UNIT-3
CAPITAL BUDGETING

Structure

3.0 INTRODUCTION

Capital budgeting, and **investment appraisal**, is the planning process used to determine whether an organization's long term investments such as purchase new machinery, replacement of machinery, new plants, new products, and research development projects are worth the funding of cash through the firm's capitalization structure (debt, equity or retained earnings). It is the process of allocating resources for major capital, or investment, expenditures. One of the primary goals of capital budgeting investments is to increase the value of the firm to the shareholders.

An efficient allocation of capital is the most important finance function in modern times. It involves decisions to commit the firm's funds to long-term assets. Capital budgeting or investment decisions are of considerable importance to a firm since they tend to determine its value by influencing its growth, profitability and risk. In this unit, we will focus on the nature and evaluation of capital budgeting decisions. You will learn about the net present value and internal rate of return methods. The unit will also discuss the cost of capital, emphasizing on the calculation of cost of debt and equity capital and retained earnings.

3.1 Learning Objectives

After going through this unit, you will be able to:

- Understand the nature and importance of investment decisions.
- Understand the capital budgeting and investment proccess, including planning and control.
- Explain the methods of calculating net present value (NPV) and internal rate of return (IRR).
- .Describe the non-DCF evaluation criteria: payback and accounting rate of return.
- Illustrate the computation of discounted payback. ,
- Compare NPV and IRR and emphasize the superiority of NPV rule.
- Understand how to take investment decisions under capital rationing.

3.2 NATURE AND TYPES OF INVESTMENT DECISIONS

The investment decisions of a firm are generally known as the capital budgeting, or capital expenditure decisions. A capital budgeting decision may be defined as the firm's decision to invest its current funds most efficiently in the long-term assets in anticipation of an expected flow of benefits over a series of years. The long-term assets are those that affect the firm's operations beyond the one-year period. The firm's investment decisions would generally include expansion, acquisition, modernization 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. It is important to note that investment in the long-term assets invariably requires large funds to be tied up in the current assets such as inventories and receivables. As such, investment in fixed and current assets is one single activity.

The following are the 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.

It is significant to emphasize those expenditures and benefits of an investment should be measured in cash. In the investment analysis, it is cash flow, which is important, not the accounting profit. It may also be pointed out that investment decisions affect the firm's value. The firm's value will increase if investments are profitable and add to the shareholders' wealth. Thus, investments should be evaluated on the basis of a criterion, which is compatible with the objective of the shareholders' wealth maximization. An investment will add to the shareholders' wealth if it yields benefits in excess of the minimum benefits as per the opportunity cost of capital. In this unit, we assume that the investment project's opportunity cost of capital is known. We also assume that the expenditures and benefits of the investment are known with certainty. Both these assumptions are relaxed in later units.

3.2.1 Importance of Investment Decisions

Investment decisions require special attention because of the following reasons:[1]

- They influence the firm's growth in the long run
- They affect the risk of the firm
- They involve commitment of large amount of funds
- They are irreversible, or reversible at substantial loss
- They are among the most difficult decisions to make.

Growth: The effects of investment decisions extend into the future and have to be endured for a longer period than the consequences of the current operating expenditure. A firm's decision to invest in long-term assets has a decisive influence on the rate and direction of its growth. A wrong decision can prove disastrous for the continued survival of the firm; unwanted or unprofitable expansion of assets will result in heavy operating costs to the firm. On the other hand, inadequate investment in assets would make it difficult for the firm to compete successfully and maintain its market share.

Risk: A long-term commitment of funds may also change the risk complexity of the firm. If the adoption of an investment increases average gain but causes frequent fluctuations in its earnings, the firm will become more risky. Thus, investment decisions shape the basic character of a firm.

Funding: Investment decisions generally involve large amount of funds, which make it imperative for the firm to plan its investment programmes very carefully and make an advance arrangement for procuring finances internally or externally.

Irreversibility: Most investment decisions are irreversible. It is difficult to find a market for such capital items once they have been acquired. The firm will incur heavy losses if such assets are scrapped.

Complexity: Investment decisions are among the firm's most difficult decisions. They are an assessment of future events, which are difficult to predict. It is really a complex problem to correctly estimate the future cash flows of an investment. Economic, political, social and technological forces cause the uncertainty in cash flow estimation.

There are many ways to classify investments. One classification is as follows:

- Expansion of existing business
- Expansion of new business
- Replacement and modernization.

3.2.2 Expansion and Diversification

A company may add capacity to its existing product lines to expand existing operations. For example, the Gujarat State Fertilizer Company (GSFC) may increase its plant capacity to manufacture more urea. It is an example of related diversification. A firm may expand its activities in a new business. Expansion of a new business requires investment in new products and a new kind of production activity within the firm. If a packaging manufacturing company invests in a new plant and machinery to produce ball bearings, which the firm has not manufactured before, this represents expansion of new business or unrelated diversification. Sometimes a company acquires existing firms to expand its business. In either case, the firm makes investment in the expectation of additional revenue. Investments in existing or new products may also be called as revenue-expansion investments.

Check Your Progress

1. How do we define capital budgeting decisions?
2. How do we usually define long-term assets?
3. What type of decisions may be termed as a firm's long-term investment decisions?
4. Why do investment decisions require special attention from a firm's management?

3.2.3 Replacement and Modernization

The main objective of modernization and replacement is to improve operating efficiency and reduce costs. Cost savings will reflect in the increased profits, but the firm's revenue may remain unchanged. Assets become outdated and obsolete with technological changes. The firm must decide to replace those assets with new assets that operate more economically. If a cement company changes from semi-automatic drying equipment to fully automatic drying equipment, it is an example of modernization and replacement. Replacement decisions help to introduce more efficient and economical assets and therefore, are also called cost-reduction investments. However, replacement decisions that involve substantial modernization and technological improvements expand revenues as well as reduce costs.

Yet another useful way to classify investments is as follows:

- Mutually exclusive investments
- Independent investments
- Contingent investments

3.2.4 Mutually Exclusive Investments

Mutually exclusive investments serve the same purpose and compete with each other. If one investment is undertaken, others will have to be excluded. A company may, for example, either use a more labour-intensive, semi-automatic machine, or employ a more capital-intensive, highly automatic machine for production. Choosing the semiautomatic machine precludes the acceptance of the highly automatic machine.

3.2.5 Independent Investments

Independent investments serve different purposes and do not compete with each other. For example, a heavy engineering company may be considering expansion of its plant capacity to manufacture additional excavators and addition of new production facilities to manufacture a new product—light commercial vehicles. Depending on their profitability and availability of funds, the company can undertake both investments.

3.2.6 Contingent Investments

Contingent investments are dependent projects; the choice of one investment necessitates undertaking one or more other investments. For example, if a company decides to build a factory in a remote, backward area, it may have to invest in houses, roads, hospitals, schools etc. for employees to attract the work force. Thus, building of factory also requires investment in facilities for employees. The total expenditure will be treated as one single investment.

3.3 INVESTMENT EVALUATION CRITERIA

Three steps are involved in the evaluation of an investment:

- Estimation of cash flows
- Estimation of the required rate of return (the opportunity cost of capital)
- Application of a decision rule for making the choice

The first two steps, discussed in the subsequent units, are assumed as given. Thus, our discussion in this unit is confined to the third step. Specifically, we focus on the merits and demerits of various decision rules.

3.3.1 Investment Decision Rule

The investment decision rules may be referred to as capital budgeting techniques, or investment criteria. A sound appraisal technique should be used to measure the economic worth of an investment project. The essential property of a sound technique is that it should maximize the shareholders' wealth. The following other characteristics should also be possessed by a sound investment evaluation criterion:[2]

- 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 recognize 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 maximizes the shareholders' wealth.
- It should be a criterion which is applicable to any conceivable investment project independent of others.

These conditions will be clarified as we discuss the features of various investment criteria in the following pages.

