Economics of Banking and Finance Markets
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Lecture - 04
Understanding interest rate: Debt market II

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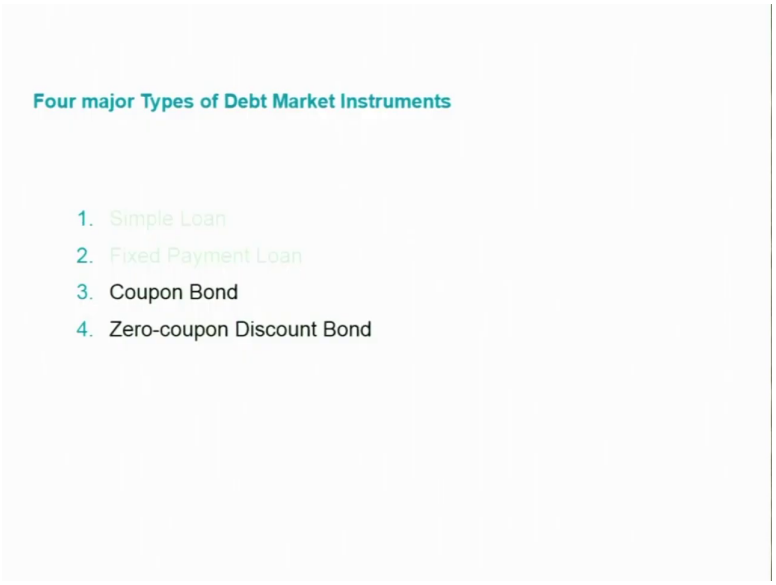

Welcome to this session. In the previous session, we had discussed two types of bond ,one is called coupon bond and another is called zero-coupon bond.

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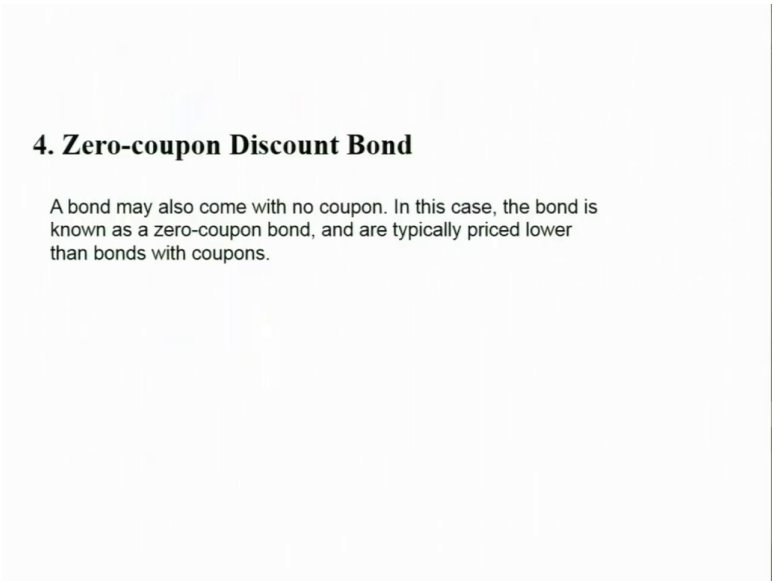

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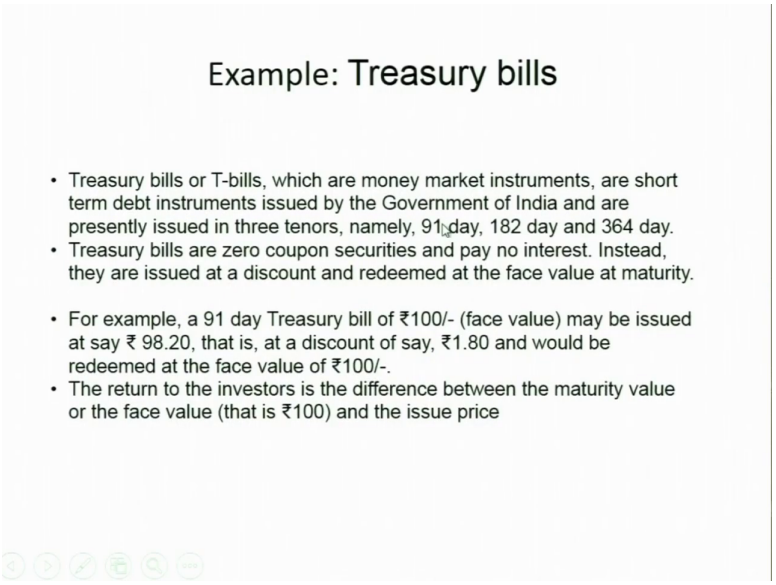

So, in the case of zero-coupon bond we saw that the bond that do not come with any coupon payment, this is one example we have shown there, and we also discussed India's treasury bill as an example for a zero-coupon bond. And now let us discuss how to determine the present value of a zero-coupon bond.

