond

$$\text{Bond Price} = M / (1+i)^n$$

- Calculating Bond Price for Callable and Puttable Bonds**

For the callable bonds, while calculating the bond price the issuer's ability to call the bond must be kept in mind. While for the calculations for puttable bonds the buyer's ability to sell the bond should also be taken care of. **The yield for callable bonds is referred to as yield-to-call, and the yield for puttable bonds is referred to as yield-to-put.**

This calculation for callable and puttable bonds requires two simple modifications to the yield-to-maturity formula:

$$\text{Bond Price} = \text{Cashflow} * \frac{1 - \left( \frac{1}{(1 + \text{interest rate})^n} \right)}{\text{interest rate}} + \left[ \frac{\text{Call Value}}{1 - \left( \frac{1}{(1 + \text{interest rate})^n} \right)} \right]$$

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Source: Wikipedia

Annotations on the formula:

- Red circle around  $\frac{1}{(1 + \text{interest rate})^n}$ : Call price replaces maturity value
- Red circle around  $\text{Call Value}$ : Time until call date replaces time to maturity

- Term Structure of Interest rates**

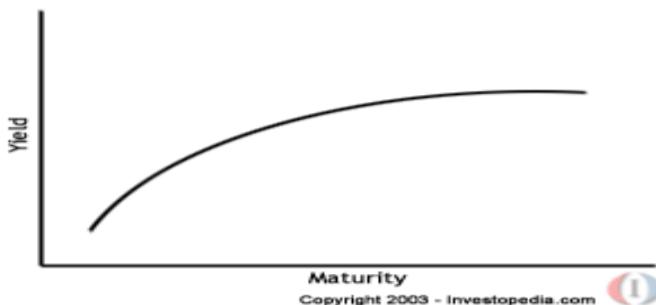
The term structure of interest rates, also known as the yield curve, is a very common bond valuation method. Constructed by graphing the yield to maturities and the respective maturity dates of benchmark fixed-income securities, the yield curve is a measure of the market's expectations of future interest rates given the current market conditions. Treasuries, issued by the federal government, are considered risk-free, and as such, their yields are often used as the benchmarks for fixed-income securities with the same maturities. The term structure of interest rates is graphed as though each coupon payment of a non-callable fixed-income security were a zero-coupon bond that "matures" on the coupon payment date. The exact shape of the curve can be different at any point in time.

There are three main patterns created by the term structure of interest rates:

- 1) **Normal Yield Curve**- This is the yield curve shape that forms during normal market conditions, wherein investors generally believe that there will be no

significant changes in the economy, such as in inflation rates, and that the economy will continue to grow at a normal rate. During such conditions, investors expect higher yields for fixed income instruments with long-term maturities that occur farther into the future.

It is noted if current interest rate increase, the price of bond will decrease and its yield will increase.

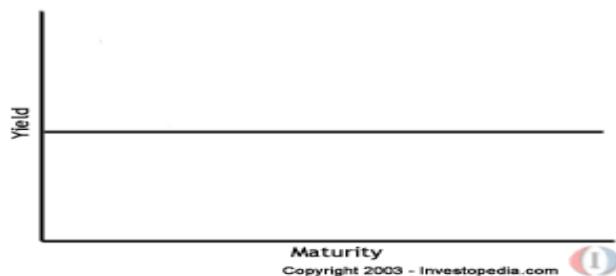


**Figure 9.3 Normal Yield curve**

(Source Investopedia)

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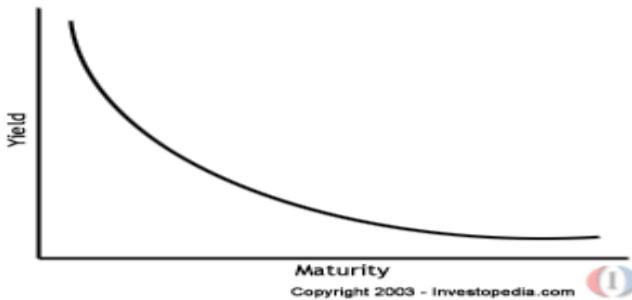
- 2) **Flat Yield Curve**- These curves indicate that the market environment is sending mixed signals to investors, who are interpreting interest rate movements in various ways. During such an environment, it is difficult for the market to determine whether interest rates will move significantly in either direction farther into the future. A flat yield curve usually occurs when the market is making a transition that emits different but simultaneous indications of what interest rates will do. Where in long-term interest rates decline, a flat curve can sometimes lead to an inverted curve.



