Water Economics and Governance
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Lecture – 38
Evaluation of Water Projects: Capital Budgeting Methods (Contd.)

Hi, everyone. The earlier sessions this week we have been talking about the evaluation of water project in terms of its economic feasibility and we were discussing the various capital budgeting methods. We did talk about a couple of methods in the previous session the payback period which is one of the very basic capital budgeting technique and then the discounted payback period which is a step further in order to consider the time value of money in a payback period.

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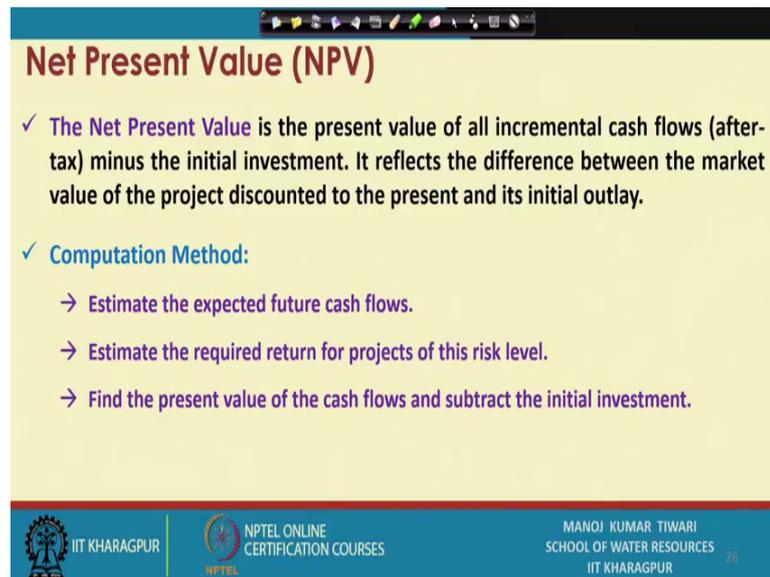The one of the major drawbacks of payback period that it does not consider the time, value of money in order to overcome that a discounted payback period method which has been devised also we discussed in the previous session.

So, today we will take up next method which is NPV or Net Present Value.

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So, NPV or Net Present Value is actually one of the most used method for capital budgeting the method is fairly simple it eventually estimates the present value of all incremental cash flow if there are taxes or if there are depreciation or if there are like the time value of money discounts. So, all these thing are considered and then net incremental cash flow is quantified or is measured and the total investment the total initial outlay was is will be subtracted from the net incremental cash flow or from the total cash flow and that gives the net present value. So, it actually reflects the difference between the market value of the project discounted to the present and it is initial outlay or initial expenditure.

So, whatever initial investment that is to be subtracted from the overall market value of the project at that particular time and then the difference gives us the net present value so; obviously, the net present value if higher is actually better because that suggests that this project or this activity is likely to run in profit or likely to generate more revenues than its initial outlay or then its investment cost.

So, the procedure for estimating is that we first need to estimate the expected future cash flows then we need to estimate the required return for the given risk level and find the present value of cash flow based on the return or based on the discount rate which whatever we consider and then subtract the initial investment from that sum of the net cash flows. So, that is what gives us the net present value

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The net present value is estimated using this formula that where the C 0 is the initial investment. So, this initial investment will actually be subtracted from the total net cash which is coming after all the discounts and at a required rate of return. Now, the if you see this C t is let us say net cash flow generated by the project at any given time or let us say in the year t or in the t-th year, if t is the time scale or let us say at 5 years so, t becomes 5.

So, in that case the value of the cash generated during that will be discounted using the rate of return required or the discount rate which we have selected. So, that will be discounted and as we have discussed earlier during the discounted payback period method as well that this discounting is done by dividing 1 plus rate of return to the power t.

So, if let us say I am getting a net profit of 5 lakhs in fourth year let us say in the fourth year of the project I am generating a net profit of 5 lakh from any project or any activity. So, that value of 5 lakh will be taken as 5 divided by 1 plus whatsoever my expected rate of return or discount rate let us say consider that my expected rate of return is 10. So, if my rate of return is 10, this becomes k, then k becomes 10 by 100 because 10 percentage. So, that is 10 by 100 equal to 0.1 to the power 4 because it is in the fourth year. So, this becomes 5 divided by 1.1 to the power 4. So, instead of 5, I will have to take this value and this value is to be summed for all times.

