Investment Management
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Lecture - 08
Pricing and Valuation of Bonds

Hello there. As part of our discussion on the course Investment Management, we are talking about bonds as an investment and this session is focused on Pricing and Valuation of Bonds. Basically, when it comes to understanding of financial instruments, we get to see a lot of keywords or jargons or terminology that might be crucial to understand the financial value or implications of the financial instrument that we are planning to invest in.

And in that context, we need to understand the terminologies or the factors that is important for finding the financial value of bonds as an investment tool.

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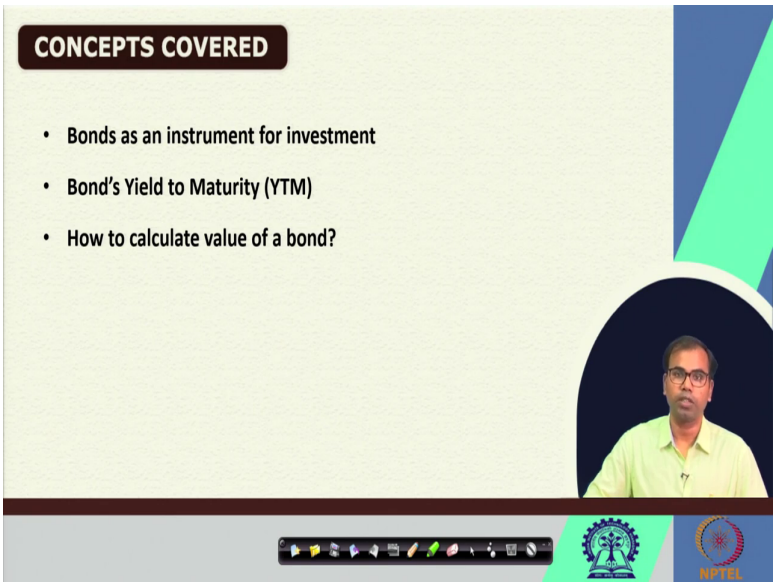

Here, in this session, we are going to talk about bonds Yield to Maturity or as known also as yield to YTM and how do we calculate YTM or how we arrive at the value of YTM, which is an important input for finding the financial value of a bond. And subsequently, we will also try to see how we can price or value a bond in terms of the intrinsic value based on the cash flows and see the implementation of the tools that we have discussed in previous two sessions.

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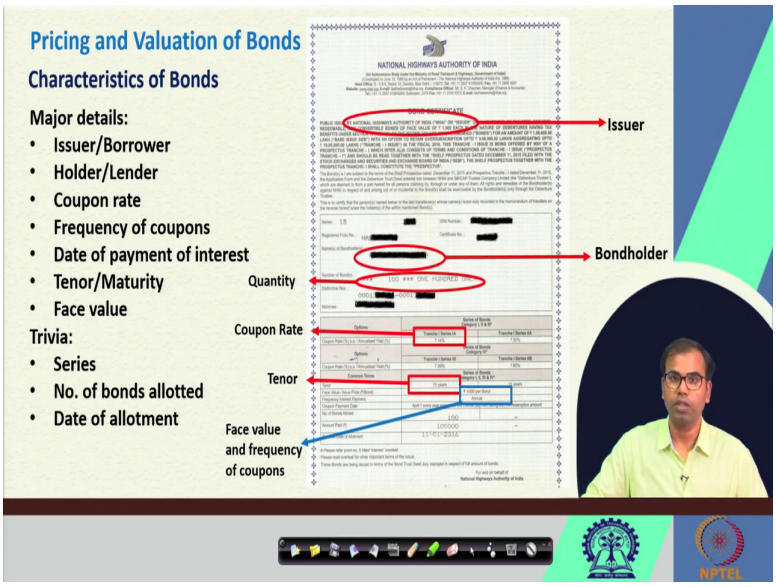

When it comes to bonds, we get to see a lot of factors or information associated with bonds. For example, we can see some major details such as who is the issuer of the bond, essentially who is the borrower that is raising funds by issuing bond, who is the holder of a bond which is basically a lender.

What is the coupon rate that is payable on a bond if it is a coupon bearing bond? How frequently the coupons are going to be paid? What is the payment of in payment terms which means on what date or how many times a year and at what date of the year should the payment be paid?

What is the maturity of the bond or tenor and the face value? Along with these information, we also see some certain information such as the type of bond in terms of different series, how many bonds a particular bond holder has and what is the date of allotment or date of

settlement of a bond because these things also matter when it comes to finding the financial value. For example, if we talk about a typical bond certificate, a bond certificate looks like this.

