Infrastructure Finance
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Lecture - 10
Analysis of Project Viability Cost of Capital

Hi, welcome to this course on infrastructure finance. This is lectured 10 and we will continue about our discussion on analysis of project viability, that we did from the previous class. More specifically in this class, we will focus on the of capital and how will be actually calculate the cost of capital because it actually plays a very important role in determining the project viability. Before we actually get into the topic of today's lecture, we will spent some time to discuss the thought question that we put fourth at the end of the previous lecture.

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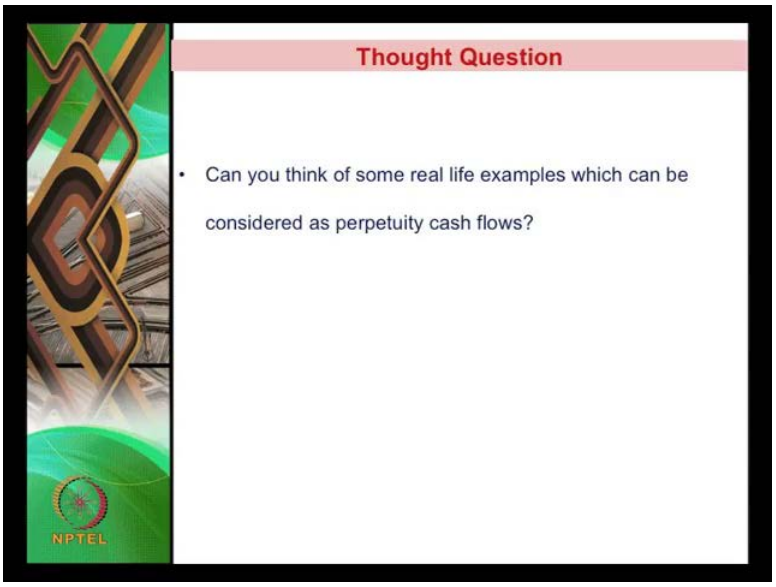

So, the question was, can you think of some real-life examples which can be considered as perpetuity cash flows. Now, we will try and spilt the questions into several parts and try and discuss each of them because there are several important key operative words in this question. One is the term called cash flows, now it is important for as to understand cash flows can be both an inflow and an outflow. So, cash flows is not be always considered as thought of as only a cash inflow, but it can be also a cash outflow.

Then we also have another important word which is your perpetuity. So, perpetuity is a cash flow that occurs for an indefinite terms. In real life we probably will have very little examples where cash flows occur for indefinite term, but for all practical purposes, a cash flow that occurs for a very long period can be assume or approximated to be perpetuity cash flow. So, from that perspective if you look at some examples of perpetuity cash flows, we can think of several. The most common example that one could remember is what is called as your pension.

So, when you actually receive pension the pension is a regular payment in most cases it occurs every month and it occurs for an indefinite period. That is we are not very sure when the pension is going to stop because the pension keeps coming as long as the holder of a pension policies alive. So, it is more frequently modeled as a perpetuity cash flow. Another example of perpetuity cash flow could be, let say the professional tax that we pay or our salary income. So, as long as you are actually going to earn your salary income, one is obliged to pay what is called as your professional tax.

So, this is the fixed amount that you would be paying for each and every month. So, this is in a sense what is called as your perpetuity cash out flow. It is called a perpetuity because, it is going to happen for a very long period of time as long as one is continue to earn a salary we are going to incur this professional tax outflows. So, this is your perpetuity cash out flow. Now, are there any other examples in the context of infrastructure projects, which we can model as perpetuity cash flows. In many cases a infrastructure projects have either a long duration or it actually has concessions that actually stretches several years into the future.

So, today you have let us say the Bangalore international airport project. There the concession or the license given to the private operator to operate the airport is for about 60 years. So, 60 years is a fairly a long duration. So, the cash flows that occurred during such a long duration can be modeled as a perpetuity cash flow, but we will have to make some approximations when we talk about a perpetuity cash flow.

One is we assume in many cases, though it is not uniform we assume the cash flow is to be uniform. Second if the cash flows are growing we kind of assume that, it grows at a constant growth rate. For example, we assume a 2 percent growth rate 3 percent growth

rate. So, on that actually makes it possible for us to model a cash flows are occur over a long duration as a perpetuity cash flow. So, several projects.

For example, a power project we will continue to generate power for twenty-five years and thirty years. This is a fairly long duration and in many instances we can actually modeled the project cash flows as a perpetuity cash flows. So, there are several examples in real life and most of in the case of infrastructure projects where because of the long duration of the project cash flows return to model the mass perpetuity cash flows. They may not be really indefinite that because of the fact that they occur over a long duration of time, we kind of model them as a perpetuity cash flow.

Now, let us go to the topic of the day which is really look at what is the cost of capital. Now, what do we actually mean by cost of capital with our previous lecture we talked about the time value of money. In the time value of money we simply said that cash flows that accrue in the future need to be discounted to the present. We need to actually sum up all the cash flows of the future cash flows in present value terms and that actually gives the sum of all the benefits from the project. Now, if you really look at it we calculate the present value of a cash flow from the future.

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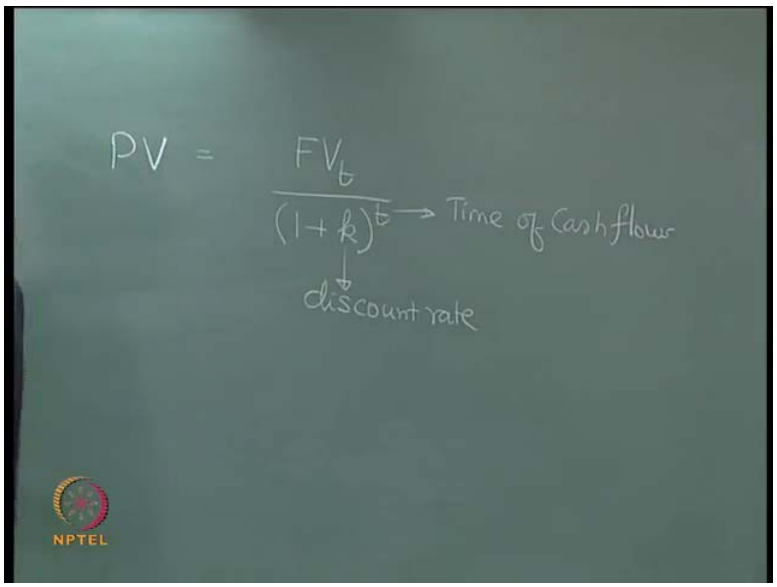

So, we have the future value, at time t and we determine the present value of this cash flow by dividing by the discount rate. Where k is your discount rate and t represents the time of your cash flows. So, when we actually discount the future cash flows by a

discount rate, we get actually the present value. Now, the question is, what is this discount rate. So, this discount rate is referred to as the cost of capital. See for example, capital is considered as a commodity or a good like any other good that we actually purchased from the market place, which actually as a cost. We may go head and seek capital the capital also as certain amount of cost.

