

Theory of Investment:

1. The Accelerator Theory of Investment:

The accelerator principle states that an increase in the rate of output of a firm will require a proportionate increase in its capital stock. The capital stock refers to the desired or optimum capital stock, K . Assuming that capital-output ratio is some fixed constant, v , the optimum capital stock is a constant proportion of output so that in any period t ,

$$K_t = vY_t$$

Where K_t is the optimal capital stock in period t , v (the accelerator) is a positive constant, and Y is output in period t .

Any change in output will lead to a change in the capital stock. Thus

$$K_t - K_{t-1} = v(Y_t - Y_{t-1})$$

$$\text{and } I_{nt} = v(Y_t - Y_{t-1}) [I_{nt} = K_t - K_{t-1}]$$

$$= v\Delta Y_t$$

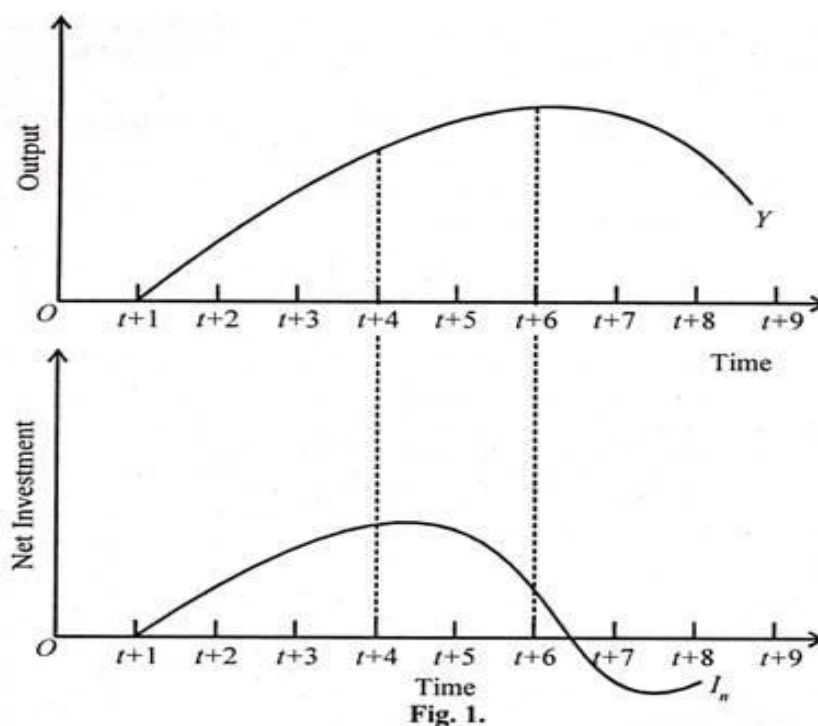
Where $\Delta Y_t = Y_t - Y_{t-1}$, and I_{nt} is net investment.

This equation represents the naive accelerator.

In the above equation, the level of net investment is proportional to change in output. If the level of output remains constant ($\Delta Y = 0$), net investment would be zero. For net investment to be a positive constant, output must increase.

This is illustrated in Figure 1 where in the upper portion, the total output curve Y increases at an increasing rate up to $t + 4$ periods, then at a decreasing rate up to period $t + 6$. After this, it starts diminishing. The curve I_n in the lower part of the figure, shows that the rising output leads to increased net investment up to $t + 4$ period because output is increasing at an increasing rate.

But when output increases at a decreasing rate between $t + 4$ and $t + 6$ periods, net investment declines. When output starts declining in period $t + 7$, net investment becomes negative. The above explanation is based on the assumption that there is symmetrical reaction for increases and decreases of output.



In the simple acceleration principle, the proportionality of the optimum capital stock to output is based on the assumption of fixed technical coefficients of production. This is illustrated in Figure 2 where Y and Y_1 are the two isoquants.

The firm produces T output with K optimal capital stock. If it wants to produce Y_1 output, it must increase its optimal capital stock to K_1 . The ray OR shows constant returns to scale. It follows that if the firm wants to double its output, it must increase its optimal capital stock by two-fold.

Eckaus has shown that under the assumption of constant returns to scale, if the factor-price ratios remain constant, the simple accelerator would be constant. Suppose the firm's production involves the use of only two factors, capital and labour whose factor-price ratios are constant.

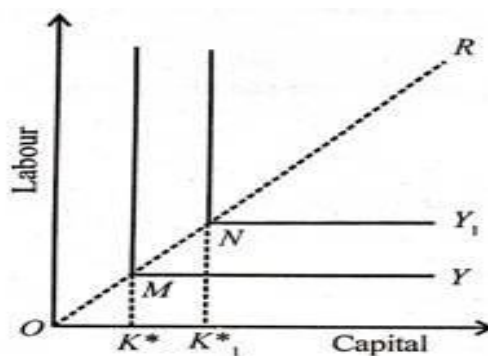


Fig. 2.

In Figure 3, Y , Y_1 and Y_2 are the firms' isoquants and C , C_1 and C_2 are the isocost lines which are parallel to each other, thereby showing constant costs. If the firm decides to increase its output from Y to Y_1 , it will have to increase the units of labour from L to L_1 and of capital from K to K_1 and so on.

The line OR joining the points of tangency e , e_1 and e_2 is the firms' expansion path which shows investment to be proportional to the change in output when capital is optimally adjusted between the isoquants and isocosts.

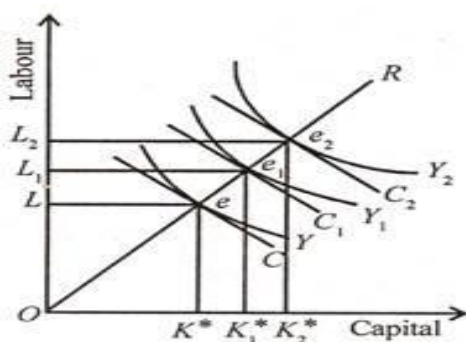


Fig. 3

2. The Flexible Accelerator Theory or Lags in Investment:

The flexible accelerator theory removes one of the major weaknesses of the simple acceleration principle that the capital stock is optimally adjusted without any time lag. In the flexible accelerator, there are lags in the adjustment process between the level of output and the level of capital stock.

This theory is also known as the capital stock adjustment model. The theory of flexible accelerator has been developed in various forms by Chenery, Goodwin, Koyck and Junankar. But the most accepted approach is by Koyck.

Junankar has discussed the lags in the adjustment between output and capital stock. He explains them at the firm level and extends them to the aggregate level. Suppose there is an increase in the demand for output. To meet it, first the firm will use its inventories and then utilise its capital stock more intensively.

If the increase in the demand for output is large and persists for some time, the firm would increase its demand for capital stock. This is the decision-making lag. There may be the administrative lag of ordering the capital.

