# TECHNIQUES OF CAPITAL BUDGETING

# CAPITAL EXPENDITURES AND THEIR IMPORTANCE

- The basic characteristics of a capital expenditure (also referred to as a capital investment or just project) is that it involves a current outlay (or current and future outlays) of funds in the expectation of receiving a stream of benefits in future

- Importance stems from
  - Long-term consequences
  - Substantial outlays
  - Difficulty in reversing

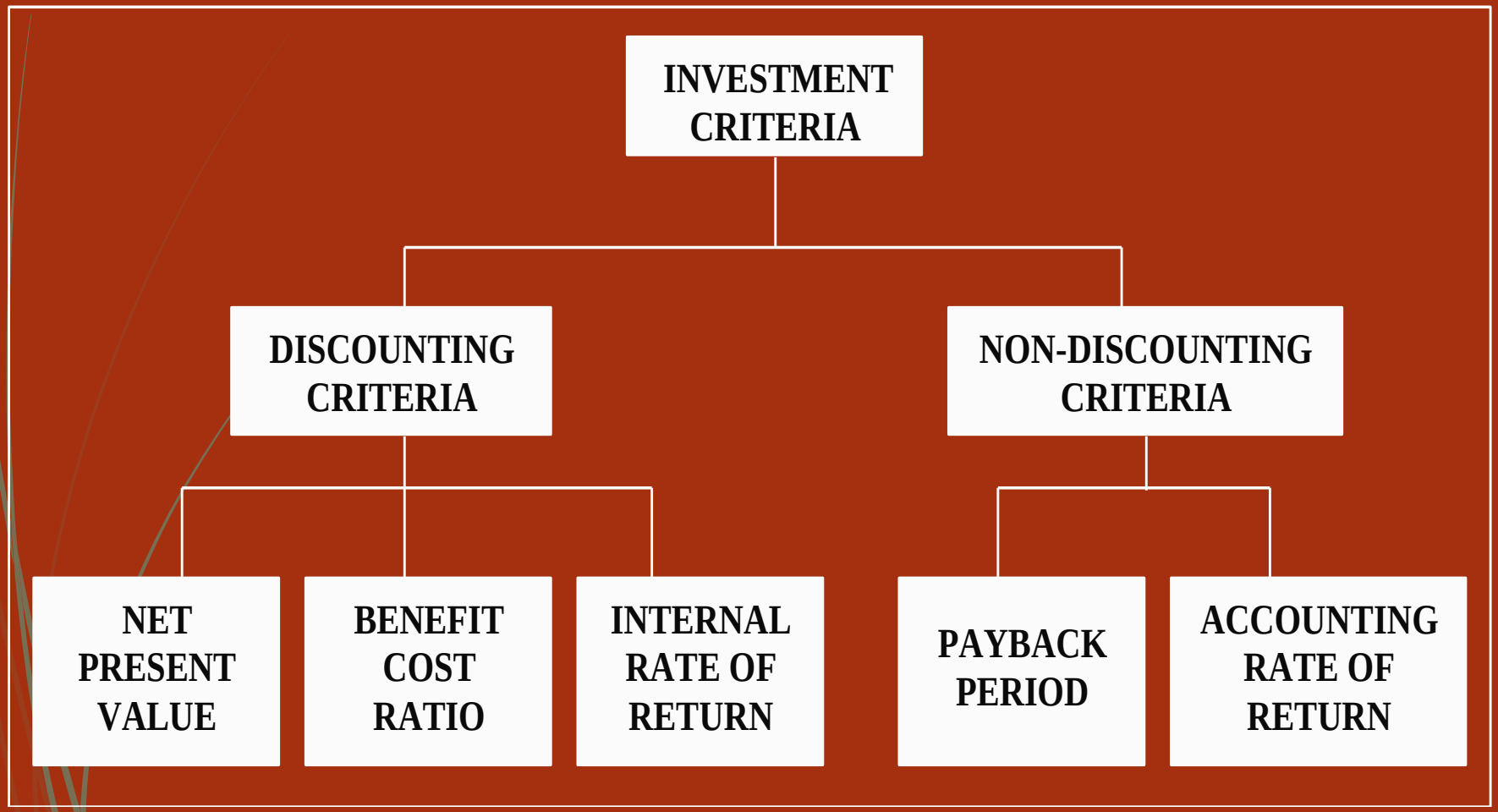
# CAPITAL BUDGETING PROCESS

- Identification of Potential Investment Opportunities
- Assembling of Investment Proposals
- Decision Making
- Preparation of Capital Budget and Appropriations
- Implementation
- Performance Review

# PROJECT CLASSIFICATION

- Mandatory Investments
- Replacement Projects
- Expansion Projects
- Diversification Projects
- Research and Development Projects
- Miscellaneous Projects

# INVESTMENT CRITERIA



# 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.

# NET PRESENT VALUE

$$NPV = \sum_{t=1}^{n} \frac{C_t}{(1 + r_t)^t} - \text{Initial investment}$$

# 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, $NPV = 0$

# PROPERTIES OF THE NPV RULE

- Npvs are additive
- Intermediate cash flows are invested at cost of capital
- Npv calculation permits time-varying discount rates
- Npv of a simple project as the discount rate

# Benefit-Cost Ratio/ Profitability Index

- Profitability index/ Benefit-cost Ratio is the ratio of the present value of cash inflows, at the required rate of return, to the initial cash outflow of the investment.

Benefit-cost Ratio : $BCR = \frac{PVB}{I}$

*PVB* = present value of benefits
*I* = initial investment

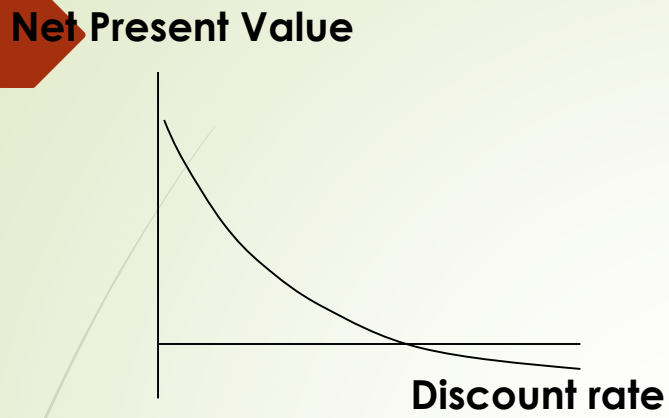
