a project is positive, (NPV > 0) it should be accepted. Thus, if the present value of a project is either zero or negative, the project should be rejected.

A few examples will make clear the decision rule based on the net present value method.

Exmaple 1: *Suppose a firm is considering to buy a machine today for Rs. 25,000. The use of this machine in the production process of a commodity causes firm's revenue to rise by Rs. 15,000 in each of the next two years. Assume the rate of interest is 10 per cent per annum and the machine has no scrap value. Should the firm invest in this machine?*

Solution:

$$NPV = \frac{R_1}{(1+i)} + \frac{R_2}{(1+i)^2} - C_0$$

$$= \frac{15000}{1+0.1} + \frac{15000}{(1+0.1)^2} - 25000$$

$$= 15000 \times \frac{1}{1+0.1} + 15000 + \frac{1}{(1+0.1)^2} - 25000$$

$$= 15000 \times \frac{10}{11} + 15000 \times \frac{10}{11} \times \frac{10}{11} - 25000$$

$$= 13636.4 + 12396.7 - 25000$$

$$= 1033.1$$

Thus we found that net present value of the machine is positive. It should therefore be accepted for making investment in it.

Example 2: *Suppose a firm is thinking of investing in a machine project which costs capital expenditure equal to Rs. 1,50,000 and net cash flows from the machinery project are given below:*

Years	*1*	*2*	*3*	*4*	*5*
Net Cash Flow	*20,000*	*55,000*	*55,000*	*45,000*	*35,000*

Suppose the firm can borrow investment funds at 10 per cent annual rate of interest. Whether the firm should undertake the project?

Solution: We have to find out the net present value to evaluate the project which we calculate below:

$$NPV^1 = \frac{R_1}{(1+i)} + \frac{R_2}{(1+i)^2} + \frac{R_3}{(1+i)^3} + \frac{R_4}{(1+i)^4} + \frac{R_5}{(1+i)^5} - C_0$$

$$= \frac{20,000}{1+0.1} + \frac{55,000}{(1+0.1)^2} + \frac{55,000}{(1+0.1)^3} + \frac{45,000}{(1+0.1)^4} + \frac{35,000}{(1+0.1)^5} = 1,50,000$$

$$= \frac{20,000}{1.1} + \frac{55,000}{1.21} + \frac{55,000}{1.331} + \frac{45,000}{1.4641} + \frac{35,000}{1.6105} - 1,50,000$$

$$= 1,57,426.6 - 1,50,000 = 74,26.6$$

It is thus clear that net present value (NPV) is positive. Therefore, it is worthwhile to undertake the proposed project.

Net Present Value Method : Choice Among Multiple Projects

In our above analysis we were concerned with explaining a rule regarding whether or not a project should be approved for investment. Now, we will discuss the choice by a firm when several projects are available for investment. In this case we need to compare the present values of the various projects. The project which has the highest present value should be undertaken.

1. If a capital project has a salvage value (*i.e.*, scrap value) at the end of its operation during its life period, it will also be added as a cash flow in the last period of its life.

The project with the highest present value will make greatest contribution to the objective of maximising wealth of a firm. Thus, in case of choice among multiple projects we arrive at the following decision rule "*If the two or more mutually exclusive projects are available for investment, undertake the project which has the highest present value.*"

It may be pointed out that we face difficulties in the use of this rule when projects, instead of being mutually exclusive are *interdependent*, that is, undertaking of a project may change the benefits or returns from other projects. For instance, a project of flood control may increase the benefits or revenue from the project of growing wheat on an agricultural farm. In case of these interdependent projects we have to modify the rule. In this case we should compare not the present values of individual projects but various 'sets' of interdependent projects. Thus, for the choice of a single project from various projects, they must be mutually exclusive, that is, independent of each other.

Let us illustrate this decision rule concerning mutually exclusive multiple projects by giving an example.

Example: *Two projects A and B are available to a firm. Initial investment cost in the current year and net cash flow in the next of each is given below. The projects have no cash flows after one year and no salvage value. Which project a firm should choose if market rate of interest is 10 per cent annum?*

Project	*Initial investment-cost this year*	*Net cash-flow in the next year*
Project *A*	100 lakh	120 lakh
Project *B*	150 lakh	180 lakh

Solution: Net Present value (*NPV*) of Project *A* $= \frac{R_1}{(1+i)} - C_0$

$$= \frac{120}{1+0.10} - 100 = 120 \times \frac{10}{11} - 100$$

$$= 109.09 - 100 = 9.09$$

Net Present value (*NPV*) of Project *B* $= \frac{180}{1.1} - 150$

$$= 180 \times \frac{10}{11} - 150 = 163.63 - 150 = 13.63$$

Thus the net present value of the project *B* is greater than the net present value of project *A*. Therefore, the firm which aims at maximising wealth should undertake project *B*.

Internal Rate of Return (IRR) Method

Another important method of evaluating investment project is internal rate of return method. This evaluation method is also based on present value of net cash flows generated by a project over its life period. *Internal Rate of Return (IRR) is the rate of discount that equates the present value of net cash flows equal to the initial investment cost of the project.* If R_1, R_2, R_3, ... R_n represent the net cash flows associated with a project which have a initial investment cost equal to C_0. Internal rate of return (IRR) is calculated by setting.

$$\frac{R_1}{(1+r)} + \frac{R_2}{(1+r)^2} + \frac{R_3}{(1+r)^3} + \ldots \frac{R_n}{(1+r)^n} = C_0$$

or

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

Solving for r, we get the internal rate of return.

