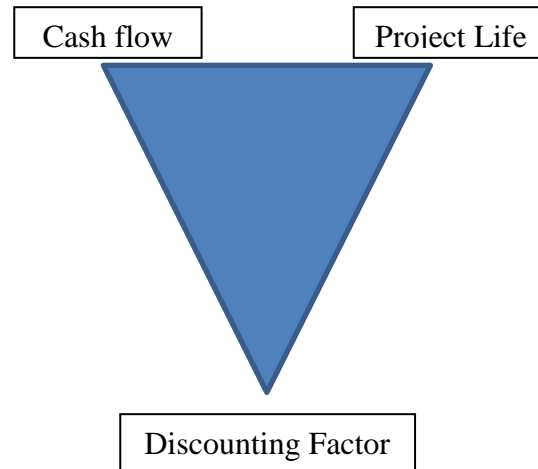


# CAPITAL BUDGETING TECHNIQUES

## Introduction:

Any investment decision depends upon the decision rule that is applied under circumstances. However, the decision rule itself considers following inputs.



The effectiveness of the decision rule depends on how these three factors have been properly assessed. Estimation of cash flows requires immense understanding of the project before it is implemented; particularly macro and micro view of the economy, polity and the company. Project life is very important; otherwise it will change the entire perspective of the project. So, great care is required to be observed for estimating the project life. Cost of capital is being considered as discounting factor which has undergone a change over the years. Cost of capital has different connotations in different economic philosophies. Particularly, Pakistan has undergone a change in its economic ideology from a closed-economy to open-economy. Hence determination of cost of capital would carry greatest impact on the investment evaluation. This chapter is focusing on various techniques available for evaluating capital budgeting projects. We will discuss all investment evaluation criteria from its economic viability point of view and how it can help in maximizing shareholders' wealth. We shall also look for following general virtues in each technique.

1. It should consider all cash flows to determine the true profitability of the project.
2. It should provide for an objective and unambiguous way of separating good projects from bad projects.
3. It should help ranking of projects according to its true profitability.
4. It should recognize the fact that bigger cash flows are preferable to smaller ones and early cash flows are preferable to later ones.
5. It should help to choose among mutually exclusive projects that project which maximizes the shareholders' wealth.
6. It should be a criterion which is applicable to any conceivable investment project independent of others.

A number of capital budgeting techniques are used in practice. They may be grouped in the following two categories:

- **Capital budgeting techniques under certainty**
- **Capital budgeting techniques under uncertainty**

### **Capital budgeting techniques under certainty:**

Capital budgeting techniques (Investment appraisal criteria) under certainty can also be divided into following two groups:

- i. Non-Discounted Cash Flow Criteria:**
  - a) Pay Back Period (PBP)
  - b) Accounting Rate Of Return (ARR)
- ii. Discounted Cash Flow Criteria:**
  - a) Net Present Value (NPV)
  - b) Internal Rate of Return (IRR)
  - c) Profitability Index (PI)

### **Non-Discounted Cash Flow Criteria:**

These are also known as traditional techniques:

#### **a) Pay Back Period (PBP) :**

The pay back period (PBP) is the traditional method of capital budgeting. It is the simplest and perhaps, the most widely used quantitative method for appraising capital expenditure decision.

#### **Meaning:**

It is the number of years required to recover the original cash outlay invested in a project.

#### **Methods to compute PBP:**

There are two methods of calculating the PBP.

- i. The first method can be applied when the CFAT is uniform. In such a situation the initial cost of the investment is divided by the constant annual cash flow: For example, if an investment of Rs. 100000 in a machine is expected to generate cash inflow of Rs. 20,000 p.a. for 10 years. Its PBP will be calculated using following formula:

$$PBP = \frac{\text{Initial Investment}}{\text{Constant Annual Cash inflow}} = \frac{100000}{20000} = 5\text{years}$$

- ii. The second method is used when a project's CFAT are not equal. In such a situation PBP is calculated by the process of cumulating CFAT till the time when cumulative cash flow becomes equal to the original investment outlays.

For example, A firm requires an initial cash outflow of Rs. 20,000 and the annual cash inflows for 5 years are Rs. 6000, Rs. 8000, Rs. 5000, Rs. 4000 and Rs. 4000 respectively. Calculate PBP. Here, When we cumulate the cash flows for the first three years, Rs. 19,000 is recovered. In the fourth year Rs. 4000 cash flow is generated by the project but we need to recover only Rs. 1000 so the time required recovering Rs. 1000 will be  $(Rs.1000/Rs.4000) \times 12 \text{ months} = 3 \text{ months}$ . Thus, the PBP is 3 years and 3 months (3.25 years).

