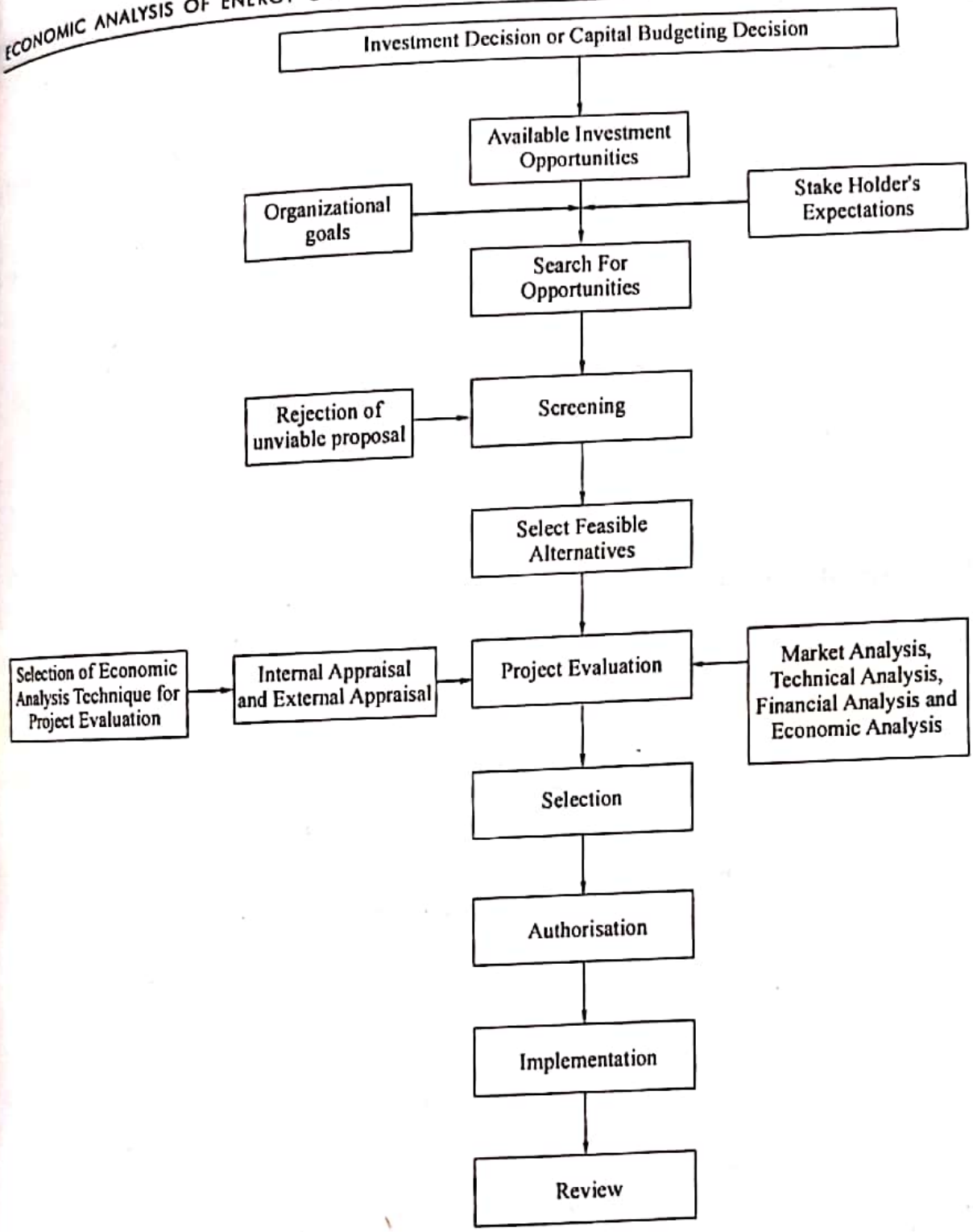

Fig. 5.2.

5.2. ECONOMIC ANALYSIS TECHNIQUE

Before investing in energy equipment, first of all the organisation decides to invest in increasing its energy efficiency. The method adopted for appraisal of capital investment proposals should be a sound one. Any appraisal method should provide the following :

(*i*) A basis of distinguishing between acceptable and non-acceptable projects.