3.3.2 Evaluation Criteria

A number of investment criteria (or capital budgeting techniques) are in practice. They may be grouped in the following two categories:

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
   - Accounting rate of return (ARR)

Discounted payback is a variation of the payback method. It involves discounted cash flows, but, as we shall see later, it is not a true measure of investment profitability. We will show in the following pages that the net present value criterion is the most valid technique of evaluating an investment project. It is consistent with the objective of maximising the shareholders' wealth.

> **Check Your Progress**
>
> 5. Which are the two main categories in which we divide the evaluation criteria of capital budgeting decisions?

3.4 NET PRESENT VALUE METHOD

The net present value (NPV) method is the classic economic method of evaluating the investment proposals. It is a DCF technique that explicitly recognizes the time value of money. It correctly postulates that cash flows arising at different time periods differ in value and are comparable only when their equivalents—present values—are found out. The following steps are involved in the calculation of NPV:

- 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. The appropriate discount rate is the project's opportunity cost of capital, which is equal to the required rate of return expected by investors on investments of equivalent risk.
- 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).

Let us consider an example.

Illustration 3.1: Calculating Net Present Value

Assume that Project A costs Rs3000 now and is expected to generate year-end cash inflows of Rs 1000, Rs 900, Rs 800, Rs 700, and Rs 600 in 5 years. The opportunity cost of the capital may be assumed to be 10 per cent.

The net present value for Project A can be calculated by referring to the present value table. The calculations are shown below:

$$NPV = \frac{Rs\ 1000}{(1+0.10)} + \frac{Rs\ 900}{(1+0.10)^2} + \frac{Rs\ 800}{(1+0.10)^3} + \frac{Rs\ 700}{(1+0.10)^4} + \frac{Rs\ 600}{(1+0.10)^5} - Rs\ 3500$$

NPV = [Rs 1000($PVF_{1,0.10}$)+ Rs 900($PVF_{2,0.10}$)+ Rs 800($PVF_{3,0.10}$)+ Rs 700($PVF_{4,0.10}$)+ Rs 600($PVF_{5,0.10}$)]- Rs 3000

NPV = [Rs 1000x 0.909+Rs 900x0.826+Rs 800x 0.751+Rs 700x 0.683+Rs 600 x 0.6201 - Rs 3000

NPV = Rs 3,104 - Rs 3,000=+ Rs 104

Thus, it generates a positive net present value (NPV = Rs 104). Project A adds to the wealth of owners; therefore, it should be accepted.

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

$$NPV=V= \frac{A1}{(1+i)} + \frac{A2}{(1+i)^2} + \cdots \frac{An}{(1+i)^n} - A_0 \qquad (1)$$

where A_1, A_2... represent net cash inflows (after but before depreciation) in year 1, 2..., A_0 is the initial cost of the investment and n is the expected life of the investment. I=rate of interest

3.4.1 Why is NPV Important?

A question may be raised: why should a financial manager invest Rs 3,000in Project A? Project A should be undertaken if it is best for the company's shareholders; they would like their shares to be as valuable as possible. Let us assume that the total market value of a hypothetical company is Rs 10,000, which includes Rs 3,000 cash that can be invested in Project A. Thus the value of the company's other assets must be Rs 7,000. The company has to decide whether it should spend cash and accept Project A or to keep the cash and reject Project A. Clearly Project A is desirable since its PV (Rs 3,104) is greater than the Rs 3,000 cash. If Project A is accepted, the total market value of the firm will be: Rs 7,000 +• PV of Project A = Rs 7,000 + Rs 3104 = Rs 10,104; that is, an increase by Rs 104. The company's total market value would remain only Rs 10,000 if Project A was rejected.

3.4.2 Acceptance Rule

It should be clear that the acceptance rule using the NPV method is to accept the investment project if its net present value is positive (NPV > 0) and to reject it if the net present value is negative (NPV < 0). Positive NPV contributes to the net wealth of the shareholders, which should result in the increased price of a firm's share. The positive net present value will result only if the project generates cash inflows at a rate higher than the opportunity cost of capital. A project with zero NPV (NPV = 0) may be accepted. A zero NPV implies that project generates cash flows at a rate just equal to the opportunity cost of capital. The NPV acceptance rules are:

- 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. Using the NPV method, projects would be ranked in order of net present values; that is, first rank will be given to the project with highest positive net present value and so on.

3.4.3 Evaluation of NPV Method

NPV is the true measure of an investment's profitability. It provides the most acceptable investment rule for the following reasons:

- ***Time value:*** It recognizes the time value of money—a rupee received today is worth more than a rupee received tomorrow.
- ***Measure of true profitability:*** It uses all cash flows occurring over the entire life of the project in calculating its worth. Hence, it is a measure of the project's true profitability. The NPV method relies on estimated cash flows and the discount rate rather than any arbitrary assumptions, or subjective considerations.
- ***Value-additivity :*** The discounting process facilitates measuring cash flows in terms of present values; that is, in terms of equivalent, current rupees. Therefore, the NPVs of projects can be added. For example, NPV (A + B) = NPV (A) + NPV (B). This is called the value-additivity principle. It implies that if we know the NPVs of individual projects, the value of the firm will increase by the sum of their NPVs. We can also say that if we know values of individual assets, the firm's value can simply be found by adding their values. The value-additivity is an important property of an investment criterion because it means that each project can be evaluated, independent of others, on its own merit.

- ***Shareholder value:*** The NPV method is always consistent with the objective of maximization of the shareholder value. This is the greatest virtue of me method.

Are there any limitations in using the NPV rule? The NPV method is a theoretically sound method. In practice, it may pose some computational problems.

- ***Cash flow estimation:*** The NPV method is easy to use if forecasted cash flows are known. In practice, it is quite difficult to obtain the estimates of cash flows due to uncertainty.
- Discount rate: It is also difficult in practice to precisely measure the discount rate.
- Mutually exclusive projects: Further, caution needs to be applied in using the NPV method when alternative (mutually exclusive) projects with unequal lives, or under funds constraint are evaluated. The NPV rule may not give unambiguous results in these situations.
- Ranking of projects: It should be noted that the ranking of investment projects as per the NPV rule is not independent of the discount rates.4 Let us consider an example.

Suppose two projects—X and Y—both costing Rs. 50 each. Project X returns Rs.100 after one year and Rs. 25 after two years. On the other hand, Project Y returns Rs. 30 after one year and Rs. 100 after two years. At discount rates of 5 per cent and 10 per cent, the NPV of projects and their ranking are as follows:

	NPV at 5%	Rank	NPV at 10%	Rank
Project X	67.92	II	61.57	I
Project Y	69.27	I	59.91	II

Check Your Progress

6. Describe the basic approach of calculating the net present value of an investment proposal.
7. Why is NPV method considered perhaps the best method for evaluating the profitability of a project? Are there any difficulties associated with this method?

It can be seen that the project ranking is reversed when the discount rate is changed from 5 per cent to 10 per cent. The reason lies in the cash flow patterns. The impact of the discounting becomes more severe for the cash flow occurring later in the life of the project; the higher is the discount rate, the higher would be the discounting impact. In the case of Project Y, the larger cash flows come later in the life. Their present value will decline as the discount rate increases.

3.5 INTERNAL RATE OF RETURN METHOD

The internal rate of return (IRR) method is another discounted cash flow technique, which takes account of the magnitude and timing of cash flows. It is the rate which equates the present value of the expected future cash flows with the cost of the investment. Other terms used to describe the IRR method are yield on an investment, marginal efficiency of capital, rate of return over cost, time-adjusted rate of internal return and so on. The concept of internal rate of return is quite simple to understand in the case of a one-period project. Assume that you deposit Rs 10,000 with a bank and would get back Rs 10,800 after one year. The true rate of return on your investment would be:

Rate of return = $\frac{10800-10000}{10000} = \frac{10800}{10000} - 10000 = 1.08 - 1 = 0.08$ or, 8%

The amount that you would obtain in the future (Rs. 10,800) would consist of your investment (Rs. 10,000) plus return on your investment (0.08 x Rs. 10,000):

10,000(1.08)= 10,800

10,000 = $\frac{10800}{(1.08)}$

You may observe that the rate of return of your investment (8 per cent) makes the discounted (present) value of your cash inflow Rs (10,800) equal to your investment (Rs. 10,000).

