The Keynesian Theory of Investment

According to the classical theory there are three determinants of business investment, viz., (i) cost, (ii) return and (iii) expectations.

According to Keynes investment decisions are taken by comparing the marginal efficiency of capital (MEC) or the yield with the real rate of interest (r).

So long as the MEC is greater than r, new investment in plant, equipment and machinery will take place.

However, as more and more capital is used in the production process, the MEC will fall due to diminishing marginal product of capital. As soon as MEC is equated to r, no new investment will be made in any income-earning asset.

Marginal Efficiency of Capital:

The MEC is the rate of discount which equates the present value of a series of cash flows obtainable from an income-earning asset like a machine over its entire economic life to the cost of the machine. The MEC is the rate of return at which a project is expected to breakeven.

This depends on the immediate profits (cash flows) expected from operating the project and the rate at which these are expected to decline through reduction in the price of output, or increases in the real wages or cost of raw materials and fuel.

If all possible projects in an economy are arranged in descending order of their MEC, investors will accept those with MEC higher than r and reject those whose MEC is lower than r. The MEC is not the same as the marginal product of capital which is concerned only with the immediate effect of additional capital on possible output and not with how long the resulting profits can be expected to persist.

The MEC is the rate of return (profits) on an extra rupee worth of investment. The marginal efficiency of capital decreases as the amount of investment increases (as shown in Fig. 18.1). This is because initial investments are concentrated on the 'best' opportunities and yield high rates of return; later investments are less productive and secure progressively lower returns.

The amount of investment undertaken depends not only on expected returns but also on the cost of capital, that is, the interest rate. Investment will be profitable up to the point where the marginal efficiency of capital is equal to the cost of capital. In Fig. 18.1 at an interest rate of 20% only $0I_0$ amount of investment is worthwhile. A fall in the interest rate to 10% increases the amount of profitable investment $0I_1$.

If the supply price of capital goods changes over time it becomes necessary to draw a distinction between MEC and marginal efficiency of investment (MEI).

It will be readily apparent from Fig. 18.1 that there is a link between the monetary side of the economy and the real economy a fall in interest rates will stimulate more investment, which, in its turn, will result in a higher level of national income.

If expectations change and investors expect to receive better returns from each investment — because, for example, of technological progress — then at any given rate of interest such as 20%) more investment will be undertaken than before; that is, the marginal efficiency of capital schedule will shift to the right, as shown in Fig. 18.1(b), and investment will increase from OI_2 to OI_0.

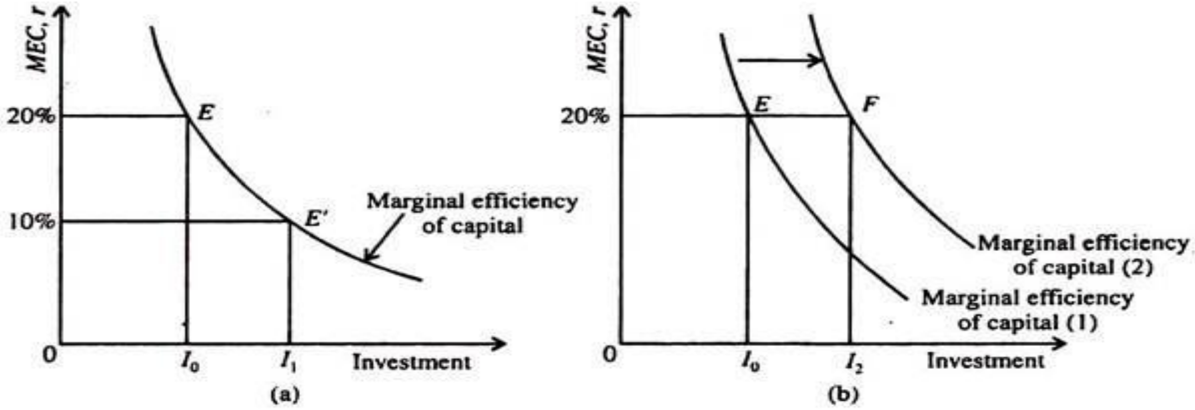

Fig. 18.1 Marginal Efficiency of Capital and the Decesion to Invest

The MEC is calculated by using the following formula:

$$C_0 = \frac{R_1}{(1+e)} + \frac{R_2}{(1+e)^2} + \ldots\ldots + \frac{R_n}{(1+e)^n} \qquad \ldots (1)$$

where C_0 is the purchase price of the machine in the base year, R_1, R_2, etc. are the expected cash flows from the machine in the first, second and subsequent years and e is the MEC which acts as the balancing factor. It makes the two sides of the above equation equal. Here R_n is the expected cash flow from the machine in the last year which also includes the scrap value of the machine.

It may be noted that e varies directly with r and inversely with C_0, i.e., the initial cost of purchasing the machine. A simple method of calculating e for an infinitely durable capital good is available. In this case the economic life of the machine (which depends on the annual rate of depreciation) is not known. We know that

$$C_0 = \frac{R_1}{(1+e)} + \frac{R_2}{(1+e)^2} + \ldots + \frac{R_n}{(1+e)^n} \quad \ldots (2)$$

or, $C_0 = R(1 + e)^{-1} + R(1 + e)^{-2} + \ldots + R(1 + e)^{-n} + R(1 + e)^{-(n+1)}$

(assuming that $R_1 = R_2 = \ldots\ldots = R_n$)

or, $C_0(1 + e)^{-1} = R(1 + e)^{-2} + \ldots + R(1 + e)^{-n} + R(1 + e)^{-(n+1)}$ ... (3)

If we subtract equation (2) from equation (1) we get

$$C_0 - C_0(1 + e)^{-1} = R(1 + e)^{-1} - R(1 + e)^{-(n+1)} \quad \ldots (4)$$

or, $C_0[1 - (1 + e)^{-1}] = R(1 + e)^{-1}$ ... (5)

As $n \to \propto$, $R(1 + e)^{-(n+1)}$ tends to zero and is ignored here.

or, we can rewrite the equation (4) as

$C_0[1 + e - 1] = R$ by multiplying all the three terms by $(1 + e)$

or, $C_0[e] = R$

or, $e = \frac{R}{C_0}$

The term R is called by Keynes the expected (prospective) rate of return on new investment (the machine) and C_0 is the purchase price of the machine. If e exceeds r, an income-earning asset like a machine should be purchased.

Example:

2. Suppose you have an opportunity to purchase an asset which costs Rs. 1,000. It is expected to yield Rs. 585 at the end of the first year and Rs. 585 at the end of the second year (and zero thereafter). If the market rate of interest is 10%, is it to your advantage to purchase the asset? Explain your answer.

Ans. In this case $PV = \frac{585}{(1+r)} + \frac{585}{(1+r)^2} = \frac{585}{1+0.1} + \frac{585}{(1+0.1)^2}$

$$= \frac{585+585}{1.21} = 1{,}015.28$$

So $NPV = 15.28$. Therefore, the machine should be purchased. In this case MEC is

$$e = \left(\frac{585}{1{,}000}\right) \times 100\% = 11.1\%$$

So $e - r = 11.1\% - 10\% = 1.1\%$ which is positive. Therefore, the machine should be purchased.

Factors Determining Investment:

Anything which increases a firm's profit prospects by increasing R will increase its level of investment. On the other hand, if the purchase price of capital (C_0) increases, investment will fall.

The following factors affect a firm's investment decisions:

(i) Increased optimism among managers:

If managers are more optimist about the future, they will place more orders for machines. This will enable them to make more profit by venturing out in those areas where demand for consumer goods is picking up.

(ii) An increase in the growth rate of the economy:

Keynes assumed that all investment is autonomous and is thus independent of national or per capita income. However, according to the acceleration theory of investment (to be discussed later in this chapter), investment has an induced component as well. So anything which increases the demand for consumer goods is always beneficial for the capital goods producing industry.

If India's growth rate (as measured by the annual rate of increase of per capita income) increases there will be more demand for consumer goods such as food and textiles. So industries producing such goods will be stimulated and the managers of such industries will place more orders for purchase of machines.