As capital is not easily available and in abundance in the financial capital market, there is the financial lag in raising finance to buy capital. Finally, there is the delivery lag between the ordering of capital and its delivery.

Assuming "that different firms have different decision and delivery lags then in aggregate the effect of an increase in demand on the capital stock is distributed over time. This implies that the capital stock at time t is dependent on all the previous levels of output, i.e.

$$K_t = f(Y_t, Y_{t-1}, \dots, Y_{t-n}).$$

This is illustrated in Figure 4 where initially in period t_0 , there is a fixed relation between the capital stock and the level of output.

When the demand for output increases, the capital stock increases gradually after the decision and delivery lags, as shown by the K

curve, depending on the previous levels of output. The increase in output is shown by the curve T. The dotted line K is the optimal capital stock which equals the actual capital stock K in period t.

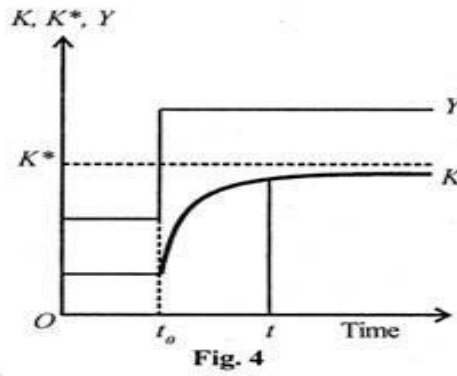


Fig. 4

Koyck's Approach:

Koyck's approach to the flexible accelerator assumes that the actual capital stock depends on all past output levels with weights declining geometrically. Accordingly,

$$K_t = v(1-\lambda)(Y_t + \lambda Y_{t-1} + \lambda^2 Y_{t-2} + \dots + \lambda^n Y_{t-n}) \quad \dots(1)$$

where $0 < \lambda < 1$. If there is no change in income and it is equal to $\bar{Y}$ the expected volume of output also remains unchanged, then

$$\begin{aligned} \bar{K} &= v(1-\lambda)(\bar{Y} + \lambda \bar{Y} + \lambda^2 \bar{Y} + \dots + \lambda^n \bar{Y}) \\ &= v(1-\lambda)\bar{Y}(1 + \lambda + \lambda^2 + \dots + \lambda^n) \end{aligned} \quad \dots(2)$$

where $(1 + \lambda + \lambda^2 + \dots + \lambda^n) = 1/(1-\lambda)$ are the weights in geometric series and equation (2) becomes

$$\bar{K} = v\bar{Y}(1-\lambda) \times 1/(1-\lambda)$$

or $\bar{K} = v\bar{Y}$

If equation (1) is valid, then K_{t-1} is also true. Therefore, we can rewrite equation (1) as

$$K_{t-1} = v(1-\lambda)(Y_{t-1} + \lambda Y_{t-2} + \lambda^2 Y_{t-3} + \dots + \lambda^n Y_{t-n-1})$$

Multiplying by λ we have

$$\lambda K_{t-1} = v(1-\lambda)(\lambda Y_{t-1} + \lambda^2 Y_{t-2} + \lambda^3 Y_{t-3} + \dots + \lambda^{n+1} Y_{t-n-1}) \quad \dots(3)$$

Subtracting equation (3) from equation (1), we get

$$K_t - \lambda K_{t-1} = v(1-\lambda)(Y_t + \lambda^{n+1} Y_{t-n-1})$$

Since the term λ^{n+1} tends to zero, the above equation becomes

$$K_t - \lambda K_{t-1} = (1-\lambda)vY_t$$

or

$$K_t = (1-\lambda)vY_t + \lambda K_{t-1} \quad \dots(4)$$

This process of rewriting equation (1) as equation (4) is called the *Koyck transformation*.

Net investment is the change in the stock of capital, $K_t - K_{t-1}$. Therefore, subtract K_{t-1} from both sides of the equation to get the expression net investment,

$$\begin{aligned} K_t - K_{t-1} &= (1-\lambda)vY_t + \lambda K_{t-1} - K_{t-1} \\ I_{nt} &= (1-\lambda)vY_t + K_{t-1}(\lambda - 1) \end{aligned}$$

or

$$I_{nt} = (1-\lambda)vY_t - (1-\lambda)K_{t-1} \quad \dots(5)$$

The net investment ($K_t - K_{t-1}$) is called the *distributed lag accelerator* which is inversely related to the capital stock of the previous period and is positively related to the output level.

To convert net investment to gross investment, add depreciation (D_t) to both sides of equation (5),

$$I_{gt} + D_t = I_{nt} = (1-\lambda)vY_t - (1-\lambda)K_{t-1} + D_t \quad \dots(6)$$

Depreciation is assumed to be proportional to last year's capital stock and is estimated by $D_t = \delta K_{t-1}$. By adding this to equation (6), gross investment (I_{gt}) is

$$\begin{aligned} I_{gt} &= (1-\lambda)vY_t - (1-\lambda)K_{t-1} + \delta K_{t-1} \\ &= (1-\lambda)vY_t - [(1-\lambda) - \delta]K_{t-1} \\ &= (1-\lambda)vY_t - (1-\lambda\delta)K_{t-1} \end{aligned} \quad \dots(7)$$

This equation represents the flexible accelerator or the stock adjustment principle. This suggests that "net investment is some fraction of the difference between planned capital stock and actual capital stock in the previous period...The coefficient $(1-\lambda)$ tells us how rapidly the adjustment takes place. If $\lambda = 0$ [i.e. $(1-\lambda) = 1$] then adjustment takes place in the unit period".

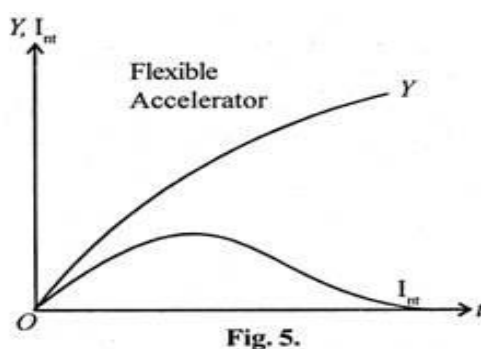
To conclude, the flexible accelerator is a very important contribution to the theory of investment which solves the problem of lags in investment demand. It not only incorporates the effects of lags but also of depreciation and excess capacity in the capital stock adjustment.

It's Comparison with Naive Accelerator:

Since the flexible accelerator and naive accelerator are both accelerators, their long-run response of investment to a change in output will be similar. Let us consider a situation where output (Y) is rising at a decreasing rate and ultimately stops rising at a high level.

In the case of the flexible accelerator, net investment will increase during several periods before the negative effect of the increased capital stock outweighs the positive effect of further increases in output and ultimately net investment will become zero.

This is shown in Figure 5. On the other hand, in the case of the naive accelerator, net investment will be decreasing continuously and will also become zero, as shown in Figure 6. In both the accelerators, gross investment will be equal to depreciation.