**Decision Rule:**

The PBP can be used as a decision criterion to select investment proposal.

- ✓ If the PBP is less than the maximum acceptable payback period, accept the project.
- ✓ If the PBP is greater than the maximum acceptable payback period, reject the project.

This technique can be used to compare actual pay back with a standard pay back set up by the management in terms of the maximum period during which the initial investment must be recovered. The standard PBP is determined by management subjectively on the basis of a number of factors such as the type of project, the perceived risk of the project etc. PBP can be even used for ranking mutually exclusive projects. The projects may be ranked according to the length of PBP and the project with the shortest PBP will be selected.

**Merits:**

1. It is simple both in concept and application and easy to calculate.
2. It is a cost effective method which does not require much of the time of finance executives as well as the use of computers.
3. It is a method for dealing with risk. It favours projects which generates substantial cash inflows in earlier years and discriminates against projects which brings substantial inflows in later years . Thus PBP method is useful in weeding out risky projects.
4. This is a method of liquidity. It emphasizes selecting a project with the early recovery of the investment.

**Demerits:**

1. It fails to consider the time value of money. Cash inflows, in pay back calculations, are simply added without discounting. This violates the most basic principles of financial analysis that stipulates the cash flows occurring at different points of time can be added or subtracted only after suitable compounding/ discounting.
2. It ignores cash flows beyond PBP. This leads to reject projects that generate substantial inflows in later years. To illustrate, consider the cash flows of two projects, “A” & “B”:

Year	Project “A”	Project “B”
0	Rs. 200,000	Rs. 200,000
1	100,000	40,000
2	60,000	40,000
3	40,000	40,000
4	20,000	80,000
5		60,000
6		70,000

The PB criterion prefers A, which has PBP of 3 years in comparison to B, which has PBP of 4 years, even though B has very substantial cash flows in 5&6 years also. Thus, it does not consider all cash flows generated by the projects.

3. It is a measure of projects capital recovery, not profitability so this can not be used as the only method of accepting or rejecting a project. The organization need to use some other method also which takes into account profitability of the project.
4. The projects are not getting preference as per their cash flow pattern. It gives equal weightage to the projects if their PBP is same but their pattern is different. For example, each of the following projects requires a cash outlay of Rs.20,000. If we calculate its PBP it is same for all projects i.e. 4 years so all will be treated equally. But the cash flow pattern is different so in fact, project Y should be preferable as it gives higher cash inflow in the initial years.

## CASH INFLOWS

years	Project X	Project Y	Project Z
1	5,000	8,000	2,000
2	5,000	6,000	4,000
3	5,000	4,000	6,000
4	5,000	2,000	8,000
5	5,000	-	-

5. There is no logical base to decide standard PBP of the organization it is generally a subjective decision.
6. It is not consistent with the objective of shareholders' wealth maximization. The PBP of the projects will not affect the market price of equity shares.

### Uses:

The PBP can be gainfully employed under the following circumstances.

1. The PB method may be useful for the firms suffering from a liquidity.
2. It is very useful for those firms which emphasizes on short run earning performance rather than its long term growth.
3. The reciprocal of PBP is a good approximation of IRR which otherwise requires trial & error approach.

### Payback Reciprocal and the Rate of Return:

Payback is considered a good approximation of the rate of return under following two conditions.

1. The life of the project is too large or at least twice the payback period.
2. The project generates constant annual cash inflow.

Though pay back reciprocal is a useful way to estimate the project's IRR but the major limitation of it is all investment project does not satisfy the conditions on which this method is based. When the useful life of the project is not at least twice the PBP, it will always exceed the rate of return. Similarly, if the project is not yielding constant CFAT it cannot be used as an approximation of the rate of return.

### Discounted Payback Period:

One of the major limitations of PBP method is that it does not take into consideration time value of money. This problem can be solved if we discount the cash flows and then calculate the PBP. Thus, *discounted payback period* is the number of years taken in recovering the investment outlay on the present value basis. But it still fails to consider the cash flows beyond the payback. For example, one project requires investment of Rs.80,000 and it generates cash flow for 5 years as follows.