We can now develop a formula for the rate of return (*r*) on an investment (C_0) that generates a single cash flow after one period (C_1) as follows:

$$r = \frac{C_1-C_0}{C_0} = \frac{C_1}{C_0} - 1 \qquad (2)$$

Equation (2) can be rewritten as follows:

$\frac{C_1}{C_0}$ = 1+r

$$C_0 = \frac{C_1}{(1+r)} \qquad (3)$$

From Equation (3), you may notice that the rate of return, r, depends on the project's cash flows, rather than any outside factor. Therefore, it is referred to as the internal rate of return. 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. There is no satisfactory way of defining the true rate of return of a long-term asset. IRR is the best available concept. We shall see that although it is a very frequently used concept in finance, yet at times it can be a misleading measure of investment worth. IRR can be determined by solving the following equation for r.

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

$$C_0 = \sum_{r=1}^{n} \frac{C_1}{(1+r)^1}$$

$$\sum_{r=1}^{n} \frac{C_1}{(1+r)^1} - C_0 = 0 \qquad (4)$$

It can be noticed that the ERR equation is the same as the one used for the NPV method. In the NPV method, the required rate of return, k, is known and the net present value is found, while in the IRR method the value of r has to be determined at which the net present value becomes zero.

3.5.1 Calculating IRR by Trial and Error

The value of r in Equation (2) can be found out by trial and error. The approach is to select any discount rate to compute me 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 me 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. The following illustration explains the procedure of calculating IRR.

Illustration 3.2: Trial and Error Method for Calculating IRR

A project costs Rs. 16,000 and is expected to generate cash inflows of Rs. 8,000, Rs. 7,000 and Rs. 6,000 at the end of each year for next 3 years. We know that IRR is the rate at which project will have a zero NPV. As a first step, we try (arbitrarily) a 20 per cent discount rate. The project's NPV at 20 per cent is:

NPV $= -$ Rs.16,000+Rs.8,000($PVF_{1.020}$)+Rs. 7,000($PVF_{2,0.20}$)+Rs.6,000($PVF_{3,\ 0.20}$)

= - Rs.16,000+Rs.8,000x0.833+Rs.7,000x0.694+Rs.6,000x0.579

= -Rs. 16,000+Rs. 14,996=-Rs. 1,004

A negative NPV of Rs. 1,004 at 20 per cent indicates that the project's true rate of return is lower than 20 per cent. Let us try 16 per cent as the discount rate. At 16 per cent, the project's NPV is:

NPV = -Rs.16,000+Rs.8,000($PVF_{1,0.16}$)+Rs.7,000($PVF_{2,0.16}$)+Rs.6,000($PVF_{3,\ 0.16}$)

= -Rs.16,000+Rs.8,000x0.862+Rs.7,000x0.743+Rs.6,000x0.641

= -Rs. 16,000+Rs. 15,943=-Rs. 57

Since the project's NPV is still negative at 16 per cent, a rate lower than 16 per cent should be tried. When we select 15 per cent as the trial rate, we find that the project's NPV is Rs. 200:

NPV = -Rs.16,000+Rs.8,000($PVF_{1,0.15}$)+ Rs. 7,000($PVF_{2,0.15}$)+Rs.6,000($PVF_{3,0.15}$)

= -Rs.16,000 + Rs.8,000x0.870 + Rs.7,000x0.756 + Rs. 6,000x0.658

= -Rs. 16,000 + Rs. 16,200 = Rs. 200

The true rate of return should lie between 15-16 per cent. We can find out a close approximation of the rate of return by the method of linear interpolation as follows:

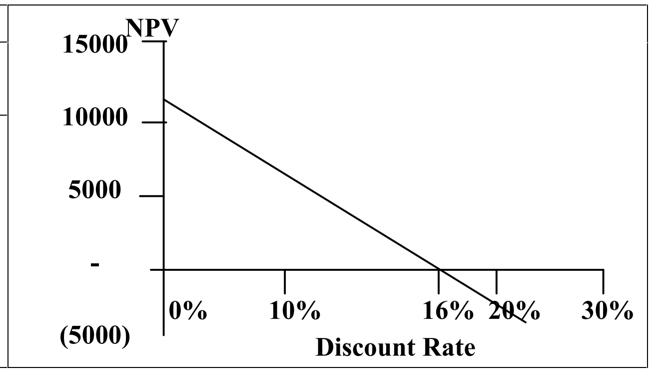
		Difference
PV required	Rs. 16,000	
		200
PV at lower rate, 15%	16,200	
		257
PV at higher rate, 16%	15,943	
r = 15% + (16% - 15%)200/257		
= 15%+ 0.80%= 15.8%		

3.5.2 NPV Profile and IRR

We repeat to emphasize that NPV of a project declines as the discount rate increases, and for discount rates higher than the project's IRR, NPV will be negative. NPV profile of the project at various discount rates is shown in Table 2.2. At 16 per cent, the NPV is zero; therefore, it is the IRR of the project. As you may notice, we have used the Excel spreadsheet to make the computations and create the chart using the Excel chart wizard.

Table 2.2 NPV Profile

1	**NPV Profile**		
2	**Cash Flow**	**Discount Rate**	**NPV**
3	-20000	0%	12580
4	5430	5%	7561
5	5430	10%	3649
6	5430	15%	550
7	5430	16%	0
8	5430	20%	(1942)
9	5430	25%	(3,974)



3.5.3 Acceptance Rule

The accept-or-reject rule, using the IRR method, is to accept the project if its internal rate of return is higher than the opportunity cost of capital (r > k). Note that k is also known as the required rate of return, or the cut-off. The project shall be rejected if its internal rate of return is lower than the opportunity cost of capital (r < k). The decision maker may remain indifferent if the internal rate of return is equal to the opportunity cost of capital. Thus the IRR acceptance rules are:

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

3.5.4 Evaluation of IRR Method

The IRR method is like the NPV method. It is a popular investment criterion since it measures profitability as a percentage and can be easily compared with the opportunity cost of capital. IRR method has following merits:

- ***Time value:*** The IRR method recognizes the time value of money.
- ***Profitability measure:*** It considers all cash flows occurring over the entire life of the project to calculate its rate of return.
- ***Acceptance rule:*** It generally gives the same acceptance rule as the NPV method.
- ***Shareholder value:*** It is consistent with the shareholders' wealth maximization objective. Whenever a project's IRR is greater than the opportunity cost of capital, the shareholders' wealth will be enhanced.

Like the NPV method, the IRR method is also theoretically a sound investment evaluation criterion. However, IRR rule can give misleading and inconsistent results under certain circumstances. Here we briefly mention the problems that IRR method may suffer from.

- ***Multiple rates:*** A project may have multiple rates, or it may not have a unique rate of return. As we explain later on, these problems arise because of the mathematics of IRR computation.
- ***Mutually exclusive projects:*** It may also fail to indicate a correct choice between mutually exclusive projects under certain situations. This pitfall of the IRR method is elaborated later on in this unit.
- ***Value additivity:*** Unlike in the case of the NPV method, the value additivity principle does not hold when the IRR method is used—IRRs of projects do not add.7 Thus, for Projects A and B, IRR(A) + IRR(B) need not be equal to IRR (A + B). Consider an example given below.