This is an example of a bond certificate issued by National Highway Authority of India and as you can see this bond certificate has certain information, which is relevant to the bond holder because these information will essentially translate into the financial value or the interest that the bond holder is entitled to.

So, the first thing that comes to our notice when we look at the bond certificate is the issuer of the bond. So, in as told earlier, this bonds is issued by National Highway Authority of India which means NHAI is the issuer of the bond which is raising funds by issuing bonds like this.

Then comes the second keyword or second information that is bond holder. So, whenever there is a bond issued to a particular entity or individual, most of the time we see that the name of the holder or the person to whom the bond is issued or the entity to whom the bond is issued is mentioned in the bond certificate itself. Of course, there are different categories of bond where the details of bond holder might not be there, but this particular bond certificate carries the name of the bond holder.

Then comes the most important information which is coupon rate or the rate at which the coupon is to be paid to the bond holder by the issuer. So, in this particular case, we can see that this bond is of a particular type, which is series 1B and for this for this particular bond, the coupon rates could be varying dependent on that what type of bond that this particular bond is. If it is series 1A, then coupon rate is 7.14 percent and if this is the series 1B, then coupon rate is 7.39 percent.

If this is series 2A, then coupon rate is 7.35 percent and if this bond is series 2B, then coupon rate is 7.60 percent. Since we know that this bond is particularly series 1B, then we know that coupon rate could be 7.39 percent to be paid to the bond holder. Now, once we understand the

issuer, bond holder and coupon rate, the next piece of information that is important is the tenor which is basically the number of years for which a bond is issued.

In this context, that tenor is 10 years particularly for this series 1A and 1B bond, if it were a series 2A or 2B bond, then the tenor would have been 15 years. So, in this particular bond case, since we know that this is series 1B. So, tenor is 10 years in this case. Then another piece of information is about the face value.

As we can see here, the face value of the bond is given to be 1000 rupees per bond and the frequency of coupon, which means the interest that is to be paid to the bond holder per year, which is annual frequency, which means the interest is accrued to the bond holder once every year.

And if we look at certain more details, we can see that the interest is to be paid on 1st April of every year till the time it matures. So, which is basically the coupon payment rate and of course, certain other information that might be trivial, but of interest is number of bonds allotted, which is 100 in this case. So, we can figure out the value of this bond certificate appears to be 100 bonds of 1000 rupees each is 1 lakh rupees and the date of allotment is given as well.

So, these are certain information which we can look at the bond certificate if we hold a physical copy of bond certificate or for that matter electronic copy as well. But many a times we might observe that these bonds are not available in physical copy, which means we do not hold a bond certificate such as this one in our hand rather bonds are traded in financial market.

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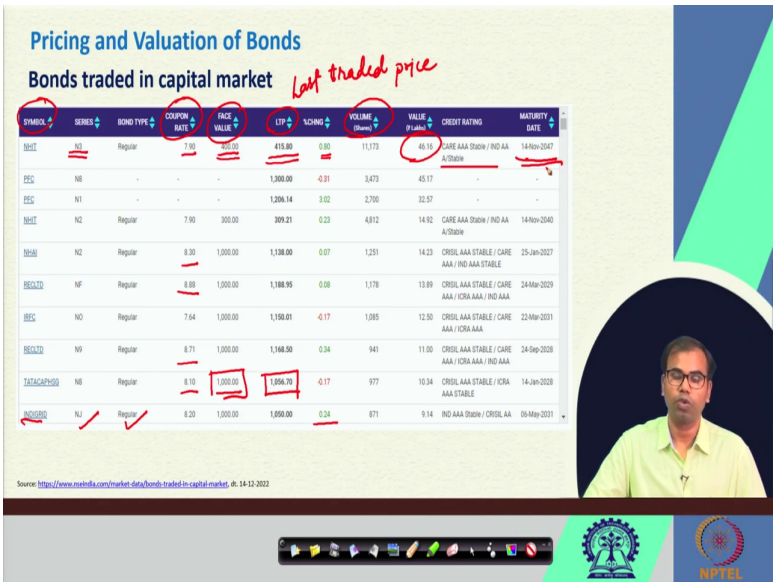

So, if you look at the capital market, for example, National Stock Exchange in India, we can see in the dashboard there are certain information available with respect to different bonds. So, in this example, we can see the symbol of the bond which is basically going to give us the idea about the issuer, the details of the issuer if we click on these links, we can see the details of the issuer of the bond.