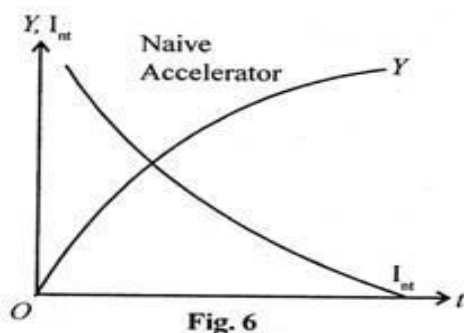


3. The Profits Theory of Investment:

The profits theory regards profits, in particular undistributed profits, as a source of internal funds for financing investment. Investment depends on profits and profits, in turn, depend on income. In this theory, profits relate to the level of current profits and of the recent past.

If total income and total profits are high, the retained earnings of firms are also high, and vice versa, Retained earnings are of great importance for small and large firms when the capital market is imperfect because it is cheaper to use them.

Thus if profits are high, the retained earnings are also high. The cost of capital is low and the optimal capital stock is large. That is why firms prefer to reinvest their extra profit for making investments instead of keeping them in banks in order to buy securities or to give dividends to shareholders. Contrariwise, when their profits fall, they cut their investment projects. This is the liquidity version of the profits theory.



Another version is that the optimal capital stock is a function of expected profits. If the aggregate profits in the economy and business profits are rising, they may lead to the expectation of their continued increase in the future. Thus expected profits are some function of actual profits in the past,

$$K_t = f(\pi_{t-1})$$

Where K is the optimal capital stock and $f(\pi_{t-1})$ is some function of past actual profits.

Edward Shapiro has developed the profits theory of investment in which total profits vary directly with the income level. For each level of profits, there is an optimal capital stock. The optimal capital stock varies directly with the level of profits.

The interest rate and the level of profits, in turn, determine the optimal capital stock. For any particular level of profits, the higher the interest rate, the smaller will be the optimal capital stock, and vice versa. This version of the profits theory is explained in terms of Figure7.

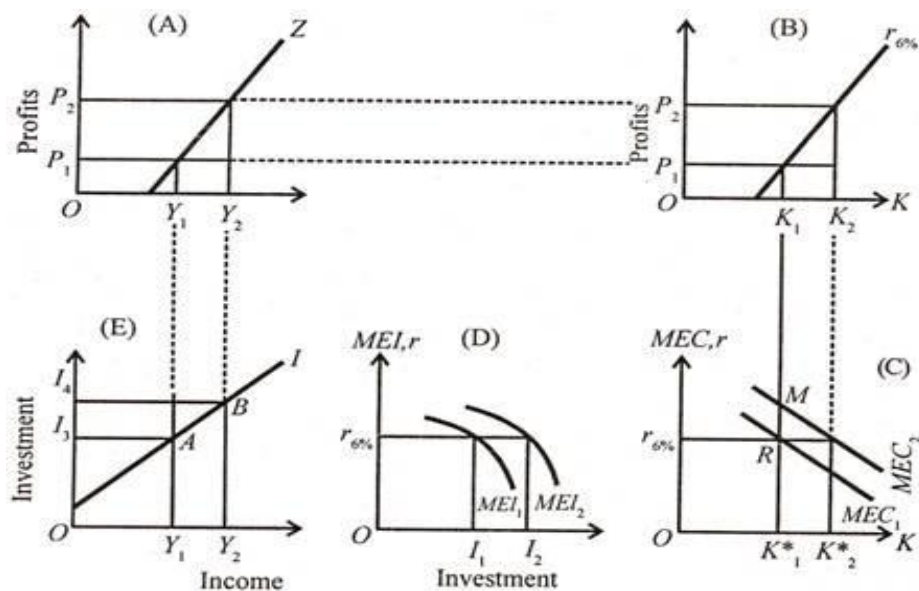


Fig. 7

The curve Z in Panel (A) shows that total profits vary directly with income. When the income is Y_1 , profits are P_1 and with increase in income to Y_2 profits rise to P_2 . Panel (B) shows that the interest rate and the profits level determine the capital stock. At P_2 profits levels and $r6\%$ interest rate, the actual capital stock is K_2 and at the lower profits level P_1 and interest rate $r6\%$, the actual capital stock declines to K_1 .

In Panel (C), the MEC curve is drawn for each level of profits, given the actual capital stock and the rate of interest. As such, the curve MEC_1 relates the profits level P_1 to the optimal capital stock K_1 when $r6\%$ is the interest rate. The higher curve MEC_2 relates the profit level P_2 to the higher optimal capital stock K_2 , given the same rate of interest $r6\%$.

Suppose that the level of profits is P_1 , the market interest rate is $r6\%$ and the actual capital stock is K_1 . With this combination of the variables, the optimal capital stock in Panel (C) is K so that the actual capital stock, $K_1 = K_1$ the optimal capital stock.

As a result, net investment is zero. But there is still I_1 replacement investment at $r6\%$, as indicated by MEI_1 curve in Panel (D). The combination of I_2 investment and Y_1 income level establishes point A on the investment curve I in Panel (E) of the figure.

Now begin with P_2 level of profits and Y_2 income level in Panel (A) so that at $r6\%$ interest rate in Panel (C), the optimal capital stock is K_2 . Assuming again that the actual capital stock is K_1 , the optimal capital stock is greater than the actual, $K_2 > K_1$ at this profit-income combination.

Here the MEC_2 is higher than $r6\%$ interest rate by RM . As a result, the MEI_1 curve shifts upward to MEI_2 in Panel (D). Since $K_2 > K_1$ net investment is positive. This is shown by $I_1 - I_2$ in Panel (D). So when profits increase to P_2 with the rise in income to Y_2 , the optimal capital stock K_2 being greater than the actual capital stock K_1 at $r6\%$ interest rate, investment increases from I_3 to I_4 in Panel (E) which is equal to net investment $I_1 - I_2$ in Panel (D). The combination of I_4 and Y_2 , establishes point B on the upward sloping I curve.

To sum up, in the profits theory of investment, the level of aggregate profits varies with the level of national income, and the optimal capital stock varies with the level of aggregate profits. If at a particular level of profits, the optimal capital stock exceeds the actual capital stock, there is increase in investment to meet the demand for capital. But the relationships between investment and profits and between aggregate profits and income are not proportional.

It's Criticism:

The theory is based on the assumption that profits are related to the level of current profits and of the recent past. But there is no possibility that the firm's current profit of this year or of the next few years can measure the profits of the next year or of the next few years. A rise in current profits may be the result of unexpected changes of a temporary nature. Such temporary profits do not induce investment.

4. Duesenberry's Accelerator Theory of Investment:

J.S. Duesenberry in his book Business Cycles and Economic Growth presents an extension of the simple accelerator and integrates the profits theory and the acceleration theory of investment.