(*ii*) Ranking of projects in order of their desirability.

(iii) Choosing among several alternatives.

(iv) A criterion which is applicable to any conceivable projects.

(v) Recognising the fact that bigger benefits are preferable to smaller ones and early benefits are preferable to later ones.

Following are the main methods generally used for economic analysis for project evaluation:

1. Pay-back period method
2. Discounted cash flow method
   (*a*) The net present value method
   (*b*) Present value index method
   (*c*) Internal rate of return method
3. Accounting rate of return method.

5.2.1. Simple Pay Back Period Method. The term pay-back (or pay out or pay off) refers to the period in which the project will generate the necessary cash to recoup the initial investment.

Example : If a project requires Rs 40,000 as initial investment and it will generate an annual cash inflow of Rs 10,000 for ten years, the pay-back period will be 4 years, calculated as follows :

$$\text{Simple pay back period} = \frac{\text{Initial investment}}{\text{Annual cash in flow}}$$

$$\text{or} = \frac{\text{First cost}}{\text{Yearly benefits} - \text{yearly costs}}$$

$$= \frac{\text{Rs } 40{,}000}{\text{Rs } 10{,}000} = 4.$$

Uneven cash in flows : In the above example, It is presumed that the annual cash inflows are uniform. How ever, it may not always be uniform. The cash flow each year may be uneven. In such a case cumulative cash inflows will be calculated and by interpolation, the exact pay-back period can be calculated.

Example : If a project requires an initial investment of Rs 10,000 and the annual cash inflows for the 5 years are Rs 3,000, Rs 4,000, Rs 2,500, Rs 2,000 and Rs 2,000 respectively. Then, the payback period will be calculated as follows :

Year	Cash inflows	Cumulative cash inflows
1	3,000	3,000
2	4,000	7,000
3	2,500	9,500
4	2,000	11,500
5	2,000	13,500

The above table shows that in three years Rs 9,500 has been recovered, Rs 500 is left out of initial investment. In the fourth year cash inflow is Rs 2,000. It means the pay-back period is between three to four years. So, in this condition the pay back period is calculated as follows :

$$\text{Simple pay back period} = 3 \text{ years} + \frac{500}{2,000} \text{ years} = 3.25 \text{ years}.$$

Merits and demerits : The merits and demerits in using simple pay back period are summarised below :

Merits :

(*i*) It is simple to apply, easy to understand.

(*ii*) In case of capital rationing, a company is compelled to invest in projects having shortest payback period.

(*iii*) This method gives an indication to the prospective investors specifying when their funds are likely to be repaid.

(*iv*) It does not involve assumptions about future interest rates.

(*v*) Ranking projects according to their ability to repay quickly may be useful to firms when experiencing liquidity constraints.

Demerits :

(*i*) It fails to take into account the timing of returns and the cost of capital. It fails to consider the whole life time of a project

(*ii*) Method ignores cash generation beyond the payback period and this leads to discrimination against projects that generate substantial cash inflows in later years.

(*iii*) It is a measure of a project's capital recovery, not profitability.

uitability : In spite of the above limitations, the pay-back method can profitably be sed in the following cases :

1. Firms suffering from liquidity crises.
2. Firms emphasing short-term earning performance.

2.2. Discounted Cash Flow (*DCF*) Method or Time Adjusted Technique. The iscounted cash flow technique is an improvement of the simple pay-back period method.

It takes into account both the interest factor as well as the return after the pay back period. Discounted cash flow method involves three stages.

1. Calculation of cash inflows and outflows over the full life of the asset.
2. Calculation of discounted cash flows.
3. Aggregating discounted cash inflows and comparing the total with discounted cash out flows.

DCF method recognises that Re. 1 of today (cash outflow) is having worth more than Re. 1 received at a future date (cash inflow). In this method, all the cash flows *i.e.*, cash outflow and cash inflow are to be discounted at the appropriate rate of interest which is the cost of capital in order to find out the present value.