Then again, the series of the bond which is basically the type of bond it has been issued, bond type is given there and one of the most important pieces of information here is coupon rate. So, we can see different bonds are issued at different coupon rate for example, this bond is for 7.9 percent, this bond is 8.30 percent, this is 8.88 percent, 8.71 percent, 8.10 and so on.

And next to coupon rate, we have the face value which implies the face value of the bond issued by that particular issuer in that series and type. More information are available on

capital market dashboard because these bonds are more or less traded frequently. So, we can see is Last Traded Price which is LTP. So, last traded price is basically the price at which it was last traded in the last trading session or on that particular day last time.

So, for example, the face value of this bond is 400 rupees and last time it was traded for 415 rupee 80 paisa which means there is a percentage change as well from the previous trade. So, this tells us about what premium or discount this particular bond is trading at.

So, if face value is 1000 rupees and the bond is traded for 1056 rupees 70 paisa then we can say that this bond is traded at premium because buyers and sellers are quoting or bid you know asking for more than the face value of the bond and that is why it is traded at premium.

If the trading price of this bond, a particular bond is less than the face value then we can say that this bond is traded at a discount. But in this case particularly all the examples here these bonds are traded at premium because people are willing to pay higher price compared to the face value of these bonds.

And then certain other information such as percentage change from the previous trading volume of volume or units of the bonds that are being traded or sold, the value of those trade and again the rating of those bonds and maturity date are some other information, which are available when we look at the dashboard or the information source for bonds that are being traded in capital market.

Most of these information are very important for finding the value or finding the worth of a bond because if as an investor we want to invest our money in one such asset for example, this a particular bond then we need to understand whether we are investing in the right kind of asset or not and that will be decided on the basis of the value of the bond that we are going to own that we are going to invest in.

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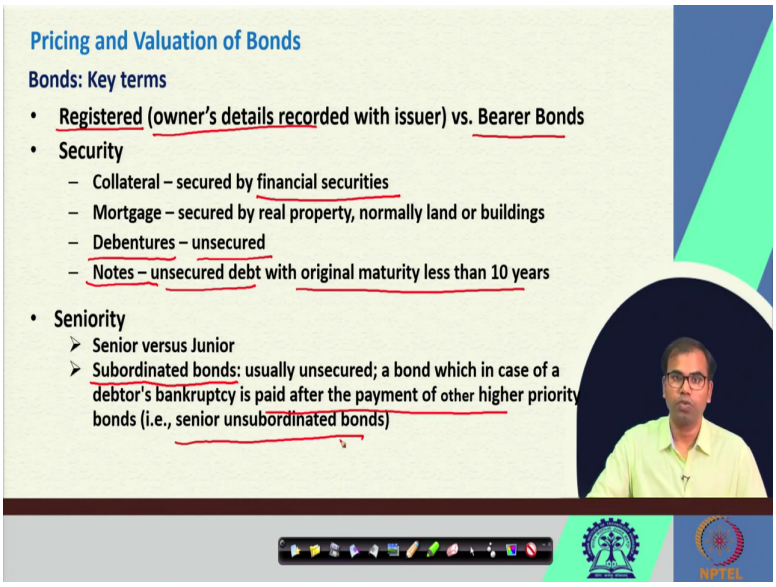

In this context we should also understand certain other theoretical terminologies which we might come across while dealing with bond. For example, I was showing earlier a copy of physical bond certificate where we had the details of the holder, details of the bond holder printed on the bond certificate itself.

Which means there are bonds where owners detail are recorded with the issuer which means issuer knows about who about the holder of the bond, which means who is holding on the bond is recorded with the issuer. And these bonds are known as registered bonds and on the contrary, there are bearer bonds which are basically the bonds with no details of the owner with no details about the owners with the issuers.

So, for example, if it is electronic trading then most of the time issuer might not really know who is owning the bond at a particular moment. So, in that case maybe bearer bond would be

referred to and otherwise if the details of the owner is recorded with the issuer then we can say that it is a registered bond. Other key terminology are related to security of the bond so, most of the time we can see whether a bond is secured or unsecured.

For example, if it is a collateral bond then we can say that these bonds are secured by financial security or backed by financial security. So, for example, if a bond has certain underlying asset which are financial instruments, then we can say that it is collateral. Similarly, if there are market based bonds then we can say that it is secured by real property typically it is land or building housing complex, some commercial complex, sometimes roads or other infrastructure.

So, mortgage based bonds are there which are again secured bond. There is another category of debt instrument known as debentures. These are typically unsecured which means there is no underlying asset securing the debt instrument or debenture. And then there are nodes which are again unsecured debt, but typically they have maturity, original maturity of less than 10 years whereas, in case of debentures it could be more than 10 years as well.