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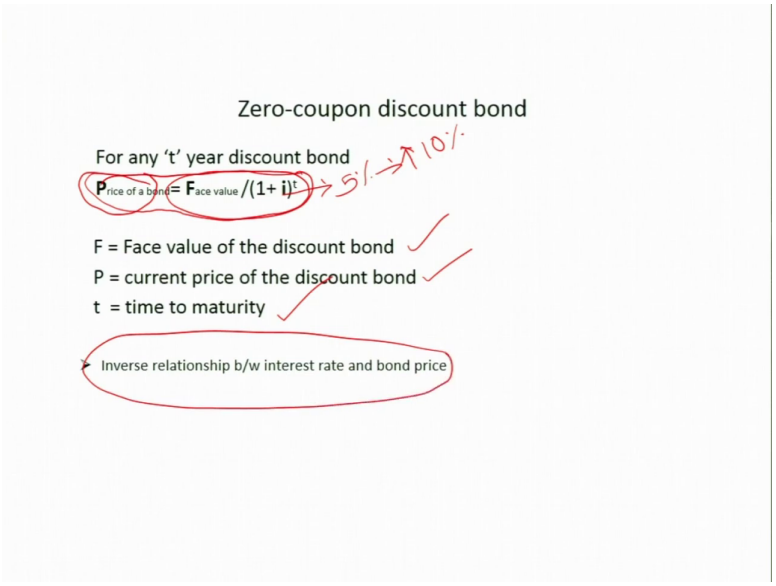

The formula for calculating for any t year discount bond; the price of bond can be calculated as face value divided by 1 plus i raised to t the period. So, as I mentioned here F is the face

value of the discount bond, and P the current price of the discount bond and t is the time to maturity.

From this formula, you can also see that there is an inverse relationship between interest rate and bond price. Just look at this formula; the price of this bond is equal to face value divided by 1 plus i. Suppose if you increase this i the value of this i suppose initially it was 5 percentage; when you increase this one to make it to 10 percentage you can see that; obviously, from this value formula itself you can see that, when you raise the rate of interest from 5 percentage to 10 percentage, the price of bond be declined. You can see that when you plug some numerical values in this formula, you can see that when you raise the interest rate, when you raise the value of i the price of bond will decline or if you reduce the value of I the price of bond will increase.

If you reduce the rate of interest or suppose the rate of interest in the market declines, then you can see that the price of bond will be increasing. So, from this formula itself, you can see that there is an inverse relationship between interest rate and bond price.

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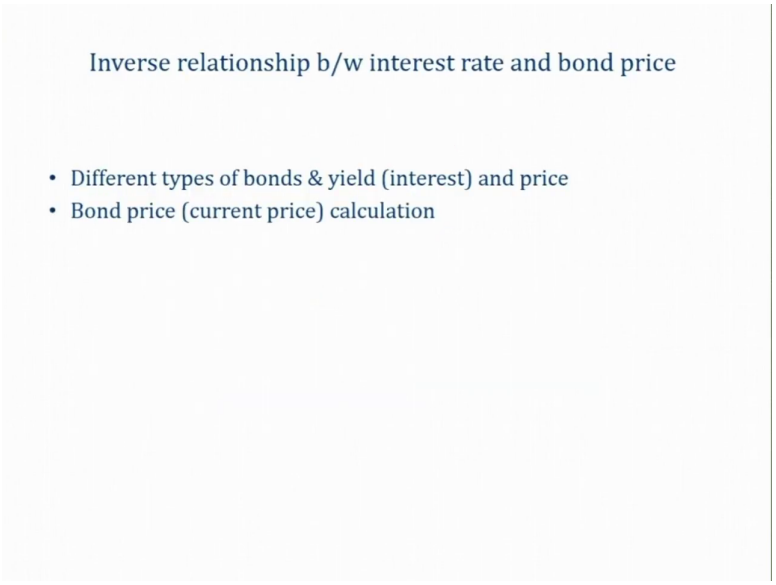

This inverse relationship between interest rate and the bond price, we can also understand this using an illustrative example. When you go through the bond price calculation the formula that you we used in the zero coupon bond and in even in the coupon bond, we can find the inverse relationship.

