Economic Environment and Business Strategy
Prof. Sukumar Vellakkal
Department of Economic Sciences
Indian Institute of Technology Kanpur
Week- 04
Lecture- 16

Debt Markets: Bonds and Interest Rate Fundamentals

Welcome back, everyone. Today, we turn our attention to one of the most fundamental components of the financial market: the debt market, also commonly referred to as the bond market. These markets play a vital role in how governments, corporations, and even individuals raise funds, manage risk, and plan for their futures. One of the key themes used in the debt market is the interest rate. To gain a better understanding of the concept of interest rates, let's begin by exploring the four major types of debt instruments commonly found in the bond market. These are simple loans, fixed-payment loans, coupon bonds, and zero-coupon or discount bonds.

Each of these instruments works differently and carries its own implications for borrowers, lenders, and the economy. Let's begin by examining each of these four debt instruments in detail, so we can gradually understand what is meant by an interest rate. So, eventually, we'll define what an interest rate is. And while doing so, we'll also come to know what is meant by a bond, what the different types of bonds are, and how they have been used in the financial market.

As I mentioned earlier, there are four significant types of debt market instruments. So, let's go one by one. So let me begin with a simple loan. A simple loan refers to the type of loan that we usually obtain from a bank, for example, for a period of one year, or a loan that you lend to someone. To gain a clear understanding of this concept, I'd like to introduce you to another term closely related to the debt market: future value or future cash flow.

Sometimes we refer to it, for the time being, as CF. Therefore, the value of an investment on a future date is based on its present value and the interest rate. I want to provide a straightforward example. For example, you invest 100 today in a bank that guarantees 5% interest per year. So, after one year, you will obviously have 105, which is the original 100 plus the 5% interest.

Therefore, the future cash flow one year from now, at a 5% interest rate, is $105. Using a simple interest rate formula, we estimated that the future cash flow of $100 at a 5% interest rate would be $105. It's a fundamental formula to begin with, which will significantly assist you once we start discussing other debt instruments. Here is the formula to define the future cash flow, which I mentioned as 105. This is equal to the present value, which is 100 plus the present value multiplied by the interest rate.

So, when you calculate this, it is actually 100 plus. When you multiply this, you will get $5, and this is $100. That means you can also calculate the CF as the future cash flow, which is equal to the present value plus one plus i. Therefore, the $100 investment yields $5, which explains why an interest rate is sometimes referred to as a yield. Here, based on this straightforward example, we will define the rate of interest as the yield you receive for your present investment.

That is why the rate of interest is sometimes better understood by referring to it as yield or yield to maturity. From this yield to maturity, I said that the $100 is what you invest. You are going to get 105, so that means 100 is 105, which is the yield to maturity. When you invest, the interest rate that equates the present value of all future cash flows, including those in the future, is the key concept. We will introduce the concepts of coupon payments and face value in relation to a bond with its current market price. YTM is considered the most accurate measure of a bond's return because it reflects both the interest payments and the capital gains or losses that occur over the bond's life.

For example, when you invest $100, you will receive $105 in the future. This means that the 5 is the yield to maturity. When you convert this, you will get 5 percent. In that way, the maturity period is one year; one year is the period of maturity. After the maturity period, you will receive 105, which is equivalent to the present value of 100.

Equating to a future cash flow of $ 105, which is actually equated by this rate of interest, highlights the important distinction I mentioned earlier regarding a few concepts. The coupon rate refers to the fixed percentage of the face value paid periodically; for example, when you buy a government bond, it is sometimes noted that the coupon rate is 8.5% or 8%. So, if you buy a 10-year bond from the Government of India, there will be, for example, an 8% or 7% coupon payment. The coupon payment will be made.

So that one is called the fixed percentage of the face value paid periodically. Then, the interest rate is the general term for the cost of borrowing or return on lending. Consequently, the yield to maturity is the actual market rate of return, considering the bond's current price, not just its coupon. In essence, the YTM represents the internal rate of return for a bond, which captures the total return if the bond is held to maturity under current market conditions. What we did in the previous slide was calculate one-year loans.

For example, a one-year bond is issued. What is the return you are going to get with a one-year interest rate? However, you are aware that most investments are made over a period of more than one year. Suppose you invest $1,000 today in a bank account that offers a 4% annual interest rate. So, compounded yearly for the next 40 years, you know that when you invest $1,000 next year, you will earn $1,040. However, if you don't withdraw it, then $1,040 will be the principal for the following year. For that, you will receive a 4% rate; accordingly, if you calculate manually, it will be an equivalent task.