Decision Rule: According to internal rate of return (IRR) method, *if the internal rate of return (r) of a capital project is greater than the cost of capital, investment in the project should*

be made. If the internal rate of return (r) is less than the cost of capital, the project should be rejected. When the internal rate of return from a project exceeds the cost of capital, it will increase the value of the firm and is therefore, worthwhile to make investment in the project. For instance, if the use of funds costs 12 per cent per annum (that is, cost of capital is 12 per cent per, annum) to a firm and if internal rate of return from the project is 15 per cent, the project should be accepted for investment.

It may however be noted that it is not easy to calculate internal rate of return when the life of a project exceeds one year. Fortunately, these days electronic calculators are available with which we can easily calculate internal rate of return from the data. Further, calculations of present values and internal rate of return can be done using personal computers through simple computer programmes such as *Lotus 1-2-3* or *Microsoft Excel.*

However, in the absence of calculators and computers, internal rate of return (IRR) can be obtained through *trial and error method.* In this trial and error method, a discount rate is arbitrarily selected and the present value of cash flows generated by the project is calculated using that discount rate. If the present value so obtained is higher than the cost of capital to the firm, then a higher discount rate is chosen to evaluate the future cash flows of the project. If with this new higher discount rate, the present value of future cash flows of the project is lower than the initial cost of the project, then in that case repeat the process by reducing the discount rate. This iterative process should be continued until we find the discount rate which make present value of cash flows equal to the cost of the project. This discount rate at which present value of future cash flows from a project becomes equal to the initial cost of the project to the firm represents the internal rate of return from the capital project.

Example: *Suppose a firm is considering to invest in a project whose initial investment cost to it equals Rs. 1,000. Net cash flows from this project which start coming after a year is Rs. 450 per year for five years. After 5 years the project machine has no salvage value. Firm has to borrow investment funds at 20 per cent per annum from a bank. Calculate internal rate of return from the project and give advise whether to accept or reject the project.*

Solution:

$$\frac{R_1}{(1+r)}+\frac{R_2}{(1+r)^2}+\frac{R_3}{(1+r)^3}+\frac{R_4}{(1+r)^4}+\frac{R_5}{(1+r)^5}=C_0$$

$$\frac{450}{(1+r)}+\frac{450}{(1+r)^2}+\frac{450}{(1+r)^3}+\frac{450}{(1+r)^4}+\frac{450}{(1+r)^5}=1{,}000$$

Using the calculator r has been found to be equal to 34.9. Thus, 34.9 per cent is the internal rate of return from the investment in the proposed project. Since, internal rate of return (34.9%) exceeds the cost of capital (*i.e.* cost of borrowed funds) of 20 per cent, the project should be accepted for investment.

Choice Among Several Investment Projects. The method of internal rate of return can also be sued to make a choice among several projects. This issue is faced when a firm has limited funds for making investment. To decide about choosing among alternative investment projects on the basis of the criterion of internal rate of return, internal rates of return (IRR) are calculated from the cash flows of various available projects. Then, in terms of the magnitudes of internal rate of return of the various projects can be given rank-ordering from the highest rate of return to the lowest rate of return. Then investment funds should be employed to those projects which yield highest possible rates of return from the given limited available funds.

Comparison of NPV and IRR Methods

When evaluating a single project, the NPV and IRR methods yield the same results. When net present value (NPV) of a project is positive, internal rate of return exceeds the cost of capital and when net present value (NPV) of a project is negative, internal rate of return is less

than the cost of capital. This is because when net present value of a project is positive, it implies that the rate at which future cash flows have been discounted to obtain the net present value is greater than the implied rate of return which represents the discount rate which makes the present value of future net cash flows equal to the initial cost of project[2]. In fact, in case of a single project, NPV and IRR are the two sides of the same coin. Therefore, in case of a single investment project, the two evaluation methods always lead to the same accept-reject decision.

However, in case of two or more mutually exclusive projects, that is, when only one out of two or more projects has to be undertaken for investment, the two evaluation criteria can lead to contradictory results, Consider Table 34.3 where values of future net cash flows generated by two projects *A* and *B* are given, and both the net present value (NPV) and internal rate of return (*IRR*) of the two projects have been calculated. It will be seen from the table that project *A* has lower net present value (Rs. 622) but a higher rate of return (34.9%), whereas project *B* has a higher net present value (675) but a lower internal rate of return (24.2). Thus, on the basis of the net present value (NPV) criterion project *B* should be chosen, while according to internal rate of return (IRR) criterion, project *A* is recommended for investment. So in this case we get inconsistent results from the two evaluation criteria. The inconsistent results are due to the difference in the rate of return at which annual cash flows are reinvested for the next years. Whereas under the net present value method, the net cash flows generated by a project are implicitly assumed to be reinvested at the firm's cost of capital used by the firm for evaluation, in the IRR method the net cash flows generated by the project are implicitly assumed to be reinvested at the same higher rate of return *earned* on the project. This is somewhat unrealistic assumption because the rate of return on firm's reinvestment of its annual cash flows may not be as high as from the investment in the project under consideration. Therefore, *the net present value (NPV) is considered to be superior or better than internal rate of return (IRR) criterion in deciding which of the two mutually exlusive projects should be chosen for investment.* To conclude, when the two or more projects provides contradictory or inconsistent results, it is preferable for the firm to choose a project with a higher net present value (NPV) than the one with higher internal rate of return (IRR).