$$PI = \frac{\text{PV of cash inflows}}{\text{Initial cash outlay}} = \frac{PV(C_t)}{C_0}$$

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

# 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.

# INTERNAL RATE OF RETURN




The internal rate of return (IRR) of a project is the discount rate that makes its NPV equal to zero. It is represented by the point of intersection in the above diagram

*Net Present Value*

- Assumes that the discount rate (cost of capital) is known.
- Calculates the net present value, given the discount rate.

*Internal Rate of Return*

- Assumes that the net present value is zero
- Figures out the discount rate that makes net present value zero

# Acceptance Rule

- Accept the project when $r > k$
- Reject the project when $r < k$
- May accept the project when $r = k$

# PROBLEMS WITH IRR

- Non-conventional cash flows
- Mutually exclusive projects
- Lending vs. Borrowing

# NPV vs IRR

- NPV & IRR are two closely related investment criteria.
- Both are time adjusted methods for measuring an investment's worth.
- In case of independent projects, the two methods lead to the same decisions.
- However, under certain situations, a conflict arises between the two.

# Conventional & Non-Conventional Cash Flows

- A conventional investment has cash flows the pattern of an initial cash outlay followed by cash inflows. Conventional projects have only one change in the sign of cash flows; for example, the initial outflow followed by inflows, i.e., – + + +.

- A non-conventional investment, on the other hand, has cash outflows mingled with cash inflows throughout the life of the project. Non-conventional investments have more than one change in the signs of cash flows; for example, – + + + – ++ – +.