Duesenberry has based his theory on the following propositions:

- (1) Gross investment starts exceeding depreciation when capital stock grows.
- (2) Investment exceeds savings when income grows.
- (3) The growth rate of income and the growth rate of capital stock are determined entirely by the ratio of capital stock to income. He

regards investment as a function of income (Y), capital stock (K), profits (π) and capital consumption allowances (R). All these are independent variables and can be represented as

$$I = f(Y_{t-1}, K_{t-1}, \pi_{t-1}, R_t)$$

Where t refers to the current period and (t-1) to the previous period. According to Duesenberry, profits depend positively on national income and negatively on capital stock.

$$\pi = aY - bK$$

Taking account of lags, this becomes

$$\pi_{t-1} = aY_{t-1} - bK_{t-1}$$

Where t refers to profits during period t, Y_{t-1} and K_{t-1} are income and capital stock of the previous period respectively and a and b are constants. Capital consumption allowances are expressed as

$$R_t = kK_{t-1}$$

The above equation shows that capital consumption allowances are a fraction (k) of capital stock (K_{t-1}).

Duesenberry's investment function is a modified version of the accelerator principle,

$$I_t = \alpha Y_{t-1} + \beta K_{t-1} \dots (1)$$

where investment in period t is a function of income (X) and capital stock (K) of the previous period (t—1). The parameter (a) represents the effect of changes in income on investment, while the parameter ((3) represents the influence of capital stock on investment working through both the marginal efficiency of investment and profits.

Since the determinants of investment also affect consumption, the consumption function can be written as,

$$C_t = f(Y_{t-1} - \pi_{t-1} - R_{t-1} + d_t)$$

Where d_t stands for dividend payments in period t. Since $\pi = f(Y, K)$, $R = kY$ and $d = f(\pi)$, these independent variables can be subsumed under Y and K. Thus

$$C_t = a Y_{t-1} + b K_{t-1} \dots (2)$$

The parameter, a, in equation (2) is MPC and it also reflects increase in profits. This increase is reduced by the effect of profits on dividends and the effect of changes in dividends on consumption. The influence of changes in capital stock on consumption is reflected by the parameter b. This influence results from the influence of capital stock on profits through the influence of profits on dividends on consumption. The capital stock is represented by the following equation which is an identity,

$K_t = (1-k) K_{t-1} + I_t$
It is derived as under :

$$K_t = K_{t-1} + (I_t - R_t)$$

$$R_t = kK_{t-1}$$

$$K_t = K_{t-1} + I_t - kK_{t-1}$$

$$K_t = (1-k) K_{t-1} + I_t$$

$$[\because I_t = \alpha Y_{t-1} + \beta K_{t-1}]$$

The capital stock equation can be written as

$$K_t = (1-k) K_{t-1} + \alpha Y_{t-1} + \beta K_{t-1}$$

$$= [(1-k) K_{t-1} + \beta K_{t-1}] + \alpha Y_{t-1}$$

$$= K_{t-1} [(1-k) + \beta] + \alpha Y_{t-1}$$

$$\text{Or } K_{t-1} = K_{t-2} [(1-k) + \beta] + \alpha Y_{t-2}$$

.....(3)

The national income identity can be written as

$$Y_t = I_t + C_t$$

$$= \alpha Y_{t-1} + \beta K_{t-1} + aY_{t-1} + bK_{t-1}$$

[From equations (1) and (2)]

$$= [\alpha Y_{t-1} + aY_{t-1}] + [\beta K_{t-1} + bK_{t-1}]$$

$$= (\alpha + a) Y_{t-1} + (\beta + b) K_{t-1}$$

.....(4)

By substituting the value of K_{t-1} in equation (4), we get

$$Y_t = (\alpha + a) Y_{t-1} + (\beta + b) \{ K_{t-2} [(1-k) \beta] + \alpha Y_{t-2} \}$$

$$= (\alpha + a) Y_{t-1} + (\beta + b) \{ a Y_{t-2} + [(1-k) + \beta] K_{t-2} \}$$

.....(5)

Again, the national income equation (4) can be written as

$$Y_{t-1} = (\alpha + a) Y_{t-2} + (\beta + b) K_{t-2}$$

$$\text{Or } (\beta + b) K_{t-2} = Y_{t-1} - (\alpha + a) Y_{t-2}$$

Having obtained the value of K_{t-2} , substitute it in equation (5),

$$Y_t = (\alpha + a) Y_{t-1} + \alpha (\beta + b) Y_{t-2} + [(1-k) + \beta] \{ Y_{t-1} - (\alpha + a) Y_{t-2} \}$$

By taking common factors, we have

$$Y_t = [(\alpha + a) Y_{t-1} + (1-k + \beta) Y_{t-1}] + [\alpha (\beta + b) Y_{t-2} - (\alpha + a) (1-k + \beta) Y_{t-2}]$$

$$= [(\alpha + a) + (1-k + \beta)] Y_{t-1} + [\alpha (\beta + b) - (\alpha + a) (1-k + \beta)] Y_{t-2}$$

.....(6)

This is a generalised version of a multiplier-accelerator process.

Next Duesenberry compares his formulation with a simple multiplier-accelerator process. In a simple model of the multiplier-accelerator, investment equation takes the following form

$$I_t = \alpha Y_{t-1} - K_{t-1}$$

whereas in his model, the investment equation is in this form

$$I_t = \alpha Y_{t-1} + \beta K_{t-1}$$

where the value of parameter $\beta = -1$ and investment is regarded as net investment so that $k = 0$. Depreciation is not considered. The influence of changes in capital stock on consumption is also neglected so that $b = 0$.

Substituting all these values in equation (6), we obtain the simple form of the equation for the multiplier-accelerator process. Thus

$$\alpha (\beta + b) = \alpha (-1)$$

$$Y_t = [(\alpha + a) + (1-0-1)] Y_{t-1} + [\alpha (-1+0) - (\alpha + a) (1-0-1)] Y_{t-2}$$

$$\text{Or } Y_t = (\alpha + a) Y_{t-1} + a (-1) Y_{t-2} \quad \text{.....(7)}$$

The a (MPC) in equation (7) will be much smaller than MPC out of disposable income because it reflects the influence of changes in income on profits and business savings. Simultaneously, the a in the above equation will be much less than the average capital-output ratio which is the accelerator in simple multiplier- accelerator models.

An increase, say, \$100 in income, with capital stock constant, will increase the rate of business investment by an amount which is not much larger than the increase in business savings resulting from \$100 increase in income. It will be only, say, \$25. Thus an increase in income will have a smaller immediate effect on expenditure than would occur in a simple multiplier-accelerator model.

On the other hand, the negative effect of an increase in capital stock, with income constant, will be much smaller than in the simple multiplier-accelerator model. If there is an increase in business capital stock of say, \$100, income being constant, it will reduce profits by a very small amount and will have correspondingly a small effect on business investment.