Table 34.3. Comparing NPV and IRR Methods

	Net Cash Flows							
Years	*0**	*1*	*2*	*3*	*4*	*5*	*NPV*	*IRR*
Project *A*	1,000	450	450	450	450	450	622	34.9
Project *B*	1,000	-300	0	600	600	2,000	675	24.2

* Initial Investment Outlay (*i.e.*, Cost of the Project) in Year 0.

Profitability Index (PI) Method

Another criterion of evaluating investment projects, which is similar to net present value method, is that of profitability index which is also called *benefit-cost ratio.* Profitability index (PI) of a capital project is defined as the ratio of present value of future cash flows from a project to the initial cost of the project. Thus

$$\text{Profitability Index (PI)} = \frac{\text{Present Value of Future Cash Flows}}{\text{Initial Cost of a Project}}$$

or

$$\text{PI} = \frac{\sum_{t=1}^{n} \frac{R_t}{(1+i)^t}}{C_0}$$

2. Note that internal rate of return can also be defined as discount rate which makes net present value (*NPV*) of the project equal to zero (*NPV* = 0).

where $\sum_{t=1}^{n} \frac{R_t}{(1+i)^t}$ is the sum of the present value of future cash flows from the project and C_0 is the initial cost of a project.

When profitability index of a project is greater than one, it means it adds more to the value of a firm it costs.

Decision rule. It is clear from above that in the method of profitability index, *a project with profitability index greater than one (PI > 1) should be accepted and a project with a profitability index less than one (PI < 1) should be rejected.* This means that those projects are accepted for investment which return more than a rupee of discounted cash flows for each rupee cost. Profitability index and net present value criterion always lead to consistent results regarding accept/reject decision when a single independent project is being evaluated. This is because when profitability index is greater than one ($PI > 1$) implies net present value being positive (NPV > 0) and when profitability index is less than one, it implies net present value being negative (NPV < 0).

However, it may be noted that when choice among alternative projects of unequal size (that is, requiring different amounts of investment outlay) are concerned, the NPV and profitability index (PI) can provide different rankings to the various projects.

The Level of Capital Expenditure and Capital Rationing

Two important decisions are required to be made in the capital budgeting process of a firm. First, if enough funds are available for investment with a firm, it has to determine the level of capital expenditure it will make. Secondly, if the limited amount of funds are available, how a firm should allocate them among various projects. Whereas the first type of decision relates to the *determination of the capital expenditure*, the second type of decision-making is called *capital rationing.*

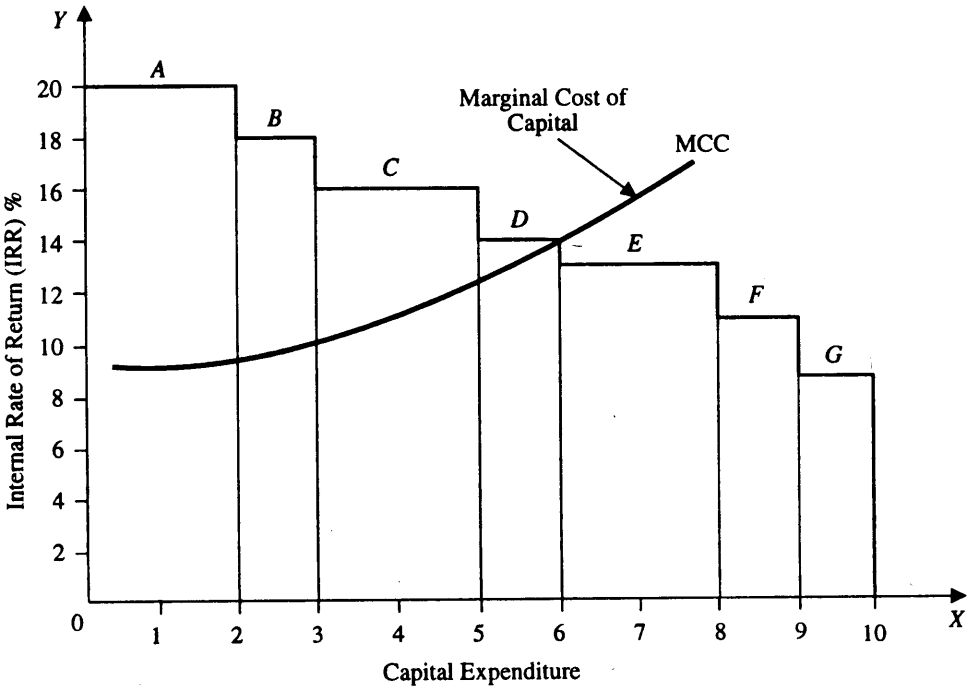

Fig. 34.1. *Determining Capital Expenditure*

Let us first explain what determines the level of capital expenditure by a firm when there is no constraint on the resources available to it. The level of capital expenditure depends on the internal rate of return (IRR) of the project on the one hand and cost of capital (*i.e.* cost of funds

for investment) on the other. In Fig. 34.1 we have drawn histograms representing seven projects. The length of a histogram shows the internal rate of return (*IRR*) of a project, while the width of a histogram represents the cost of the project, that is, funds initially required to implement it. The various projects are ranked in order of internal rate of return from them. Thus IRR of project *A* is 20%, of project *B* is 18%, of project *C* is 16% and so on. The thick line on the top of the histograms indicates decreasing rate of return of successive investment projects.