This is about security of the bond and then comes the seniority of the bond. So, typically it is based on the issuing sequence or the age of the bond. So, we can categorize them as senior or junior and in that category also we can see subordinated bonds which are typically unsecured bonds and subordinated bonds are those bonds where when a debt issuer or the issuer of the bond becomes bankrupt then the liability or obligation is paid only after the payment of other higher priority bonds.

So, for example, if the issuer of the bond becomes bankrupt then first seniors on subordinated bonds will be paid out then only subordinated bonds will be paid out in case of bankruptcy. So, these are certain terminology which might give us an idea about the types and categories of the bonds that might be available for investment for investors.

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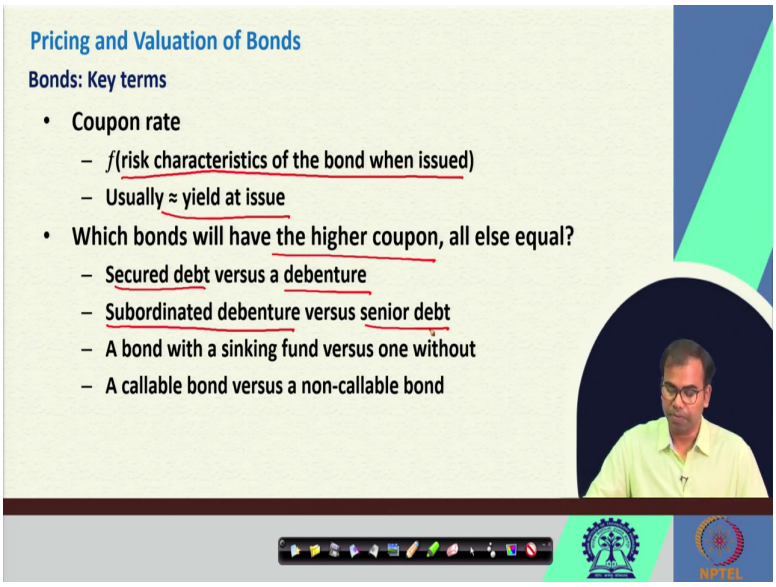

Other terms which we very often use are coupon rate and yield. So, coupon rates are typically a function of risk characteristics of the bond when the issuer is issuing the bond. So, it depends on the kind of project which is being funded by the money raised through the bond.

So, if a bond is issued to raise money to fund a very risky activity, then probably the coupon rate on that particular bond will be higher and if the bond is issued to raise funds to fund a less riskier activity or less riskier project then coupon rate might not be really high.

So, essentially coupon rate somehow reflect the risk characteristic of the bond when the issuer is issuing and usually it is the yield at issue. How these are related with yield? We will talk about that later, but for now we should understand that if a bond is carrying very high coupon

rate it somehow implies that the bond is little more risky that is why it is willing to pay higher coupon to the investors.

If we have everything else equal which bond should have higher coupon as we understand from the security point of view first secure debt versus debenture. So, if we know that there is a debt instrument issued with an underlyings security then typically it is going to pay us less return or less coupon whereas, a debenture is expected to pay higher coupon higher interest because debenture is unsecured.

So, a secured debt is supposed to be paying lesser coupon whereas, debenture is supposed to pay higher coupon. Subordinated debenture versus senior debt as discussed just now. We know that subordinated debenture is more risky because it is paid after all the higher unsubordinated debts are paid. So, these subordinated debentures are supposed to be carrying higher coupon compared to senior debt.

Similarly, a bank bond with sinking fund versus one without sinking fund of course, without sinking fund is supposed to be carrying coupon rate different from the bond that is having a sinking fund provision and a callable bond versus a non-callable bond in that context also the coupon rates will be varying because of the underlying characteristics of the bond.

So, these are certain aspect of investment in bonds that an investor should understand and then some of these information are translated into numerical calculation where we can try to find the value or the price of a bond using certain formula that we will discuss subsequently.