So, that is actually refer to as the cost of capital. In simple terms an investor who is planning to invest in the project, he expects two things. The first thing is he expects to get a return of his capital and second he expects to get some amount of return on the capital that he as to invested in the project. So, the return that the investor expects, is in a sense referred to as the cost of capital. So, the investor needs be compensated for the capital that he provides to the project.

This compensation is a returned that he expects from the project and from the borrower or from the capital seeker perspective the return expected by the investor is, he cost of capital. Now, there are other ways also to look at it. For the investor the amount that is invested in the project represents what is called as your opportunity cost of capital. If the investor has not provided money to invest in the project, then you would have probably invested the capital elsewhere and he would have obtain some returns from making their investment.

Now, the cost of capital is essentially the, opportunity cost that the investor would have lost from investing the capital elsewhere because of investing in the current project. Now, what will be the cost of capital in that sense, the cost of capital in that senses would be the returned that you would have got elsewhere. Elsewhere in the sense at elsewhere of a project, which is very similar in nature. So, in where comparing investment opportunities or in where comparing opportunity cost, you are trying to compare opportunities of similar nature of a similar risk and so on.

Now, for the investor when he is actually calculating the opportunity cost of capital, he has to really compare opportunities of similar type. So, the opportunity that you would have lost because of investing in the proposed project is this opportunity cost of capital. That is usually referred to as the expected return of the investor. In other words it is also called as your hurdle rate, hurdle rate indicates that some minimum return that the investor would expect for investing in the project.

If a project is expected to give a return that is less than the hurdle rate, then the investor is not getting adequately compensated for providing capital to this project. So, the minimum return that an investor would expect is called as your hurdle rate. This hurdle rate represents the opportunity cost of capital. To a some sense it also represents the expected return by the investor.

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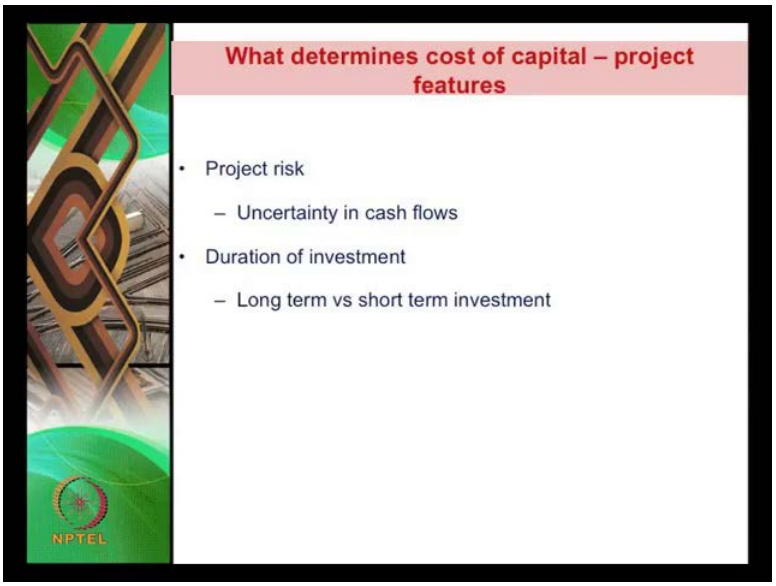

Now, what determines the cost of capital, remember we talked about discounting the future value to the present and we are trying to understand what determines this cost of capital what determines the discount rate. Broadly it can be looked that it from two perspectives. One is what features of the project determines the cost of capital or what features of the project influence the cost of capital. The fundamental concept that determines the cost of capital is called as your project risk.

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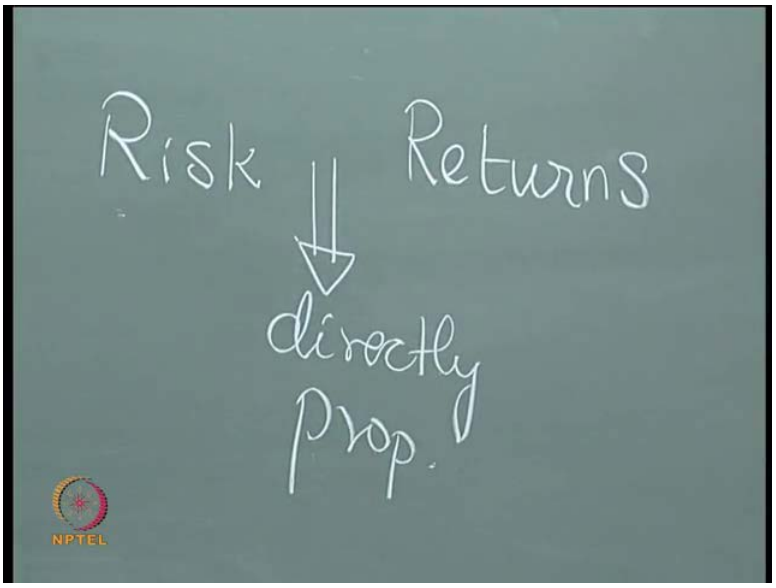

Remember in the word are finance and important correlation is between risk and return. So, you have risk of the project and then you have returns from the project right. Risk of the project and return from the project. So, these are directly proportion and these are directly proportional. So, if the project is considered to be more riskier than the investor should also expect a higher return from the project.

On the other hand if the project is less risky than the investors are satisfied with a lower return. So, this is a very important relationship, that you should be aware of the relationship between risk and return. Now, if the risk increases then the return expectation also increases and therefore, the cost of capital for the project also increases. When the investor's start expecting higher return, then as the finance manager for the project you will have to factor that as a higher cost of capital for your investment.

So, project risk is an important feature that actually determines your cost of capital. Now, what is project risk, there are several ways in which you can actually look at project risk, but fundamentally risk is something that leads to an uncertainty in cash flows. So, when the project is set to be in more riskier what we are essentially meaning is that the uncertainty in the cash flows are higher. When there is more uncertainty the project is perceived to be more riskier and therefore, the investors are expected to demand or seek a higher return.

So, if you can actually buy suitable methods or contracts variable to reduce the uncertainty in cash flows then the project is suppose to be less riskier. Now, there are several ways in which you can mitigate the uncertainty in cash flows. For example, in the case of a power generation project, if the power generation project has been able to sign a power purchase agreement with a buyer of power. If the buyer of power is suppose to be reasonably creditworthy, then the risk the uncertainty of revenue on the project is considerably reduced.

So, in essence this also reduces your project risk. Similarly, if you are able to find out ways in which we can mitigate the project risk and which increases the certainty of cash flows through any other means. For example, it could be by way of a very strong concession agreement, it could be by way of a very strong fuel supply agreement in the case of power project. Let say in the case of a power project availability of fuel is a very important role. If the fuel is not available then the power plant cannot operate and for the planned to generate revenues is very important ready availability of fuel.