There is a simple formula to calculate how much you will have after 40 years if you invest $1,000 today in a bank account that offers a 4% annual interest rate, provided that you are not withdrawing your yearly interest income. In other words, the total future cash flow can be calculated by multiplying 1000 by 1.04 raised to the power of 40, which equals 4,401. This means that the formula for the cash flow over 40 years is that the cash flow for the 40 years is equal to the present value. The present value is 1000, which is 1000 times (1 + i), where i equals 0.04, or 4%.
04, raised to the power of 40. That means if you plug in some numerical values, you will get 4401. While doing so, we derived the formula for calculating the future cash flow of this investment. That means if you invest, get that. The future cash flow that you are going to receive.

The key insight here is that compound interest allows interest to be earned on both the initial principal and the accumulated interest from previous periods. This leads to exponential growth over time. Moving forward, let's measure the interest rate here. So, what you can do here is calculate the I from here itself. You can calculate the I from this formula but let us move a little bit further.

The measuring interest rate indicates that the present value of a dollar received one year from now is worth less than a dollar received today. Why? This is the principle that we discussed in one of the previous sessions: that time has value. Money today can be invested to earn interest and grow over time, so that its value after one year is equal to one dollar. If you invest, it will be one dollar times one plus i, so the present value is represented by the symbol here. So, if you calculate the present value, to do so using the formula we discussed two slides back, initially we define CF as equal to PV times (1 + i)^1. Now, the PV can be redefined as PV equals C of the future cash flows divided by (1 + i)^n. You can plug these values into the formula, and then you will get the present value, which is $250, when you receive an amount after 50 years. That means $100.50. If you invest today at a rate of interest of 20% and wait 50 years, you will get $250 in return.

Therefore, let us calculate the yield to maturity on a simple loan using this method. To motivate you, I pose a simple question: if you lend $1,000 and expect $1,400 in return after one year, what is the yield to maturity? Yield to maturity is nothing but a rate of interest. As I mentioned earlier in the previous slide, I started with the future cash flow. Then, we need to use the present value, which is the amount you are going to invest today, plus the interest rate. Next, move the calculation to the estimate of the present value, given that you have been provided with the interest rate and the future cash flow.

Now, given this, we will calculate the rate of interest using the symbolic law. Here, the present value is $1,000, the cash flow is $ 1,400, and the number of years is 1. If you plug in this value, you will get the value that I plus I one plus I raised to the power of 1 equal Cf, which is Cf divided by P v. Here is what we have defined: 1 plus i raised to the power of 1 is equal to Cf divided by PV.

This is going to be 1.4. That means the information I have here indicates that you will receive 40 percent. To conclude this discussion, for simple loans, the interest rate is equal to the yield to maturity. Now, let's move on to another type of debt instrument. That one is called a fixed-payment loan. Similarly, you can calculate using this method, as I have only used one year. You can apply it to any number of years, for any year you choose.

You just put that value here, and then you will get the rate of interest. Now, let's move on to another debt instrument called a fixed payment loan. This is essentially an EMI loan, which is what you get when you take a car loan, a bike loan, or an education loan. You need to pay an EMI, which is a monthly payment. For now, let us make it a yearly payment. A fixed payment loan involves making equal payments over the life of the loan.

Here is what I mentioned: LV is the loan value. Suppose you have taken an education loan of 10 lakhs. Let that be the loan value, then the fixed annual payment, which is the amount you need to make every year, and finally, the number of years until maturity. You could give it, for example, 10 years or 20 years, and the interest rate that the bank requires. Please verify that all these values are plugged in correctly.

For example, could you enter the loan amount here, such as 10 lakhs, and specify the monthly payment, for instance, as needed? Not every month, for the sake of simplicity, we made it a year; every year you need to pay, for example, 25,000, so then the number of years will be 20 or 25. By plugging in all this information, you will determine the rate of interest. From this, you can calculate the rate of interest, so accordingly, you need to do some manipulation of this frame value. That means we bring i plus one to the left-hand side, and then you can calculate the rate of interest from here.

You can calculate either of them. Suppose you are given only the fixed payment, the rate of interest, and the number of years; then you can calculate the loan value, or, otherwise, whichever information is missing. Therefore, by rearranging the formula, you can obtain detailed information. Now, let's move on to another vital debt instrument: the bond. Bonds are widely regarded as one of the most prevalent instruments in the debt market. Even governments and large corporations borrow.