So, if my project life is let us say n years, then the t value will be ranging from 1 to n because it is n here let us say n is for example, n is 5. So, then I will have to take this value. So, capital generated or cash flow generated in year 1 divided by 1 plus 1 to the power 1 then capital generated in the year 2 divided by 1 plus 1 to the power 2 plus in year 3, 1 point 1 to the power 3 and that way up to n it will be estimated 1 plus 1 to the power n. So, all this will be summed and what this gives this gives me the net cash inflow in present terms for the project. So, if this is my net cash and C 0 is my initial investment, so, the difference of the two is considered as net present value of the project.

So, obviously, net present value will be probably negative for capital intensive project in the beginning because when the when we are not let us say we consider just two year phase only, the sum of these two may not be going to be a large number as opposed to C 0, but as the duration of project increases. So, these numbers will keep on adding and this term will actually keep on increasing. So, when this term becomes more than the capital investment that much life period of the project would be helpful in order to make the project into positives, otherwise the project is actually not generating enough revenues to cover up its initial outlay or the basic investment that has been done in the form of capital at the starting of the project.

So, based on this we accept a project if its net present value is greater than 0. So, if net present value is greater than 0; that means, the generated revenue or the present value of the generated revenue is higher than the present value of the capital. So, for a project of any time duration n, when we discount the future earnings to the present time by using the appropriate rate of return and even after that we see that the net revenues or net cash inflow the sum of the cash inflow in present terms is greater than the capital invested; that means, the project is safe and we can accept this project.

So, the acceptance criteria become NPV greater than 0 and, obviously, a positive NPV means that project is expected to add values while a negative NPV means it is expected to generate losses in terms of the capital. So, this is the net present value concept.

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And, let us take an example and see how the net present values are worked out. So, consider that Surat municipal corporation decides to add an Industrial Water Supply Unit to meet the industrial demand for next 10 years. So, our project duration is becoming here 10 year the required investment were estimated at 40 [FL]. So, my initial outlay or the investment is 40 [FL]. A uniform tariff structure was proposed to charge water supplied at rate 40 kilo liter initially with 20 percent hike proposed after every 2 year. So, uniform tariff structure, by now you will be aware of what uniform tariff structure if you are following the earlier lectures we have discussed this in detail in week 5 or week 6.

So, the uniform tariff structure means that the price of the water is uniform irrespective of the volume consumed; price per unit, not the total tariff. So, that means, whether somebody is consuming 10 kilo liter, 20 kilo liter, 40 kilo liter he has to pay the for the water at a fixed price like to begin with rupees 40 per kilo liter and then it says that it will be increased 20 percent after every 2 year. There is a 20 percent hike proposed after every 2 years.

The initial demand for water is estimated at 12 million liters per day 12 MLD is the demand and it is forecasted to increase 3 million liters per year. So, that way our demand is also changing annually, now says that the assumed operation and maintenance expenses to be rupees 25 per kilo liter for first 3 years, rupees 30 per kilo liter for next 3 years and rupees 40 per kilo liter for next 4 years.

So, the total duration is 10 year and that is how we should take the operation and maintenance expenses and then we need to determine the net present value of the project at 12 percent discount rate or 12 percent return rate. It also says that ignore all other cost and revenue and consider tax rate at flat 40 percent on the net income. So, we get the valuable information from this problem statement that what is the demand.

So, the demand of water for the 10 years, that we can actually estimate from here, then we can estimate the rate of operation and maintenance expenses. So, O and M expenses also we can estimate that 25 for first 3 years, then 30 for next 3 years and then 40 for next 4 years. We also get the value of the unit water or water tariff to begin with that is 40 here again it is 40 here because it is hiked by 20 percent every 2 years, so that means, for next 2 years it is going to be 48, 48 and then again 1.2 times 48. So, that way the tariff is also given.

So, using these three basic information, there are tax rate which is at a flat 40 percent and the initial investment is 40 [FL]. So, you will use this information in order by the approach suggested approach and we will try to compute the net present value for this project.