So, if we have a fuel supply agreement that ensures availability of fuel, then the cash flows to the project becomes all the more certain. When you have certainty in this cash flows the project risk becomes reduced. The second feature that determines the cost of capital is your duration of investment, that is for how long do you actually need the capital. We have projects of short-term duration, we have projects of a long-term duration.

So, investors generally expect a higher return from the long-term investment as compared to a short-term investment. All things being the same a investor would expect higher returns from a long-term investment. That is if the project is actually going to give returns over a longer period of time, then there is no expectations would be higher.

The cost of capital also would be higher. So, if a project is let us say for example, borrowing for an eight-year period, the interest rate generally expected to be higher as compared to borrowing for a three-year period. So, if you need long-term capital, then you also would need to be in a position to have or service, a higher return for the investors of those instruments.

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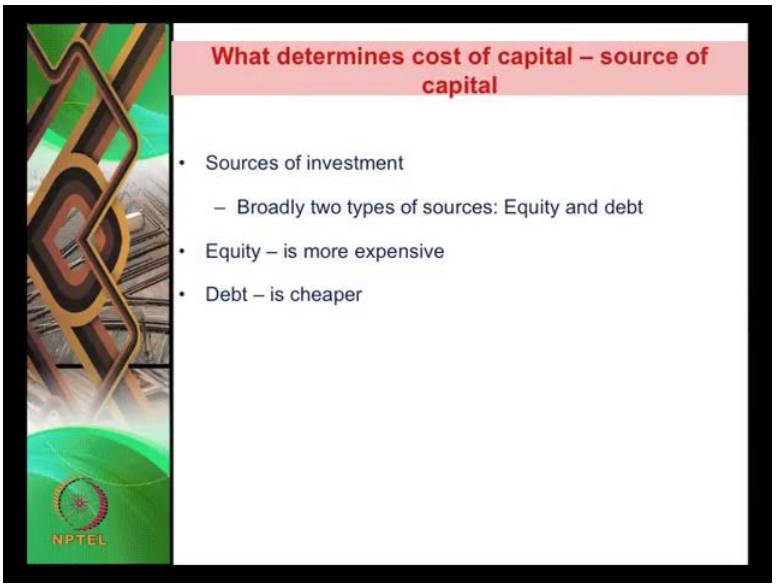

We go to the next feature, the sources of capital also determine the cost of capital. So, broadly what are the different sources of capital. If you look at the source of they can be classified into two categories equity and debt. So, when you actually want to attract investment for a project, we can either get it by way of equity or you can get it from debt. Now where you actually get the capital also determines what is going to be the cost of capital for your project.

So, between these two sources equity is more expensive, that is equity investors would expect a higher return as compared to debt investors. A debt is cheaper, there are various reasons is to why debt is cheaper as compare to equity, but at a very broad level at this stage it suffice to understand that equity is expensive as compared to debt therefore, if you are able to fund the project with a substantial amounts of debt we will actually have a cost of capital that is lower as compare to financing a project with substantial amounts of equity. So, how we source of capital also plays an important role will determining your cost of capital.

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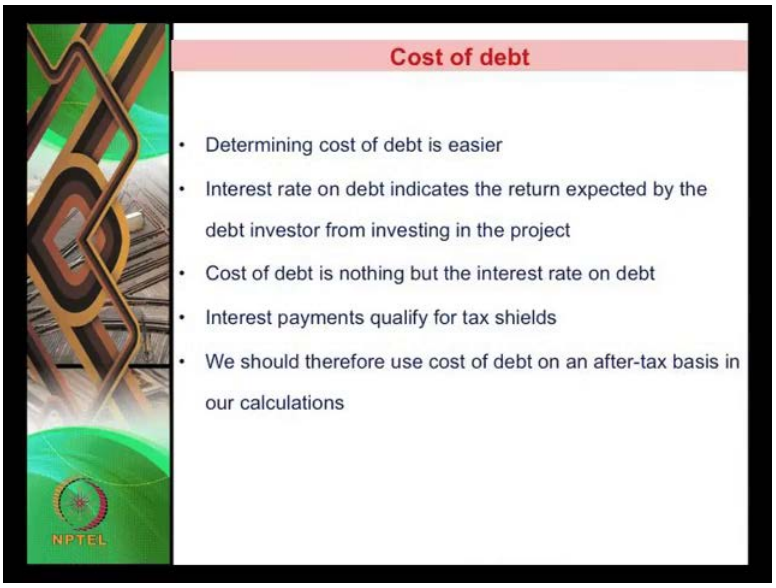

Now after having discussed what influences caused. We will try and actually spent some time to understand, how do we actually find out the cost of different sources of capital. First let us look at a cost of debt. So, determining the cost of debt is a generally consider be easier because we know very well that what is a return that debt investors expect debt investor expect a certain amount of interest on their investment. So, this in a sense represent the cost of capital of debt.

So, essentially when you look at getting debt the cost of debt is nothing but the interest rate on the debt, but we will have understand an important feature here. That is when you are actually paying interest on debt, the interest that we actually pay gives us certain amount of tax shields for the borrowing company. So, we will have to account for the tax shields, that we get by paying interest in calculating your cost of debt. So, let me explain the concept of the interest tax shields. So, let us assume that there is a company which is very similar in nature, but differs only by the way in which it has been financed.

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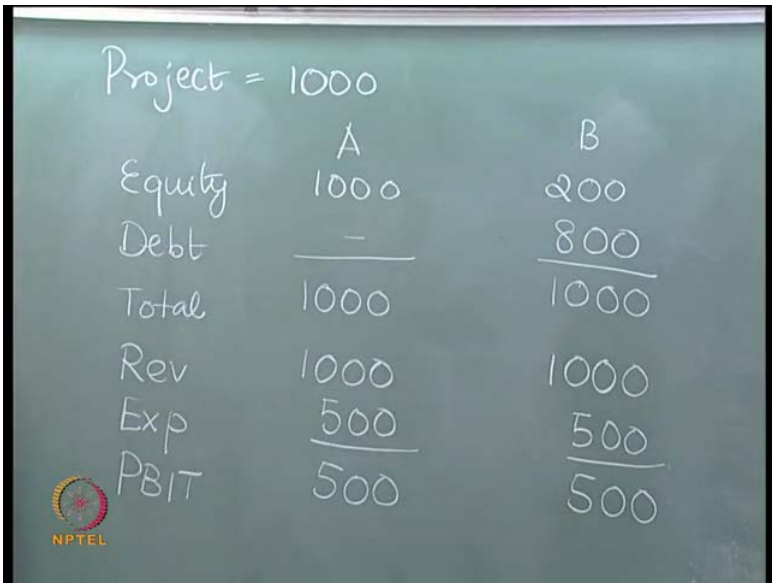

Let us say there is a project which cost thousand and there are two companies that are involved in implementing this project. There differ by the way in which the project has been funded. Let us say there is company A and company A has funded this project entirely by equity. So, the entire thousand needed for implementing the project has come from equity. Then there is company B, which is obtained debt and only 200 of the project is funded by equity and then the remaining 800 is funded by debt. So, the total investment in both the cases works out to be thousand.