In other words, there will be more demand for food-producing and textile-producing machines. This is because the demand for capital (investment) goods is a derived (indirect) demand. In fact, the acceleration principle suggests that a small increase in the demand for consumer goods leads to an accelerated increase in the demand for capital goods.

(iii) An increase in capital stock:

An increase in society's stock of capital — all other factors remaining the same — will lead to a fall in the marginal physical product of capital and will reduce the MEC by lowering the prospective rate of return on new investment.

(iv) A change in technology:

A favourable technological change (not an adverse technology shock) will shift the MEC schedule to the right and will increase the volume of investment even if the rate of interest remains constant.

(v) Changes in the rate of interest:

Economists differ in their views about the interest rate sensitivity of investment. Some Keynesian economists argue that investment depends largely upon expected return and is not very interest rate sensitive, so that even large changes in interest rates have little effect upon investment (the marginal efficiency of capital curve being very steep).

Thus the Keynesians economists claim that monetary policy will not be very effective in influencing the level of investment in the economy. By contrast the monetarists argue that investment is very interest rate-sensitive.

So even small changes in interest rates will have significant impact upon investment (the marginal efficiency of capital/investment curve being very shallow). Thus, monetarists claim that monetary policy will be effective in influencing the level of investment. Empirical evidence tends to support the Keynesian view that interest rates have only a limited effect on investment.

However, the neo-classical economists such as Dale Jorgenson and his co-workers have abandoned the classical and the Keynesian theories of investment on the ground that both are unrealistic. They have developed an alternative theory of investment in terms of the profit- maximising behaviour of a firm under perfect competition. It is to this theory to which we turn now.

1. The Accelerator Theory of Investment:

The accelerator theory of investment, in its simplest form, is based upon the nation that a particular amount of capital stock is necessary to produce a given output.

For example, a capital stock of Rs. 400 billion may be required to produce Rs. 100 billion of output. This implies a fixed relationship between the capital stock and output.

Thus, $X = K_t / Y_t$

where x is the ratio of K_t, the economy's capital stock in time period t, to Y_t, its output in lime period t. The relationship may also be written as

$K_t = xY_t$ …(i)

If X is constant, the same relationship held in the previous period; hence

$K_{t-1} = xY_{t-1}$

By subtracting equation (ii) from equation (i), we obtain

K_t _K_{t-1} = $xY_{t.x}$ Y_{t-1} = $x(Y_t - Y_{t-1})$ …(ii)

Since net investment equals the difference between the capital stock in time period t and the capital stock in time period t – 1, net investment equals x multiplied by the change in output from time period t – 1 to time period t.

By definition, net investment equals gross investment minus capital consumption allowances or depreciation. If I_t represents gross investment in time period t and D_t represents depreciation in time period t, net investment in time period t equals $I_t – D_t$ and

$I_t - D_t = x\ (Y_t – Y_{t-1}) = x\ \Delta\ Y$.

Consequently, net investment equals x, the accelerator coefficient, multiplied by the change in output. Since x is assumed constant, investment is a function of changes in output. If output increases, net investment is positive. If output increases more rapidly, new investment increases.

From an economic standpoint, the reasoning is straightforward. According to the theory, a particular amount of capital is necessary to produce a given level of output. For example, suppose Rs. 400 billion worth of capital is necessary to produce Rs. 100 billion worth of output. This implies that x, the ratio of the economy's capital stock to its output, equals 4.

If aggregate demand is Rs. 100 billion and the capital stock is Rs. 400 billion, output is Rs. 100 billion. So long as aggregate demand remains at the Rs. 100 billion level, net investment will be zero, since there is no incentive for firms to add to their productive capacity. Gross investment, however, will be positive, since firms must replace plant and equipment that is deteriorating.

Suppose aggregate demand increases to Rs. 105 billion. If output is to increase to the Rs. 105 billion level, the economy's capital stock must increase to the Rs. 420 billion level. This follows from the assumption of a fixed ratio, x, between capital stock and output. Consequently, for production to increase to the Rs. 105 billion level, net investments must equal Rs. 20 billion, the amount necessary to increase the capital stock to the Rs. 420 billion level.