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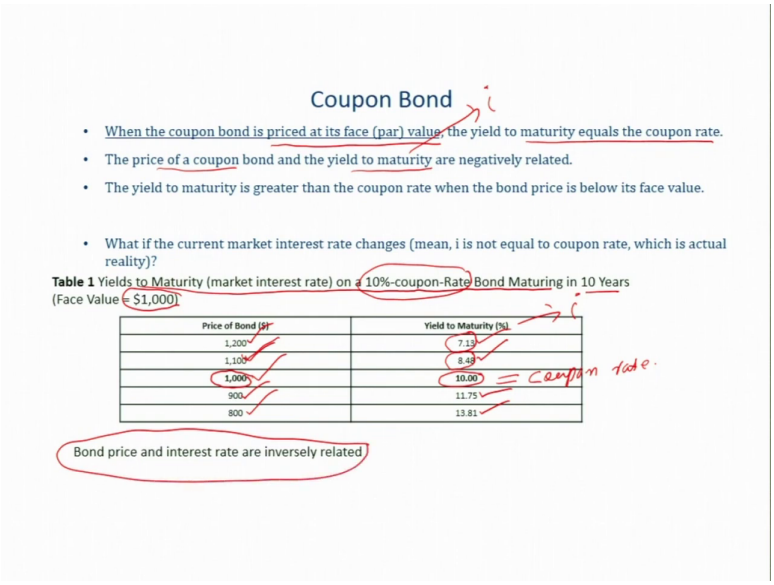

Before we discuss some illustrative example to elaborate the inverse relationship, I just want to add some more points with regard to the coupon bond. When the coupon bond is priced at its face value the yield to maturity equals the coupon rate. The price of a coupon bond and yield to maturity are negatively related, then the price of the bond and the yield to maturity; that means, yield to maturity is nothing but a rate of interest, they are negatively related, and yield to maturity is greater than the coupon rate when the bond price is below its face value. What if the current market rate of interest rate changes, means i is not equal to the coupon rate, which is actual reality.

In this case, let us see what the relationship between changes in the market rate of interest or the yield to maturity and the price is. In this case let us take an example to calculate the yield to maturity (market interest rate) on a 10-percentage coupon rate bond maturing in 10 years. Suppose the face value of this bond is 1000. This is the bond value. Suppose the face value is 1000 and suppose the and the coupon pay rate coupon rate also we say that this is 10 percentage.

Suppose the current rate of interest (the yield to maturity) is 10 percentage. So, here when the yield to maturity is equal to the coupon rate you can see that the current price of this bond, that is the face value of the bond, is equal to its face value; that means, a bond with face value of 1000 will be traded at its face value itself.

So, in this case, when there is no difference between the yield to maturity and the coupon rate (both are equal), then the face value of the bond is equal to the current price of the bond. What if the current rate of interest or the yield to maturity is less than the agreed coupon rate of 10 percentage? Suppose the assume that, due to the demand forces and supply forces, the rate of interest is going to be 8.48 percentage. In this case if you plug this value in the formula that we discussed a few minutes before, you will be getting the current price of the bond, which is going to be 1100. That means, the bond which is going to be maturing after 10 years with when the current rate of interest is 8.48, it will be currently traded at 1100.

What would happen when the rate of interest further decline? Suppose so, the current rate of interest is 7.13 at that time, when the rate of interest declines, the price of bond will increase and, in this example, the current price of this bond with a face value of 1000 is going to be 1200.

So, this is the case when we see that when the rate of interest is decreasing. What if the yield to maturity is greater than the coupon payment coupon rate? So, in this case the face value with 1000 bond will be traded at 900.

Further, when the rate of interest further increases to 13.81, the price of bond further declines, it will be traded at 800 today. From this illustrative example also, you can see that bond price and interest rates are inversely related.