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So, let us see how the calculation goes. It is going up to 39. So, this becomes our water demand which is provided to us, operation and maintenance rate is also provided to us. So, 25 for first 3 year, 30 for next 3 and 40 rupees per kilo liter for next 4 years. So, this

is also provided to us and a tariff structure is also provided to us 40, 48 and then again 20 percent hike, then for next 2 year 20 percent hike and then for next 2 year 20 percent hike. So, this way we get actually the tariff structure also, 20 percent hike after every 2 year.

Now, when we know the operation and maintenance rate we can compute the yearly operation and maintenance cost as well. How we will compute that. So, for example, let us take for a year 1. So, our total demand is 12 million liters per day. Now, 12 million litres per day means 12 into 10 to the power 6 litres per day or we can say it equal to 12 into 10 to the power 3 kilo litres per day. So, basically 12 million litres is equal to 12 into 10 to the power 3 which is equal to 12000 kilo litres per day is the demand. So, when the demand is 12000 kilo litres per day this much kilo liter is being consumed in a day and 1 kilo liter exerts an operation and maintenance cost of 25. So, this into 25, this much rupees per day is the operation and maintenance expenditure and when we are computing it for a year we have to multiply it with 365. So, this number comes out to 10.95 [FL] rupees.

So, that way we can estimate the operation and maintenance cost, yearly operation and maintenance cost. For example, when the when the demand is 30 million litres per day or 30000 kilo litres per day the rate is the operation and maintenance rate is 40. So, this into 40 rupees per kilo liter and into 365, if one solves this he will get this value 43.8 [FL]. So, this way we can estimate the yearly operation and maintenance cost.

Similarly, we can estimate revenues from water charges, yearly revenues from water charges in similar fashion. So, what we will do here, that the consumption is still the same 12000 kilolitres per day. Now, the O and M rate or O and M expenditure is 25. So, maybe multiplied with 25 for getting the O and M cost; however, the tariff rate is 40. So, instead of 25 if we multiply this by 40, so, what we get is this number.

Similarly, here instead of multiplying this by 40, so, let us say not using this 40 over here and rather using the water tariff rate which is 69.12 then we are not going to get this number, but what we are going to get is this number, revenue from water charges. So, this way we will be able to calculate the revenue for water charges.

Now, the yearly O and M is the expenditure of the company while the revenue generated or revenue from water charges is the income of the company. So, you must be very clear

about this that whatever you are getting here is actually this is the expenditure and this is the income. So, we got the yearly expenditure and we got the yearly income for this said proposal. Now, when we know that this is going to be my income and this is my going to be my expenditure.

So, I can determine the cash flow net cash flow. So, that cash flow is going to be basically income which is cash flow in minus expenditure which is cash flow out. So, this O and M expenditure in the form of basically O and M and this is in form of your revenue from tariff. So, we need to subtract the expenditure from income we need to subtract the yearly operation and maintenance cost from the revenues recovered from water charges and if we take this difference if we subtract it here, we get these values after subtraction.

So, the values that you are seeing here in the column cash flow, is actually the net money inflow into the system on an annual basis. So, this project is likely to bring 6.57 [FL] rupees in first year 8.21 [FL] rupees in second year, then 15.1 in the third year that way towards the end 61.13 [FL] rupees in the tenth year. So, that is how the money is going to flow in this system if this project is implied. Now, whatever the money is net money is flowing in there is taxes on to that and the question says that the tax is at flat 40 percent rate. So, 40 percent of this is going to be the taxes. So, this number multiplied by 0.4 will actually be giving this number.

So, we can estimate the taxes and if we reduce the taxes if we subtract the taxes from the cash flow we get cash flow after the taxes. So, this is my net cash flow after the taxes which is probably the figure that I want that after paying the taxes after paying the operation and maintenance cost and recovering all the revenues the company now will have a net cash inflow into their system now for the cash inflow into their system they will have to pay taxes. So, the 40 percent as taxes and when those taxes those 40 percent taxes are paid the company what company left with the cash flow after taxes which is used to estimate the net present value of the of the project or of the company that is operating this project.