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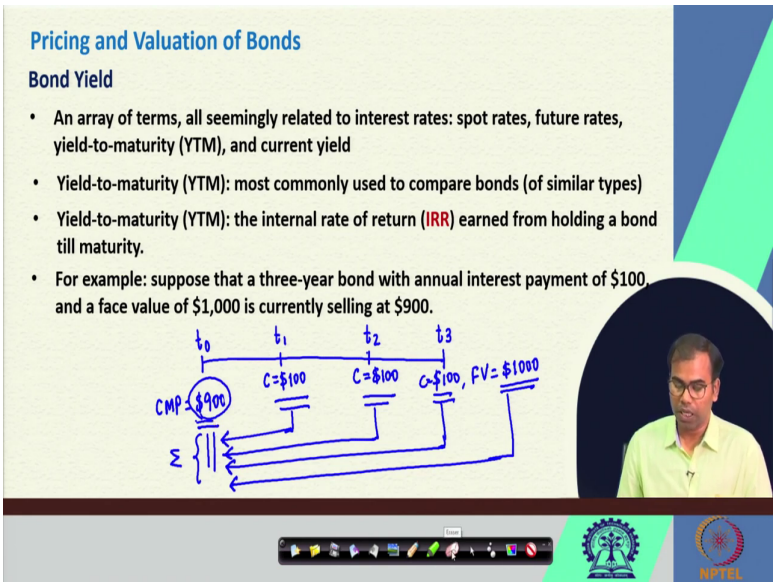

So, to start with let us talk about bond yield. As mentioned earlier also we know that while dealing with bonds there might be a situation where we can deal with or we come across an array of terms and most of the time all these terms might seemingly be related to interest rates. For example, you might come across terms like spot rates, future rates, YTM or yield to maturity and current yield.

Earlier we have also seen flat yield as one of the terms that we have dealt with so, most of the time these in terms all represent some sort of interest rate. Now, yield to maturity that is one of the most commonly used rate of interest or rate that investors or analyst use to compare bonds of similar types. Of course it goes without saying that if bonds are of different types then there is no point comparing yields for bonds of different types.

We cannot compare an apple with an oranges. So, it makes more sense to compare yield of a bond which is senior unsubordinated debt whereas, yield on a bond of a subordinated debt. So, that does not make any sense at all. So, but when we have two similar type of bond let us say both secured bond we need to understand about the comparability of the yields and then maybe we can make a decision based on YTM.

So, what is YTM? That is the question. If we try to understand YTM is basically the internal rate of return that we earn from holding a bond till maturity, which means if we hold a bond which is a financial instrument with fixed rate of interest till maturity the rate of internal rate of return will be the yield to maturity in this case.

How do we define it mathematically? So, for that let us take an example where there is a three year bond with annual interest payment of 100 dollar and a face value of 1000 dollars, but current market price, current selling price is 900.

So, imagine the situation we have a three year bond this is today's time this is t 1, this is t 2 and this is t 3 which is basically year 1, year 2 and year 3 and it says that every year we are getting a coupon of 100 dollar and we are also getting a face value of 1000 dollar which we are entitled to receive at the end of the maturity.

But current market price or the current sale price is 900 dollar, which means this 900 dollar in today's term is equal to the sum of present value of all the coupons that are going to come from this particular bond investment and the face value.

So, we can say that the present value of this 100 dollar and this second 100 dollar and third 100 dollar all three sum together plus present value of this 1000 dollar of face value all these sum together which is in terms of discounted value must be equal to 900.

So, what do we do with that maybe we use the discounting method as discussed earlier if you could recall from previous discussion, we have discussed about two approaches one is finding

the future value and another is finding the present value. Now, we have to find the present value here. So, we will use the discounting approach.

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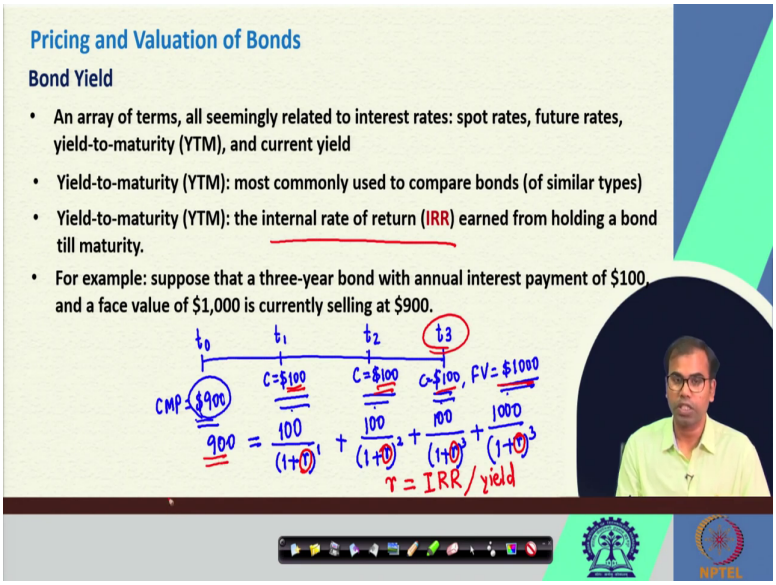

And for discounting approach we know that we need to find 100 dollar plus 1 1 plus r to the power 1 plus 100 dollar divided by 1 plus r to the power 2, 100 dollar plus 1 plus divided by 1 plus r to the power 3 plus this 1000 dollars of face value divided by 1 plus r to the power 3 should be equal to 900. And whatever this value of r we get by equating this expression equating 900 with these terms this r should be also known as internal rate of return or in this case yield.