Present value formula is the reversal of compound interest formula. So, the present value,

$$P.V. = \frac{F.V.}{\left(1+\frac{r}{100}\right)^n} \quad \text{or} \quad P.V. = \frac{F.V.}{(1+i)^n}$$

where $F.V.$ = Future value

r = Rate of interest per annum

n = Number of years

$P.V.$ = Present value

i = Interest rate per annum (or K discount rate of return pernum)

Example

If Re. 1 received at the end of 2nd year, is discounted at 10% per annum. Then the present value will be

$$P.V. = \frac{1}{(1+0.10)^2} = \text{Re } 0.82645$$

Discounted cash flows methods for evaluating capital investment proposals are of three types as explained below :

5.2.2.1. Net Present Value (NPV) Method. This method follows the DCF technique and recognises the time value of money. In this method cash inflows and cash outflows associated with each project are first worked out. The present values of these cash inflows and outflows are then calculated at the rate of return acceptable to the management. This rate of return is considered as the cut-off rate and is generally determined on the basis of cost of capital suitably adjusted to allow for the risk element involved in the project. The net present value is the difference between the total present value of future cash outflows and the total present value of future cash inflows.

The net present value (*NPV*) of a project is equal to the sum of the present values of all the cash flows associated with it. Net present value,

$$NPV = \frac{CF_0}{(1+K)^0} + \frac{CF_1}{(1+K)^1} + ... + \frac{CF_n}{(1+K)^n} = \sum_{t=0}^{n} \frac{CF_t}{(1+K)^t}$$

where CF_t = *Cash flow occuring at the end of year 't' (t = 0, 1 ...n)*

n = *Life of the project*

K = *Discount rate or cost of capital or cut-off rate.*

Example: Calculate the net present value for a small sized project requiring an initial investment of Rs 10,00,000 and which provides a net cash inflows of Rs 3,00,000 each years for five years. Assume cost of funds to be 10% per annum and there is no scrap value.

Solution.

$$NPV = (-)\frac{10,00,000}{(1.10)^0} + \frac{3,00,000}{(1.10)^1} + \frac{3,00,000}{(1.10)^2} + \frac{3,00,000}{(1.10)^3} + \frac{3,00,000}{(1.10)^4} + \frac{3,00,000}{(1.10)^5}$$

= Rs.1,37,236.

Acceptance* or rejection criterion :

(*i*) If *NPV* is Positive, *i.e.*, (*NPV* > zero)	Present value of cash inflows is more than cash outflows, then proposal must be accpeted.
(*ii*) If *NPV* is zero , *i.e.*, (*NPV* = zero)	Cash inflows are generated at a rate equal to the minimum required (Break even point). The Proposal can be accepted.
(*iii*) If *NPV* is negative, *i.e.*, (*NPV* < Zero)	Present value of cash in flows is less than the present value of cash out flows. Then the proposal should be rejected.

So, here NPV is positive (Rs. 1,37236). Proposal is accepted.

Merits of NPV method :

(*i*) The important one is that it recognises the time value of money.

(*ii*) It uses the discount rate which is the firm's cost of capital.

(*iii*) It considers all cash flows over the entire life of the project.

(*iv*) It is simple to find out the acceptable projects.

* Note : The acceptance or rejection of a proposal depends on the NPV.

Limitations :

(*i*) It is difficult to calculate

(*ii*) Unless the cost of capital is known, this method cannot be used.

(*iii*) It assumes that intermediate cash inflows are reinvested at the firms cost of capital which is not always true.

(*iv*) NPV method favours long lived projects.

5.2.2.2. Present Value Index Method or Profitability Index (*PI*) Method. It is the ratio of present value of cash inflows (discounted at the cost of capital which is the minimum required rate of return) to the present value of cash out flows.

$$PI \text{ or Benefits Cost Ratio} = \frac{\text{Present value of future cash inflows}}{\text{Present value of future cash outflows}} \times 100$$

Acceptance rule :

PI should be greater than one or alteast equal to one for the acceptance of the proposal.

Example : Project *A* requiring an investment of Rs 2,00,000 shows excess present value Rs 40,000 while another project '*B*' requiring an investment of Rs 20,000 shows an excess on present value of Rs 10,000.

	Project '*A*'	**Project '*B*'**
Present value index	$\frac{2,40,000}{2,00,000} \times 100$	$\frac{30,000}{20,000} \times 100$
	= 120%	= 150%

Here we select project 'B' according to the present value index method, because the present value index of project 'B' is greater.