So, this column the column that you the row that you see here actually gives the net cash flow after taxes, but one problem is still there, that this cash flow that you are seeing is coming in to different years and it is not normalized. So, the cash generated in first year

in the form of 3.9 [FL] while cash generated in the tenth year is around 36 [FL], so this 36 [FL] if you compare it with the first year or with the present value will not have the 36 year value, we have already discussed it that the time value of money should be brought into the picture and these values should normally should be normalized for the future times.

So, for that we use the rate of return or discount rate we can call that. So, it says that the discount rate is 12 percent discount rate or 12 percent rate of return is given into the question. So, we will use that 12 percent discount rate and get the discounted cash flow. So, how we will get the discounted cash flow we know the cash flow after the taxes. So, this 3.9 into sorry 3.9 divided by let us say for getting discounted cash flow for this. So, 3.9 divided by 1.12 because 12 percent is the net flow, 12 percent is the rate of return. So, 1.12 to the power t in this case is 1. So, 1.12 to the power 1, this becomes 3.52.

Similarly, for any arbitrary let us say you take this; so, this will become 14 point for this particular case it will become 14.508 divided by 1.12 to the power it is after 5 year to the power 5. So, that value will actually be equal to 8.32 t. Similarly, for the last one which is in the tenth year it is going to be whatever value is this divided by 1.12 to the power 10.

So, that way we will get the discounted cash flow and this discounted cash flow are the final values where we have incorporated all the aspects of the project. We have incorporated the O and M expenses for the project then revenues generated from the project what is the net saving then what is going to be the taxes onto that after taxes what is left and then whatsoever is left, what is the time value of that amount.

So, based on that we get from year 1 to 10 these are the net funds or net money that is going to be generated from the project. So, once we know these as per the concept of net present value we will have to sum all these.

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So, when we sum these numbers what we get is the, because that discounted cash flow is actually this. This is our discounted cash flow for a one particular year and this is the summation. So, summing the discounted cash flow for year here one to 10 this gives the total sum as rupees 76.83 [FL] rupees. So, 76.83 [FL] rupees is the sum of the discounted cash flow. Now, the initial outlay that was planned is 40 [FL] rupees. So, we get the net present value as sum of the discounted cash flow minus initial outlay. So, 76.83 minus 40 and 36.83 [FL] becomes the net present value of the project.

So, this is substantially higher than 1 sub means substantially higher than 0 and that that is why we can say that this project is likely to generate profits and likely to generate revenues for the firm or for the organization. So, that is how the concept of net present value is considered for the capital budgeting and for the assessment of economic feasibility of a project. So, once we are able to find out the NPV of the project we can make decisions about the whether it is economically feasible or not.

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The NPV usually is one of the most preferred methods as we said in the beginning. However, it also has certain pros and cons. So, the advantages include that it considers the time value of money. In calculation of NPV with the after cash flow and before cash flow both are considered over the life span of the project. Profitability and risk of the project are given high priority based on the rate of return and those factors that we choose and it eventually helps in maximizing the firms value.

While as, onto the negative sides if you see, it is relatively difficult to use because we need to discount all these values and calculate. It is not that difficult, but when you compare with a simple let us say payback period. So, for compared to those simple methods it is relatively little difficult then it cannot give the accurate decisions if amount of investment of mutually exclusive projects is not equal.

There are ways to handle this problem though how the when the time frame or the amount of investment of the mutually exclusive projects are not equal how to handle this, but generally it is not recommended in that senses because then we rather go with the rate of return or internal rate of return procedure which gives the more better clue about the preference of the mutually exclusive projects.

Further for unequal life project also when the life is unequal. So, the because one project will evaluate the net present value for 4 years time while other may evaluate for 6 year time. So, there is a time gap which makes the decision of the NPV questionable and the

discount rate which is used or the rate of return which is used is not calculated here, but rather is taken based on a based on secondary informations or secondary knowledge and that is what used in order to calculating the net present value because that discount rate has to be taken. So, that it depends on a taking discount rate or taking the time value of money from the secondary sources and it does not estimate that.

So, those are some of the disadvantages we will talk about the next method in the coming up session where we will talk about the internal rate of return which overcomes some of these discounts of NPV while handling the time value of money as well.

Thank you.