So, here the yield is basically the internal rate of return that we earn from holding a bond till maturity, which means if we hold this bond till year 3 we are going to get different cash flows 100 dollars of coupon for 3 years and 1000 dollars of lump sum payment at the end of the 3

years. So, the present value of all these cash flow will be will be calculated using discount rate r and found a value of 900 which is current value or the present value of all these cash flows. So, this r is basically the yield to maturity.

So, if we express this relationship between the cash flows present value and discounting rate or internal rate of return, we find that this is the way we calculate. And here y is essentially the rate of discounting which is used for finding the present value of these cash flow and this y denotes the rate which is known as yield. Here in this case if we try to calculate this, we find the yield to be 14.3 percent.

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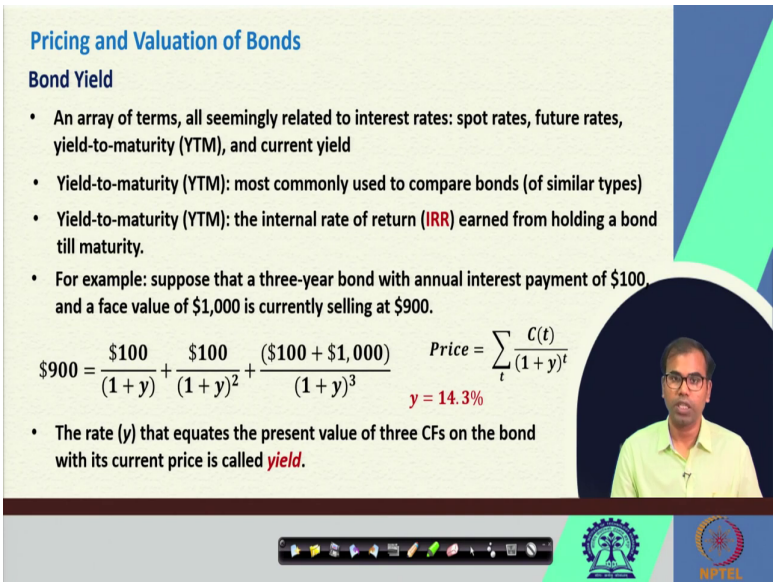

So, essentially if we summarize this formula, we get the price of the bond or price of a financial security here is sum of the present value of all these cash flows coming in

discounted with a rate that is y in this case yield and this essentially is the yield we are talking about.

So, the rate that is used here as r or y that equates the present value of these cash flows on the bonds with it currents price is called yield. Now, if we continue with this example or to understand this example with more sophistication.

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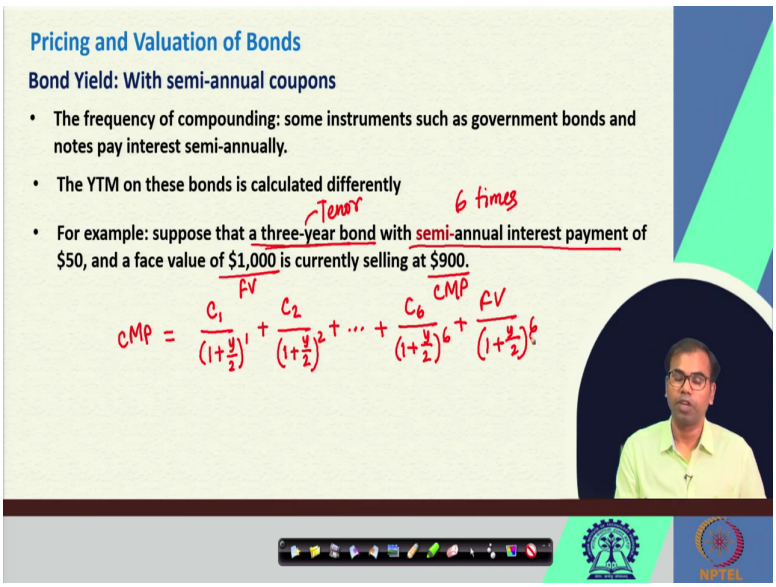

If we look at the situation where we have semi-annual coupons instead of annual coupons so, what happens when the coupons are coming in semi annually which means twice a year every 6 month. So, in this case the frequency of compounding will come into the picture and the frequency of compounding will change the calculation some instruments such as government bonds and nodes pays interests semi annually and for that the YTM calculation will be done slightly differently.