Since x equals 4 and the change in output equals Rs. 5 billion, this amount, Rs. 20 billion, may be obtained directly by multiplying x, the accelerator coefficient, by the change in output. Had the increase in output been greater, (net) investment would have been larger, which implies that (net) investment is positively related to changes in output.

In this crude form, the accelerator theory of investment is open to a number of criticisms.

First, the theory explains net but not gross investment. For many purposes, including the determination of the level of aggregate demand, gross investment is the relevant concept.

Second, the theory assumes that a discrepancy between the desired and actual capital stocks is eliminated within a single period. If industries producing capital goods are already operating at full capacity, it may not be possible to eliminate the discrepancy within a single period. In fact, even if the industries are operating at less than full capacity it may be more economical to eliminate the discrepancy gradually.

Third, since the theory assumes no excess capacity, we would not expect it to be valid in recessions, since they are characterized by excess capacity. Based on the theory, net investment is positive when output increases. But if excess capacity exists, we would expect little or no net investment to occur, since net investment is made in order to increase productive capacity.

Fourth, the accelerator theory of investment, or acceleration principle, assumes a fixed ratio between capital and output. This assumption is occasionally justified, but most firms can substitute labor for capital, at least within a limited range. As a consequence, firms must take into consideration other factors, such as the interest rate.

Fifth, even if there is a fixed ratio between capital and output and no excess capacity, firms will invest in new plant and equipment in response to an increase in aggregate demand only if demand is expected to remain at the new, higher level. In other words, if managers expect the increase in demand to be temporary, they may maintain their present levels of output and raise prices (or let their orders pile up) instead of increasing their productive capacity and output through investment in new plant and equipment.

Finally, if and when an expansion of productive capacity appears warranted, the expansion may not be exactly that needed to meet the current increase in demand, but one sufficient to meet the increase in demand over a number of years in the future.

Piecemeal expansion of facilities in response to short-run increases in demand may be uneconomical or, depending upon the industry, even technologically impossible. A steel firm cannot, for example, add half a blast furnace. In view of these and other criticisms of the accelerator theory of investment, it is not surprising that early attempts to verify the theory were unsuccessful.

Over the years, more flexible versions of the accelerator theory of investment have been developed. Unlike the version of the accelerator theory just presented, the more flexible versions assume a discrepancy between the desired and actual capital stocks which is eliminated over a number of periods rather than in a single period. Moreover, it is assumed that the desired capital stock, K*, is determined by long-run considerations. As a consequence

$$K_t - K_{t-1} = (K_t^* - K_{t-1}) \ (0 < \lambda < 1),$$

where K_t is the actual capital stock in time period t, K_{t-1} is the actual capital stock in time period t-1, K_t^* is the desired capital stock, and λ is a constant between 0 and 1. The equation suggests that the actual change in the capital stock from time period t – 1 to time period t equals a fraction of the difference between the desired capital stock in time period t and the actual capital stock in time period t—1. If λ were equal to 1, as assumed in the initial statement of the accelerator theory, the actual capital stock in time period t equals the desired capital stock.

Since the change in the capital stock from time period t – 1 to time period t equals net investment, $I_t - D_t$ we have

$$I_t - D_t = K_t - K_{t-1} = \lambda (K_t^* - K_{t-1}).$$

Consequently, net investment equals A multiplied by the difference between the desired capital stock in time period t and the actual capital stock in time period t- 1. The relationship, therefore, is in terms of net investment.

To account for gross investment, it is common to assume that replacement investment is proportional to the actual capital stock. Thus, we assume that replacement investment in lime period t, $D_t$equals a constant δ multiplied by the capital stock at the end of time period t-$_1$, K_{t-1}, or

$$D_t = \delta K_{t-1} \ (0 < \delta < 1).$$

For example, if δ equals 0.05, then 5 percent of the economy's capital stock at the beginning of time period *t* wears out or is destroyed during the period.