**Figure 9.4 Flat Yield curve**

(Source Investopedia)

- 3) **Inverted Yield Curve-** The inverted yield curve indicates that the market currently expects interest rates to decline as time moves farther into the future, which in turn means the market expects yields of long-term bonds to decline. It is also noted that as interest rates decrease, bond prices increase and yields decline.



**Figure 9.5 Inverted Yield curve**  
(Source: Investopedia)

#### 9.4 Duration of Bond

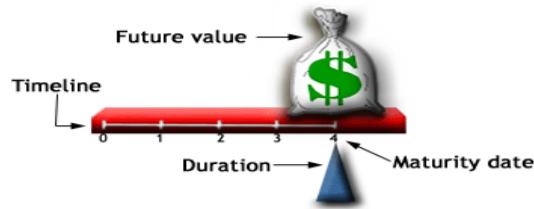
The term duration has a special meaning in the context of bonds. It is a measurement of how long, in years, it takes for the price of a bond to be repaid by its internal cash flows. It is an important measure for investors to consider, as bonds with higher durations carry more risk and have higher price volatility than bonds with lower durations.

For each of the two basic types of bonds the duration is the following:

1. Zero-Coupon Bond– Duration is equal to its time to maturity.
2. Vanilla Bond- Duration will always be less than its time to maturity.

- **Duration of a Zero coupon bond**

The red lever above represents the four-year time period it takes for a zero-coupon bond to mature. The fulcrum balances the red lever at the point on the time line at which the amount paid for the bond and the cash flow received from the bond are equal.



**Figure 9.6 Duration of zero coupon bonds**

(Source: Investopedia)

- **Duration of a Vanilla or Straight Bond**

Consider a vanilla bond that pays coupons annually and matures in five years. Its cash flows consist of five annual coupon payments and the last payment includes the face value of the bond. The moneybags represent the cash flows you will receive over the five-year period. Unlike the zero-coupon bond, the straight bond pays coupon payments throughout its life and therefore repays the full amount paid for the bond sooner.



- **Hedge ratio** **TATA CONSULTANCY SERVICES**

Bonds can be hedged by entering into bond futures, just as with equity futures. Two parties decide a future date and price when one party will buy the bonds from the other party. The Bond futures market gives indications about the future prices and yields of the various bonds. Though the forecast is only for a few years, they are effective for hedging, as an investor can decide on what should be the maturity of the bond so that the risk of his portfolio is at the required level, and he gets the required yield.

Hedge ratio is defined as the change in the price of the call option for every one-point move in the price of the underlying security. It is also known as delta. It gives the proportion of the change in the value of an underlying security as per the change in the value of the hedge. To hedge bonds using bond futures, the number of futures required to be bought should be known. There are two methods to calculate the number of futures required; one method uses the modified duration (which is an index of how the price of the bond changes with the change in the interest rates), it measures the change in the relative position and the futures hedge. While the other

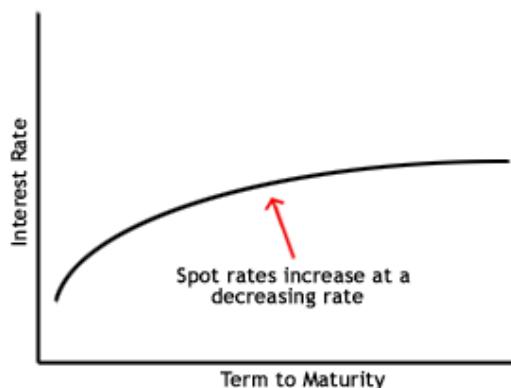
compares the change in the value of the bond for 1 basis point (1 basis point =  $1/100 * 1\%$ , the basis point is used to calculate the changes in interest rates and the yield of a fixed-income security. A bond whose yield increases from 8% to 8.5% is said to be increased by 50 basis points) change in yield to the impact of a basis point change in the yield on the futures price. The ratio of the change is called the Hedge Ratio.

