Capital Budgeting

Nature of Investment Decisions

- The **investment decisions** of a firm are generally known as the **capital budgeting, or capital expenditure decisions.**

- The firm's investment decisions would generally include **expansion**, **acquisition**, **modernisation** and **replacement** of the long-term assets. Sale of a division or business (**divestment**) is also as an investment decision.

- Decisions like the change in the **methods of sales distribution**, or an **advertisement campaign** or a **research and development programme** have long-term implications for the firm's expenditures and benefits, and therefore, they should also be evaluated as investment decisions.

Features of Investment Decisions

- The exchange of current funds for future benefits.
- The funds are invested in long-term assets.
- The future benefits will occur to the firm over a series of years.

Importance of Investment Decisions

- Growth
- Risk
- Funding
- Irreversibility
- Complexity

Investment Evaluation Criteria

- Three steps are involved in the evaluation of an investment:
  1. Estimation of cash flows
  2. Estimation of the required rate of return (the opportunity cost of capital)
  3. Application of a decision rule for making the choice

Investment Decision Rule

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

Evaluation Criteria

- 1. ***Discounted Cash Flow (DCF) Criteria***
  - Net Present Value (NPV)
  - Internal Rate of Return (IRR)
  - Profitability Index (PI)
- 2. ***Non-discounted Cash Flow Criteria***
  - Payback Period (PB)
  - Discounted payback period (DPB)
  - Accounting Rate of Return (ARR)

Net Present Value Method

- Cash flows of the investment project should be forecasted based on realistic assumptions.
- Appropriate discount rate should be identified to discount the forecasted cash flows.
- Present value of cash flows should be calculated using the opportunity cost of capital as the discount rate.
- Net present value 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).

Net Present Value Method

- The formula for the net present value can be written as follows:

$$NPV = \left[\frac{C_1}{(1+k)} + \frac{C_2}{(1+k)^2} + \frac{C_3}{(1+k)^3} + \cdots + \frac{C_n}{(1+k)^n} \right] - C_0$$

$$NPV = \sum_{t=1}^{n} \frac{C_t}{(1+k)^t} - C_0$$

Calculating Net Present Value

- Assume that Project *X* costs Rs 2,500 now and is expected to generate year-end cash inflows of Rs 900, Rs 800, Rs 700, Rs 600 and Rs 500 in years 1 through 5. The opportunity cost of the capital may be assumed to be 10 per cent.

$$\text{NPV} = \frac{\text{Rs } 900}{(1+0.10)^1} + \frac{\text{Rs } 800}{(1+0.10)^2} + \frac{\text{Rs } 700}{(1+0.10)^3} + \frac{\text{Rs } 600}{(1+0.10)^4} + \frac{\text{Rs } 500}{(1+0.10)^5} - \text{Rs } 2{,}500$$

$$= [\text{Rs } 900(\text{PVF}_{1,\,0.10}) + \text{Rs } 800(\text{PVF}_{2,\,0.10}) + \text{Rs } 700(\text{PVF}_{3,\,0.10}) + \text{Rs } 600(\text{PVF}_{4,\,0.10}) + \text{Rs } 500(\text{PVF}_{5,\,0.10})] - \text{Rs } 2{,}500$$

$$= [\text{Rs } 900 \times 0.909 + \text{Rs } 800 \times 0.826 + \text{Rs } 700 \times 0.751 + \text{Rs } 600 \times 0.683 + \text{Rs } 500 \times 0.620] - \text{Rs } 2{,}500$$

$$= \text{Rs } 2{,}725 - \text{Rs } 2{,}500 = +\text{Rs } 225$$

Why is NPV Important?

- Positive net present value of an investment represents the maximum amount a firm would be ready to pay for purchasing the opportunity of making investment, or the amount at which the firm would be willing to sell the right to invest without being financially worse-off.

- The net present value can also be interpreted to represent the amount the firm could raise at the required rate of return, in addition to the initial cash outlay, to distribute immediately to its shareholders and by the end of the projects' life, to have paid off all the capital raised and return on it.

Acceptance Rule

- Accept the project when NPV is positive
  $NPV > 0$
- Reject the project when NPV is negative
  $NPV < 0$
- May accept the project when NPV is zero $NPV = 0$

The NPV method can be used to select between mutually exclusive projects; the one with the higher NPV should be selected.