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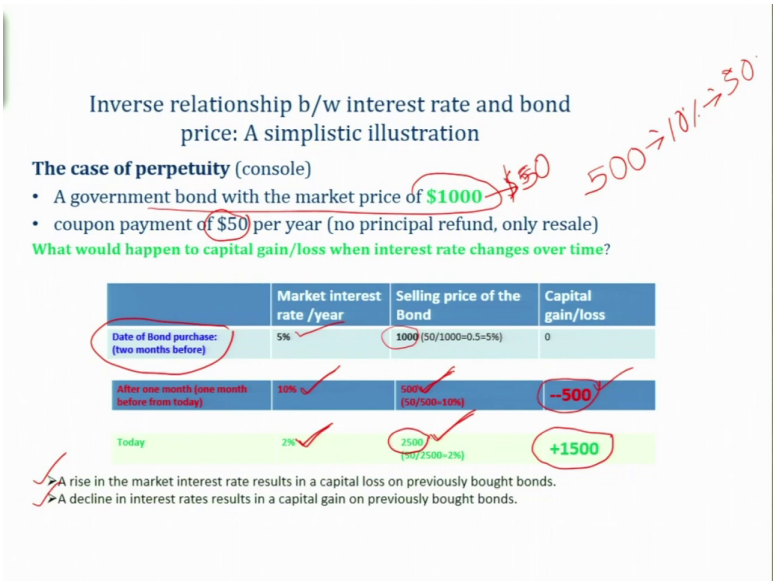

I am also going to further explain inverse relationship between interest rate and bond to you using another simple illustrative example. To explain this, let us take the case of a perpetuity; that means, a console; that means, there is no maturity period for this bond; that means, a perpetual bond which has a indefinite lifetime.

Suppose government issued a bond with a market price of 1000. Let us take this example and look at this then the coupon payment here is 50 per year; that means, there is no principal refund, only you can sell this bond in the market and whoever is buying this one will be entitled for a coupon payment of 50 per year.

What would happen to the capital gain or loss when interest rate changes over time? In this case, look at the date of purchase, suppose someone had purchased this bond with 1000 as the face value two months before, you see that look at this the market rate of interest at that time , that is, 2 months before, the yield to maturity or the market rate of interest was 5 percentage.

You know that, at that day the bond will be purchased at 1000, then let us see if there is a movement in the rate of interest suppose after one-month; that means, just one month before today, you know that the market rate of interest increased to 10 percentage. So, someone who bought this bond will get 50 dollar per year, that means, after one month when the market rate of interest is 10 percentage, the current price of this 1000 bond is going to be only 500, right? Because this bond is going to give you only 50 dollar. When the current rate of interest is 10 percentage, someone buying a bond of 500 is going to get 50 dollar.

In this case when the rate of interest increased to 10 percentage from 5 percentage, the bonds selling price decreases to 500 from 1000s. So, you can see that when the rate of interest increases the price of this bonds becomes 500. It was bought at 1000 over 2 months back and today, but after one-month the market price of this bond is only 500.

So, those who bought this bond over 2 months back now suffer a capital loss of 500 because of the inverse relationship between market price of bond and the interest rate. And, we take another case, what if today when the market rate of interest decreased to 2 percentage. In this case you can see that this 1000 bond anyway going to give you 50 dollar per year irrespective of what is the current market rate of interest. So, you can see that someone who invest 1000 dollar today is going to get only at a 2-percentage rate of interest, means going to get only 20, but this 1000 bond bought 2 months back is going to give you 50 per year so; that means, this

bond will be further sold in the market at 2500 because the current rate of interest is 2 percentage.

So, in this case you can see that the person who bought this bond 2 months before on this date if he/she sells this bond today, the market price the current price is going to be 2500. That is, this person is going to make a capital gain of 1500. So, from this illustrative example what you can see that a rise in the market interest rate results in a capital loss on previously bought bonds, and a decline in interest rates result in capital gain on previously bought bonds.

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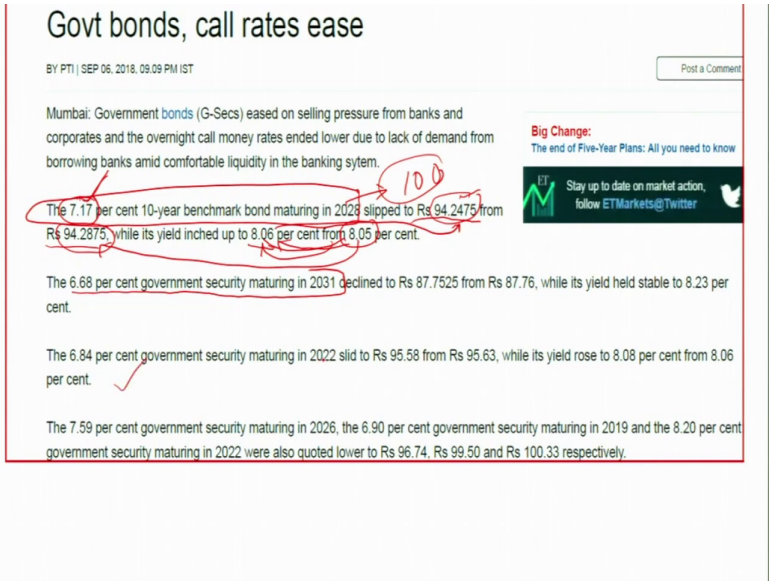