But a part of the decline in business investment will be offset by a reduction in business saving. Such changes will reduce the effect on an increase in income on expenditure for some time because investment will decline slowly, as capital accumulates, provided there is no further increase in income. The system will therefore, be much more stable than a simple multiplier-accelerator system.

5. The Financial Theory of Investment:

The financial theory of investment has been developed by James Duesenberry. It is also known as the cost of capital theory of investment. The accelerator theories ignore the role of cost of capital in investment decision by the firm.

They assume that the market rate of interest represents the cost of capital to the firm which does not change with the amount of investment it makes. It means that unlimited funds are available to the firm at the market rate of interest.

In other words, the supply of funds to the firm is very elastic. In reality, an unlimited supply of funds is not available to the firm in any time period at the market rate of interest. As more and more funds are required by it for investment spending, the cost of funds (rate of interest) rises. To finance investment spending, the firm may borrow in the market at whatever interest rate funds are available.

Sources of Funds:

Actually, there are three sources of funds available to the firm for investment which are grouped under internal funds and external funds.

These are:

- (1) Retained earnings which include undistributed profits after taxes and depreciation allowances are internal funds.
- (2) Borrowing from banks or through the bond market; and borrowing through equity financing or by issuing new stock (shares) in the stock market are the sources of external funds.

1. Retained Earnings:

Retained earnings are the cheapest source of funds because the cost of using these funds is very low in the short run. There is no risk involved in spending these retained earnings or to repay debt. In fact, the cost of using these funds is the opportunity cost which is the return that the firm could obtain to repay debt or to buy the shares of other companies.

The opportunity cost of internal funds will be less than the cost of external funds. When the firm lends these funds to other borrowers, it usually earns the market rate of interest. If it borrows funds from banks or through the bond market, it has to pay a higher interest rate. This difference in interest rate is the opportunity cost to the firm.

2. Borrowed Funds:

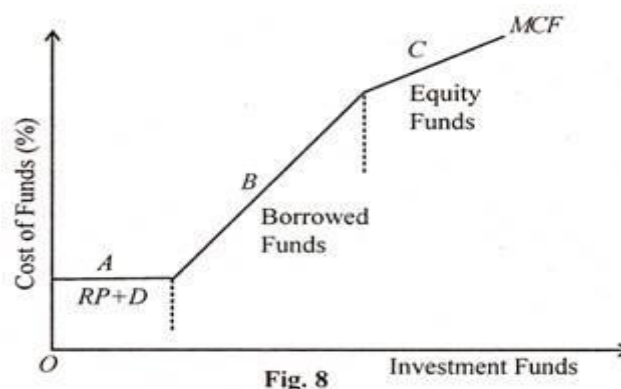
When the firm needs funds more than the retained earnings, it borrows from the banks or through the bond market. The cost of borrowed funds (rate of interest) rises with the amount of borrowing. As the ratio of debt service to earnings from investment of funds rises, the marginal cost of borrowed funds rises. This is because the opportunity cost (risk) of not repaying debt increases.

3. Equity Issue:

A third source is equity financing by issuing new shares in the stock market. The imputed cost of equity funds is more costly than the opportunity cost of retained earnings or borrowed funds. Duesenberry points out that “the yield cost of equity finance is usually of the order of 7 to 10 percent for large firms. To this must be added floatation costs plus any reduction in the value of existing shares resulting from the issue. The differential is further increased by the differential tax treatment of bond and equity finance.”

Cost of Funds:

The cost of capital to the firm will vary according to its source and how much funds it requires. Keeping these considerations in view, we construct the marginal cost of funds curve MCF in Figure 8 which shows the various sources of funds. The cost of funds is measured on the vertical axis and the amount of investment funds on the horizontal axis.



Region A of the MCF curve shows financing done by the firm from retained profits (RP) and depreciation (D). In this region, the MCF curve is perfectly elastic which means the true cost of funds to the firm is equal to the market rate of interest.

The opportunity cost of funds is the interest forgone which the firm could earn by investing its funds elsewhere. No risk factor is involved in this region. Region B represents funds borrowed by the firm from banks or through the bond market.

The upward slope of the MCF curve shows that the market rate of interest for borrowed funds rises as their amount increases. But the sharp rise in the cost of borrowing is not only due to a rise in the market rate of interest but also due to the imputed risk of increased debt servicing by the firm. Region C represents equity financing.

No imputed risk is involved in it because the firm is not required to pay dividends. The gradual upward slope of MCF curve is due to the fact that as the firm issues more and more of its stock, its market price will fall and the yield will rise.

The cost of funds may vary from firm to firm and consequently the shape and position of the MCF curve will differ from one firm to another. But in general, it will be like the MCF curve of Figure 8. If we aggregate MCF curves of different firms there will be a smooth S-shaped MCF_1 curve, as in Figure 9. This curve shifts upward from MCF_1 to MCF_2 when the cost of funds (interest rate) rises from R_1 to R_2 and shifts downward from MCF_2 to MCF_1 with the fall in the cost of funds from R_2 to R_1 .

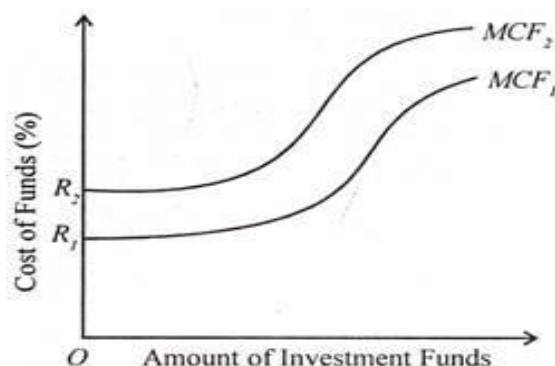


Fig. 9

The amount of investment funds is determined by the intersection of MEI and MCF curves. The main determinants of the MEI curve are the rate of investment, output (income), level of capital stock and its age and rate of technical change. The determinants of MCF are retained earnings (profits minus dividends), depreciation, debt position of firms and market interest rate.

It is the shifts of the MEI and MFC curves that determine the level of investment funds. Suppose the MEI and MCF curves intersect at point E in Figure 10 which determines OI investment at the interest rate (the cost of funds) OR. If the MCF curve shifts to the right to MCF_1 with the increase in retained earnings (profits) of the firm, the MEI curve will cut the MCF_1 curve at E_1 .