# NPV vs. IRR

- **Conventional Independent Projects:**

  In case of conventional investments, which are **economically *independent*** of each other, NPV and IRR methods result in same accept-or-reject decision if the firm is not constrained for funds in accepting all profitable projects.

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# NPV vs. IRR

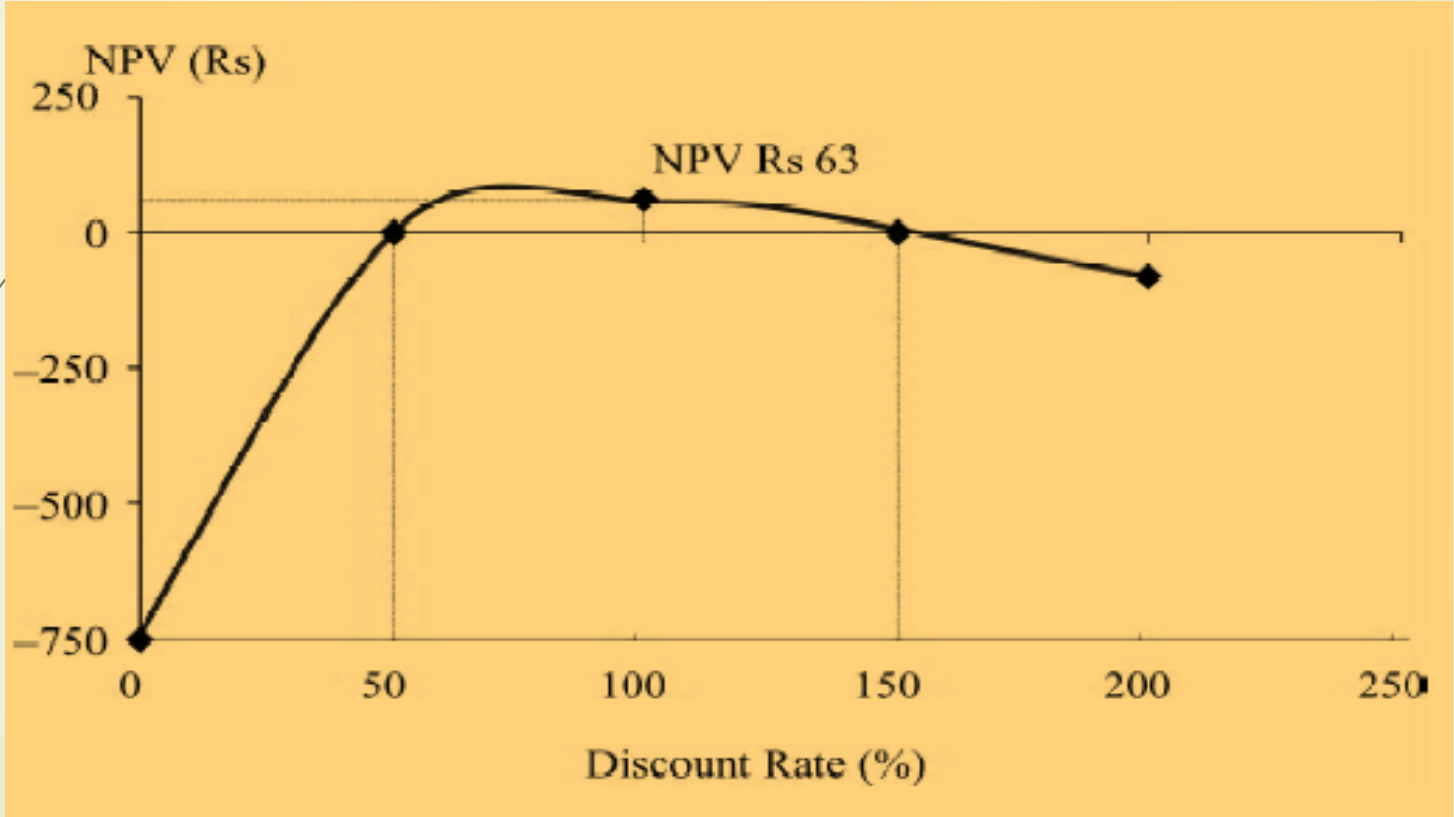
- **Lending and borrowing-type projects:**
  - Project with initial outflow followed by inflows is a **lending type project**, and project with initial inflow followed by outflows is a **borrowing type project.** Both are conventional projects.