So, both the firms have implemented the same project, the only difference been how it has been funded. Now, let us assume that the revenues are also the same because the project is the same. So, both the companies actually have the same amount of revenues thousand. For the sake of simplicity let us assume that, the expenses are 500, all the operating expenses amount to 500 and therefore, that profit before interest and tax works out to 500. Now, for a company which is actually borrowed certain amount of capital, it has to pay an interest.

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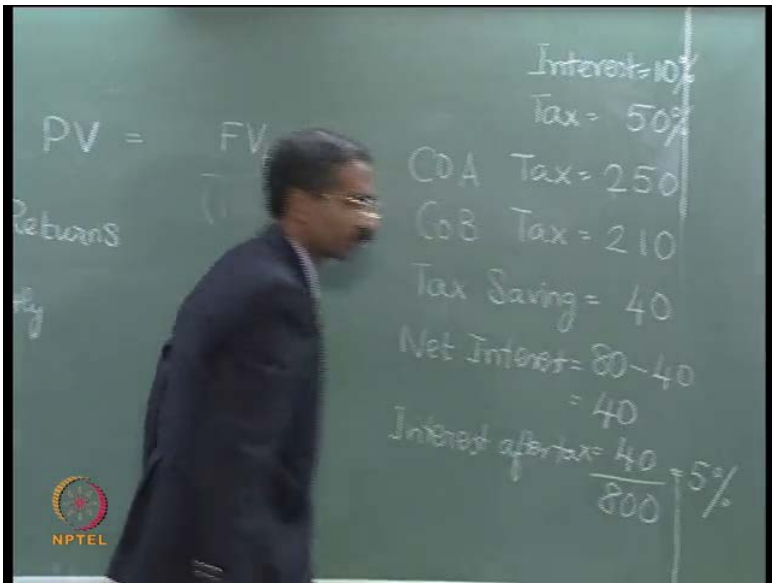

If you assume the interest on debt is 10 percent then the interest paid by company is nil because a company has not borrowed any capital. The interest that is paid by company B is 80 because the company is actually borrowed 800 and 10 percent of 800 is 80. So, this lists to a situation of profit before tax of 500 in the case of company A and 420 in the case of company B. If you assume tax for the sake of simplicity is 50 percent the profit after tax will therefore, be 250 in the case of company A and 210 in the case of company B. Now, what do we actually see here. So, company A has paid a tax of 250 and company B has paid at tax of 21. So, if you really look at it company B as saved tax to the certain to the extent of 40.

So, tax saving by company B is 40. Why has this tax saving happened, the tax saving as simply happened because the company has paid an interest of 80 and this interest payment reduces the amount of tax that the company has paid . So, because of this tax saving of 40, the net interest that the company has paid is the 80 minus 40 that will be equal to.

The company is actually paid an interest of 80, but because of this interest payment it is actually been able to enjoy a lower tax to the extent of 40. Therefore, the net interest the company has paid would be 80 minus 40 is just 40. So, if we use the net interest this 40 on a total debt capital of 800. So, we actually get the interest after tax would be 40 divided by 800 this will be equal to. So, the net interest after continuing the tax shields

for the companies only 5 percent. So, this represents the after-tax cost of debt. So, after-tax cost of debt is 5 percent.

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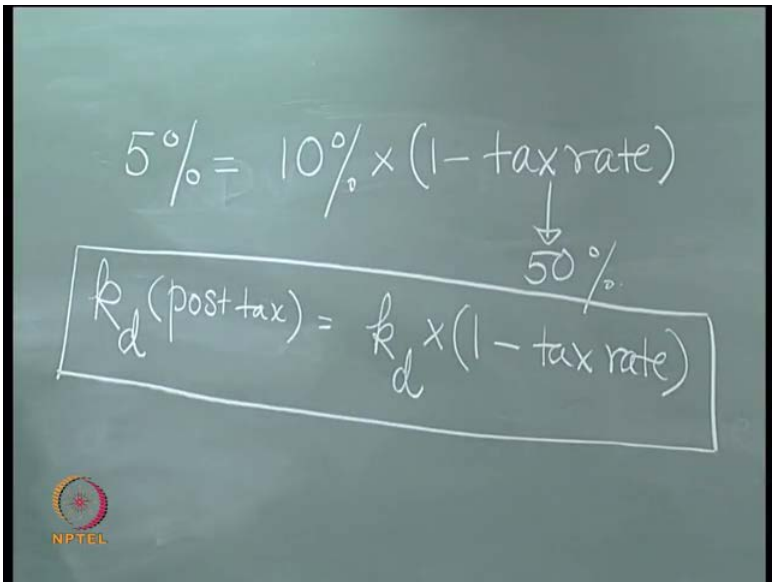

So, this is nothing but the pre-tax cost of debt 10 percent multiplied by 1 minus your tax rate. So, we have assumed the tax rate to be 50 percent. So, in essence the post tax cost of debt, cost of debt I am denoting by k d. Then post tax is nothing but the cost of debt pre-tax multiplied by 1 minus your tax rate. So, whenever we are using the cost of debt we should always accounted on a post tax cost of debt. So, yes cost of debt is nothing but the interest that is paid, but because interest enjoyed certain amount of tax shields, we use the post tax cost of debt.

Next let us go back to finding out the cost of equity. So, unlike debt where the cash flows are contractually specified. So, when you actually borrow a clearly specify that you will be able to pay 10 percent interest, 8 percent interest, 6 percent interest and so on. Unlike this contractually obliged payments in the case of debt, equity does not involve any contractual payment of obligations. Therefore, becomes very difficult for us to directly calculate the cost of equity. So, the common model which involves to estimate a cost of equity is your capital asset of pricing model.

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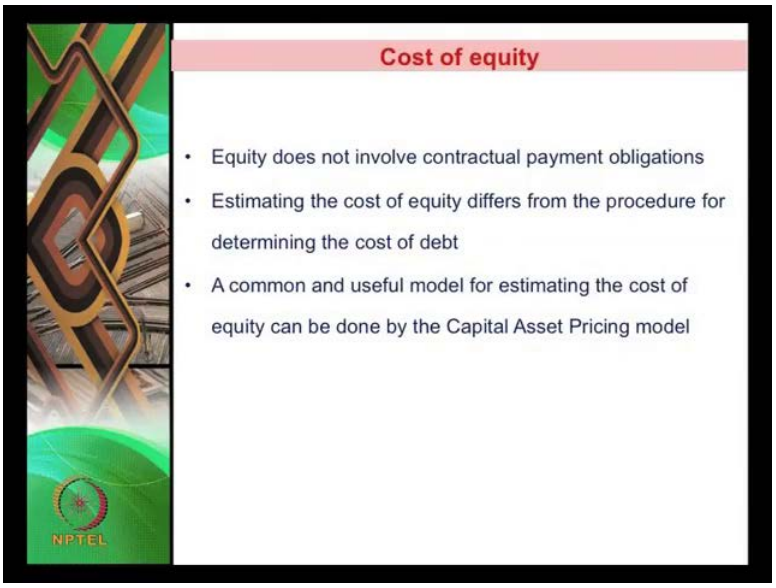

So, the procedure for estimating the cost of equity is very different as compared to the cost of debt. Simply because of the fact that, it is not possible to clearly identify a number because of the lack of a contractual payment obligations. So, what is this capital asset pricing model that we talk about that can be used to estimate the cost of equity capital. So, asset pricing model is a very simple model, which estimates the cost of equity by this expression.