The NPV and IRR of Projects A and B are given below:

Project	C_0 (‘)	C_1 (‘)	NPV @ 10% (‘)	IRR (%)
A	-100	+ 120	+ 9.1 r	20.0
B	-150	+ 168	+ 2.7	12.0
A + B	-250	+ 288	+ 11.8	15.2

It can be seen from the example that NPVs of projects add:

NPV(A) + NPV(B) = NPV(A + B) = 9.1 + 2.7 = 11.8, while

IRR(A) + IRR(B) IRR(A + B) = 20%+12% # 15.2%

3.5.5 NPV versus IRR

The net present value and the internal rate of return methods are two closely related investment criteria. Both are time-adjusted methods of measuring investment worth. In case of independent projects, two methods lead to same decisions. However, under certain situations (to be discussed later in this section), a conflict arises between them. It is under these cases that a choice between the two criteria has to be made.

Equivalence of NPV and IRR: Case of Conventional Independent Projects

It is important to distinguish between conventional and non-conventional investments in discussing the comparison between NPV and IRR methods. A conventional investment can be defined as one whose cash flows take 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, is one, which has cash outflows mingled with cash inflows throughout the life of the project.8 Non-conventional investments have more than one change in the signs of cash flows; for example, - +

In case of conventional investments, which are economically independent of mil other, NPV and IRR methods result in same accept-or-reject decision if the firm be is not constrained for funds in accepting all profitable projects. Same projects would be indicated profitable by both methods. The logic is simple to understand. As has been explained earlier, all projects with positive net present values would be accepted. If the NPV method is used, or projects with internal rates of return higher than the internal rates of return would be accepted if the IRR method were followed. The last marginal project acceptable under the NPV method is the one, which has zero net present value; while using the IRR method, this project will have an internal rate of return equal to the required rate of return. Projects with positive net present values would also have internal rates of return higher than the required rate of return and the marginal project will have zero present value only when its internal rate of return is equal to the required rate of return.

We know that NPV is:

$$NPV=\sum_{t=1}^{n} \frac{C_1}{(1+k)^t}-C_0 \qquad (5)$$

and IRR is that rate r which satisfies the following equation:

$$NPV=\sum_{t=1}^{n} \frac{C_1}{(1+r)^t}-C_0 = 0 \qquad (6)$$

Subtracting Equation (6 from Equation (5), we get

$$NPV=\sum_{t=1}^{n} \frac{C_1}{(1+k)^t} - \frac{C_1}{(1+r)^t} \qquad (7)$$

As we know that C(, A:, r and t are positive, NPV can be positive (NPV > 0) only if $r > k$. NPV would be zero if and only if $r = k$ and it would be negative (NPV < 0) If $r < k$. Thus, we find that NPV and IRR methods are equivalent as regards the acceptance or rejection of independent conventional investments.

Figure 2.2 also substantiates this argument where oa_2 represents the highest net present value for the project at zero discount rate; at this point NPV is simply the difference between cash inflows and cash outflows. At r_2, discount rate, the net present value is zero and therefore, by definition, r, is the internal rate of return of the project. For discount rate (say r_3) greater than IRR, the net present value would be negative. Conversely, for discount rate (say r_1) lower than IRR, the net present value of the project will be positive. Thus, if the required rate of return is r., the project will be accepted under both methods since the net present value, oa_1 is greater than zero and internal rate, r_2, exceeds the required rate, r_1. Project could also be accepted if the required rate is r_2 as net present value is zero and the required rate and internal rate are equal. But the project would be rejected under either method if the required rate is r_3, as the net present value is negative and the internal rate of return is lower than the required rate of return (i.e., $r_2 < r_3$).

Assuming $\frac{1}{1+r}$

= x, we obtain – $3{,}750x^2 + 4{,}000x - 1{,}000 = 0$

This is a quadratic equation of the form: $ax^2 + bx + c = Q$, and we can solve it by using the following formula:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Substituting values, we obtain

$$x = \frac{-4000 \pm \sqrt{(4000)^2 - 4 \; -1000 \; (-3750)}}{2(-3750)}$$

$$x = \frac{-4000 \pm 1000}{-7500} = \frac{2}{5}, \frac{2}{3}$$

Since $x = \frac{1}{l+r}$, therefore

$$\frac{1}{l+r} = \frac{2}{5}, \frac{1}{l+r} = \frac{2}{3}$$

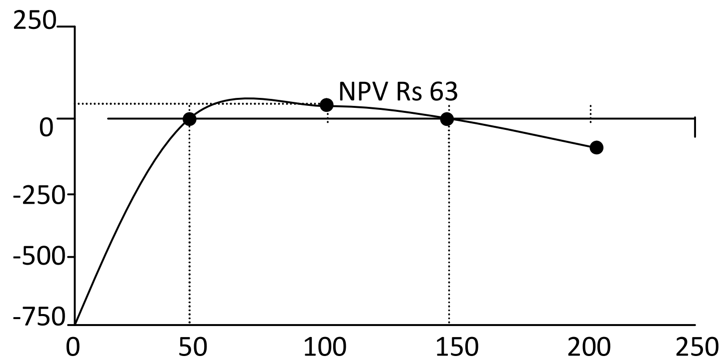
$r = \frac{3}{2}$ or 150%, $r = \frac{1}{2}$ = 50%

Check Your Progress

8. Define the basic method of calculating the internal rate of return (IRR) while appraising an investment project.
9. In the IRR system, how do we decide which projects to accept or reject ?
10. What is the main difference between the concepts of NPV and IRRRs.

It is obvious from the above calculation that Project I yields dual rates of return: 50 per cent and 150 per cent. At these two rates of return the net, present value of the project is zero. It needs to be emphasized here that this dilemma does not arise when the NPV method is used—we have simply to specify the required rate of return and find NPV. The relationship between discount rates and NPVs are shown in Figure 2.4, where the discount rate is plotted along the horizontal axis and net present value along the vertical axis.

At zero rate of discount, the net present value of the project is simply the difference of undiscounted cash flows. It is - Rs. 750 for Project I (- 1,000 + 4,000 -3,750 = - 750). As the discount rate increases, the negative net present value diminishes and becomes zero at 50 per cent. The positive net present value increases as the discount rate exceeds 50 per cent, but reaching a maximum it starts decreasing and at 150 per cent it again becomes zero.



Discount Rate (%)

Fig. 2.4 Dual Rales of Return

It should be clear from Figure 2.4 that Project I combines the features of both lending and borrowing.” The first part of the figure has an upward slope typical of a loan; the second part has a downward slope typical of an ordinary investment (lending). Since the NPV curve cuts the horizontal-axis twice, the project has two rates of return, 50 and 150 per cent.

Which of the two rates is correct? None. The project would be worthwhile only when the opportunity cost of the capital falls between these two rates; NPV is positive at the discount rates ranging between 50 and 150 per cent.

The number of rates of return depends on the number of times the sip of the cash flow stream changes. In the case of Project I above, there are two reversals of sign (- + -), and there are two rates of return. Reversal of sign is a necessary but not n sufficient condition for multiple rates of return.

A number of adaptations of the IRR criterion have been suggested to take care of the problem of multiple rates. In our opinion, none of them will work satisfactorily. The simple, straightforward alternative is to use the NPV rule.

Difference: Case of ranking mutually exclusive projects

We have shown that the NPV and IRR methods yield the same accept-or-reject rule in case of independent conventional investments. However, in real business situations there are alternative ways of achieving an objective and, thus, accepting one alternative will mean excluding the other. As defined earlier, investment projects are said to be **mutually exclusive** when only one investment could be accepted and others would have to be excluded.12 For example, in order to distribute its products a company may decide either to establish its own sales organization or engage outside distributors. The more profitable out of the two alternatives shall be selected. This type of exclusiveness may be referred to as technical exclusiveness. On the other hand, two independent projects may also be mutually exclusive if a financial constraint is imposed. If limited funds are available to accept either Project A or Project B, this would be an example of **financial exclusiveness or capital rationing**. The NPV and IRR methods can give conflicting ranking to mutually exclusive projects. In the case of independent projects ranking is not important since all profitable projects will be accepted. Ranking of projects, however, becomes crucial in the case of mutually exclusive projects. Since the NPV and IRR rules can give conflicting ranking to projects, one cannot remain indifferent as to the choice of the rule.