MCC curve shows the marginal cost of capital which is shown to be increasing. This is because as the firm borrows more funds, the greater the degree of risk will be borne by the lenders to the firm. This is because as the firm borrows more funds, there is a greater risk of default in its paying back the funds borrowed. Therefore, as a firm borrows more funds a higher rate of interest will be demanded by the lenders. *A project will be undertaken if internal rate return exceeds marginal cost of capital.* Thus, a firm will invest in new projects as long as internal rate of return (IRR) from investment projects is greater than the cost of capital. It will be seen from Fig. 34.1 that given the cost of capital as shown by the curve MCC, the firm will undertake projects *A, B, C* and *D*. It will not go further as internal rate of return (IRR) on additional projects is less than the cost of capital. It will be seen from Fig. 34.1 that the firm will make total investment or incur capital expenditure equal to Rs. 6 lakhs.

Capital Rationing. However, unconstrained investment funds for a firm are not generally available. Quite often a firm has a limited amount of investment funds. With the given constraint of available funds, it has to decide which projects it should choose for implementation and accordingly allocate or ration capital funds to them.

Suppose investment funds available for a firm for investment are Rs. 4 lakhs. It will be seen from the Table 34.4 that projects *A, B* and *D* cost Rs. 4 lakhs; and projects *A* and *C* also together cost Rs. 4 lakhs; and projects *A* and *B* (which together cost 3 lakhs and therefore leave Rs. one lakh unutilised). In this case of choice of projects with a limited resources, the use of criteria of NPV and IRR conflict with each other. This will be easily understood from the data given in Table 34.4.

Table 34.4. Capital Rationing

Project	*Initial Cost of Project*	*NPV*	*IRR*	*IRR (Ranking)*
A	2,000,00	10,000	20	1
B	1,000,00	4,000	18	2
C	2,000,00	7,000	16	3
D	1,000,00	2,500	14	4
E	1,000,00	2,000	13	5
F	1,000,00	1,900	11	6
Idle or Unutilised Balance	1,000,00	0	0	7

In this case *optimum choice is one which provides the highest NPV to the firm.* It will be seen from the table that the sum of NPV of the projects *A, B* and *D* are Rs. 16,500 (10,000 + 4,000 + 2,500 = Rs. 16,500), the sum of NPV of the projects *A* and *C* is Rs. 17,000 (10,000 + 7,000 = 17,000) and NPV of the projects *A* and *B* (with idle funds of Rs. one lakh is 10,000 + 4,000 + 0 = 14,000). Thus, the NPV of the projects *A* and *C* is the maximum. This means that if Rs. 4 lakh are invested in them, they will increase the value of the firm by the largest amount among the alternative choices.

It should be carefully noted that the ranking of internal rate of return (IRR) of project *C* comes third, while project *B* comes second but it is not chosen on the basis of the NPV criterion. The choice of projects when a firm faces constraint of resources the use of NPV criterion for choosing projects for investment ensures the maximum profitability.

35

Cost of Capital

Introduction

In the long-term investment analysis in the previous chapter we have seen that both in the net present value approach and rate of return approach for deciding to invest in a capital project we have to discount the future cash flows at an appropriate rate of interest. This appropriate rate of interest reflects the cost of capital which the firm has to incur for raising investment funds. In general, *cost of capital is the rate of return* required by lenders and stockholders to lend or invest their funds in the firm. There are three sources of funds to the firm for investment in capital projects.

1. By borrowing from others which is called *debt capital.*
2. By selling common stock to the investors which is called *equity capital.*
3. Using retained earnings (*i.e.*, undistributed profits) of the firm for investment expenditure.

The cost of using retained earnings for investment is the opportunity cost, that is, return foregone which could be obtained by lending or investing outside the firm. Therefore, the cost of using retained earnings is treated at par with the cost of equity capital and is therefore not discussed separately. In what follows we explain how the costs of debt capital and equity capital are estimated.

Cost of Debt Capital

Borrowing money from others is one of the important ways a firm raises funds for investment. The instrument for this is the issue of bonds or debentures which provide lenders annual interest payments and returning the principal sum at maturity. Since the interest payments made by a firm on the borrowed funds are deducted from firm's income to obtain its taxable income, to determine the cost of debt capital adjustment must be to obtain after-tax cost of it for the firm. For a given rate of interest (i) and the marginal tax rate (t), the firm's cost of debt capital (r_d) is

$$r_d = i\,(1 - t)$$

For example, if a firm borrows funds at 15 per cent rate of interest and marginal tax rate is 40 per cent, cost of debt capital for it will be

$$\begin{aligned} r_d &= 0.15\,(1 - 0.40) \\ &= 0.15 - 0.06 \\ &= 0.09 \text{ or } 9 \text{ per cent} \end{aligned}$$

It is evident from above that due to the interest payments being deductible from firm's

income to determine its taxable income, the after tax cost of debt capital is lower than the interest rate charged by the borrowers from the firm. Besides, two other important things are worth mentioning with regard to the cost of debt capital. First, if the firm does not earn profits, its pre tax and after-tax cost of debt capital will be the same because no marginal tax is payable by the firm. Secondly, since only consideration in measuring cost of capital is the *cost of raising new funds*, we are concerned with marginal cost of capital and not its average cost. This is also because the investment decision requires comparing the rate of return on new projects with cost of raising *new* capital (that is, marginal cost of capital).