They borrow by issuing bonds. That means a debt instrument. There are mainly two types of bonds. One is referred to as a coupon bond, and the other is called a zero-coupon bond. The formal definition of a bond is a debt instrument in which an investor lends money to an entity, typically a corporation or government, which borrows the funds for a defined period at a variable or fixed interest rate. So, when it comes to bond issuers, they are the entities that borrow the money.

Bonds are used by companies, municipalities, states, and sovereign governments to raise money for financing a variety of projects and activities. In this case, the suppliers who issue bonds, primarily companies, municipalities, states, and sovereign governments, issue the bond or supply it. Then who demands the bond? Those who demand it are typically those who lend money to the government or large corporations; they are the demanders of this bond. Also, recall that a bond is a debt instrument, so those who demand it are those who lend to the government, companies, large corporations, etc. The owners of bonds who buy them from the issuer are the debt holders or creditors of the issue.

Therefore, they own the bonds issued by the supplier. So, based on this, let's first define what is meant by a coupon bond. A coupon bond refers to a bond that pays a coupon at each interest payment period. Normally, every six months, the bond will give you a coupon rate. Ten percent suppose the government issues a treasury bill, for example $10,000, so they will be paying you, for instance, 10 percent.

No treasury bill has a coupon. To make the idea very simple, for a 10-year bond, suppose the government is offering you a 10 percent coupon rate every year; that means whoever holds this bond will receive a 10 percent coupon or interest income from the government. The supplier of this bond is the party to this agreement, so a coupon is stated as a nominal percentage of the par value, which is the principal amount of the bond; therefore, each coupon is redeemable per period for that percentage. For example, a 10 percent coupon on a 1000 par bond, whose face value is redeemable each period. Note that it is essential to clarify that sometimes people can get confused between the coupon rate and the interest rate. Sometimes people get confused, but the coupon rate is sometimes denoted as the interest rate, but the actual rate of interest is the yield to maturity, which is the actual market rate of interest.

To gain a better understanding of bonds, visit this website, which provides a link to the BSE stock market. There, you can also see not only stocks but also the debt and bond markets. Additionally, if you go to the RBI website, you will get lots of information about bonds, including what bonds are and what the different types of bonds are. The RBI, on behalf of the central government, auctions bonds periodically to raise funds for the government. I'm showing you a screenshot of a coupon bond here. Hence, what you can see here is that the face value is 1000; that is the face value or par value.

As you can see at the bottom, these are the coupons. That means this coupon is valid for every six months. That means you can redeem each of these coupons every six months. In the first six months, you redeem this.

In another six months, you redeem this one. That means you just redeem this one with the issuer of the bonds. You will receive the coupon payment. Who is holding this bond? What is written here? Before proceeding, I would also like to explain another type of bond known as a perpetual bond. A perpetual bond is a type of bond that has no maturity date.

That means it is issued for life. They are not redeemable. In the previous slide, the screenshot I showed you is for 50 years. That is not a perpetual bond, but a perpetual bond means there is no maturity date at all, so they pay a stream of interest payments equal to the coupon rate. They agree to pay you a coupon rate throughout your lifetime, which means it will remain in effect until the issuer redeems it. The issuer has an important point here: it has the option to buy back the bond after a specified period.

The call option is typically exercisable five years after the date of issuance. Now, let's move on to calculating the price of a coupon bond. The formula here is that the price of a coupon bond equals the present value of the coupons it offers. The price represents the present value of the bond. That means to buy a coupon bond, how much you need to pay today, so that is the PV of the bond; that is the price that you need to pay.

For example, the principal payment, which you are going to get at the end, also needs to be calculated. So, the present value of the bond is the present value of the yearly coupon payment plus the present value of the principal payment. You also need to consider the coupon payment, as well as the present value of the principal payment, which means you must discount the present value of the principal payment accordingly. You need to do that.

That will be the market price for a coupon bond. I have defined here what 'p' represents, namely the current price, also known as the present value. This can also be the PV of the bond, which is essentially the cost of the bond. 'C' means the yearly coupon payment, 'F' is the face value of the bond, and 'N' is the number of years to maturity. The formula is P equals C times (1 + i). You can now see that this represents the Coupon payment stream. This is the pay stream from the coupon payment, and the last component is the present value. This is the present value of the principal payment. An important note here is that the par value of a bond is the amount of money that bond issuers agree to repay to the purchaser upon the bond's maturity, also referred to as the face value. As commonly supposed in the previous example, the face value of 1000 will be printed on the bond itself. That is the reason we call it the face value; it's already printed there and clearly states that at the end of the maturity period, you will receive $1,000, plus the coupon payment.