Sometimes you read in the newspaper including business daily reporting like this; what does it mean? Here, suppose this is a fixed rate coupon bond. suppose at a 7.17 percentage 10-year benchmark bond maturing in 2028; that means, issued in 2018. It slipped to 94.2475, what does it mean?

It means, this is the coupon payment right, this is the coupon rate. The face value of this bond is 100. when the market rate of interest (that the yield to maturity). When the actual rate of interest or yield to maturity is different from the coupon rate, then this bond will be traded less than the face value. That is if the yield to maturity is greater than 7.17, this bond will be traded at a price less than its face value of 100. So, then you can see that it is less than here, you can see that at 94.2475. Not only that, what I am going to say here is that when the market rate of interest move, that is, when the market rate of interest increases from 8.05 percentage to 8.06 percentage, the bond price also will change.

Anyway, this bond will be traded at a rate less than the face value of 100 because the current rate of interest is greater than the coupon payment. When the current rate of interest increases further from 8.05 to 8.06, this security or this bond will be further traded at 94.2475 from 94.2875; that means, when the current market rate of interest was 8.05 this bond was traded at 94.2875 (actually we know that the face value is in fact, 100), and if the rate of interest increased to 8.06 then this bond will be traded at 94.2475. So, this is how you can interpret when you read the business daily.

Similarly with different maturity. Another is fixed rate 6.68 percentage government security maturing in 2031. So, here also you can apply the same logic in understanding what does it mean by the current price of this bond when the yield to maturity (the rate of interest) changes. Same way you can see this one maturing in after 4 years you can apply the same logic here.

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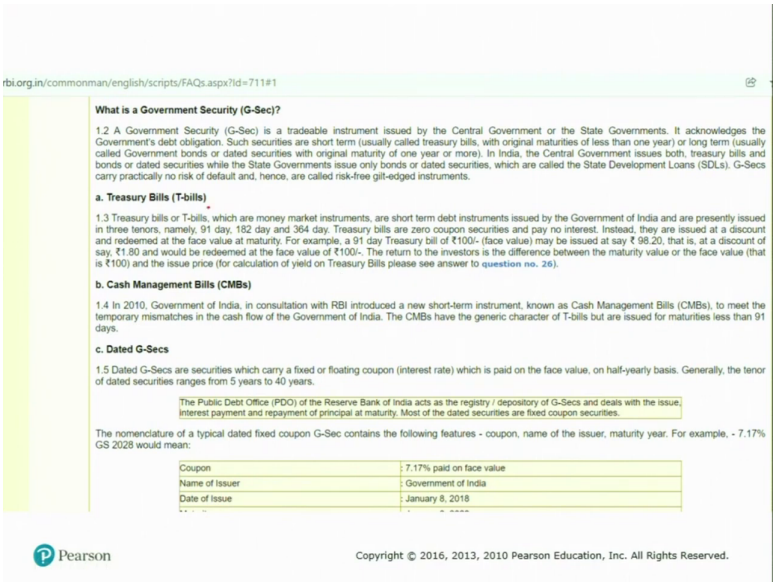

This I have shown you just before just to get an idea of different types of government bond. One is treasury bill, a money market instrument with less than 1 year maturity period. this is zero coupon bond and then coupon bond that we had discussed before.

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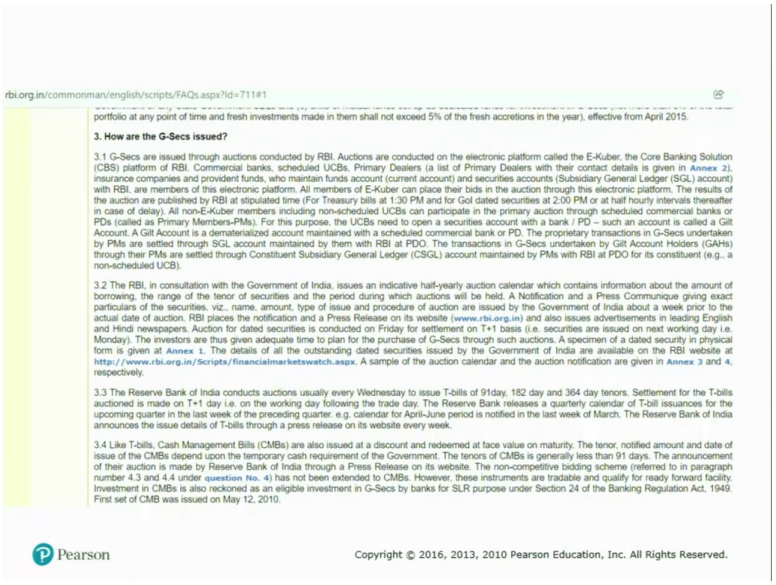