COST OF EQUITY CAPITAL

A firm can raise funds through equity either internally through ploughing back of its retained earnings (*i.e.*, accumulated undistributed profits) or externally through issuing new common stock (that is, equity shares) for sale to the public. *The cost of equity capital is the minimum rate of return that is required by the investors to buy the shares (common equity) of the firm.* Determining the cost of equity capital is more complicated and controversial as compared to the cost of debt capital. Three methods of estimating cost of equity capital have been suggested. They are :

1. *The Risk-Free Rate Plus Risk Premium*
2. *The Dividend Valuation Model*
3. *The Capital Asset Pricing Model*

We explain below in some detail these three methods of estimating cost of equity capital.

Risk-Free Rate Plus Risk Premium

As mentioned above, cost of equity capital is the rate of return that investors require to invest in the common stock (shares) of the firm. Investors in the common stock of the firm are rewarded in two ways. First, they get dividends annually on the shares held by them from the firm. Secondly, they gain from appreciation in the prices of equity shares of the firm. However, investment in the common stock is riskier than investment in debt capital (*i.e.*, bonds or debentures) of the firm which bears fixed rate of interest. This is because whereas bonds have to be paid a fixed rate of interest annually and the principle amount at maturity before any dividends are distributed among the shareholders, the dividends can fluctuate very much depending on the rise and fall of profits of the firm. Besides, the prices of common stock (*i.e.*, shares) of a firm can change very much; they can even fall and thus involve a good deal of risk. Therefore, because of the risk involved in the investment in the common stock of the firm, the shareholders must be rewarded a risk premium over and above risk-free return on capital. The risk involved in investment in common shares of the firm arises because of two factors. First, risk on investment in common stock arises because investors invest in the common stock of a private firm as against investment in *risk-free Government securities.* Return on long-term Government securities is considered as risk-free return as its payment is guaranteed by the Government. Secondly, there is extra risk involved in buying shares rather than bonds of a firm. Since dividends vary with the firm's profits, stocks are riskier than the bonds. Therefore, they must carry additional premium. Thus, the *cost of equity capital is estimated to be equal to the risk-free rate of return plus a risk premium.* In notational terms :

$$r_e = r_f + r_p$$

where

r_e = cost of equity capital

r_f = risk-free rate of return

r_p = risk premium

The two components of risk mentioned above can be represented by e_1 and e_2 respectively. Thus, the cost of equity is

$$r_e = r_f + e_1 + e_2$$

The first type of risk premium (e_1) is generally estimated by taking the difference between the interest rate on private firm's bonds and the interest rate of Government bonds (*i.e.*, long-term Government securities). The second type of risk premium (e_2) associated with investing in common stock rather than bonds of the firm depends on one's judgement rather than objective criterion. Financial analysts usually assume that return on a firm's common equity shares is about 3 to 5 per cent points more than the interest rate on firm's bonds. The exact additional return on equity as opposed to firm's bond is calculated by taking the historical difference between the average yield (rate of dividend plus capital gains) on firm's equity capital and average interest rate on firm's bonds.

Let us take an example for estimating cost of equity capital in this method. Suppose the firm's return on equity capital is 4 per cent greater as against return on its bonds. Further suppose that rate of interest on Central Government's securities is 11 per cent and a private firm's bonds bear 14 per interest. Therefore, the difference between the risk-free return and yield on private firm's bonds in this case is :

$$0.14 - 0.11 = 0.03$$

The total risk premium in this case is

$$e_p = e_1 + e_2 = 0.03 + 0.04 = 0.07$$

It follows from above that cost of equity capital is

$$r_e = r_f + r_p$$
$$= 0.11 + 0.07 = 0.18 \text{ or } 18 \text{ per cent.}$$

It is important to note that dividends paid on equity capital (shares) are not deductible from firm's income. Therefore, no tax adjustment is made in determining the cost of equity capital on account of dividend payments which are not deductible from firm's income.