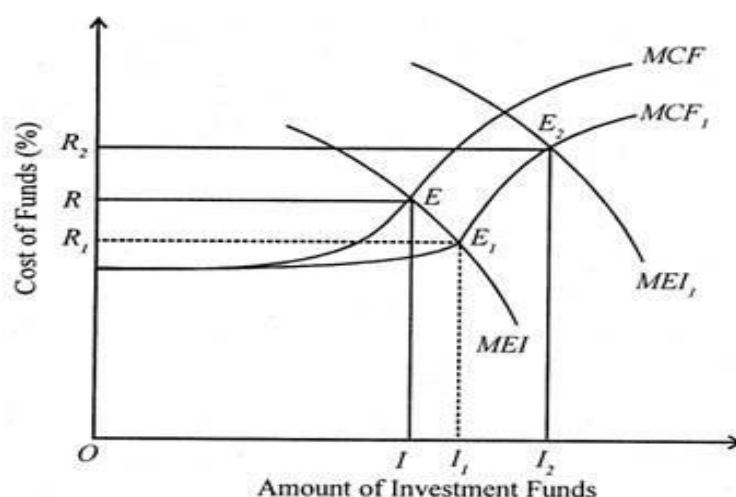


Fig. 10

The cost of funds will fall from OR to OR_1 but investment funds will rise to OI_1 from OI. On the other hand, if the MEI curve shifts to the right to MEI_1 with the increase in income and capital stock, it will cut the MCF_1 curve at point E_2 . There will be increase in both the cost of funds to OR_2 and in the investment funds to OI_2 .

The above explanation is related to the short-run behaviour of MEI and MCF curves. But the same factors that determine the position and shifts of these curves have different effects over the business cycle.

Since the MEI curve depends primarily on output, it shifts backward to the left to MEI_1 when output (income) decreases in a recession, as shown in Figure 11. Both MEI and MEI_1 curves intersect the MCF curve in its perfectly elastic region. In a recession, retained profits decline but depreciation allowances remain with firms.

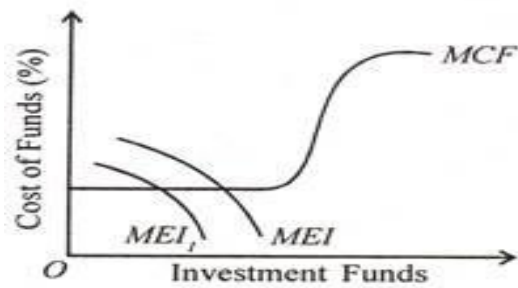


Fig. 11

So the elastic portion of the MCF curve becomes shorter. Meyer and Kuh found that firms generally spend more of their retained earnings in recessions and a low interest rate does not have any effect on investment. But when recovery starts, the MEI_1 curve shifts outward to the right to MEI .

As a result, there is an increase in investment spending of the firm out of its retained earnings in the perfectly elastic portion of the MCF curve. Thus during a recession, monetary policy or the market rate of interest plays no role in determining the cost of capital of a firm.

On the other hand, during a boom when output increases, the MEI curve shifts outward to the right to MEI_1 and intersects the MCF curve in its elastic rising region, as shown in Figure 12. In the upswing leading to boom, firms borrow funds on interest for investment spending. Thus monetary policy or interest rate is an important determinant of investment only in boom years.

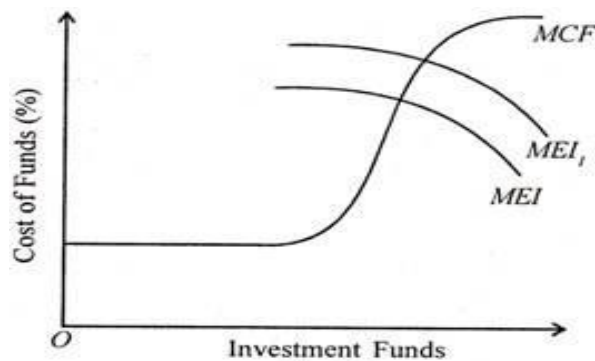


Fig. 12

Its Criticisms:

The financial theory of investment has been criticised on the following grounds:

1. The results of studies by Meyer and Kuh on investment behaviour of firms show that when demand is expanding rapidly, capacity expansion is the most important determinant of business investment during boom periods. In terms of our Figure 8, the MEI curve intersects the MCF curve in region B. In recessions and early years of recovery, the MEI curve shifts back to region A, and the level of retained earnings provides the best explanation of investment spending.
2. Meyer and Kuh found that firms take a longer view while making investment spending, whereas Duesenberry explains a short-run model of investment. Their results indicate that firms primarily invest in capacity expansion during a boom period and their overall level of investment will not fall as much as indicated by Duesenberry's short-run model when the interest rate rises. On the other hand, firms generally spend most of their retained earnings on technological improvements to reduce costs and on advertisement to increase their market share.
3. Empirical evidence in the theory of investment by Kuh and Meyer shows that monetary policy is the least effective of all the macroeconomic policy instruments. In the analysis represented in Figure 10, we have seen that the market rate of interest plays only a small role in the financial theory of investment. Critics point out that the main effect of rising interest rates would be to increase the steepness (or reduce the elasticity) of region B of the MCF curve.

This would stop investment when retained earnings of firms had been exhausted. On the other hand, declining interest rates would flatten (increase the elasticity) region B of the MCF curve. This would have no effect in a recession if firms finance their investment spending from retained earnings. Thus monetary policy would be more effective in controlling a boom than in stimulating investment in recession.

4. This theory neglects the role of fiscal policy in investment which is more effective than monetary policy. A reduction in corporate taxes in a recession can increase investment by firms. On the other hand, an increase in corporate taxes can reduce investment and shift the MCF curve to the left.

Changes in depreciation allowances can also help in manipulating investment in recessions and booms. Investment spending is also influenced by the level and changes in aggregate demand. Besides taxes, expenditure policy and other government measures also affect aggregate demand and the MEI curve which in turn influence the level of investment.

6. Jorgensons' Neoclassical Theory of Investment:

Jorgenson has developed a neoclassical theory of investment. His theory of investment behaviour is based on the determination of the optimal capital stock. His investment equation has been derived from the profit maximisation theory of the firm.

It's Assumptions:

Jorgenson's theory is based on the following assumptions:

1. The firm operates under perfect competition.
2. There is no uncertainty.
3. There are no adjustment costs.
4. There is full employment in the economy where prices of labour and capital are perfectly flexible.
5. There is a perfect financial market which means the firm can borrow or lend at a given rate of interest.
6. The production function relates output to the input of labour and capital.
7. Labour and capital are homogeneous inputs producing a homogeneous output.
8. Inputs are employed upto a point at which their MPPs are equal to their real unit costs.
9. There are diminishing returns to scale.
10. There is the existence of "putty-putty" capital which means that even after investment is made, it is instantly adapted without any costs to a different technology.
11. The capital stock is fully utilised.
12. Changes in current prices always produce ceteris paribus proportional changes in future prices.
13. The price of capital goods equals the discounted value of the rental charges.
14. The firm maximises the present value of its current and future profits with perfect foresight in relation to all future values.