Example :

	Proposal '*A*' Rs.	**Proposal '*B*'** Rs.
Present value of cash inflows	50,000	22,500
Initial capital outlay	40,000	15,000
NPV	10,000	7,500
Profitability index	$\frac{50,000}{40,000} \times 100 = 125\%$	$\frac{22,500}{15,000} \times 100 = 150\%$

According to NPV method, proposal '*A*' would be preferred. But according to *PI* method, proposal '*B*' would be preferred. It is seen from the above example, that the project

selection by NPV method is better (except under capital rationing) because it indicates the absolute figure of Rs 10,000 as apposed to Rs 7,500, according to PI method which is only a relative measure of profitability.

5.2.2.3. Internal Rate of Return Method. This method calculates the rate of return that the investment is expected to yield. *IRR* is the rate at which the sum of discounted cash inflows equals the sum of discounted cash outflows. So, IRR is the rate which discounts the cash flows to zero. So,

$$\frac{\text{Discounted cash inflows}}{\text{Discounted cash out flows}} = 1$$

Thus, in this method cash outflows and cash inflows are known but discount rate is to be calculated.

Example: If a sum of Rs 1600 invested in a project at starting of the years becomes Rs 2000 at the end of a year, the rate of return comes to 25%. Calculated as follows :

Initial investment or cashout flow,

$$I = \frac{R}{1+K}$$

where R = Cash inflow

K = Rate of return yielded by the investment (or IRR or discount rate)

$$1,600 = \frac{2,000}{1+K}$$

or $K = 0.25$ or 25%

It means $$\frac{\text{Discounted cash inflows}}{\text{Discount cash outflows}} = \frac{2000/(1+0.25)}{1600} = \frac{1600}{1600} = 1$$

Using formula refer article 5.2.2

$$P.V. = \frac{F.V.}{(1+K)^n} = \frac{2000}{(1+0.25)^1} = 1600$$

Net present value of flows = NPV of cash in flows – NPV of cash out flows

= discounted cash inflows – discounted cash outflows

= 1600 – 1600 = 0

In case the return is over a number of years, not limited to one year then the calculation would take the following pattern,

$$0 = \frac{CF_0}{(1+K)^0} + \frac{CF_1}{(1+K)^1} + \ldots\ldots + \frac{CF_n}{(1+K)^n} = \sum_{t=0}^{n} \frac{CF_t}{(1+K)^t}$$

where CF_t = Cash flow at the end of year 't'

K = Discount rate

n = Life of the project.

IRR of a project is the discount rate (K), which makes its *NPV* of cash flows to zero.

Acceptance/Rejection criterion : *IRR* is the maximum rate of interest which an organisation can afford to pay on the capital invested in a project. A project would qualify to be accepted if *IRR* exceeds the cut-off rate. While evaluating two or more projects, a project giving a higher *IRR* would be preferred. This means that higher the rate of return, higher the profit on investment.

Example : A company has to select one of the following two projects.

Year	Project A	Project B
	Cash out flows	Cash out flows
Year 0	Rs 11000	Rs 10000
	Cash in flows	Cash in flows
Year 1	Rs. 6,000	Rs. 1,000
Year 2	Rs. 2,000	Rs. 1,000
Year 3	Rs. 1,000	Rs. 2,000
Year 4	Rs. 5,000	Rs. 10,000

Using the internal rate of return method suggest which project is preferable.

Solution : The cash inflows are not uniform and hence the *IRR* will have to be calculated by trial and error method.

Project *A* :

Year	Cash inflows Rs.	Discounting Factor at 10%	Present Value Rs.
1	6,000	0.909	5,454
2	2,000	0.826	1,652
3	1,000	0.751	751
4	5,000	0.683	3,415
		Total Present Value	11,272

Here *NPV* is more than initial investment. Then taking a rate of 12%, the following results will come.