### Simple PBP and Discounted PBP

Years	0	1	2	3	4	5	Simple PBP	Discounted PBP
cash flow	(80,000)	22,000	30,000	40,000	32,000	16,000	2.7 years	
PV @ 20%		0.833	0.694	0.579	0.482	0.402		
PV		18,326	20,820	23,160	15,424	6,432		
Cumulative PV of Cash flow		18,326	39,146	62,306	77,730	84,162		4.03 Years

The simple pay back of the project is 2.7 years while discounted pay back is 4.03 years which is higher than simple pay back because the discounted payback is using cash flow after discounting it with the cost of capital.

#### b) Accounting/Average Rate of Return (ARR):

This method is also known as the return on investment (ROI), return on capital employed (ROCE) and is using accounting information rather than cash flow.

##### Meaning:

The ARR is the ratio of the average after tax profit divided by the average investment.

##### Method to compute ARR:

There are a number of alternative methods for calculating ARR. The most common method of computing ARR is using the following formula:

$$ARR = \frac{\text{Average Annual Profit After Tax}}{\text{Average Investment}} \times 100$$

The average profits after tax are determined by adding up the PAT for each year and dividing the result by the number of years.

The average investment is calculated by dividing the net investment by two. Thus,

Where, EBIT is earnings before interest and taxes, T tax rate,  $I_0$  book value of investment in the beginning,  $I_n$  book value of investment at the end of n years.

For example, A project requires an investment of Rs. 10,00,000. The plant & machinery required under the project will have a scrap value of Rs. 80,000 at the end of its useful life of 5 years. The profits after tax and depreciation are estimated to be as follows:

Years	1	2	3	4	5
<b>PAT (Rs.)</b>	50,000	75,000	125,000	130,000	80,000

We shall calculate ARR using above formula.

$$ARR = \frac{(50000 + 75000 + 125000 + 130000 + 80000) \div 5}{(1000000 + 80000) \div 2} = 17.04\%$$

#### **Decision Rule:**

The ARR can be used as a decision criterion to select investment proposal.

- ✓ If the ARR is higher than the minimum rate established by the management, accept the project.
- ✓ If the ARR is less than the minimum rate established by the management, reject the project.

The ranking method can also be used to select or reject the proposal using ARR. It will rank a project number one if it has highest ARR and lowest rank would be given to the project with lowest ARR.

#### **Merits:**

1. It is simple to calculate.
2. It is based on accounting information which is readily available and familiar to businessman.
3. It considers benefit over entire life of the project.

#### **Demerits:**

1. It is based upon accounting profit, not cash flow in evaluating projects.
2. It does not take into consideration time value of money so benefits in the earlier years or later years cannot be valued at par.
3. This method does not take into consideration any benefits which can accrue to the firm from the sale or abandonment of equipment which is replaced by a new investment. ARR does not make any adjustment in this regard to determine the level of average investments.
4. Though it takes into account all years income but it is averaging out the profit.
5. The firm compares any project's ARR with the one which is arbitrarily decided by management generally based on the firm's current return on assets. Due to this

yardstick sometimes super normal growth firm's reject profitable projects if it's ARR is less than the firm's current earnings.

**Use:**

The ARR can better be used as performance evaluation measure and control device but it is not advisable to use as a decision making criterion for capital expenditures of the firm as it is not using cash flow information.

**Discounted Cash Flow Criteria:**

These are also known as modern or time adjusted techniques because all these techniques take into consideration time value of money.

**a) Net Present Value (NPV):**

The net present value is one of the discounted cash flow or time-adjusted technique. It recognizes that cash flow streams at different time period differs in value and can be computed only when they are expressed in terms of common denominator i.e. present value.

**Meaning:**

The NPV is the difference between the present value of future cash inflows and the present value of the initial outlay, discounted at the firm's cost of capital.

The procedure for determining the present values consists of two stages. The first stage involves determination of an appropriate discount rate. With the discount rate so selected, the cash flow streams are converted into present values in the second stage.