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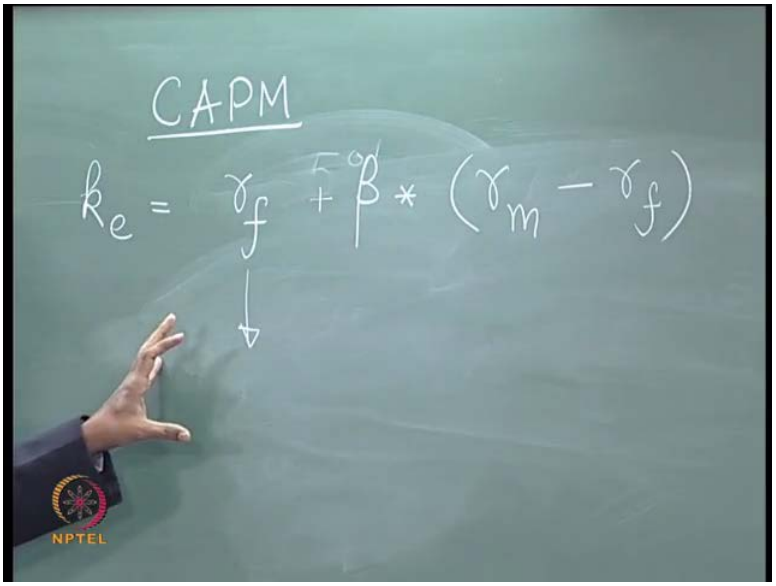

Cost of equity is nothing but your a risk free rate of return plus your measure called beta multiplied by r m, which is the rate of the return obtain from a market portfolio subtracted by your risk free rate of return. So, we can use this expression to estimate what will be the cost of equity, but before that let us understand what is the different terms constitute. So, r f is nothing but the risk free rate of return.

So, where can we actually get information about the risk of free rate of return. So, first of all we will have to assume, we will have to find out an instrument which can be considered to be risk free. That is if you are making an investment in that instruments there is no risk f or the holder of the instrument or the holder of the security. So, the contractual payments that are supposed to occur, will come and the investor is not exposed to any uncertainty in terms of the cash flows.

So, a risk free instrument is essentially considered to be a financial instrument or a bond issued by the government. Any security that is issued by the government, any bond security that is issued by the government is considered to be risk free because generally assume that governments do not default on their payment obligations. I mean they has been instances where governments have defaulted, but it is been very very rare instance. Governments of countries that are considered to be creditworthy do not default.

So, therefore we assume the interest rate on the bonds issued by the government as the risk free rate of return. The risk free rate of return could actually vary from government the government. For example, the rate of return issued by a U S government bond is going to be different from the rate of return that we enjoy on, let us say a bond issued by the Indian government. Bonds issued by the Indian government for a variety of reasons might actually give a higher return as compared to bonds that are issued by the U S government. In essence both the bonds are risk free, but because of certain other factors it is a different in terms of the risk free rate of return.

So, which risk free rate of return should we actually take. So, you should take that rate of return, where the project is going to be implemented. So, for example, if you actually going to implement the project in India, then we should actually take the risk free rate of return that are prevailing in India. So, you could probably get information about the risk free rates of return in the markets or from any of the other financial information sources. Next is your beta, beta is nothing but a measure that captures the risk of a particular

security we saw we the market. So, to understand beta, let us understand it by a simple graph.

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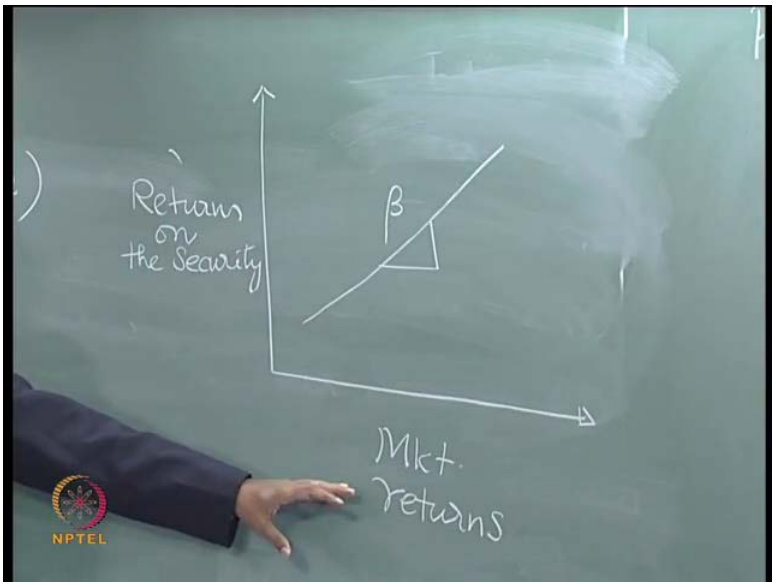

So, this is a graph where we actually try and capture. Let us say the market returns and then we captured the returns on the security, that we are interested in. So, if we plot a graph between the market returns and the returns on the security were a period of time. We could probably get a line something like this. So, this slope of this line is tentatively the beta. So, this measures the sensitivity of the securities return as compared to the market returns. Now, if beta is considered to be a value of 1, then a security gives return that is in tune with the market return. So, if the market gives a return of 10 percent then the security will also be giving return of 10 percent.

So that actually means that beta is 1. If the beta is more than 1, then the security gives a return that is high of then the market returns. If the market gives 10 percent then the security will give 12 percent. So, when I mean by security I actually mean the equity of the company that we are interested in. When beta is less than 1, then we are having a scenario where the equity is actually giving a lower return as compared to the market return.

So, beta is essentially a measure of the risk of the equity as compared to the market. So, that is beta, then we have returns on the market portfolio r m is nothing but returns on the market portfolio. So, over a period of time market gives certain amount of returns. So, if

we actually make an investment in a list of securities, in a list of equities that comprise or represents what is the market, then the returns that we get from such a portfolio is called as your market returns. So, when we talk about market returns, in India we look at several stock market indicators. So, we have the BSE Sensex, then we have the various national stock exchange indexes.

So, they are all nothing but a market portfolio. So, the return that we get, by investing in such portfolio would be called as your market returns. Market returns net of the risk free rate of return multiplied by beta plus your risk free rate of return would give you the estimated or expected value for cost of equity.