Here what we had discussed so far is about the concept of the yield to maturity, which means the rate of interest. Let's now discuss how interest rate is determined.

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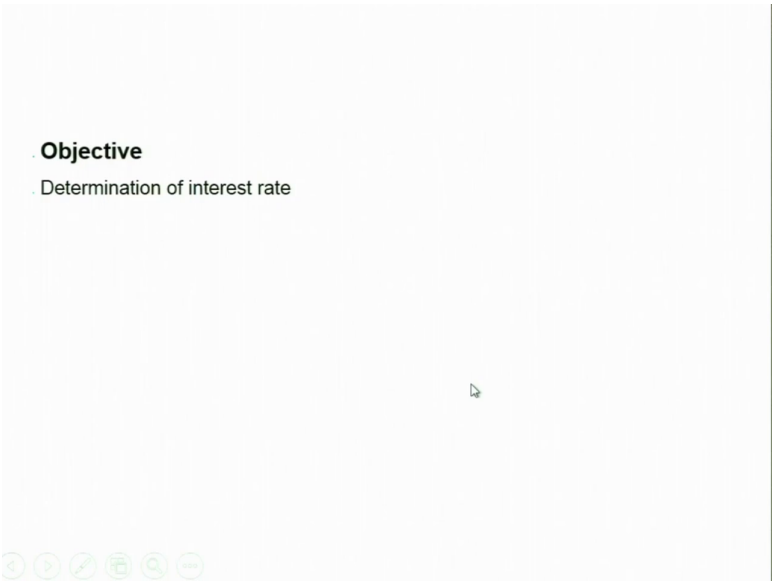

So, for the next couple of minutes we are going to discuss the determination of interest rate in the market. When we mentioned that the market rate of interest moves for example, from 8.5 percentage to 8.9, we are talking about the market rate of interest. Let us now discuss how market rate of interest are determined, that is, the determination of interest rate.

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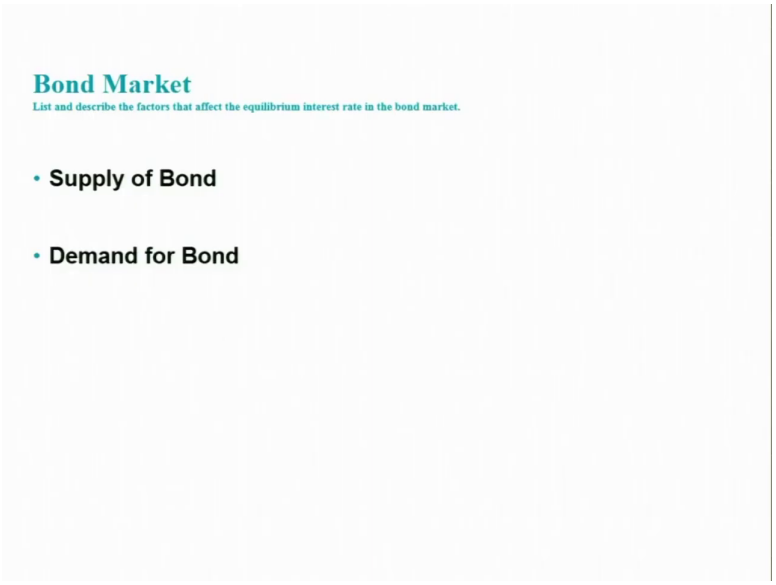

To understand how market interest rates are determined, we need to discuss the bond markets.

So, in here we are going list and describe the factors that affect equilibrium interest rate in the bond market and then discuss the supply of bond and demand for bond.