Since net investment, $I_t - D_t$, equals $\lambda (K_t^* - K_{t-1})$, we have, upon substitution,

$$I_t - \delta K_{t-1} = \lambda (K_t^* - K_{t-1}),$$

or

$$I_t = \lambda (K_t^* - K_{t-1}) + \lambda K_{t-1}, \qquad ..(iii)$$

where I_t represents gross investment, K_t* the desired capital stock, and K_t. , the actual capital stock in time period t$_{-1}$. Thus, gross investment is a function of the desired and actual capital stocks.

Finally, according to the accelerator model, the desired capital stock is determined by output. Yet, rather than specifying that the desired capital stock is proportional to a single level of output, the desired capital stock is commonly specified as a function of both current and past output levels. Consequently, the desired capital stock is determined by long-run considerations.

In contrast to the crude accelerator theory, much empirical evidence exists in support of the flexible versions of the accelerator theory.

2. The Internal Funds Theory of Investment:

Under the internal funds theory of investment, the desired capital stock and, hence, investment depends on the level of profits. Several different explanations have been offered. Jan Tinbergen, for example, has argued that realized profits accurately reflect expected profits.

Since investment presumably depends on expected profits, investment is positively related to realized profits. Alternatively, it has been argued that managers have a decided preference for financing investment internally.

Firms may obtain funds for investment purposes from a variety of sources:

(1) Retained earnings,

(2) Depreciation expense (funds set aside as plant and equipment depreciate),

(3) Various types of borrowing, including sale of bonds,

(4) The sale of stock.

Retained earnings and depreciation expense are sources of funds internal to the firm; the other sources are external to the firm. Borrowing commits a firm to a series of fixed payments. Should a recession occur, the firm maybe unable to meet its commitments, forcing it to borrow or sell stock on unfavorable terms or even forcing it into bankruptcy.

Consequently, firms may be reluctant to borrow except under very favourable circumstances.

Similarly, firms may be reluctant to raise funds by issuing new stock. Management, for example, is often concerned about its earnings record on a per share basis. Since an increase in the number of shares outstanding tends to reduce earnings on a per share basis, management may be unwilling to finance investment by selling stock unless the earnings from the project clearly offset the effect of the increase in shares outstanding.

Similarly, management may fear loss of control with the sale of additional stock. For these and other reasons, proponents of the internal funds theory of investment argue that firms strongly prefer to finance investment internally and that the increased availability of internal funds through higher profits generates additional investment. Thus, according to the internal funds theory, investment is determined by profits.

In contrast, investment, according to the accelerator theory, is determined by output. Since the two theories differ with regard to the determinants of investment, they also differ with regard to policy. Suppose policy makers wish to implement programs designed to increase investment.

According to the internal funds theory, policies designed to increase profits directly are likely to be the most effective. These policies include reductions in the corporate income tax rate, allowing firms to depreciate plant and equipment more rapidly, thereby reducing their taxable income, and allowing investment tax credits, a device to reduce firms' tax liabilities.

On the other hand, increases in government purchases or reductions in personal income tax rates will have no direct effect on profits, hence no direct effect on investment. To the extent that output increases in response to increases in government purchases or tax cuts, profits increase. Consequently, there will be an indirect effect on investment.

In contrast, under the accelerator theory of investment, policies designed to influence investment directly under the internal funds theory will be ineffective. For example, a reduction in the corporate tax rate will have little or no effect on investment because, under the accelerator theory, investment depends on output, not the availability of internal funds.

On the other hand, increases in government purchases or reductions in personal income tax rates will be successful in stimulating investment through their impact on aggregate demand, hence, output.

Before turning to the neoclassical theory, we should note in fairness to the proponents of the internal funds theory that they recognize the importance of the relationship between investment and output, especially in the long run. At the same time, they maintain that internal funds are an important determinant of investment, particularly during recessions.

3. <u>The Neoclassical Theory of Investment:</u>

The theoretical basis for the neoclassical theory of investment is the neoclassical theory of the optimal accumulation of capital. Since the theory is both long and highly mathematical, we shall not attempt to outline it. Instead, we shall briefly examine its principal results and policy implications.

According to the neoclassical theory, the desired capital stock is determined by output and the price of capital services relative to the price of output. The price of capital services depends, in turn, on the price of capital goods, the interest rate, and the tax treatment of business income. As a consequence, changes in output or the price of capital services relative to the price of output alter the desired capital stock, hence, investment.