Year	Cash inflows Rs.	D.F at 12%	Present Value Rs.
1	6,000	0.893	5,358
2	2,000	0.797	1,594
3	1,000	0.712	712
4	5,000	0.636	3,180
		Total Present Value	10,844

The *IRR* is thus more than 10% but less than 12%. The exact rate may be calculated as follows:

$$IRR = \frac{\text{Difference in calculated Present value and required net cash out lay}}{\text{Difference in calculated present values}} \times \text{Difference in rate} + \text{lower rate}$$

or $$IRR = \frac{P_1 - C}{P_1 - P_2} \times D + L$$

where, L = Lower rate of interest

P_1 = Present value at lower rate

P_2 = Present value at higher rate

C = Cash outlay

D = Difference in rate

$$IRR = 10\% + \frac{11,272 - 11,000}{11,272 - 10,844} \times (12 - 10)\% = 10\% + \frac{272}{428} \times 2\% = 11.3\%$$

Project B :

Year	Cash inflows Rs	Discount factor at 15%	Present value Rs.
1	1,000	0.870	872
2	1,000	0.756	756
3	2,000	0.658	1,316
4	10,000	0.572	5,720
		Total Present Value	8662

Since present value at 15% comes only to Rs 8662, a lower rate of discount should be taken. Taking a rate of 10% the following will be the present value.

Year	Cash in flows Rs	Discounting factor 10%	Present value Rs
1	1,000	0.909	909
2	1,000	0.826	826
3	2,000	0.751	1,502
4	10,000	0.683	6,830
		Total present value	10,067

The *P.V.* at 10% comes to Rs 10,067 which is more or less equal to the initial investment

$$IRR = 10\% + \frac{10,067 - 10,000}{10,067 - 8,662} \times (15 - 10)\% = 10 + 0.24 = 10.24\%$$

The *IRR* in case of project '*A*' is higher as compared to project '*B*'. Hence project '*A*' is preferable.

Merits :

1. It considers the time value of money
2. It takes into account the cash flows over the entire life of project.
3. It makes sense to businessmen who prefer to think in terms of rate return and find an absolute quantity, like NPV, some what difficult to work with.
4. This method is more meaningful and acceptable to the user.

Limitations :

1. It is difficult to understand and compute.
2. It assumes that intermediate cash inflows are reinvested at the internal rate the project. But it may not be always correct.

5.2.3. Accounting or Average Rate of Return (ARR) Method. Average rate return is calculated by dividing the average net profit after tax by the average investme So, Accounting or Average Rate of Return,

$$ARR = \frac{\text{Average net profit after tax}}{\text{Average investment}} \times 100$$

where Average investment $= \frac{\text{original investment} + \text{salvage}}{2}$

Alternatively ARR is calculated by dividing the net profit after tax by the origi investment. It is also called return on investment (ROI) method.

$$ARR \text{ or } ROI = \frac{\text{Average net profit after tax}}{\text{Original investment}} \times 100$$

Acceptance rule. The project which gives the highest rate of return over the minimum required rate of return is acceptable.

ROI must always be higher than cost of money (interest rate). The greater the return on investment better is the investment.

Merits :

(i) It is simple to understand and use.

(ii) It places emphasis on the profitability of the project rather than on liquidity as in the case of payback method.

Limitations :

(i) It does not take into account the time value of money.

(ii) Cash inflow is not taken into account. Only net profit after tax is considered.

53. RISK ANALYSIS

In reality, the actual outcome is usually be different from that estimated. There are a number of reasons, cost and revenue factors which may not move in line with the original expectations especially as the life of the project increases. Decisions are made on the basis of forecasts which themselves depend upon future events whose occurrence cannot be anticipated with absolute certainty because of technical, economical, political, financial, business, foreign exchange and taxation, social, fiscal risks and other reasons. Some proposal may not involve any risk *e.g.*, government bonds. Some may be less risky *e.g.*, expansion of existing business while others may be more risky *e.g.*, taking up a new venture, or launching a new product.

The cash inflows occurring during the estimated life of project must be multiplied by the probability factor of getting the cash flow. For example, for a cash inflow of Rs 100 taking the probability factor of 0.7. Then Rs. 70 to be considered for the purpose of capital budgeting decisions.

According to risk, discount rate/probability factor is taken. If the risk is greater, the discount rate should be more. Discount factor or probability factor may be calculated according to past experience. For example

A firm submitted bids in respect of 200 projects during the last 10 years. It bids were accepted in respect of 40 such projects. It is again submitting its bid for 201st project. On the basis of past experience, it can be said that the chances of accepting the firm's bid for the 201st project are 20% and the chances of the bid being rejected are 80%.