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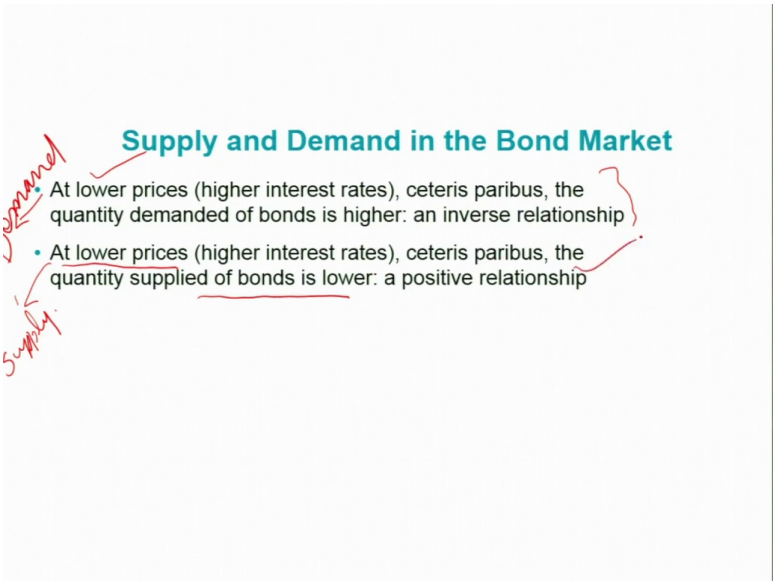

To discuss the supply and demand in the bond market, we can see here that at lower prices the quantity demanded of bond is higher; that means, there is an inverse relationship between

price and quantity demanded. At lower prices the quantity supplied of bond is lower, that is, there is a positive relationship between price and quantity supplied.

When it comes to demand part, when the bond prices are lower the quantity demanded of bond will be higher. So, similarly when the prices of bonds are higher, the demand for the bond is going to be lower. So, there is an inverse relationship here when it comes to the demand for bond. When it comes to the supply of bonds, there will be low supply of bonds at a lower prices, it means there is a positive relationship between price of bond and quantity supplied in the bond markets.

We are going to examine these aspects in detail. Coming to the supply part, when the price is low the quantity demand supplied is going to be lower, why? Because when the price of bond is low; that means, the market interest rate is high; that means, the interest rate to be paid on the supplied bond is going to be high; it is a costly proposition for the suppliers of bonds. Because of that when the price is low; that means, when the interest rate is high the supplier of bonds will be less willing to supply bonds in the markets. Because of that you can see that there is a positive relationship.

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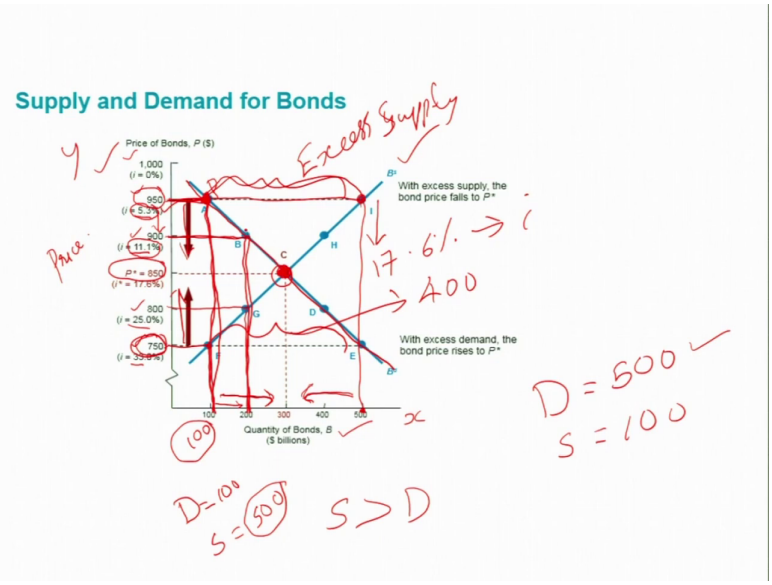

We can discuss this idea using the demand curve and supply curve. Look at the demand curve here, you can see here, it is negatively sloping.

On the left-hand side, we denote with the price of bonds and on the horizontal axis (the x axis) we are measuring the quantity of bonds. On the y axis we are measuring the price of bonds price. Here, in the bracket we also denote the rate of interest you can see from here that on the y axis when the price of bond we denoted it like that 750, 800, 900, 950 like this. But in bracket, you can see, that when we are increasing the price of bonds, reading vertically upwards, the increase in the price of bonds you can also see that in the bracket, the rate of interest is declining because we already discussed there is an inverse relationship between price of bonds and rate of interest. The quantity of bonds is given on the x axis.