The NPV and ERR rules will 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 (initial investments) 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.

	Cash Flow (‘)				***NPV***	
Project	***C_0***	***C_1***	***C_2***	***C_3***	***at 9%***	***IRR***
M	-1680	1400	700	140	301	23%
N	-1680	140	840	1510	321	17%

At 9 per cent discount rate, project N has higher NPV of Rs. 321 than Project ATs NPV of Rs. 301. However, Project N has a lower IRR of 17 per cent than Project M’s IRR of 23 per cent. Why this conflict?. Which project should we accept?. Let us see how NPVs of Projects M and N behave with discount rates. The NPV profiles of two projects would be as shown in Table 2.5.

The net present values of Projects M and N, as a function of discount rates, are plotted in Figure 2.5. It is noticeable from the NPV calculations as well as from Figure 2.5 that the present value of Project N falls rapidly as the discount rate increases. The reason is that its largest cash flows come late in life, when the compounding effect of time is most significant. Reverse is true with Project M as its largest cash flows come early in the life when compounding effect is not so severe. The internal rates of Projects M and N respectively are 23 per cent and 17 per cent. The NPV profiles of two projects intersect at 10 per cent discount rate. This is called Fisher’s intersection.[14]

Table 2.3 NPV Profiles of Projects M and N

Discount Rate (%)	***Project M***	***Project N***
0	560	810
5	409	520

10	276	276
15	159	70
20	54	-106
25	-40	-251
30	- 125	-388

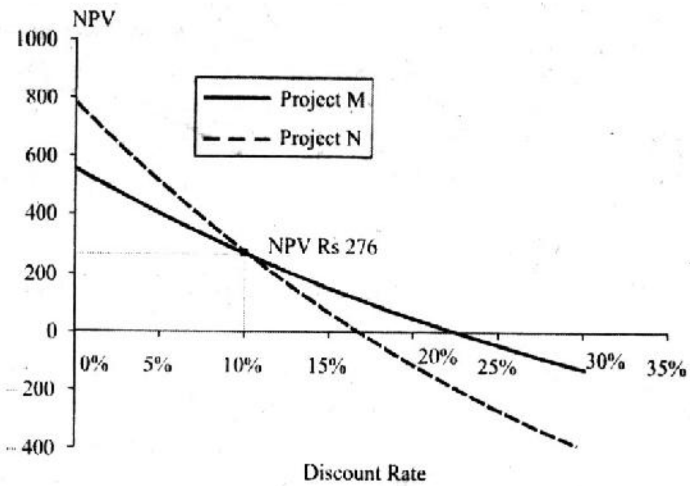


Fig. 2.5 NPV versus IRR

Fisher's intersection occurs at the discount rate where the NPVs of two projects are equal. We can determine the discount rate at which Fisher's intersection occurs as follows:

$$-1680+\frac{1400}{(1+r^*)}+\frac{700}{(1+r^*)^2}+\frac{140}{(1+r^*)^3} = -1680+\frac{140}{(1+r^*)}+\frac{840}{(1+r^*)^2}+\frac{1510}{(1+r^*)^3}$$

This equation can be simplified by bringing all terms over the left-hand side.

$$-\frac{1260}{(1+r^*)}+\frac{140}{(1+r^*)^2}+\frac{1370}{(1+r^*)^3} = 0$$

Solving for r*—Fisher's intersection rate—by trial and error, we obtain: r* = 10%. We can write the following formula for determining the rate at which Fisher's intersection occurs for two Projects M and N:

$NPV_M = NPV_N$

$$\sum_{t=1}^{n}\frac{C_{1\ M}}{1+r^{*\ t}} - C_{0\ M} = \sum_{t=1}^{n}\frac{C_{1\ N}}{1+r^{*\ t}} - C_{0\ N} \qquad (8)$$

It is notable from Table 2.5 and Figure 2.5 that at the discount rates less than the intersection rate (10 per cent). Project N has the higher NPV but lower IRR (17 percent). On the other hand, at the discount rates greater than the intersection rate (10 per cent). Project M has both higher NPV as well as higher IRR (23 per cent). Thus, if the required rate of return is greater than the intersection rate, both NPV and IRR methods will yield consistent results. That is, the project with higher internal rate of Mini n will also have higher net present value. However, if the required rate of return is than the intersection rate, the two methods will give contradictory results. That is, the project with higher internal rate of return will have lower net present value and Vice versa.

Which project should we choose between Projects M and NRs. Both projects generate positive net present value at 9 per cent opportunity cost of capital. Therefore, both are profitable. But Project N is better since it has a higher NPV. The IRR rule, however, indicates that we should choose Project M as it has a higher IRR. If we choose Project N, following the NPV rule, we shall be richer by an additional value of 120. Should we have the satisfaction of earning a higher rate of return, or should we like to be richer ? The NPV rule is consistent with the objective of maximizing wealth. When we have to choose between mutually exclusive projects, the easiest procedure is to compare the NPVs of the projects and choose the one with the larger NPV.

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. If we prefer Project N to Project M, there should be incremental benefits in doing so. To see this, let us calculate the incremental flows of Project N over Project M. We obtain the following cash flows:

		Cash Flow (‘)			***NPV***	
Project	C_0	C_1	C_2	C_3	***at 9%***	***IRR***
(N-M)	0	-1260	140	1370	20	10%

The IRR on the incremental flows is 10 per cent. It is more than the opportunity cost of 9 per cent. Therefore, Project N should be accepted. Project N is better than Project M despite its lower IRR because it offers all benefits that Project M offers plus the opportunity of an incremental investment at 10 per cent—a rate higher than 11io required rate of return of 9 per cent. It may be noticed that the NPV of the Incremental flows is the difference of the NPV of Project N over that of Project M; this is so because of the value-additivity principle.

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 (i.e., lending and borrowing type pattern). This would result in multiple rates of return and ultimately the NPV method will have to be used.

Some people find it difficult to appreciate that the IRR rule can mislead. Let us, for instance, assume that we are considering two mutually exclusive Projects M and N, and we are also contemplating an investment opportunity, say Project O, to occur after one year. Project O has the following cash follows:

		Cash Flow (‘)			***NPV***	
Project	C_0	C_1	C_2	C_3	***at 9%***	***IRR***
O	0	-1400	700	948	37	11%

We have established so far that Project N is better than Project M, since it adds more wealth. Still some may argue in favour of Project M. Their reasoning could I that if we accept Project M today, we would also be able to undertake Project O ne; year that can be financed out of the cash flows generated by Project M in the fir year. This reasoning implies a capital shortage next year to undertake Project O if Project M is rejected in the absence of capital constraint. Project N is definitely better (NPV is higher) than Project M, and Project O can also be accepted next year by raising Rs. 1,260 at a rate equal to the cost of capital. It is very unlikely that the large companies would face capital constraint. However, some companies do impose capital rationing on their divisions for control purposes. Such impositions are thought to b real constraints by management people at the lower levels. Even if there is a capital constraint, real or self-imposed, the IRR rule cannot be used for ranking projects. The problem under capital rationing is to determine the portfolio of projects, which have the largest net present value satisfying such portfolio. We shall show later on that this problem can be handled through the programming techniques.

Settlement of investment: Another condition, under which the NPV and IRR methods will give contradictory ranking to the projects, is when the cash outlays are of different sizes. Let us consider Projects A and B, involving following cash flows:

	Cash Flow (')		***NPV***	
Project	***C_0***	***C_1***	***at 10%***	***IRR***
A	-1000	1500	364	50%
B	-100000	120000	9091	20%

Project A's NPV at 10 per cent required rate of return of '. 364 and IRR is 50 percent. Project B's NPV at 10 per cent required rate of return is '. 9,091 and internal rate of return is 20 per cent. Thus, the two projects are ranked differently by the NPV and IRR rules.