From the above discussion it is clear that a firm must take into consideration the risk factor while determining return/cash flows from a project for capital budgeting decisions. However, incorporation of risk factor in capital budgeting decisions is a difficult task. Some of the popular techniques used for this purpose are as follows :

1. **General techniques**
   (*a*) Risk adjusted discount ratio
   (*b*) Certainty equivalent coefficient
2. **Quantitative techniques :**
   (*a*) Sensitivity analysis
   (*b*) Probability assignment
   (*c*) Standard deviation
   (*d*) Coefficient of variation
   (*e*) Decision tree.

Sensitivity analysis is an assessment of risk. Sensitivity analysis is carried out particularly on projects where the feasibility is marginal.

The various micro and macro factors that are considered for the sensitivity analysis are as follows :

1. **Micro factors :** Micro factors can be changed by firm's management. They are–
   (*a*) Operating expenses
   (*b*) Capital structure
   (*c*) Costs of debt, equity
   (*d*) Changing of the forms of finance e.g. leasing
   (*e*) Changing the project duration.
2. **Macro factors :** Macro factors cannot be changed by firm's management. They are –
   (*a*) Changes in interest rates
   (*b*) Changes in tax rates
   (*c*) Changes in the accounting standards e.g., method of calculating depreciation
   (*d*) Changes in the depreciation rates
   (*e*) Extension of various government subsidized projects e.g., rural electrification.
   (*d*) General employment trends e.g., if the government changes the salary scales.
   (*e*) Imposition of regulations on environmental and safety issues in the industry
   (*i*) Energy price change.
   (*j*) Technology changes.

So, sensitivity analysis is very important in taking any important decision because it brings changes in various parameters in the analysis of financial statements.

Usually sensitivity analysis provides information about cash flows under three assumptions:

(*i*) Pessimistic

(*ii*) Most likely, and

(*iii*) Optimistic

It explains how sensitive are the cash flows under these three different situations. The larger is the difference between the pessimistic and optimistic cash flows, the more risky is the project and vice versa.

Example : A Limited Company is considering investing in a project requiring a capital out-lay of Rs 2,00,000. Forecast for annual income is as follows :

Year	Rs.
1	90,000
2	90,000
3	80,000
4	80,000
5	60,000

You are required to evaluate the project according to each of the following methods

1. Pay back method
2. Rate of return on original investment method
3. Rate of return on average investment method
4. Net Present Value (*NPV*) method taking cost of capital as 10%
5. Profitability index (PI) method.

Solution :

Statement of cash flow

Year	Rs
0	(2,00,000)
1	90,000
2	90,000
3	80,000
4	80,000
5	60,000

1. Pay-back period : Rs 1,80,000 is recovered in 2 years. The balance of Rs 20,000 will be recovered in $\frac{20,000}{80,000}$ or 0.25 year.

Pay back period $= 2 \text{ years} + \frac{20000}{80000}$ years.

Payback period $(PBP) = 2.25$ years.

2. Rate of return on original investment method.

Year	Returns (Rs)
1	90,000
2	90,000
3	80,000
4	80,000
5	60,000
Total Returns	4,00,000

Average Annual Return Rs. 80,000

Rate of Return $= \frac{80,000}{2,00,000} \times 100 = 40\%$

3. Rate of Return on average investment method $= \frac{80,000}{1,00,000} \times 100 = 80\%$

4. Net present value method taking cost of capital as 10%

Discounted cash flow.

Year	Cash flow (Rs.)	Discounted factor @ 10%	Present value (Rs)
0	(2,00,000)	1	(2,00,000)
1	90,000	0.909	81,810
2	90,000	0.826	74,340
3	80,000	0.751	60,080
4	80,000	0.683	54,640
5	60,000	0.621	37,260
		Excess cash inflow (NPV)	1,08,130

5. Profitability index method.

$$= \frac{\text{Total present value of cash inflows}}{\text{Total present value of cash outflows}}$$

$$= \frac{81,810 + 74,340 + 60,080 + 54,640 + 37,260}{2,00,000} = \frac{3,08,130}{2,00,000}$$

$= 1.541$ or 154%.