Discounted Cash Flow Model

The first method of cost of equity capital, namely, "risk-free return plus premium" considers risk involved in investment in shares of common stock of the firm but does not take into account the possibility of *growth in dividend on shares and increase in the price of shares over time.* The discounted cash flow model considers both the increase in dividends and increase in price or value of shares of the firm to determine cost of equity capital. This model is also called 'dividend Valuation model'. It may be noted again that the cost of equity capital is the return on a share of the firm that must be paid to the investors to invest in the firm. *Value or price of a share of common stock of the firm is the present value of all future dividends expected to be paid on a share of the common stock* using the investor's required rate of return (r_e) as the discount rate. If the current dividend (D) per share is expected to remain constant indefinitely over time, the present price or value (P) of a share of equity capital of the firm will be

$$P = \sum_{t=1}^{\infty} \frac{D}{(1 + r_e)^t} \qquad ...(1)$$

$$P = D\left[\sum_{t=1}^{\infty} \frac{1}{(1+r_e)^t}\right] \quad ...(2)$$

If it is assumed that dividend on a share remains constant over time and is to be paid indefinitely, then it can be shown that the bracketed term in equation (2) above reduces to $\frac{1}{r_e}$. With this the equation (2) for the price of a share of equity capital becomes

$$P = \frac{D}{r_e} \quad ...(3)$$

That is, *price of a share of equity capital (i.e., common stock) of a firm is the annual dividend per share divided by the required rate of return* (r_e).

Now, if dividend on a share of the firm is expected to grow annually at the rate g, it can then be proved that price per share of the firm will be

$$P = \frac{D}{r_e - g} \quad ...(4)$$

Solving equation (4) for r_e (that is, required rate of return or cost of equity capital) we have

$$r_e = \frac{D}{P} + g \quad ...(5)$$

This means that the cost of equity capital (r_e), that is, *return required by the investors to invest in the common stock of the firm is equal to the ratio of dividend paid per share (D) by the firm and price of its share (P)* plus the expected annual growth rate of dividend payments by the firm. $\frac{D}{P}$ in equation (5) above is often referred to as *dividend yield per share*. It should be noted that g is the *historic growth rate* of dividends paid by the firm in the past which is expected to continue in the future. The growth rate of dividends can also be based on the *forecasts* made by the financial analysis which are based on expected sales, profit margins and competitive strength of the firm and are published in Business Magazines.

Example. Let us illustrate the computation of cost of equity capital according to the Dividend Valuation Model with a numerical example. Suppose a business firm is paying a dividend of 16 per share on its common stock that is currently selling for Rs 200 per share and security analysts forecast that dividend per share will increase at the rate of 5 per cent per year. What will be the cost of equity capital in this case ?

$$r_e = \frac{D}{P} + g$$

$$r_e = \frac{16}{200} + 0.05$$

$$= \frac{2}{25} + 0.05$$

$$= 0.08 + 0.05 = 0.13 \text{ or } 13 \text{ per cent.}$$

Numerical Problem

Suppose the current price of a share of HCL Computers is Rs 312. The dividend paid per share of the firm the next year is expected to be Rs 24 per share. Further, past data reveals that dividend per share has been growing at an average compound annual rate of 8 per cent over the past 8 years and it is expected that this growth rate in dividend will be maintained in the future too. Using this information, calculate the cost of equity capital by dividend valuation method.

Solution.

According to *discounted cash flow method* which is also called dividend valuation method, cost of equity capital is

$$r_e = \frac{D}{P} + g$$

where

D = annual dividend per share

g = the annual growth rate in the dividend per share

P = the current price of the share.

Substituting the values of D, g and P in the above formula, we have

$$r_e = \frac{24}{312} + 0.08$$

$$= 0.077 + 0.08 = 0.157 \text{ or } 15.7\%$$

Capital Asset Pricing Model (CAPM)

For determining cost of capital, this is a very important method developed during 1970s and 1980s and is extensively used by the modern financial analysts. To determine the cost of equity capital, this model takes into consideration not only the risk differential between the risk-free Government securities and the shares of common stock but also the risk differential between the common stock and the *average common stock* of all firms in the market taken together, (or, broad-based market portfolio of shares of various firms.

The risk differential between the common stock and Government's securities is given by $r_m - r_f$ where r_m stands for the return on the average common stock and r_f for the return on risk-free Government securities.

On the other hand, relative risk differential between the common stock of a firm and the common stock of all firms measured by a risk index, called *beta coefficient* (β). This β-coefficient is the ratio of the variability of return on the common stock of a firm and the variability in the average return on the common stock of all firms. This β-coefficient is obtained by regressing the average return on all capital stock (or a representative basket of stocks) on the return on a share of the common stock of a firm, say a firm J. This is represented by k_i^J. Thus,

$$k_i^J = a + \beta k_i^m$$

where k_i^J = return on a share of a common stock of a firm J in the ith period.

k_i^m = the average return on all common stocks of all firms in the ith period.

If the β-coefficient for the stock of a firm is estimated to be equal to 1, this means that the value of a firm varies in proportion to the return on all stocks. This implies average risk of investment in the common stock of a firm. The greater the value of β-coefficient for the stock of a firm, the greater the variability in the return on the common stock of the firm which therefore means higher risk for the investors. Thus, if β-coefficient for the common stock of a firm is equal to 2, it means the variation in return on the common stock of a firm is twice that of the variation in return on the total stock of all firms and this shows higher risky stock of that firm for investment purposes. On the other hand, if the value of β-coefficient is less than 1, say it is equal to 0.5, this will indicate lower risky stock of the firm as in this case 1 per cent variation in the total stock of all firms will be associated with a $\frac{1}{2}$ per cent variation in the return on the stock of that firm.