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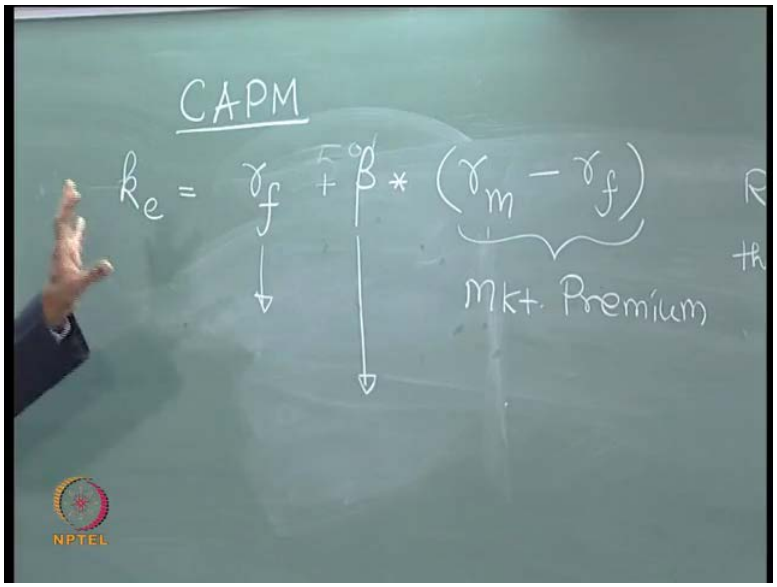

So, the term r m minus r f is also denoted by what is called as your market premium. You are actually having a risk free rate of return, how much are you able to get more by investing in the market because investing in the market carries amount of risk as compared to a risk go free premium compared to an instrument that offers risk less return. So, how much premium does a market give as compared to the risk free instrument. So, that is your market premium. So, we simply use this expression to calculate your cost of equity capital.

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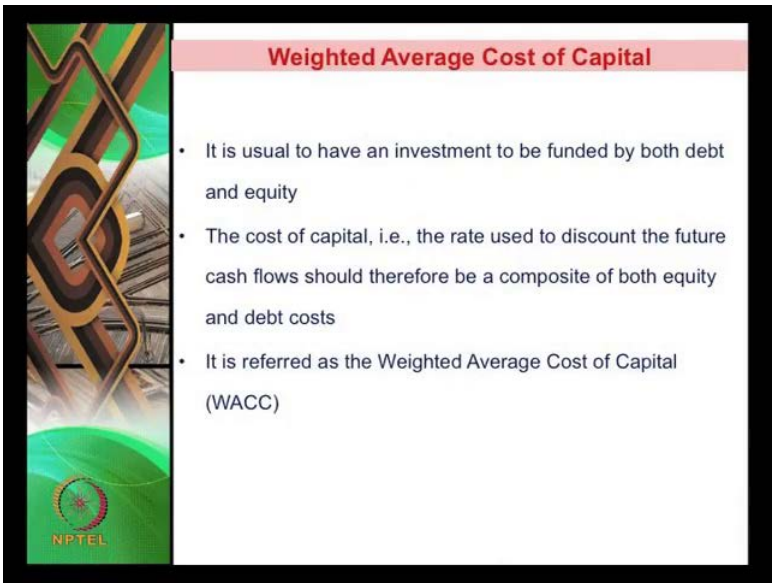

Next we will have to understand a third component, which is called as your weighted average cost of capital. Remember a project can actually get investment from both equity and debt. There is a cost of debt, there is a cost to equity. Now, how do we actually determine the cost of capital for the project because capital is obtained from both equity as well as debt. So, then that is what we actually how to encounter what is called as your weighted average cost of capital.

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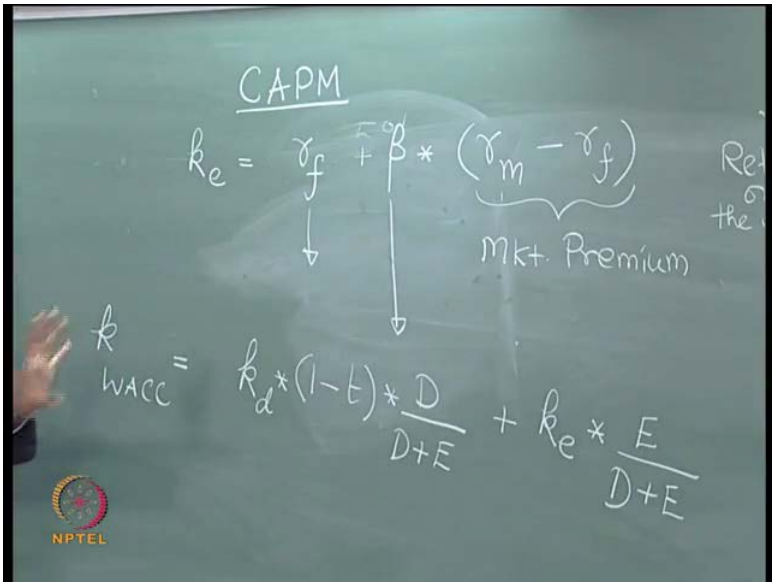

How do we calculate the weighted average cost of capital, weighted average cost of capital is nothing but cost of debt on an after-tax basis multiplied by the proportion of debt funding that we use for funding the project. So, let us assume D is the amount of debt that we have used. The total funding for the project it is nothing but the debt plus equity. So, this ratio D by D plus E, represents the proportion of debt funding that we actually have to use for the project plus cost of equity multiplied by the proportion of equity funding. In essence this is nothing but a weighted average cost of both debt and equity, that is simply the weighted average cost of capital.

When we actually have to determined what is the cost of capital that we have the use. Then we will have the use a weighted average cost of capital because this indicates this is the hurdle rate that the project will have to meet, to satisfy the investor expectations.

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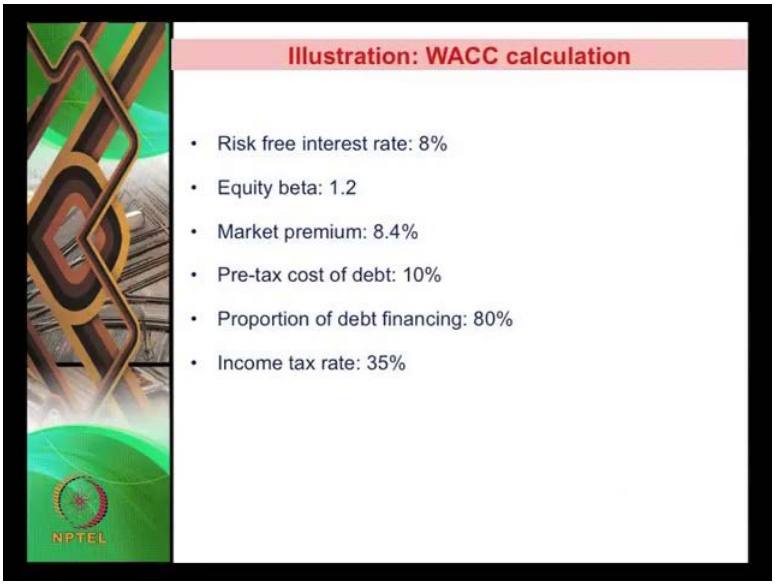

Let us do a simple illustration to calculate the weighted average cost of capital. Let us assume that we have a project with the following features. The risk free interest rate is 8 percent again as saving the risk of the interest rate keeps varying from time to time. It keeps varying from country to country. So, we will have choose the approximate indicators prevailing at the time that the project is being implemented to identify what will be the risk-free interest rate. Then we have information about equity beta which is1.2.