This curve is negatively sloping; that means, higher the price there going to be low demand. So, when the price is this one, the quantity demanded is going to be 100, and similarly when the when price of bond increases further; that means, the demand for bond decreases further, what does it mean? That means when the price of bond is 950 the quantity demanded is 100-dollar billion dollar.

When the price of bond declines from 950 to 900 the quantity demanded increases. The quantity demanded increases from 100 to 200 billion dollar, why? Because when the price of bond decreases; that means, from 950 to 900 you can see that the rate of interest increases from 5.3 percentage to 11.1 percentage. That means the return that you are getting when you are lending money in the bond market (when you are demanding bond means you are lending your money in the bond market). So, when the price of bond declines the rate of interest that you are going gain increases, that is, here you are going to get 11.1 percentage.

That is how we interpret the inverse relationship between price of bonds and quantity demanded in the market so; that means, when price of bonds decreases the demand for bond increases.

What about the supply side? So, look at when the price of bond is a 750 the current the rate of interest is 33.30 percentage at that time. When the price of bonds increased to 800 the quantity supplied decreases to 200; that means, rate of interest decreases when price of bond increases, means rate of interest decreased to 25 percentage. Similarly, suppose when the price of bond is 950, the supply of bond in this market is going to be 500 billion dollars.

And you know that when the price of bond increased to 950 from 750 the rate of interest decrease decline from three 33.0 percentage to 5.3 percentage; that means, from a bond

supplier's perspective, be it a government or a corporation, the cost of borrowing declines because rate of interest for them is the cost of borrowing.

That means, when the bond price increase, rate of interest decrease, that is, the cost of borrowing decreases and then they borrow more and more. As a result, you can see that there is a positive relationship between price of bond and the quantity supplied in the bond market. So, from this diagram let us look at, for example, the point P, this point P is not going to be the equilibrium point.

Equilibrium point is at a point when supply of bond is equal to the demand for bonds. So, when look at here point P, the price of bond is 950, at this point you can see that the you can also see that the price is very high 950, but the market rate of interest is only 5.3 percentage; at this point you can see that the market demand is going to be only 100.

The demand for bond is equal to 100 here, but at this price, at this rate of interest, you can see that the supply of bond is going to be this 500. So, supply of bond is going to be 500. So, you can clearly see that supply is greater than demand here. you can see this much excess supply is in the market. So, just to summarize this point when the price is 950 in the market you can see there is deficiency of demand.

Because rate of interest is very low, only 100 billion dollars will be demanded. But supply of bonds is 500 billion dollars because the rate of interest is very low. So, as a result the supplier of bonds are willing to accept low price, there will be a downward pressure on the price, there will be a downward pressure on the price, that is, the supplies of bonds are willing to accept a lower price for this bond; that means, they are willing to accept a lower price; that means, they are willing to pay high rate of interest.

So, when the rate of interest increases or when the price of bond decreases, the demand for bond also gradually increases. So, when the price of bond decreases; that means, rate of interest increase, there is a gradual increase in the demand for bonds, then you can see that when the price decrease; that means, the rate of interest decrease there will be a decline in the supply of bond.

At this point you can see that there is excess supply of bonds and what if the price is going to be 750? What if the price of this bond is going to be 750? That means, the rate of interest is

33.6. So, at this point, you can see that the demand for bond is going to be 500 and supply of bond is going to be only 100.

Because you can see that the rate of interest is very high 33.3. So, for the demand is they are getting very high return. So, they will be demanding 500, but the supply is only 100. Because of that, there is going to be an upward pressure on the price of this bond. So, you can see that this much is excess demand, that is excess demand is going to be 400, that is the excess demand.

Because of that there will be upward pressure on the price, and price increases and finally, this is going to be the equilibrium price. So, from this figure what we have seen that the price of bond or in another words, you can say that the rate of interest is determined by the demand for and supply of bonds. So, in this case you can see that the price of bond is going to be 850 and the market rate of interest is going to be 17.6 percentage this is the rate of interest. This is the equilibrium of quantity of bonds (where the quantity demanded equals the quantity supplied) and the equilibrium price (that is, equilibrium rate of interest)

This rate of interest is being determined, in this diagram, by the demand and supply forces. In the next session we will discuss various aspects of the supply and demand of bonds in detail, and what are the factors that affect the supply and demand for bonds.

Thank you.

Key words: bond market; demand; supply; price; interest rate determination; equilibrium; excess demand; excess supply