| Project | Cash Flows (Rs) | | | NPV at 10% |
|---|---|---|---|---|
| | $C_0$ | $C_1$ | IRR | |
| X | −100 | 120 | 20% | 9 |
| Y | 100 | −120 | 20% | −9 |

# Problem of Multiple IRRs

- A project may have both lending and borrowing features together.
- IRR method, when used to evaluate such non-conventional investment can yield multiple internal rates of return because of more than one change of signs in cash flows.
- The reason for more than one rate of return solution lies in the algebra of the IRR equation.

# Dual IRR for Project I



# Dual IRR for Project I

- Which of the two rates is correct?
- The project is worthwhile only when the opportunity cost of capital falls between these two rates.
- Positive NPV at discount rate ranging between 50% and 150%.
- A number of adaptation of IRR criterion have been suggested to take care of the problem of multiple rates. But none works satisfactorily.
- Thus, simple straightforward alternative is to use NPV rule.

# Case of Ranking Mutually Exclusive Projects

- Investment projects are said to be mutually exclusive when only one investment could be accepted and others would have to be excluded.
- Two independent projects may also be mutually exclusive if a financial constraint is imposed.
- The NPV and IRR rules give conflicting ranking to the projects under the following conditions:
  - The cash flow pattern of the projects may differ. That is, the cash flows of one project may increase over time, while those of others may decrease or *vice-versa*.
  - The cash outlays of the projects may differ.
  - The projects may have different expected lives.

# Timing of cash flows

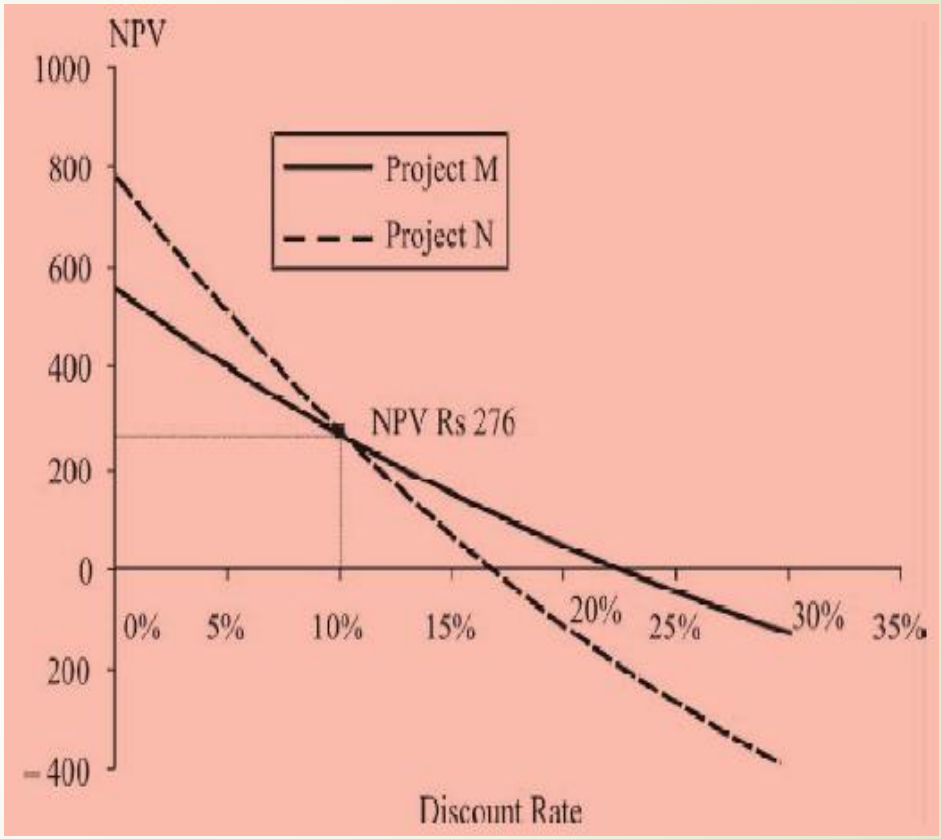
- The most commonly found condition for the conflict between the NPV and IRR methods is the difference in the timing of cash flows. Let us consider the following two Projects, M and N.