As we have explained earlier, the NPV method gives unambiguous results. Since the NPV of Project B is high, it should be accepted. The same result will be obtained if we calculate the internal rate of return on the incremental investment:

The incremental investment of '. 99,000 (i.e., '. 100,000 - '. 1,000) will generate cash inflow of '. 118,500 after a year. Thus, the return on the incremental investment is 19.7 per cent, which is in excess of the 10 per cent required rate of return. We should, therefore, prefer Project B to Project-4.

Project life span: Difference in the life spans of two mutually exclusive projects can also give rise to the conflict between the NPV and IRR rules. To illustrate, let us consider two mutually exclusive Projects, X and Y, of significantly different expected lives:

		Cash Flow (')					***NPV***	
Project	***C_0***	***C_1***	***C_2***	***C_3***	***C_4***	***C_5***	***at 10%***	***IRR***
X	-10000	-12000	-	-	-	-	909	20%
Y	-10000	0	0	0	0	20120	2493	15%

Both the projects require initial cash outlays of **'**. 10,000 each. Project X generates a cash flow of **'**. 12,000 at the end of one year, while Project Y generated cash flow of **'**.

20,120 at the end of fifth year. At 10 per cent required rate of return, Project X's net present value is ‘. 908 and internal rate of return is 20 per cent, while Project Ts net present value is ‘. 2,495 and internal rate of return is 15 per cent. Thus, the two methods rank the projects differently. The NPV rule can be used to choose between the projects since it is always consistent with the wealth maximization principle. Thus, Project Y should be preferred since it has higher NPV. The problem of choosing between the short and long-lived assets, which have to be replaced in future, is discussed later on.

3.6 PAYBACK

The payback (PB) is one of the most popular and widely recognized traditional methods of evaluating investment proposals. It is based on the assumption that the degree of risk associated with the fixed asset is the length of time required to recover the investment from the firm's cash flow. 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:

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

Illustration 34: Payback (Constant Cash Flows)

Assume that a project requires an outlay of Rs 2,00,000 and yields annual cash inflow of Rs 40000 for 9 years. The payback period for the project is:

PB= $\frac{Rs.200000}{Rs40000}$ = 5years

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. Consider the following example.

Illustration 35: Payback (Uneven Cash Flows)

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?. When we add up the cash inflows, we find that in the first three years Rs 19,000 of the original outlay is recovered. In the fourth year cash inflow generated is Rs 3,000 and only Rs 1,000 of the original outlay remains to be recovered. Assuming that the cash inflows occur evenly during the year, the time required to recover Rs 1,000 will be (Rs 1,000/ Rs 3,000) x 12 months = 4 months. Thus, the payback period is 3 years and 4 months.

3.6.1 Acceptance Rule

Many firms use the payback period as an investment evaluation criterion and a method of ranking projects. They compare the project's payback with a predetermined, standard payback. The project would be accepted if it's 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. Thus, if the firm has to choose between two mutually exclusive projects, the project with shorter payback period will be selected.

3.6.2 Evaluation of Payback

Payback is a popular investment criterion in practice, It is considered to have certain virtues.

Simplicity: The most significant merit of payback is that it is simple to understand and easy to calculate. The business executives consider the simplicity of method as a virtue. This is evident from their heavy reliance on it for appraising investment proposals in practice.

- ***Cost effective:*** Payback method costs less than most of the sophisticated techniques that require a lot of the analysts" time and the use of computers.
- ***Short-term effects:*** A company can have more favorable short-run effects on earnings per share by setting up a shorter standard payback period.16 It should, however, be remembered that this may not be a wise long-term policy as the company may have to sacrifice its future growth for current earnings.
- ***Risk shield:*** The risk of the project can be tackled by having a shorter standard payback period as it may ensure guarantee against loss. A company has to invest in many projects where the cash inflows and life expectancies are highly uncertain. Under such circumstances, payback may become important, not so much as a measure of profitability but as a means of establishing an upper bound on the acceptable degree of risk.[17]
- ***Liquidity:*** The emphasis in payback is on the early recovery of the investment. Thus, it gives an insight into the liquidity of the project. The funds so released can be put to other uses.
- In spite of its simplicity and the so-called virtues, the payback may not be a desirable investment criterion since it suffers from a number of serious limitations:
- ***Cash flows after payback:*** Payback fails to take account of the cash inflows earned after the payback period. For example, consider the following projects X and Y:

	Cash Flow (‘)				***NPV***	
Project	C_0	C_1	C_2	C_3	***Payback***	***NPV***
X	-4000	0	4000	2000	2 years	+806
Y	-4000	2000	2000	0	3 years	-530

As per the payback rule, both the projects are equally desirable since both return the investment outlay in two years. If we assume an opportunity cost of 10 per cent, Project X yields a positive net present value of X 806 and Project Y yields a negative net present value of Rs. 530. As per the NPV rule. Project X should be accepted and Project Y rejected. Payback rule gave wrong results because it failed to consider Rs. 2,000 cash flow in third year for Project X.

- ***Cash flows ignored:*** Payback is not an appropriate method of measuring the profitability of an investment project as it does not consider all cash inflows yielded by the project. Considering Project X again, payback rule did not take into account its entire series of cash flows.
- ***Cash flow patterns:*** Payback fails to consider the pattern of cash inflows, i.e., magnitude and timing of cash inflows. In other words, it gives equal weights to returns of equal amounts even though they occur in different time periods. For example, compare the following projects C and D where they involve equal cash outlay and yield equal total cash inflows over equal time periods:

	Cash Flow (')				***NPV***	
Project	C_0	C_1	C_2	C_3	***Payback***	***NPV***
C	-5000	3000	2000	2000	2 years	+881
D	-5000	2000	3000	2000	2 years	+ 798

Using payback period, both projects are equally desirable. But Project C should be preferable as larger cash inflows' come earlier in its life. This is indicated by the NPV rule; project C has higher NPV (Rs 881) than Project D (Rs 798) at 10 per cent opportunity cost. It should be thus clear that payback is not a measure of profitability. As such, it is dangerous to use it as a decision criterion.

- ***Administrative difficulties:*** A firm may face difficulties in determining the maximum acceptable payback period. There is no rational basis for setting a maximum payback period. It is generally a subjective decision.
- ***Inconsistent with shareholder value:*** Payback is not consistent with the objective of maximising the market value of the firm's shares. Share values do not depend on payback periods of investment projects.

Let us re-emphasize that the payback is not a valid method for evaluating the acceptability of the investment projects. It can, however, be used along with the NPV rule as a first step in roughly screening the projects. In practice, the use of DCF techniques has been increasing but payback continues to remain a popular and primary method of investment evaluation (Exhibit 2.1).

3.6.3 Payback Reciprocal and the Rate of Return

Payback is considered theoretically useful in a few situations. One significant argument in favour of payback is that its reciprocal is a good approximation of the rate of return under certain conditions.

Exhibit 2.1: Capital Budgeting Methods in Practice

- In a study of the capital budgeting practices of fourteen medium to large size companies in India, it was found that all companies, except one, used payback. With payback and/or other techniques, about two-thirds of companies used IRR and about two-fifths NPV. IRR was found to be the second most popular method.
- The reasons for the popularity of payback in order of significance were stated to be its simplicity to use and understand its emphasis on the early recovery of investment and focus on risk.
- It was also found that one-third of companies always insisted on the computation of payback for all projects, one-third of its majority of projects and remaining for some of the projects. For about two-thirds of company's standard payback ranged between 3 and 5 years.

- Reasons for the secondary role of DCF techniques in India included difficulty in understanding and using these techniques, lack of qualified professionals and unwillingness of top management to use DCF techniques. One large manufacturing and marketing organisation mentioned that conditions of its business were such mat DCF techniques were not needed. Yet another company stated that replacement projects were very frequent in the company, and it was not considered necessary to use DCF techniques for evaluating such projects.