For example, if in this case if we have semi-annual interest payment for this particular bond rest of the thing will remain same 3 year maturity. So, tenor is 3 year. Face value is given current market price is given. So, all we have to do is current market price is equal to coupon 1 divided by 1 plus since the YTM will be annually.

So, we can use y by 2 to the power 1 coupon 2 1 plus y by 2 to the power 2 and this will continue for entire period. So, 3 year means 3 year semi annually means 6 times right. So, we will have coupon 6 divided by 1 plus y to the power y by 2 to the power 6 and then we will have face value that is the lump sum payment 1 plus y by 2 to the power 6 and in this way the value of y will be the yield here.

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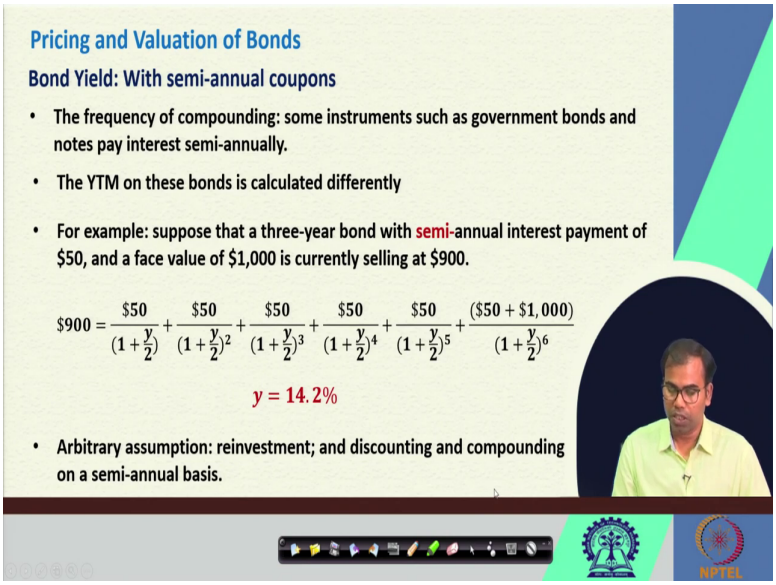

We express this relationship in very similar fashion we have the coupon here to be 50 dollar for 6 times and 1000 payment of lump sum at the end of 3 years we will use the same

approach and try to find the value of y here. Here the value of y is 14.2. Again, there is this arbitrary assumption that we will have all the fund all the money generated from the interest to be reinvested and discounting and compounded compounding is done on a semi-annual basis.

Remember in the previous session we have also discussed about the reinvestment argument where no money is withdrawn and that is how the money that we are earning through interest or coupon is reinvested further.

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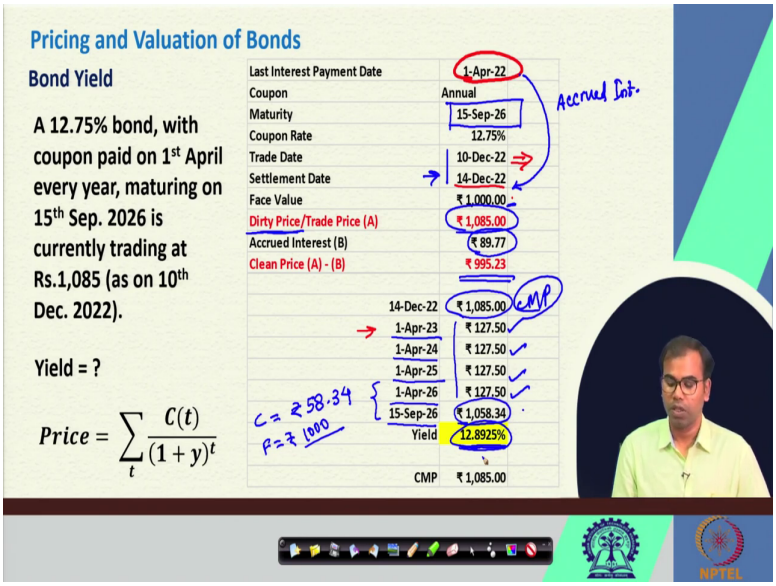

To just summarize this example of yield if we take a more defined example here we see that there is a bond which has 12.75 percent coupon rate and coupon first coupon was paid on 1st April every year and the bond is maturing on 15 September 2026. The current market price is 1,085 rupees and this is let us say as on date of 10th December 2022.