From the above analysis it follows that in the capital asset pricing model (CAPM), the cost of equity capital is given by

$$r_e = r_f + (r_m - r_f)\,\beta$$

where

r_e = the cost of equity capital of a firm

r_f = the risk-free return (*i.e.*, return on Government securities)

r_m = return on the common stock of a firm

β = Beta-coefficient

Numerical Problem

Suppose the common stock of the Indian firm 'Reliance Petroleum' has a beta (β) coefficient of 0.8 and present risk-free rate of return is 9 per cent. If the expected return on the investment in the common stock on the market as a whole is 15 per cent, using Capital Asset Pricing Model (CAPM), calculate the cost of equity capital of the Reliance Petroleum.

Solution.

According to Capital Asset Pricing Model (CAPM), the cost of equity capital is

$$r_e = r_f + (r_m - r_f)\,\beta$$

Substituting the values of $r_f = 9$, $r_m = 15\%$ and $\beta = 0.8$ in the above formula, we have

$$\begin{aligned} r_c &= 9 + (15.0 - 9.0)\,0.8 \\ &= 9 + (6 \times 0.8) \\ &= 9 + 4.8 = 13.8\% \end{aligned}$$

Overall Cost of Capital or Composite Cost of Capital

The cost of capital is calculated in order to compare it with the benefits or rate of return expected to be obtained from the proposed capital expenditure projects (that is, long-term investment proposals). As we know that the purpose of capital or long-term investment expenditure is to determine which proposed capital project should be actually undertaken by the firm. If the expected return from a capital project exceeds the cost of capital, it is undertaken by the firm.

It is worth mentioning that capital expenditure whose cost is measured and compared with the return expected to be obtained relates to the proposed *new or marginal* capital expenditure project for which funds are to raised. In other words, we are concerned with *the marginal cost of capital.* Thus, for evaluating new capital expenditure projects, *historical cost* of capital (that is, costs of capital incurred in the earlier periods) is not used. Instead, as mentioned above, we use marginal cost of capital for evaluating long-term investment projects.

It is also worth-mentioning that typically a firm's capital structure consists of both debt capital and equity capital in certain proportions. Usually, a firm plans for a *target capital structure* consisting of both debt capital and equity capital. Therefore, the firm calculates the cost of each component of capital (that is, cost of debt capital and that of equity capital) which it has to incur for raising funds in the *next year* for financing proposed capital expenditure projects.

It should be noted that for each *individual project* the firm does not actually specify the proportions of funds to be raised through debt and equity but it is generally assumed that each capital project is financed with the proportions of debt and equity capital as contained in the firm's overall target capital structure. Therefore, the cost of capital to be used in evaluating capital expenditure projects is not only based on cost of capital incurred on raising funds for financing new or marginal capital expenditure project but also consists of the same proportions of debt and equity capital as those contained in the firm's target capital structure. Thus, the overall cost of capital or what is also called *composite cost of capital is the weighted average of the cost of debt capital (r_d) and the cost of equity capital (r_e) where weights used are the proportions of debt capital and equity capital in the firm's target capital structure.*

Let w_d represent the proportion of debt capital and w_e the proportion of equity capital in the firm's target capital structure. Thus, the *overall cost of capital which is also called weighted or composite cost of capital (r_c) is*

$$r_c = w_d r_d + w_e r_e$$

where

r_c = overall cost of capital
w_d = the proportion of debt capital in the firm's capital structure
r_d = the cost of debt capital
w_e = the proportion of equity capital in the firm's capital structure
r_e = the cost of equity capital

Differences in Capital Structure and the Risk

There are differences in the capital structure of different firms. Firms belonging to manufacturing industries usually prefer a capital structure which has a smaller proportion of debt capital and larger proportion of equity capital, say 30 per cent debt capital and 70 per cent equity capital. On the other hand, firms belonging to public utilities such as electric supply companies, water supply companies, firms providing telephone services generally have a higher ratio of debt capital as compared to that of equity capital. This difference in capital structure arises because of preference for risk-bearing on the part of owners or managers of firms and also because of the nature of industry or business in which they happen to be working. It should be noted that a capital structure heavily inclined towards debt means greater risk because in this a firm commits

itself to a *fixed interest rate and payments of the principal amount at maturity in time.* As a result, risk of default arises with serious consequences when the firm is not making sufficient profits. Therefore, manufacturing companies which face competition in the market have lower proportion of debt capital as they cannot afford to bear greater risk involved in the high proportion of debt capital.

On the other hand, companies operating in public utilities usually have a monopoly position in the market and product they supply is generally a necessity which enable them to exercise greater control over the price which ensure reasonably stable flow of revenue and profits. As a result of this, risk involved is reduced very much and therefore capital structure of firms operating in public utilities have generally a higher proportion of debt capital.

NUMERICAL PROBLEMS

Problem 1. *Suppose Satyam Computers has a target capital structure of 60 per cent equity and 40 per cent debt. Over the next year it plans to raise Rs 200 crores partly by selling bonds at the after-tax cost of 8 per cent and partly by issuing new equity at Rs 350 per share at the cost of 12 per cent per share. Find out the overall cost of capital.*

Solution.