As in the case of the accelerator theory, output is a determinant of the desired capital stock. Thus, increases in government purchases or reductions in personal income tax rates stimulate investment through their impact on aggregate demand, hence, output. As in the case of the internal funds theory, the tax treatment of business income is important.

According to the neoclassical theory, however, business taxation is important because of its effect on the price of capital services, not because of its effect on the availability of internal funds. Even so, policies designed to alter the tax treatment of business income affect the desired capital stock and, therefore, investment.

In contrast to both the accelerator and internal funds theories, the interest rate is a determinant of the desired capital stock. Thus, monetary policy, through its effect on the interest rate, is capable of altering the desired capital stock and investment. This was not the case in regard to the accelerator and internal funds theories.

Concluding Remarks:

The policy implications of the various theories of investment differ. It is important, therefore, to determine which theory best explains investment behaviour. We now turn to the empirical evidence. There is considerable disagreement concerning the validity of the accelerator, internal funds, and neoclassical theories of investment.

Much of the disagreement arises because the various empirical studies have employed different sets of data. Consequently, several economists have tried to test the various theories or models of investment using a common set of data.

At the aggregate level, Peter K. Clark considered various models including an accelerator model, a modified version of the internal funds model, and two versions of the neoclassical model. Based on quarterly data for 1954-73, Clark concluded that the accelerator model provides a better explanation of investment behaviour than the alternative models.

At the industry level, Dale W. Jorgenson, Jerald Hunter, and M. Ishag Nadiri tested four models of investment behavior: an accelerator model, two versions of the internal funds model, and a neoclassical model. Their study covered 15 manufacturing industries and was based on quarterly data for 1949-64. Jorgenson, Hunter, and Nadiri found, like Clark, that the accelerator theory is a better explanation of investment behavior than cither of the two versions of the internal funds models. But unlike Clark, they concluded that the neoclassical model was better than the accelerator model.

At the firm level, Jorgenson and Calvin D. Siebert tested a number of investment models, including an accelerator model, an internal funds model, and two versions of the neoclassical model. The study was based on data for 15 large corporations and covered 1949-63. Jorgenson and Siebert concluded that the neoclassical models provided the best explanation of investment behavior and the internal funds model the worst.

Their conclusions arc consistent with those of Jorgenson, Hunter and Nadiri and with regard to the internal funds theory, with those of Clark. Clark concluded, however, that the accelerator model was better than the neoclassical model.

In short, these studies suggest that the internal funds theory does not perform as well as the accelerator and neoclassical theories at all levels of aggregation. The evidence, however, is conflicting with regard to the relative performance of the accelerator and neoclassical models, with the evidence favoring the accelerator theory at the aggregate level and the neoclassical model at other levels of aggregation.

In an important survey article, Jorgenson has ranked different variables in terms of their importance in determining the desired capital stock. Jorgenson divided the variables into three main categories: capacity utilization, internal finance, and external finance. Capacity utilization variables include output and the relationship of output to capacity. Internal finance variables include the flow of internal funds; external finance variables include the interest rate. Jorgenson found capacity variables to be the most important determinant of the desired capital stock.

He also found external finance variables to be important, although definitely subordinate to capacity utilization variables. Finally, Jorgenson found that internal finance variables play little or no role in determining the desired capital stock. This result is, at first glance, surprising. After all, there is a strong, positive correlation between investment and profits. Firms do invest more when profits are high.

However, there is also a strong, positive correlation between profits and output. When profits are high, firms are normally operating at or close to full capacity, thereby providing an incentive for firms to add to their productive capacity. Indeed, when both output and profits are included as determinants of investment, the profits variable loses all or almost all of its explanatory-power.

Jorgenson’s conclusions in regard to the importance of internal funds are, of course, consistent with the results of the tests of alternative investment models. We conclude, therefore, that the marginal funds model is inadequate as a theory of investment behavior.

Jorgenson’s conclusion in regard to the capacity utilization variables lends some support to the proponents of the accelerator model. But he finds external finance variables to be of importance in determining the desired capital stock, which suggests that the neoclassical model is the appropriate theory of investment behavior, since it includes both output and the price of capital services as determinants of the desired capital stock.