Evaluation of the NPV Method

- NPV is most acceptable investment rule for the following reasons:
  - Time value
  - Measure of true profitability
  - Value-additivity
  - Shareholder value
- **Limitations:**
  - Involved cash flow estimation
  - Discount rate difficult to determine
  - Mutually exclusive projects
  - Ranking of projects

INTERNAL RATE OF RETURN METHOD

- The internal rate of return (IRR) is the rate that equates the investment outlay with the present value of cash inflow received after one period. This also implies that the rate of return is the discount rate which makes NPV = 0.

$$C_0 = \frac{C_1}{(1+r)} + \frac{C_2}{(1+r)^2} + \frac{C_3}{(1+r)^3} + \cdots + \frac{C_n}{(1+r)^n}$$

$$C_0 = \sum_{t=1}^{n} \frac{C_t}{(1+r)^t}$$

$$\sum_{t=1}^{n} \frac{C_t}{(1+r)^t} - C_0 = 0$$

CALCULATION OF IRR

- **Uneven Cash Flows**: Calculating IRR by Trial and Error
  - The approach is to select any discount rate to compute the present value of cash inflows. If the calculated present value of the expected cash inflow is lower than the present value of cash outflows, a lower rate should be tried. On the other hand, a higher value should be tried if the present value of inflows is higher than the present value of outflows. This process will be repeated unless the net present value becomes zero.

CALCULATION OF IRR

- **Level Cash Flows**
  - Let us assume that an investment would cost Rs 20,000 and provide annual cash inflow of Rs 5,430 for 6 years
  - The IRR of the investment can be found out as follows

$$\text{NPV} = -\text{Rs } 20{,}000 + \text{Rs } 5{,}430(\text{PVAF}_{6,r}) = 0$$

$$\text{Rs } 20{,}000 = \text{Rs } 5{,}430(\text{PVAF}_{6,r})$$

$$\text{PVAF}_{6,r} = \frac{\text{Rs } 20{,}000}{\text{Rs } 5{,}430} = 3.683$$

Acceptance Rule

- Accept the project when $r > k$
- Reject the project when $r < k$
- May accept the project when $r = k$
- In case of independent projects, IRR and NPV rules will give the same results if the firm has no shortage of funds.

Evaluation of IRR Method

- IRR method has following merits:
  - ✓Time value
  - ✓Profitability measure
  - ✓Acceptance rule
  - ✓Shareholder value
- IRR method may suffer from
  - ☒Multiple rates
  - ☒Mutually exclusive projects
  - ☒Value additivity

PROFITABILITY INDEX

- Profitability index is the ratio of the present value of cash inflows, at the required rate of return, to the initial cash outflow of the investment.
- The formula for calculating benefit-cost ratio or profitability index is as follows:

$$PI = \frac{\text{PV of cash inflows}}{\text{Initial cash outlay}} = \frac{PV(C_t)}{C_0}$$

$$= \sum_{t=1}^{n} \frac{C_t}{(1+k)^t} \div C_0$$

PROFITABILITY INDEX

- The initial cash outlay of a project is Rs 100,000 and it can generate cash inflow of Rs 40,000, Rs 30,000, Rs 50,000 and Rs 20,000 in year 1 through 4. Assume a 10 percent rate of discount. The PV of cash inflows at 10 percent discount rate is:

$$\begin{aligned}
PV &= \text{Rs } 40{,}000(PVF_{1,0.10}) + \text{Rs } 30{,}000(PVF_{2,0.10}) \\
&\quad + \text{Rs } 50{,}000(PVF_{3,0.10}) + \text{Rs } 20{,}000(PVF_{4,0.10}) \\
&= \text{Rs } 40{,}000 \times 0.909 + \text{Rs } 30{,}000 \times 0.826 \\
&\quad + \text{Rs } 50{,}000 \times 0.751 + \text{Rs } 20{,}000 \times 0.68 \\
NPV &= \text{Rs } 112{,}350 - \text{Rs } 100{,}000 = \text{Rs } 12{,}350 \\
PI &= \frac{\text{Rs } 112{,}350}{\text{Rs } 100{,}000} = 1.1235.
\end{aligned}$$

Acceptance Rule

- The following are the PI acceptance rules:
  - Accept the project when PI is greater than one. PI > 1
  - Reject the project when PI is less than one. PI < 1
  - May accept the project when PI is equal to one. PI = 1
- The project with positive NPV will have PI greater than one. PI less than means that the project's NPV is negative.