I'm here to help you simplify this idea. I'd like to provide an illustrative example. Consider a bond with a par value of 1,000 set to mature in three years. The bond has a coupon rate of 3.5%, and the current market interest rate is 5%, with annual coupon payments. Typically, coupon payments are made every six months; for simplicity, I have presented them annually here.

So, what is the present value of the market price of the bond? In other words, what is the price of this bond? Or what is the discount rate? To calculate this, we can proceed as follows: the market price of the bond equals the present value (PV) of the bond, which we have already defined as the PV of the coupon payments plus the PV of the principal amount. We have all this data here; let's now calculate the present value of the principal repayment at maturity, that is, the present value of the principal amount. So, that will be $ 1,000, which you will receive after three years. It is the present value of $ 1,000 at a rate of interest of 5%, which is $863.84. Then, the present value of the annual coupon payment is calculated, so you need to bring the three-year coupon payment that you are receiving.

This is the formula for that. Here, the present value of the coupon payment is 95.3. You need to add both; then, you will get the present value of the bond, which is the PV of the bond.

Therefore, you will receive $959.14. So, that means a bond with a face value of $1,000, which means after 3 years, you will receive. $1000 after three years, and the coupon rate is 3.5%, which means every year you will be getting 3.5 percent as the coupon rate, which means that the $35 you will be getting every year, so in the ongoing market rate of interest is five percent per day, so to get that kind of bond, you need to pay the present value of 959.

Given all this information, to buy this bond, you must pay 959.14. From this, you can also calculate the discount. This bond is also called a discount bond because most bonds are sold at a discount when transacted in the market. First, let's determine the discount; then we can calculate the discount rate.

The discount is the difference between the face value and the present value. So, what is the discount rate? Just plug in the numbers again. This is the discount value, which is 40.86 divided by 1,000. The discount rate is 4.09%. Let's now move on to the fourth instrument, which is called zero-coupon bonds. In a zero-coupon bond, there is no semi-annual coupon payment; therefore, a bond may also be issued without a coupon. In this case, the bond is known as a zero-coupon bond, and it typically prices lower than bonds with coupons. This is an example of a zero-coupon discount bond, issued on October 9, 1969, and maturing in 1970 after six months.

So, here the face value is 1 lakh. Therefore, this one will be sold based on the current market rate of interest, as it does not offer a coupon. What you will get is that whoever buys this fund now will receive one lakh dollars after six months. This means you need to discount it according to the current market rate of interest. That means someone is going to buy it for less than one lakh; that will be the market price of this fund, which we need to discount at the rate of interest. An example of this is the treasury bills issued by the Government of India.

This is a short-term debt instrument. I have mentioned money market instruments here; presently, the Government of India issues three tenures of treasury bills: one for 91 days, one for 182 days, and one for 364 days, all with maturities of less than one year. Treasury bills are zero-coupon securities that pay no interest; instead, they are issued at a discount and redeemed at face value at maturity. Here, I'm providing an example from which you can calculate the interest rate. The return to investors is the difference between the maturity value, or face value, and the issue price.

From this example, you can see that the interest rate will be 7.35%. The 91-day Treasury bill has a face value of $100, but its selling price today is $98.20. The difference of $1.80 represents the interest rate. The discount value here is equivalent to the interest rate, especially if there are no coupon payments.

In such cases, you can directly equate the discount rate with the interest rate. I'm providing you with a formula to calculate the price of a bond: the face value divided by one plus the interest rate raised to the power of the time to maturity (T). You can adjust this calculation based on the day you calculate it or annualize it accordingly. What we see here is an inverse relationship. For example, from this formula itself, you can see that I have consistently used this approach throughout.

The "I" is the denominator here. For example, when I increase, you can see that P is increasing. Suppose I am going to decline; then you can see that P will increase. In the previous session, I also provided this example. In all this formula here, for example, the present value here, everywhere the I, the moment we increase I, when the rate of interest decreases, P is going to grow; otherwise, when the rate of interest increases, P is going to decline. This means there is an inverse relationship between the interest rate and the price of bonds.

From this discussion, we have identified a key theoretical relationship called the inverse relationship between interest rates and bond prices. In other words, when the interest rate increases, bond prices decline; conversely, when the interest rate decreases, bond prices tend to rise. You just plug in some values here, and then you will empirically discover this relationship. In this lecture, we discussed what the rate of interest is.

We defined the rate of interest as the yield to maturity. To better understand this concept, we also defined various debt instruments. We started with the symbol loan, then moved on to the fixed payment loan, and discussed coupon bonds. Finally, we discussed zero-coupon bonds. Thank you for watching this session. I look forward to seeing you at the next one. Thank you.