Difference between MEC and MEI

Keynes used the term 'marginal efficiency of capital' to refer to the unique rate of discount which would make the present value of the expected net returns from a capital asset just equal to its supply price when there is no rise in the supply price of the asset.

The term originates with Keynes and is sometimes known incorrectly as the internal rate of return. This latter concept is distinct in that it takes specific account of the fact that the supply price of capital assets will rise in the short run as all firms simultaneously seek to increase the size of their capital stock.

K. Boulding used the term 'marginal efficiency of investment' to refer to that rate of discount which would make the present value of the expected net returns from the capital asset just equal to its supply price in the presence of rise in its price even in the short run.

In the real commercial world a business firm's decision regarding investment in new physical capital, such as machinery, transport equipment, factories, shores, warehouses, etc. depend on whether the expected rate of return from new investment is greater or less than the market rate interest.

The market rate of interest here refers to the rate that has to be paid on the funds that need to be borrowed to acquire these assets. The assets should be acquired or the projects should be undertaken if the expected rate of return exceeds the market rate of interest.

Profitable investment decisions always involve comparisons of alternative rates of return. Whether the funds are available within the firm from undistributed profits or have to be borrowed makes no difference. Let r denote the rate of interest or yield on existing assets.

This is both the cost of borrowing funds from the external market and the return from leading a firm's surplus capital at the market rate of interest. The rate of return on new investment, or the marginal efficiency of capital, is denoted as e. It is interpreted as the 'expected rate of return over cost' on the new investment.

The crucial point of distinction between the rate of return on existing assets r and the expected rate of return over cost on new physical capital e. In other words, e may be interpreted as an internal rate of return to the firm, whereas e is the external rate of return (i.e., the rate at which the firm can lend its surplus money at the market rate of interest).

A simple example will make the concept of MEC clear. Suppose, a firm is trying to decide whether to install a machine whose life is 1 year. It has no scrap value after one year. Suppose also that, after deducting all costs except interest and the cost of the machine, there is a surplus of Rs 1,200 left at the end of the year.

Out of this gross return (profit) a sum of Rs 1,000 is required to cover (repay) the cost of the machine. Thus, the net return (i.e., the rate of return over cost) is Rs 200 which is 20% of the original investment of Rs 1,000. We have calculated this return by equating the cost of the machine, C, with the gross return on the machine, R, discounted by the rate of return, e.

The formula used for the purpose is simple this: C = R/ (1 + e) or Rs 1,000 = 1,200/ (1 + e), so that e = 0.20 or 20%. Thus, if we know the original cost of the machine and if we have an estimate of the expected gross return from it, we can calculate the MEC or the rate of return over cost of the machine.

Now, consider a situation which is slightly more complicated. Suppose the cash flow or earning from a machine is distributed over a number of years. We also assume that it has a scrap value at the end of its economic life. Let $R_1, R_2, \ldots, R_n$ represent the cash flow from a new machine in years 1, 2,…, n, respectively.

Let K be the scrap value of the machine at the end if its useful life and let C denote the original cost.

Now, by equating the cost of the machine with the sum of the gross returns plus the scap value, all discounted by the rate of return of the machine, we have:

$C = R_1 / (1 + e) + R_2 / (1 + e)^2 + \ldots + R_n / (1 + e)^n + K/ (1 + e)^n \ldots (1)$

Thus, if we can estimate C, K and R we can solve for e from equation (1). Here, the decision to make investment involves a comparison of the MEC with the market rate of interest. If the MEC is 10% and the rate of interest is 7%, the purchase of the machine is considered worthwhile.

Fig. 4 illustrates the investment-demand schedule of a hypothetical firm. Here, four important projects have been ranked in order of decreasing profitability. The most profitable project here is purchase of a machine which is supposed to produce a return of 10% and whose cost is Rs 10,000. The next best project is a new truck that costs Rs. 5,000. Its MEC is 8%.