We do not have to actually calculate the beta ourselves. For example, there are several sources which actually gives you beta of an equity. So, there are financial information portals like here yahoo finance or m s n finance, which actually gives you the beta values for several publicly traded stocks in the global markets. So, we could actually obtain the beta information from this external sources because trying to calculate or determining the beta ourselves is going to be a fairly time-consuming exercise.

Then we have indicator about market premium which is 8.4 percent. So, again market premium differs from markets to market. In some developed countries the market premium will be a little lower, but in developing countries market premium could be a little higher. On an average market premium is assumed in a very general sense to range between 6 percent to 8 percent on an average. Then we have a pre-tax cost of debt at 10 percent.

The total proportion of debt financing for the project works out to be about 80 percent. So, out of the 100 percent, 80 percent of the cost is met by debt sources and obviously this means add the remaining 20 percent is from the equity. So, and then we have an income tax rate of 35 percent. So, let us try and calculate using this information what should be the weighted average cost of capital for the particular project.

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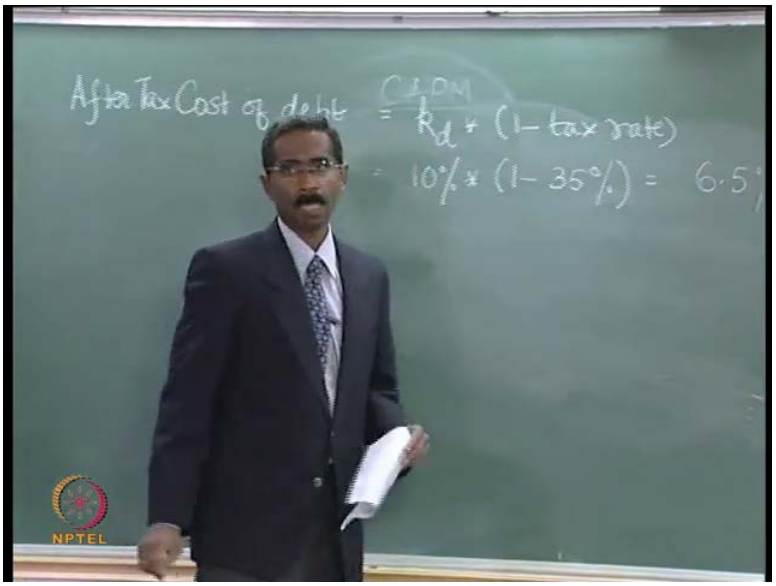

So, first we will have calculate cost of debt. Remember we have to calculate the cost of debt on an after-tax basis. So, this is after-tax cost of debt. So, after-tax cost of debt is

nothing but cost of debt multiplied by 1 minus your tax rate. So, if you substitute the values that we have for this example, then cost of debt is 10 percent multiplied by 1 minor tax rate which is 35 percent. So, the after-tax cost of debt works out to be 605 percent. Now, we have determined the cost of debt, let us now determine the cost of equity.

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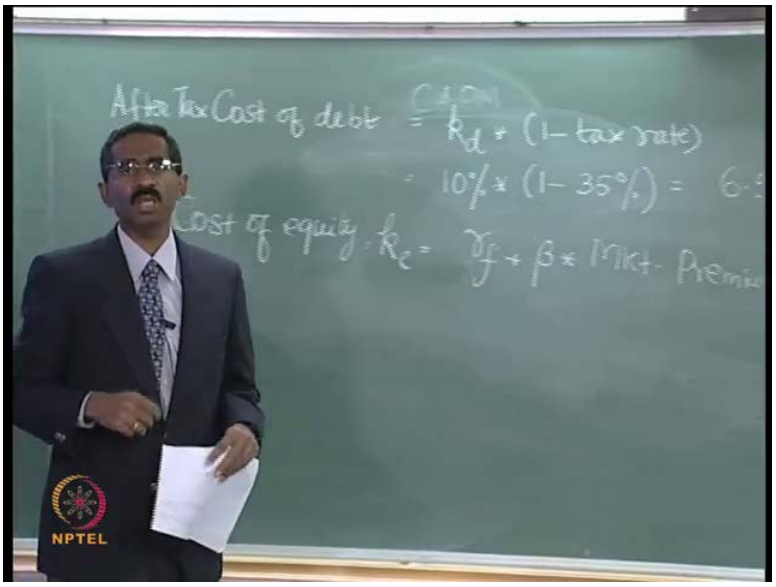

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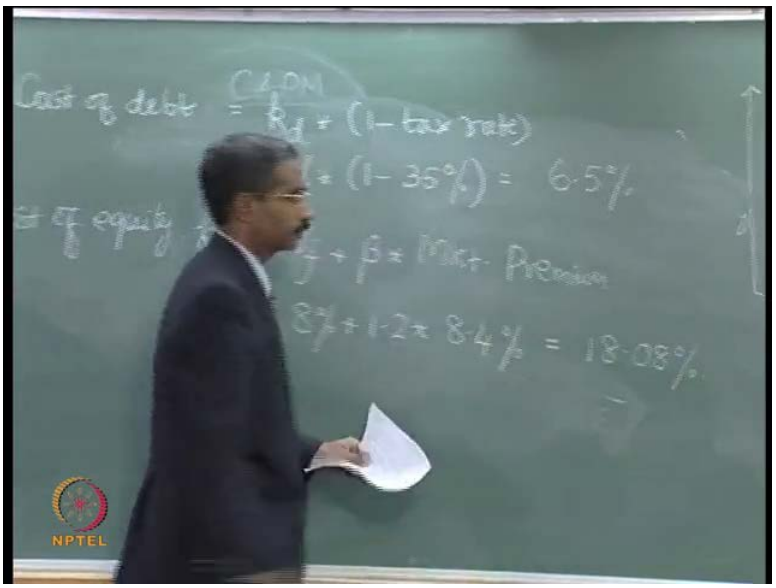

So, cost of equity we try and use the capital asset pricing model to determine what is going to be the cost of equity. So, cost of equity k e is nothing but a risk of free rate of

return plus beta multiplied by your market premium. If you substitute the values that we have for this particular project, then the risk-free rate of return is nothing but 8 percent plus your beta is 1.2 multiplied by a market premium of 8.4 percent. So, this actually gives you cost of equity of 18.08. Now, after having obtained the cost of equity and the cost of debt, we will have to find out what is your weighted average cost of capital.