The effect on the value of the bond for every 1 basis point change in yield is measured on the basis of the market price changes of the bond. The impact on the futures price is found using the yield on the Cheapest to Deliver (CTD) bond; it is assumed that the changes in the market yield of the CTD bond will be mirrored entirely in the bond to be hedged.

- **Theoretical Spot Yield Curve**

The basic yield curve does not account for securities that have varying coupon rates. The spot-rate curve addresses this point and gives the explanation for the fact that many securities may offer varying coupons. The spot-rate curve provides a more accurate measure as it adjusts the yield curve according to the variations in the interest rate of the benchmark used. **The interest rate which is taken from the spot rate yield curve is known as the spot rate.**

Figure name and number



**Figure 9.7 Spot Yield Curve**  
(Source: [www.investopedia.com](http://www.investopedia.com))

The spot-rate curve is graphed by plotting the yields of zero-coupon T-bill and their corresponding maturities. T-bills are issued by the government with maturities less than one year.

The price of a bond is calculated by finding the present values (PVs) of all the future cash flows from the bond. The future cash flows are discounted using the current yield rate as the discounting factor (which has been explained in the session previously).

But this method assumes that the yield curve remains flat, for it is only for a flat yield curve that the yield rate remains constant for all the years. However, this assumption is flawed, as the yield curve is rarely flat.

Therefore to price a bond correctly, the bond is seen as a series of zero-coupon bonds with varying maturities. Each coupon of the bond is seen as the CF resulting from the maturity of a zero-coupon bond. This is called 'Arbitrage-Free Approach' as there should be no difference in the present market value of the bond and the CFs from the series of zero-coupon bonds (if there is, it is incentive for the investors to convert the bonds to zero-coupon bonds and sell them for a profit, and the profit would soon disappear as investors take advantage of this arbitrage).

The zero-coupon rates that can be applied for each CF (that is the receipt of the coupon) have to be calculated from the current treasury yields for each tenor on the yield curve. A Treasury Par Yield Curve is built for that purpose.

A par security is one that is trading at its face value (the market price is equal to its initial issue price). Therefore, coupon rate is equal to the yield of the par security. The most liquid and mostly newly issued bonds are used to construct the par yield curve. The method used is that the coupon on all the bonds on the curve is changed till it equals the current yield, so that the market value becomes the face value (which is usually 100).

Then the spot treasury yield curve is constructed by using the discount factor, which uses the values on the par yield curve. The discounting factor, on further calculations

gives the zero-coupon spot rate, which is the interest rate for each point on the yield curve, using which the CFs arising from a bond are discounted.

### Factors affecting the pricing of the Bonds

- **Economic or Political News**

Bond prices are greatly affected by the economic and political news. Even a slight hint of an unexpected movement of the economy can have big impact on bond prices. Bonds will provide healthy and consistent returns in a healthy economy. Short-term investor is more affected by such news on the other hand the long-term investor is immune to large price fluctuations. Bond prices always move up and down depending upon the good or bad news about the economic growth.

- **Inflation**

Under an inflationary condition of an economy, bonds need to make higher interest payments to offset inflation. As a result the bond prices drop as investors pay less money for investing in them.



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- **Economic Slowdown**

Just as the threat of inflation has a negative effect on bonds, similarly a rapidly downgrading economy has the same problem and the value of the bonds go down. Bonds are not able to hold the interest of the investors causing steep price drops. Economies with huge debt, political instability, or over-valued currencies usually experience such an effect.

## Summary

- A bond can be defined as a contract between an investor and an issuer in whom the issuer of the bond promises to pay some agreed returns to the investor. The classification of a bond can be done based upon its various characteristics like: the type of issuer, priority of the bond, based upon the coupon rate and redemption features of the bond.
- The price of a bond is the sum of the present values of all expected interest payments plus the present value of the initial investment at maturity.
- Yield is a measure of the income an investor receives if he or she holds a bond until maturity; required yield is the minimum income a bond must offer in order to attract investors.
- The yield curve demonstrates the concept of the credit spread between corporate and government fixed income securities.
- Duration is the time in years it takes a bond's cash flows to repay the investor the total price of the bond.
- Benefits and risks of investing in a government security have also been discussed.
- This session dealt in detail about the various basic concepts of bonds. The topics types of bonds, pricing of the bonds and factors affecting the pricing of the bonds have been covered in detail and they give clear idea about the bonds and their trading.



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