The Model:

Jorgenson develops his theory of investment on the assumption that the firm maximises its present value. In order to explain the present value of the firm, he takes a production process with a single output (Q), a single variable input labour (L), and a single capital input (I-investment in durable goods), and p, w, and q representing their corresponding prices. The flow of net receipts (R) at time t is given by

$$R(t) = p(t)Q(t) - w(t)L(t) - q(t)I(t) \dots (1)$$

Where Q is output and p is its price; L is the flow of labour services and w the wage rate; I is investment and q is the price of capital goods.

The present value is defined as the integral of discounted net receipts which is represented as

$$W = \int_0^{\infty} e^{-rt} R(t) dt \dots (2)$$

Where W is the present value (net worth); e is the exponential used for continuous discounting; and r is the constant rate of interest.

The present value is maximised subject to two constraints. First, the rate of change of the flow of capital services is proportional to the flow of net investment. The constant of proportionality may be interpreted as the time rate of utilisation of capital stock that is the number of units of capital service per unit of capital stock. Net investment is equal to total investment less replacement investment where replacement investment is proportional to capital stock.

This constraint takes the form:

$$K(t) = I(t) - \delta K(t) \dots (3)$$

Where $K(t)$ is the time rate of change of the flow of capital services at time (t) while δ is the rate of depreciation attached to capital stock. This constraint holds at each point of time so that K , K and I are functions of time. To simplify the analysis, Duesenberry uses K in place of $K(t)$, I in place of $I(t)$, and so on.

Second, the levels of output and the levels of labour and capital services are constrained by a production function:

$$F(Q, L, K) = 0 \dots (4)$$

The marginal productivity of labour is equal to the real wage:

$$\partial Q / \partial L = w/p \dots (5)$$

Similarly, the marginal productivity of capital is equal to its real user cost:

$$\partial K / \partial L = w/p \dots (6)$$

$$\text{Where } c = q(r + \delta) - \dot{q} \dots (7)$$

In the above equation, q is the average price of capital assets, r is the rate of discount, δ is the rate of depreciation of capital goods and $\dot{q}$ is the rate of appreciation of capital assets or time derivative of q . Therefore, the crucial determinant of the optimal capital stock is c , the user cost of capital.

Since most firms own rather than rent their capital assets, therefore c is basically an implicit or shadow price constructed in order to permit parallel analytical treatment of capital and labour inputs.

Equations (5) and (6) are called “myopic decision criteria” because the firm is engaged in a dynamic optimisation process and simply equates the MP of labour with the ratio of its price and MP of capital with the ratio of user cost of capital. There are two reasons for the myopic decision in the case of capital assets.

First, it is due to the assumption of no adjustment costs so that the firm does not gain by delaying the acquisition of capital. Second, it is the result of the assumption that capital is homogeneous and it can be bought and sold or rented in a perfectly competitive market.

The myopic decision is illustrated in Figure 13 where in the upper portion the two alternative time paths of output prices, P_1 and P_2 , are shown and in the lower portion are shown the optimal capital stocks, in Panel (A), the output prices are identical up to time t_0 , and then their time paths diverge when P_1 is always lower than P_2 .

With the myopic decision, the optimal capital stock is identical up to t_0 for both time path of output prices. But after that, for the time path of P_1 price, the optimal capital stock K_1 moves at a constant rate, while for P_2 time path of output price, the optimal capital stock K_2 increases as the former rises. Thus in the Jorgenson model, there are no inter-temporal trade-offs.

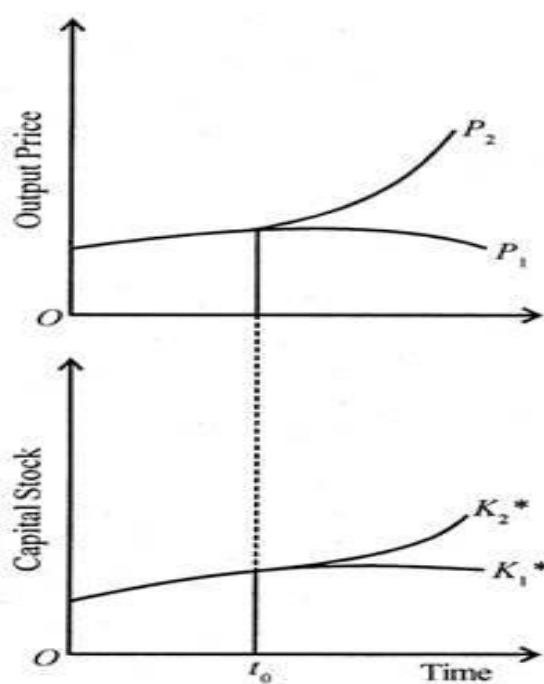


Fig. 13

Assuming that there are no adjustment costs, no uncertainty and perfect competition exists, as Jorgenson does, the firm will always be adjusted to the optimal capital stock so that $K=K$. Therefore, the question of adjustment to a discrete change in the interest rate does

not rise. Instead, Jorgenson treats this problem as one of comparing two optimal paths of capital accumulation under two different interest rates.

For this, he takes the demand for investment goods as given by the following equation:

$$I = K + \delta \dots (8)$$

Where I stands for gross demand for investment goods, K the rate of change in capital stock, δ the rate of depreciation and K the fixed level of capital assets which is expressed as

$$K = f(w, c, p) \dots (9)$$

The condition of equation (9) implies that with w and p fixed, c must remain unchanged. From the expression for c in equation (7), this, in turn, implies that holding the price of investment goods constant, the rate of change of price of investment goods must vary as the interest rate varies so as to leave c unchanged. Formally, this condition can be represented by

$$\partial c / \partial r = 0$$

Where r is the interest rate.

This condition implies that the own-interest rate on investment goods ($r - q/q$) must be left unchanged by variations in the interest rate. Jorgenson assumes that all changes in the interest rate are exactly compensated by changes in the price of investment goods so as to leave the own-interest rate on investment goods unchanged. This condition implies that

$$\partial^2 q / \partial t \partial r = q$$

He further assumes that changes in the time path of interest rate leave the time path of forward or discounted prices of capital goods unchanged. This condition implies that

$$\partial^2 q / \partial t \partial r = c$$

Combining these two conditions, we obtain

$$\partial I / \partial r = \partial k / \partial c \times c < 0$$

It implies that the demand for investment goods in two alternative situations is a decreasing function of the interest rate. This is illustrated in Figure 14 where in Panel (A), c_1 is the path of user cost of capital before a rise in the interest rate at t_0 time, and c_2 is the path after the change in interest rate. But c is constant at time t_0 .

Assuming other price p and w as given, K_1 is the path of optimal capital when the interest rate is unchanged, and K_2 is the path after the rise in interest rate. Thus at time t_0 , a rise in the interest rate lowers the demand for investment goods. This is obtained by comparing two alternative and continuous paths of optimal capital accumulation.

Jorgenson concludes that the demand for investment goods depends on the interest rate by comparing two alternative and continuous paths of capital accumulation depending on a time path of the interest rate.