  Source: Pandey, I.M., Capital Budgeting Practices of Indian Companies, *MDI Management Journal*,Vol.2,No. I (Jan. 1989).

The payback period is defined as follows:

$$\text{Payback} = \frac{\text{Initial investment}}{\text{Annual cash inflow (annuity)}} = \frac{C_0}{C} \qquad (9)$$

The formula for the present value of an annuity is given by the following equation as discussed in Unit 2. (i) in the original equation is being replaced by r, the internal rate of return).

$$C_0 = C\,\frac{1-\frac{1}{(1+r)^n}}{r} = \frac{C}{r} - \frac{C}{r}\,\frac{1}{(1+r)^n}$$

(10)

Multiplying both sides by r, we get

$$rC0 = C - C\,\frac{1}{(1+r)^n}$$

Solving for r, we find

$$r = \frac{C}{C_0} - \frac{C}{C_0}\,\frac{1}{(1+r)^n}$$

where C_0 is the initial investment, C is annual cash inflow, r is rate of return and n is the life of investment.

In Equation (10), the first right-hand term is the reciprocal of the payback period. The second right-hand term is payback reciprocal multiplied by $1/(1 + r)^n$. If n is very large or extends to infinity, the second term becomes insignificant (almost equal to zero), and we are left with the term C/C_0. Thus, IRR is equal to the reciprocal of payback.

The reciprocal of payback will be a close approximation of the internal rate of return if the following two conditions are satisfied:

- The life of the project is large or at least twice the payback period.
- The project generates equal annual cash inflows,

The payback reciprocal is a useful technique to quickly estimate the true rate of return. But its major limitation is that every 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 payback period, the payback reciprocal will always exceed the rate of return. Similarly, it cannot be used as an approximation of the rate of return if the project yields uneven cash inflows.

3.6.4 Discounted Payback Period

One of the serious objections to the payback method is that it does not discount the cash flows for calculating the payback period. We can discount cash flows and then calculate the payback. 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.

Let us consider an example. Projects P and Q involve the same outlay of Rs 4,000 each. The opportunity cost of capital may be assumed as 10 per cent. The cash flows ill the projects and their discounted payback periods are shown in Table 2.3.

Table 2.3 Discounted Payback Illustrated

			Cash Flow (')					
Project	***C_0***	***C_1***	***C_2***	***C_3***	***C_4***	***Simple PB***	***Discounted PB***	***NPV at 10%***
P	-4000	3000	1000	1000	1000	2 years	-	-
PV of cash flows	-4000	2727	826	751	683	-	2.6 years	987
Q	-4000	0	4000	1000	2000	2 years	-	-
PV of cash flows	-4000	0	3304	751	1366		2.9 years	1421

The projects are indicated of same desirability by the simple payback period. When cash flows are discounted to calculate the discounted payback period, Project P recovers the investment outlay faster than Project Q, and therefore, it would be preferred over Project Q. Discounted payback period for a project will be always higher than simple payback period because its calculation is based on the discounted cash flows. Discounted payback rule is better as it discounts the cash flows until the outlay is recovered. But it does not help much. It does not take into consideration the entire aeries of cash flows. It can be seen in our example that if we use the NPV rule, Project Q (with higher discounted payback period) is better.

3.7 ACCOUNTING RATE OF RETURN METHOD

The **accounting rate of return** (ARR), also known as the return on investment (ROI), uses accounting information, as revealed by financial statements, to measure the profitability of an investment. 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. Alternatively, it can be found out by dividing the total of the investment's book values after depreciation by the life of the project. The accounting rate of return, thus, is an average rate and can be determined by the following equation:

$$\text{ARR} = \frac{\text{Average income}}{\text{Average investment}} \tag{11}$$

In Equation (11) average income should be defined in terms of earnings after taxes without an adjustment for interest viz. EBIT (1 - T) or net operating profit after tax. Thus

$$\text{ARR} = \frac{\frac{\sum_{t=1}^{n} EBIT_1(1-T)}{n}}{\frac{I_0+I_n}{2}} \tag{12}$$

where EBIT is earnings before interest and taxes, T tax rate, /0 book value of investment in the beginning, /(book value of investment at the end of n number of years.

Illustration 3.6: Accounting Rate of Return

A project will cost Rs 40,000. Its stream of earnings before depreciation, interest and taxes (EBDIT) during first year through five years is expected to be Rs 10,000. Rs 12,000, Rs 14,000, Rs. 16,000 and Rs 20,000. Assume a 50 per cent tax rate and depreciation on straight-line basis. Project's ARR is computed in Table 2.4.

Accounting Rate of Return = $\frac{3200}{20000}$x 100 = 16 per cent

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. Thus, using this version, the ARR in Illustration 2.6 would be: Rs 3,200 ÷ Rs 40.000 x 100 = 8 per cent. This version of the ARR method is less consistent as earnings are averaged but investment is not.

Table 2.4 Calculation of Accounting Rate of Return

						(')
Period	1	2	3	4	5	Average
Earnings before depreciation. interest and taxes (EBDIT) Depreciation	10,000 8,000	12,000 8,000	14,000 8,000	16,000 8,000	20,000 8,000	14,400 8,000
Earnings before interest and taxes (EB1T) Taxes at 50%	2,000 1,000	4,000 2,000	6,000 3,000	8,000 4,000	12,000 6,000	6,400 3,200
Earnings before interest and after taxes [EBIT (1-T)]	1,000	2,000	3,000	4,000	6,000	3,200
Book value of investment: Beginning Ending Average	 40,000 32,000 36,000	 32,000 24,000 28,000	 24,000 16,000 20,000	 16,000 8,000 12,000	 8,000 - 4,000	 20,000

3.7.1 Acceptance Rule

As an accept-or-reject criterion, 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.

3.7.2 Evaluation of ARR Method

The ARR method may claim some merits:

- ***Simplicity:*** The ARR method is simple to understand and use. It does not involve complicated computations.
- ***Accounting data:*** The ARR can be readily calculated from the accounting data; unlike in the NPV and IRR methods, no adjustments are required to arrive at cash flows of the project.
- ***Accounting profitability:*** The ARR rule incorporates the entire stream of income in calculating the project's profitability.

The ARR is a method commonly understood by accountants, and frequently used as a performance measure. As a decision criterion, however, it has serious shortcomings.

- ***Cash flows ignored:*** The ARR method uses accounting profits, not cash flows, in appraising the projects. Accounting profits arc based on arbitrary assumptions and choices and also include non-cash items. It is, therefore, inappropriate to rely on them for measuring the acceptability of the investment projects.
- ***Time value ignored:*** The averaging of income ignores the time value of money. In fact, this procedure gives more weightage to the distant receipts.
- ***Arbitrary cut-off:*** The firm employing the ARR rule uses an arbitrary cut-off yardstick. Generally, the yardstick is the firm's current return on its assets (book-value). Because of this, the growth companies earning very high rates on their existing assets may reject profitable projects (i.e., with positive NPVs) and the less profitable companies may accept bad projects (i.e.. with negative NPVs).

The ARR method continues to be used as a performance evaluation and control measure in practice. But its use as an investment criterion is certainly undesirable. It may lead to unprofitable allocation of capital.

3.8 SUMMARY

- Investments involve cash flows. The profitability of an investment project is determined by evaluating its cash flows.
- The capital budgeting process involves a process of facilitating decisions which cover expenditures on long-term assets. They encompass both tangible and intangible assets.
- The phases of expenditure planning and control include identification of investment opportunities, forecasting benefits and costs, authorization of capital expenditure and control of capital projects.
- NPV, IRR and PI are the discounted cash flow (DCF) criteria for appraising the worth of an investment project.
- The net present value (NPV) method is a process of calculating the present value of a project's cash flows using the opportunity cost of capital as the discount rate, and finding out the net present value by subtracting the initial Investment from the present value of cash flows.
- Under the NPV method, the investment project is accepted if its net present value is positive (NPV > 0). The market value of the firm's share is expected 10 increase by the project's positive NPV Between the mutually exclusive projects, the one with the highest NPV will be chosen.