| Project | Cash Flows (Rs) | | | | NPV at 9% | IRR |
|---|---|---|---|---|---|---|
| | $C_0$ | $C_1$ | $C_2$ | $C_3$ | | |
| M | −1,680 | 1,400 | 700 | 140 | 301 | 23% |
| N | −1,680 | 140 | 840 | 1,510 | 321 | 17% |

# Cont....

| Discount Rate (%) | Project M | Project N |
|---|---|---|
| 0 | 560 | 810 |
| 5 | 409 | 520 |
| 10 | 276 | 276 |
| 15 | 159 | 70 |
| 20 | 54 | -106 |
| 25 | -40 | -257 |
| 30 | -125 | -388 |

**NPV Profiles of Projects M and N**




**NPV versus IRR**

The NPV profiles of two projects intersect at 10 per cent discount rate. This is called **Fisher's intersection**.

# Incremental approach

- It is argued that the IRR method can still be used to choose between mutually exclusive projects if we adapt it to calculate rate of return on the incremental cash flows.
- The incremental approach is a satisfactory way of salvaging the IRR rule. But the series of incremental cash flows may result in negative and positive cash flows. This would result in multiple rates of return and ultimately the NPV method will have to be used.

| | Cash Flows (Rs) | | | | | |
|---|---|---|---|---|---|---|
| Project | $C_0$ | $C_1$ | $C_2$ | $C_3$ | NPV at 9% | IRR |
| $(M - N)$ | 0 | – 1,260 | 140 | 1,370 | 20 | 10% |

| Project | Cash Flows (Rs) $C_0$ | $C_1$ | $C_2$ | $C_3$ | NPV at 9% | IRR |
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**As per Incremental Approach, Project N over Project M**

| Project | Cash Flows (Rs) $C_0$ | $C_1$ | $C_2$ | $C_3$ | NPV at 9% | IRR |
|---|---|---|---|---|---|---|
| (M – N) | 0 | – 1,260 | 140 | 1,370 | 20 | 10% |

The IRR on incremental flows is 10%
It is more than opportunity cost of 9%.
Therefore Project N is better than Project M.

# Modified Internal Rate of Return

- The **modified internal rate of return** (MIRR) is the compound average annual rate that is calculated with a reinvestment rate different than the project's IRR.

# Steps for calculating MRR

- Step 1 : Calculate PVC (Present Value of Costs)
- Step 2 : Calculate terminal value of cash inflows expected from the project.
- Step 3 : Obtain MIRR

# PAYBACK PERIOD

Payback period is the length of time required to recover the initial outlay on the project

| Pros | Cons |
| --- | --- |
| • Simple | • Fails to consider the time value of money |
| • Rough and ready method for dealing with risk | • Ignores cash flows beyond the payback period |
| • Emphasises earlier cash inflows | |

# Discounted Pay Back Period

- Takes into account the TVM.
- Improvement over pay back period.

# Accounting Rate of Return

- 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.
- 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.

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

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

# INVESTMENT APPRAISAL IN PRACTICE

- Over time, discounted cash flow methods have gained in importance and internal rate of return is the most popular evaluation method.

- Firms typically use multiple evaluation methods.

- Accounting rate of return and payback period are widely employed as supplementary evaluation methods.