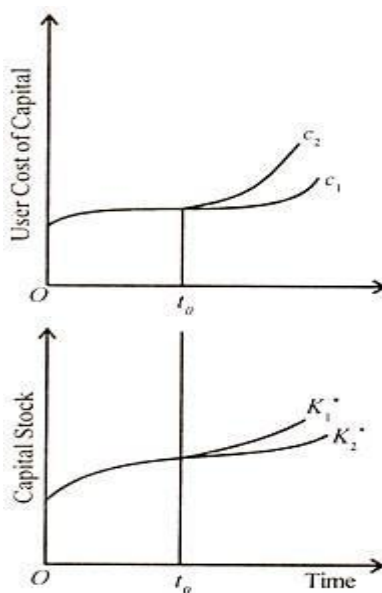


Fig. 14

It's Criticisms:

Jorgenson's neoclassical theory of investment has been criticised on the following grounds:

1. Jorgenson derives his investment function from such assumptions which do not clarify how the actual capital stock adjusts to the optimal capital stock.
2. Jorgenson's theory is based on the assumption of full employment in the economy where prices of labour and capital are perfectly flexible so that producers and consumers can anticipate changes in demand, supplies and prices of goods, But this is not a reality because there are long time lags for orders to be executed for capital goods which often lead to the fall in investment demand and the consequent idle capacity and labour unemployment in both consumer and capital goods industries.
3. Jorgenson's analysis is based on expected quantities and prices that are perfectly foreseen. But foresight is never perfect. Moreover, Jorgenson does not provide any mechanism for the formation of these expectations, except assuming that changes in current prices produce proportional changes in future prices. Further, he does not tell us anything about the expected future quantities to be sold.
4. The classical production function assumed by Jorgenson connects current investment with future outputs, and perfect foresight provides the exact current investment which produces the expected quantities of goods. Again, foresight is never perfect and current investment of capital may not be fully utilised in the future. Rather, there may be capital shortage in the future.
5. Jorgenson's definition of user cost is vague. It does not imply that future values of c (uses costs) will be identical. Consequently, a rise in the interest rate raises future user costs thereby lowering the future optimal path of capital accumulation than it otherwise would have been.
6. Jorgenson does not give a very clear economic account of his mathematical results.
7. Jorgenson labels his model as the neoclassical theory of investment but it seems to bear little relationship with the classical theory of investment.

7. Tobin's Q Theory of Investment:

Nobel laureate economist James Tobin has proposed the q theory of investment which links a firm's investment decisions to fluctuations in the stock market. When a firm finances its capital for investment by issuing shares in the stock market, its share prices reflect the investment decisions of the firm.

Firm's investment decisions depend on the following ratio, called Tobin's q :

$q = \text{Market Value of Capital Stock} / \text{Replacement Cost of Capital}$

The market value of firm's capital stock in the numerator is the value of its capital as determined by the stock market. The replacement cost of firm's capital in the denominator is the actual cost of existing capital stock if it is purchased at today's price. Thus Tobin's q theory explains net investment by relating the market value of firm's financial assets (the market value of its shares) to the replacement cost of its real capital (shares).

According to Tobin, net investment would depend on whether q is greater than ($q > 1$) or less than 1 ($q < 1$). If $q > 1$, the market value of the firm's shares in the stock market is more than the replacement cost of its real capital, machinery etc.

The firm can buy more capital and issue additional shares in the stock market. In this way, by selling new shares, the firm can earn profit and finance new investment. Conversely, if $q < 1$, the market value of its shares is less than its replacement cost and the firm will not replace capital (machinery) as it wears out.

Let us explain it with the help of an example. Suppose a firm raises finance for investment by issuing 10 lakh shares in the stock market at Rs 10 per share. Currently, their market value is Rs 20 per share. If the replacement cost of the firm's real capital is Rs 2 crores then the q ratio is 1.00 ($= \text{Rs 2 crores market value} / \text{Rs 2 crores replacement cost}$).

Suppose the market value rises to Rs 40 per share. Now the q ratio is 2 ($= \text{Rs 40} / \text{Rs 20}$). Now the market value of its shares gives Rs 2 crores ($= \text{Rs 4 crores} - \text{Rs 2 crores}$) as profit to the firm. The firm raises its capital stock by issuing 5 lakh additional shares at Rs 40 per share. Rs 2 crores collected through the sale of 5 lakh shares are utilised for financing new investment by the firm.

Panels (A) and (B) of Fig. 15 illustrate how an increase in Tobin's q induces a rise in the firm's new investment. It shows that an increase in the demand for shares raises their market value which raises the value of q and investment.

The demand for capital is shown by the demand curve D in Panel (A). The relative value of q is taken as unity, as the market value and replacement cost of capital stock are assumed equal. The initial equilibrium is determined by the interaction of demand for capital and the available supply of capital stock OK at point E , which is fixed in the short run.

The demand for capital depends mainly on two factors. First, the level of wealth of the people. The higher is the level of wealth, the more shares people wish to have in their wealth portfolio. Second, the real return on other assets such as government bonds or real estate.

A fall in the real interest rate on government bonds would induce people to invest in shares than in other forms of wealth. This would increase the demand for capital and raise the market value of capital above its replacement cost.

This means rise in the value of Tobin's q above unity. This is shown as the rightward shift of the demand curve to D_1 . The new equilibrium is established at E_1 in the long run when the replacement cost rises and equals the market value of capital. The rise in the value of q to q_1 induces an increase in new investment to OI , as shown in Panel (B) of the figure.

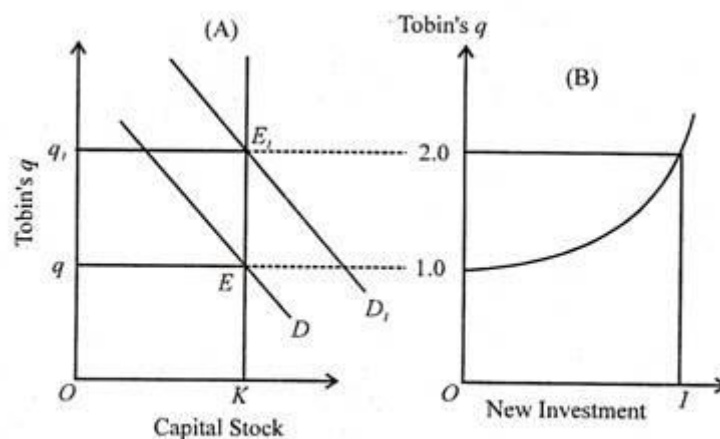


Fig. 15

Implications:

Tobin's q theory of investment has important implications. Tobin's q ratio provides an incentive to invest for firms on the basis of the stock market. It not only reflects the current profitability of capital but also its expected future profitability. Investment is expected to be higher in the future when the value of q is larger than 1.

Tobin's q theory of investment induces firms to undertake net investment even when q is less than 1 in the present. They may adopt such economic policies which bring future profitability by raising the market value of their shares.