In order to maintain the target capital structure, of Rs 200 crores it will raise 60 per cent of it through issuing new equity shares at the cost of 12 per cent per share and 40 per cent of it through selling bonds at the cost of 8 per cent. It should be noted that no adjustment on account of interest payments is required as cost of debt capital given is after-tax cost of debt capital. Thus, the overall cost of capital is

$$r_c = w_d\, r_d + w_e\, r_e$$

Substituting the value of w_e equal to 60 per cent (*i.e.*, 0.60), r_e equal to 12, w_d equal to 40 per cent (*i.e.*, 0.40), r_d equal to 8, we have

$$r_c = 0.60 \times 12 + 0.40 \times 8$$

$$= 7.20 + 3.20 = 10.4$$

Thus, the overall cost of capital is 10.4 per cent which will be used to evaluate all capital expenditure projects to decide whether or not to undertake a project.

Problem 2. *Suppose a computer firm Wipro has a current capital structure of 75 per cent equity and 25 per debt and financial managers of Wipro do not want to change its capital structure. The firm plans to finance in the next year 100 crores capital budget through using retained earnings at the capital cost of 12 per cent per share and by issuing long-term bonds at 11 per cent interest rate. Further assume that 35 per cent is the marginal tax rate. Calculate the weighted or overall cost of capital.*

Solution.

Note that financing capital budget through using retained earnings is treated at par with raising funds by externally selling common shares in the market. Further note that in this problem cost of debt capital is not directly given. Instead, interest rate on the bonds issue is given. Since interest payments are deductible from income to arrive at taxable income adjustment has to be made on this count to estimate the true cost of debt capital.

With 35 per cent rate of income tax, after-tax cost of debt capital will be

$$r_d = r_i(1-t)$$
$$r_d = 11(1-0.35) = 11 \times 0.65 = 7.15$$
$$r_c = w_e r_e + w_d r_d$$
$w_e = 75$ per cent, that is, 0.75
$r_e = 12$ per cent
$w_d = 25$ per cent, that is, 0.25
$$r_d = r_i(1-t)$$
$$r_c = w_e r_e + w_d \cdot r_i(1-t)$$
$$= 0.75 \times 12 + 0.25 \times 11(1-0.35)$$
$$= 9.0 + 0.25 \times 11(0.65)$$
$$= 9 + 0.25 \times 7.15$$
$$= 9 + 1.79 = 10.79$$

Problem 1. *Suppose the return on Government securities is 9 per cent and a bond of a firm yields 12 per cent. Calculate (1) total risk premium, (2) cost of equity capital of the firm.*

Solution.

Risk-free return is the return on Government securities which is given as 9 per cent in present problem.

The component of risk premium p_1 is given by the excess of the rate of interest on a firm's bonds (which is 12 per cent in the problem) over the interest on Government's bonds (*i.e.*, 9 per cent).

Thus, $p_1 = 12 - 9 = 3\%$

The second component of risk in buying firm's common stock (*i.e.*, common shares) rather than bonds is generally assumed to be equal to 4 percentage points greater than the return on bonds.

Thus, total risk premium is

$$r_p = p_1 + p_2 = (12 - 9) + 4 = 7 \text{ per cent}$$

Cost of equity capital

$$r_e = r_f + p_1 + p_2$$
$$= 9 + 3 + 4 = 16\%$$

Problem 4. *The current price of common stock of XYZ is Rs 2.40. The firm has just paid a dividend of 8 paise per share this year and expects that its dividend will grow in future at a constant rate of 12 per cent per year. Calculate the firm's cost of equity capital using discounted cash flow method (i.e., Dividend Valuation Method).*

Solution.

Dividend per share (D) = 8 paise
Price of share = Rs 2.40 = 240 paise
g = 12% or 0.12

$$\text{Cost of equity capital } (r_e) = \frac{D}{P} + g$$

$$= \frac{8}{240} + 0.12$$

$$= \frac{1}{30} + 0.12$$

$$= 0.033 + 0.12 = 0.153 \text{ or } 15.3\%$$

Problem 5. *If a firm borrows funds at 15% interest rate and pays a marginal income tax of 35 per cent, calculate the cost of debt capital.*

Solution.

In order to obtain a true cost of debt capital, adjustment has to be made because *interest payments are deductible from income for taxation purposes.*

Thus,

$$r_d = r_i (1 - t)$$

where r_d is cost of debt capital, r_i is rate of interest and t is rate of tax.

$$r_d = 15 (1 - 0.35)$$

$$= 15 - 5.25$$

$$= 9.75$$

Problem 6. *Suppose shares of HCL Computer Company are sold in the market at Rs 200 per share. The company declares its dividend of Rs 12 per share. Security analysts estimate that the annual growth of dividend of the company will be 8 per cent. What will be the cost of equity capital for this company ?*

Solution.

Cost of capital is the required rate of return by the investors to invest in the company

$$r_d = \frac{D}{P} + g$$

D = Rs 12 per share

P = Rs 200 per share

g = 8% or 0.08

Thus, $$r_e = \frac{12}{200} + 0.08$$

$$= \frac{6}{100} + 0.08$$

$$= 0.06 + 0.08 = 0.14 \text{ or } 14\%$$

Problem 7. *Suppose Telco Company has a beta coefficient showing variability of return on its common stock has been estimated to be equal to 0.8. Rate of interest on Government bonds is 9 per cent and the average return on the common stock on the market as a whole is 12 per cent. Find out the cost of equity capital for Telco using Capital Asset Pricing Model (CAPM).*