If this is the scenario then what will be the yield? So, if we use the same formula that we have just elaborated earlier where we have the price equal to the sum of present value of all the future cash flows discounted with y. So, in this case also we will have a bond which are paid which are essentially paying or yield every year on 1st April.

So, if we have this kind of detail. So, if we look at this on 1st April 2022 was the last time when coupon was paid and since coupon is paid annually. So, we know that next coupon will be paid on 1st April 2023 right. But suppose that as an investor I invest I buy this bond on 10th of December. So, 10th of December is the time when I enter the market and purchase this bond and the settlement is done on 14th September 14th December which means on 14th December the bond is credited to my account or it is given to me and the face value is 1.

Let us assume that on 10th of on 14th of December the market price of the bond is 1085 which is also known as dirty price because it includes the interest as well. So, first we will try to calculate the interest that is accrued from 1st April to 14th December.

So, accrued interest is basically the amount of interest that is due from the last interest payment date till the time when settlement happened. So, this is the amount of interest that is accrued. So, clean price is basically the dirty price or trade price minus the interest that is accrued. So, we have the clean price of 995.223 rupees.

Now, if you try to find the yield for this bond, we know that this bond is going to mature on 15th September 2026 and I am buying this bond on 14th December 2022. So, first coupon that is going to accrue to me is on 1st April 2023. Next coupon will be on 1st April 2024 then 2025 and 2026 and the last payment will be done on 15th September 2026 when the bond will mature and all the payment will be settled.

So, the total coupon that I am expecting to receive is 127 rupees 50 paisa or at the rate of 12.75 percent on 1000 rupees bond 4 times and then during this period I will receive a coupon of or interest of 58 rupee 34 paisa plus face value of 1000 rupees right. So, this is the amount I am going to receive on maturity. So, if we try to calculate the yield on that all we have to do

is just find the discounted value of all these cash flows at a rate which is equal to current market price.

So, this is the current market price that we have paid to buy this bond. These are the cash flows that we are expecting to receive and this is the yield for this particular bond if I hold the bond till maturity. So, this is how typically a yield is calculated for bonds which are not held by the holder at the time of issuance maybe the bond holder has purchase the bond after it was issued sometime back.

For in this example, the bond was issued at some previous time period and I as an investor entered the bond entered as bond holder on 10th December and bond is given to me credited to me on 14th December and that is how we can calculate the yield which is to be to be compared with other instrument or other yield of other bonds and that is how we can make a decision.

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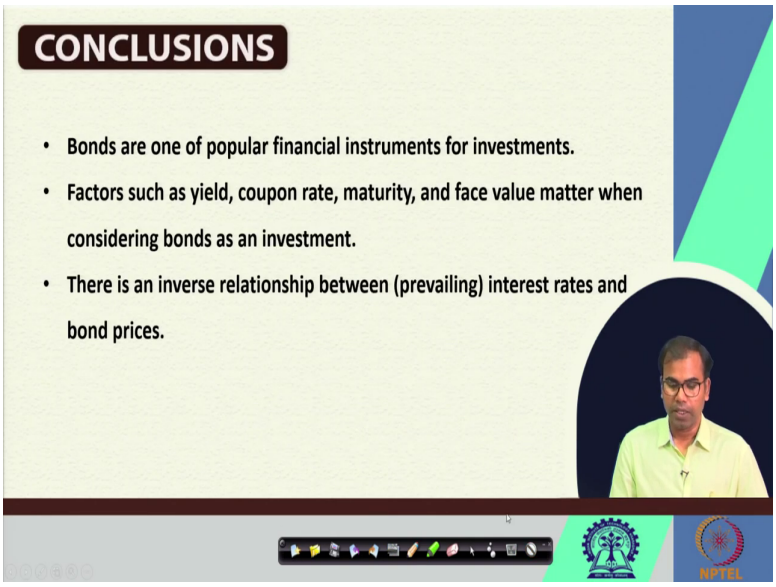

So, just to sum this up bonds are typically used as a source of as a tool of our investment where you can generate a fixed rate of income fixed rate of interest and as an investor in bond, we should always look up to the information such as yield, coupon rate, maturity, face value because these are the information that matters when it comes to the valuation of the bond.

And we will also see subsequently that the yield is inversely related with the bond prices or we can see about the relationship between coupon and bond price as well and with this I end this session.

Thank you very much.