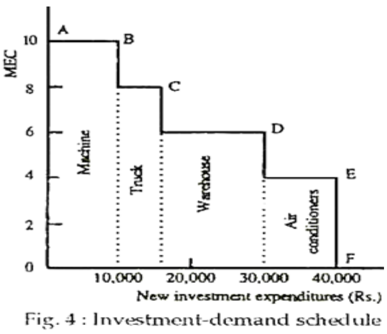

Fig. 4 : Investment-demand schedule

The third project involves expanding the warehouse capacity at a cost of Rs. 15,000 to gain an expected return of 6%. The last project in the firm's portfolio is the installation of an air-conditioner which, by improving morale and raising labour productivity, is expected to yield 4% return.

The solid line ABCDEF in Fig. 4 is the firm's investment-demand schedule. If the rate of interest is 5%, the firm would drop the fourth project (i.e., purchasing the air-conditioner) and spend Rs. 30,000 on the first three projects (Rs. 10,000 on machine + Rs. 5,000 on truck + Rs. 15,000 on warehouse expansion).

If, however, the rate of interest is 7%, the idea of expanding the warehouse would be dropped, in which case the firm would spend Rs. 15,000 on capital expansion. Thus, it is quite clear that, for any individual firm the lower the rate of interest, the larger the volume of investment.

The MEC schedule of an individual firm moves along the steps outlined in Fig. 4. By adding up, horizontally, the MEC schedules of all firms in the economy we would arrive at a downward sloping aggregate MEC schedule.

It may apparently seem that such an aggregate of MEC schedule represents the investment-demand schedule for the economy as a whole. But this is not true. It is so because what is true of an individual firm is not true of the economy as a whole.

If all firms attempt to invest more in the event of a fall in the market rate of interest the market price of capital goods will rise. This, in its turn, will lead to a fall in the MEC on all projects for all firms. This very fact that led some economists to draw a distinction between MEC and the marginal efficiency of investment (MEI).

The latter concept has been developed by K. Boulding and G. Ackley to explain the effect of changes in the prices of capital goods and show the relationship between the rate of interest and the economy's level of investment on the basis of such changes.

The distinction is brought into focus in Fig. 5. Here, we assume that the market rate of interest is 10%. This very rate makes it worthwhile to replace worn out capital. But, it does not warrant any net (new) investment in plant, equipment and machinery (or any additions to the stock of capital).

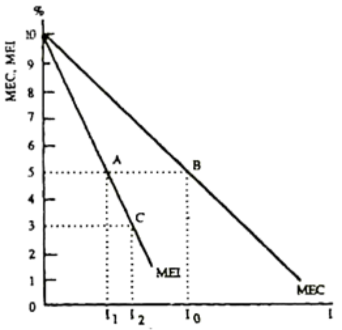

Fig. 5 : *MEC and MEI*

We finally assume that the demand for capital goods is not volatile so as to cause any fluctuation in the market price of capital goods. If the market price of capital goods remains unchanged the MEC and ME1 schedules intersect at 10% rate of interest (as shown in Fig. 5).

Now, suppose, the rate of interest drops to 5%. This will induce each firm to expand its stock of capital. Each will plan for capital expansion such that no one else wished to add to capacity. Thus, all firms taken together would be desirous of spending I_0 on new capital goods (as is shown by point B on the MEC schedule). However, when all firms demand more capital goods, the price of such goods will increase.

This, in its turn, will lead to a fall in the MEC of all firms for all their projects. Thus, actual investment will be l_1 instead of l_0, as is shown by point A on the MEI schedule. Thus, the difference between the MEC and MEI makes all the difference between desired investment (I_1) and actual investment (I_0) at a particular rate of interest (5%).

Thus, it is clear that the MEC schedule adequately represents the economy's investment-demand schedule. Like MEC, the MEI schedule is also negatively sloped. But, it is steeper (less elastic) than the MEC schedule. In any case, investment is a function of the market rate of interest. It is inversely related to r.

So, the investment demand schedule may be expressed as:

$I = f(r)$, with $\Delta I/\Delta r < 0$

In Fig.5, we also observe that if the rate of interest falls from 5% to 3%, the volume of investment rises from I_1 to I_2.