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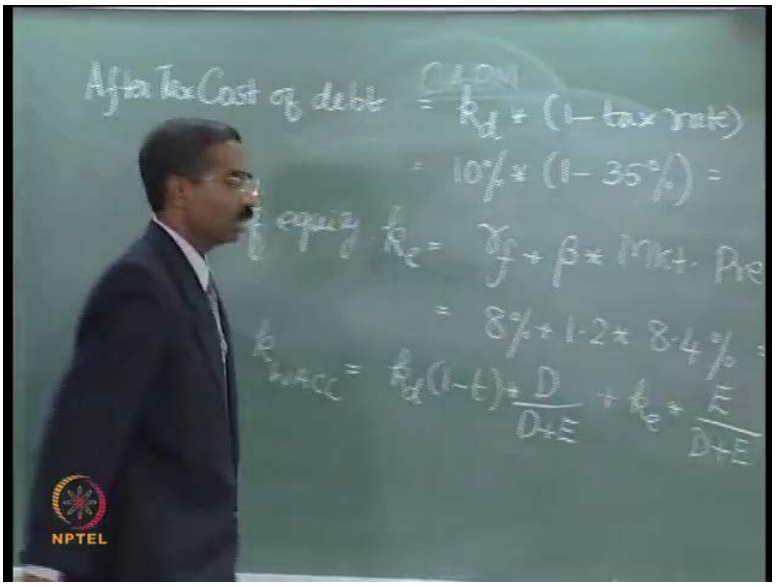

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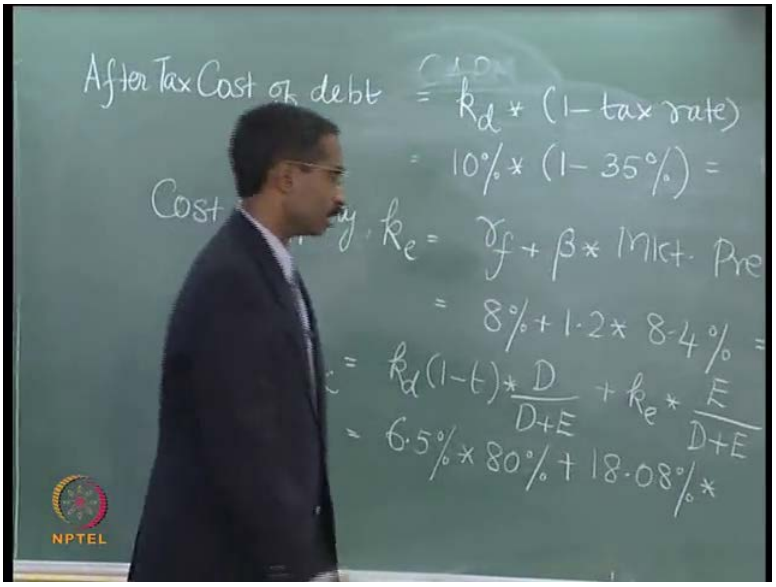

So, weighted average cost of capital nothing but after-tax cost of debt multiplied by the proportion of debt plus cost of equity multiplied by the proportion of equity. If we

substitute these values we are going to get 6.5 percent. Is the after-tax cost of debt multiplied by 80 percent which is the proportion of debt is for the project plus a cost of equity is 18.08 percent multiplied by the proportion of equity for the project which is.

If we calculate this works out to 8.82. So the weighted average cost of capital is 8.82 percent and if the project is able to provide a return of 8.82 percent, then it will be in a position to meet the return expectations of the investor.

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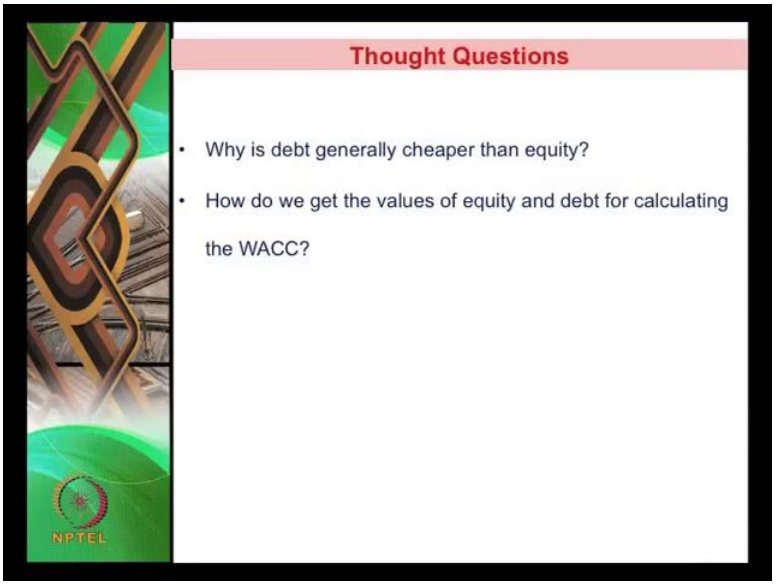

So, this brings us to the end of this lecture and before we close a couple of thought questions. Question number 1 why do we generally consider debt to be cheaper than equity and what is the reason, what is the principle behind debt being cheaper than equity. Question number 2 how do we get the values of equity and debt for calculating the weighted average cost of capital. Remember in weighted average cost of capital, we find the proportion of debt funding or the proportion of equity funding by the values of debt and equity. So, how do we get the values of this equity and debt for calculating.

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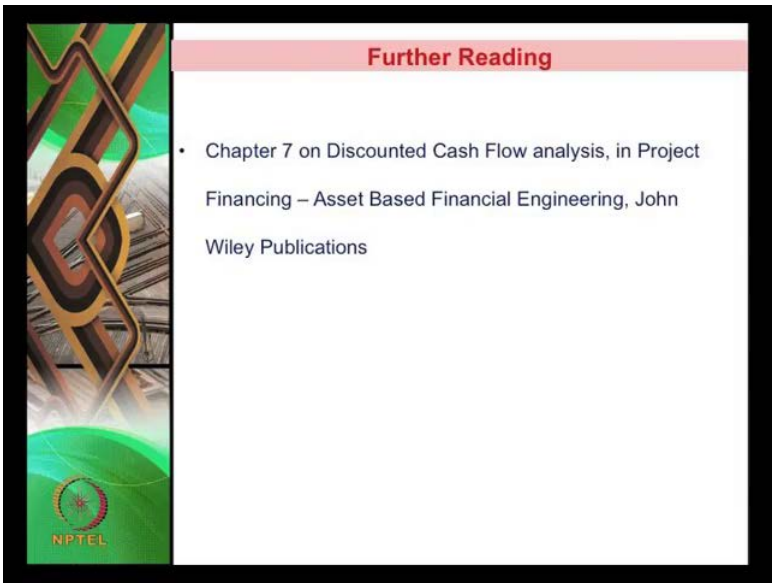

Further reading on this topic, can refer to chapter 7 on the discounted cash flow analysis in the project financing handbook by John Wiley.

Thank you.