Evaluation of PI Method

- ***Time value:*** It recognises the time value of money.

- ***Value maximization***: It is consistent with the shareholder value maximisation principle. A project with PI greater than one will have positive NPV and if accepted, it will increase shareholders' wealth.

- ***Relative profitability:*** In the PI method, since the present value of cash inflows is divided by the initial cash outflow, it is a relative measure of a project's profitability.

- Like NPV method, PI criterion also requires calculation of cash flows and estimate of the discount rate. In practice, estimation of cash flows and discount rate pose problems.

PAYBACK

- **Payback** is the number of years required to recover the original cash outlay invested in a project.
- If the project generates constant annual cash inflows, the payback period can be computed by dividing cash outlay by the annual cash inflow. That is:

$$\text{Payback} = \frac{\text{Initial Investment}}{\text{Annual Cash Inflow}} = \frac{C_0}{C}$$

Example

- Assume that a project requires an outlay of Rs 50,000 and yields annual cash inflow of Rs 12,500 for 7 years. The payback period for the project is:

PAYBACK

- **Unequal cash flows** In case of unequal cash inflows, the payback period can be found out by adding up the cash inflows until the total is equal to the initial cash outlay.
- Suppose that a project requires a cash outlay of Rs 20,000, and generates cash inflows of Rs 8,000; Rs 7,000; Rs 4,000; and Rs 3,000 during the next 4 years. What is the project's payback?

  3 years + 12 × (1,000/3,000) months

  3 years + 4 months

Acceptance Rule

- The project would be accepted if its payback period is less than the maximum or **standard payback** period set by management.
- As a ranking method, it gives highest ranking to the project, which has the shortest payback period and lowest ranking to the project with highest payback period.

Evaluation of Payback

- Certain virtues:
  - Simplicity
  - Cost effective
  - Short-term effects
  - Risk shield
  - Liquidity
- Serious limitations:
  - ☒ Cash flows after payback
  - ☒ Cash flows ignored
  - ☒ Cash flow patterns
  - ☒ Administrative difficulties
  - ☒ Inconsistent with shareholder value

DISCOUNTED PAYBACK PERIOD

- The **discounted payback period** is the number of periods taken in recovering the investment outlay on the present value basis.
- The discounted payback period still fails to consider the cash flows occurring after the payback period.

Discounted Payback Illustrated

	Cash Flows (Rs)					Simple PB	Discounted PB	NPV at 10%
	C_0	C_1	C_2	C_3	C_4			
P	– 4,000	3,000	1,000	1,000	1,000	2 yrs	—	—
PV of cash flows	– 4,000	2,727	826	751	683	—	2.6 yrs	987
Q	– 4,000	0	4,000	1,000	2,000	2 yrs	—	—
PV of cash flows	– 4,000	0	3,304	751	1,366	—	2.9 yrs	1,421

ACCOUNTING RATE OF RETURN METHOD

- The accounting rate of return is the ratio of the average after-tax profit divided by the average investment. The average investment would be equal to half of the original investment if it were depreciated constantly.

$$\text{ARR} = \frac{\text{Average income}}{\text{Average investment}}$$

or

$$\text{ARR} = \frac{\left[\sum_{t=1}^{n} \text{EBIT}_t (1-T)\right] / n}{(I_0 + I_n)/2}$$

- A variation of the ARR method is to divide average earnings after taxes by the original cost of the project instead of the average cost.

Acceptance Rule

- This method will accept all those projects whose ARR is higher than the minimum rate established by the management and reject those projects which have ARR less than the minimum rate.

- This method would rank a project as number one if it has highest ARR and lowest rank would be assigned to the project with lowest ARR.

Evaluation of ARR Method

- The ARR method may claim some merits
  - ✓ Simplicity
  - ✓ Accounting data
  - ✓ Accounting profitability
- Serious shortcomings
  - ☒ Cash flows ignored
  - ☒ Time value ignored
  - ☒ Arbitrary cut-off