**Method to compute NPV:**

The important steps for calculating NPV are given below

1. Cash flows of the investment project should be forecasted based on realistic assumptions. These cash flows are the incremental cash inflow after taxes and are inclusive of depreciation (CFAT) which is assumed to be received at the end of each year. CFAT should take into account salvage value and working capital released at the end.
2. Appropriate discount rate should be identified to discount the forecasted cash flows. The appropriate discount rate is the firm's opportunity cost of capital which is equal to the required rate of return expected by investors on investments of equivalent risk.
3. Present value (PV) of cash flows should be calculated using opportunity cost of capital as the discount rate.
4. NPV should be found out by subtracting present value of cash outflows from present value of cash inflows. The project should be accepted if NPV is positive (i.e.  $NPV > 0$ )



The NPV can be calculated with the help of equation.

**NPV = Present value of cash inflows – Initial investment**

$$W = \frac{A_1}{(1+K)^1} + \frac{A_2}{(1+K)^2} + \dots + \frac{A_n}{(1+K)^n} - C$$

$$NPV = \sum_{t=1}^n \frac{A_t}{(1+K)^t} - C \quad \text{OR} \quad NPV = \sum_{t=1}^n (CF_t \times PVIF_{K,t}) - CF_0$$

Where,

**A<sub>1</sub>, A<sub>2</sub> ...** represent the stream of benefits expected to occur if a course of action is adopted,

**C** is the cost of that action &

**K** is the appropriate discount rate to measure the quality of A's.

**W** is the NPV or, wealth which is the difference between the present worth of the stream of benefits and the initial cost.

**CF<sub>t</sub>** is the cash flow for t period

**PVIF** is the present value interest factor

#### **Decision Rule:**

The present value method can be used as an accept-reject criterion. The present value of the future cash streams or inflows would be compared with present value of outlays. The present value outlays are the same as the initial investment.

- If the NPV is greater than 0, accept the project
- If the NPV is less than 0, reject the project.

Symbolically, accept-reject criterion can be shown as below:

$$PV > C \rightarrow \text{Accept [NPV > 0]}$$

$$PV < C \rightarrow \text{Reject [NPV < 0]}$$

Where, PV is present value of inflows and C is the outlays

This method can be used to select between mutually exclusive projects also. Using NPV the project with the highest positive NPV would be ranked first and that project would be selected. The market value of the firm's share would increase if projects with positive NPVs are accepted.

For example,

Calculate NPV for a Project X initially costing Rs. 250000. It has 10% cost of capital.

It generates following cash flows:

Years	Cash flow (\$)	PV @ 10%	PV (\$)
1	90,000	0.909	81,810
2	80,000	0.826	66,080
3	70,000	0.751	52,570
4	60,000	0.683	40,980
5	50,000	0.621	31,050
		ΣPV	272,490
		NCO	(250,000)
		NPV	22,490

As the project has positive NPV, i.e. present value of cash inflows is greater than the cash outlays, it should be accepted.

#### **Merits:**

This method is considered as the most appropriate measure of profitability due to following virtues.

1. It explicitly recognizes the time value of money.
2. It takes into account all the years cash flows arising out of the project over its useful life.
3. It is an absolute measure of profitability.
4. A changing discount rate can be built into NPV calculation. This feature becomes important as this rate normally changes because the longer the time span, the lower the value of money & higher the discount rate.
5. This is the only method which satisfies the value-additivity principle. It gives output in terms of absolute amount so the NPVs of the projects can be added which is not possible with other methods. For example,  $NPV(X+Y) = NPV(X) + NPV(Y)$ . Thus, if we know the NPV of all projects undertaken by the firm, it is possible to calculate the overall value of the firm.
6. It is always consistent with the firm's goal of shareholders wealth maximization.

**Demerits:**

1. This method requires estimation of cash flows which is very difficult due to uncertainties existing in business world due to so many uncontrollable environmental factors.
2. It requires the calculation of the required rate of return to discount the cash flows. The discount rate is the most important element used in the calculation of the present values because different discount rates will give different present values. The relative desirability of the proposal will change with a change in the discount rate.
3. When projects under consideration are mutually exclusive, it may not give dependable results if the projects are having unequal lives, different cash flow pattern, different cash outlay etc.
4. It does not explicitly deal with uncertainty when valuing the project and the extent of management's flexibility to respond to uncertainty over the life of the project.
5. It ignores the value of creating options. Sometimes an investment that appears uneconomical when viewed in isolation may, in fact, create options that enable the firm to undertake other investments in the future should market conditions turn favourable. By not accounting properly for the options that investments in emerging technology may yield, naive NPV analysis can lead firms to invest too little.

**Use:**

NPV is very much in use capital budgeting practice being a true profitability measure.