- The internal rate of return (ERR) is that discount rate at which the project's net present value is zero. Under the IRR rule, the project will be accepted when its internal rate of return is higher than the opportunity cost of capital (IRR > jfc).
- I'B is the number of years required to recoup the initial cash outlay of an investment project. The project would be accepted if it's payback is less than the standard payback. The greatest limitations of this method are that it does not consider the time' value of money, and does not consider cash flows after the payback period.
- Discounted payback considers the time value of money, but like simple payback, it also ignores cash flows after the payback period. Under the conditions of constant cash flows and the long life of a project, the reciprocal of payback can be a good approximation of the project's rate of return.
- Capital rationing is a situation where in a firm may be constrained by external or internal reasons to obtain necessary funds to invest in all projects with positive NPV.
- The cost of capital to a firm is the minimum return which the suppliers of capital require. In other words, it is the price of obtaining capital; it is a compensation for time and risk.
- The cost of capital concept is of vital significance in financial decision making. It is used: (a) as a discount, or cut-off, rate for evaluating investment projects, (6) for designing the firm's debt-equity mix and (c) for appraising the top management's financial performance.
- Debt includes all interest-bearing borrowings. Its cost is the yield (return) which lenders expect from their investment. In most cases, return is equal to the annual contractual rate of interest (also called coupon rate). Interest charges are tax deductible. Therefore, the cost of debt to the firm should be calculated after adjusting for interest tax shield: where k_d is before-tax cost of debt and T is the corporate tax rate.
- Equity includes paid-up capital and reserve and surplus (retained earnings). Equity has no explicit cost, as payment of dividends is not obligatory. However, it involves an opportunity cost.
- Three steps are involved in calculating the firm's weighted average cost of capital (WACC). First, the component costs of debt and equity are calculated. Second, weights to each component of capital are assigned according to the target capital structure. Third, the product of component costs and weights is summed up to determine WACC. The weighted average cost of new capital is the weighted marginal cost of capital (WMCC). WACC for a firm which debt and equity in the capital structure, is given by the following formula:
  where ke is the cost of equity, kd is the cost of debt, T is the tax rate, D is d and £ is equity. The market value weights should be used in calculating WAC

3.9 KEY TERMS

- ***Capital Budget:*** The formal plan for the appropriation of funds is called capital budget.
- ***Payback:*** The number of years required to recover the original cash outlay invested in a project.

- ***Accounting Rate of Return:*** ARR, also known as the return on investment (ROI) uses accounting information as revealed by financial statements, measure the profitability of an investment.
- ***Internal Rate of Return Method:*** A discounted cash flow technique which takes account of the magnitude and timing of cash flows.
- ***Internal Rate of Return:*** The rate that equates the investment outlay with present value of cash inflow received after one period.
- ***Discounted Payback Period:*** The number of periods taken in recovering investment outlay on the present value basis.

3.10 ANSWERS TO 'CHECK YOUR PROGRES"

1. A capital budgeting decision is a decision to invest the firm's funds most efficient in anticipation of a projected flow of benefits (measured in cash flows) of number of years in the future.
2. Long-term assets are those assets which affect a firm's operations beyond o year.
3. A firm's long-term investment decisions would generally include expansion acquisition, modernization and replacement of long-term assets. Sale of lot term assets is also considered an investment decision. Further, business decision which have long-term implications like research and development programme advertising campaigns, etc., should also be treated as investment decisions.
4. The reasons are as follows: (1) Growth: Investment decisions affect the firm's growth in the long run. (2) Commitment of funds: Usually, in capital budgeting decisions, large amounts of funds have to be committed. Once this large quantity of funds is invested in long-term assets, the decision is irreversible, or reversible at a substantial cost. (3) Risk: Given the nature of capital budgeting decision the overall riskiness of the firm may also be considerably affected. (Complexities: Finally, investment decisions are complex decisions, as so decisions have to take into account a large number of factors which are uncertain and difficult to predict. Economic, political, social and technological fact causes uncertainty in future incomes.
5. The two main categories for assessment of capital budgeting decisions non-discounted cash flow criteria and discounted cash flow criteria. T discounted cash flow techniques use cash flows and take into account the value of money. The non-discounted cash flow criteria may measure benefit cither in cash flows or non-cash flows terms but they not consider the time value of money.
6. The first step is to forecast on a realistic basis the cash flows of the proposed project. The forecasted cash flows then should be discounted with the appropriate discount rate, otherwise known as the cost of capital. The net present value is then arrived at by subtracting the present value of cash outflows from the present value of cash inflows. The project is acceptable if the net present value is positive and rejected if the net present value is negative.
7. It is well-accepted that the best way to measure returns from a proposed project is to estimate future cash flows. This avoids the ambiguities of different accounting systems. The NPV method measures all cash flows occurring over the entire life of the project. After the future cash flows are projected, the NPV

method discounts the cash flows with the cost of capital (or opportunity cost of capital) which reflects the risks and missed opportunities in the financial market. Hence the NPV method takes into account the time value of money and risk.

8 Finally, a project is found acceptable only if the net present value is positive, that is the discounted cash inflows exceed the discounted cash outflows. This approach is consistent with the objective of shareholder value maximization.

9 However, in spite of its obvious strengths, there are difficulties in using the NPV method. First, it is not easy to forecast cash flows accurately. There are also difficulties in arriving at the cost of capital or the discount rate that we use to discount cash flows. In the case of alternative or mutually exclusive projects, a project which yields a higher amount of NPV may also be more expensive to implement. This means that a company with a funds constraint may prefer a lower cost project. Finally, the ranking of investment projects are not independent of the discount rates. This means that as the discount rate or cost of capital changes, me ranking of projects may vary.

10 In this case, as in the NPV method, the projected cash flows of the project are estimated on a realistic basis. IRR is the rate that equates the investment outlay with me present value of the cash inflows. As the cash inflows from the proposed project are uneven, the IRR has to be calculated by a trial and error method.

11 Under the IRR method, if we find that the calculated internal rate of return exceeds the assumed opportunity cost of capital we accept the proposal; otherwise we reject it. This minimum rate of return is sometimes known as the cut-off or hurdle rate.

12 In the NPV method, the required rate of return is given, and this required rate of return or cost of capital is used to calculate the present value of the projected cash inflows, and hence the NPV of the project.

13 ARR is the ratio of average profit and average investment. It is calculated from the accounting data which is available from me projected financial statements of the proposed project.

14 Payback is defined as the number of years required to recover the original cash outlay invested in a project. It is very simple to calculate as we obtain i.e Payback period of a project by the cash flows obtained on an annual basis.

15 The Payback system has serious limitations as it does not take into account the time value of money. Further, it does not take into account the cash flows earned after the payback period.

3.11 QUESTIONS AND EXERCISES

Short-Answer Questions

1What is capital budgeting?. Describe its significant for a firm.

2 Despite its weaknesses, the payback period method is popular in practice. What are the reasons for its popularity?.

3. How do you calculate the accounting rate of return? What are its limitations?
4. What is profitability index? Which is a superior ranking criterion, profitability index or the net present value?

5. What are the limitations of Profitability Index in the capital budgeting process?

Long-Answer Questions

1Under what circumstances do the net present value and internal rate of return methods differ? Which method would you prefer and why ?

2. Comment on the following statements:
   a. '"We use payback primarily as a method of coping with risk."
   b. "The virtue of the IRR rule is that it does not require the computation of the required rate of return."
   c. "The average accounting rate of return fails to give weight to the later cash flows."