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ON THE THEORY OF INVESTMENT FUNCTION--II*

ACCELERATION THEORIES OF INVESTMENT FUNCTION

Implicit in the Keynesian theory of investment function is that it is a simple function of income and then it is considered as a complex function of the expected discounted rate of return and the rate of interest. Taking the first basic relationship between income and investment a number of models were developed to explain the investment function in an economy. They can be called as "acceleration theories of investment function."

The "acceleration" principle as such was developed in the early years of this century. However, J.M. Clark first considered the usefulness of such accleration principle to explain the violent fluctuations in the demand for capital goods. The basis for acceleration principle is the simple fact that demand for investment goods is a derived demand and hence basically depends on the demand for consumption goods. Thus in the words of J.M. Clark: "It is concerned with the way in which the demand for finished products is handed on in the form of a demand for machines, tools, construction materials and unfinished goods."[40] Although originally the "acceleration principle" was used to explain the behaviour of business cycle, it proved an equally important tool for explaining investment function, as the latter was always considered an important variable in any business cycle theory, and at that a very volatile variable.

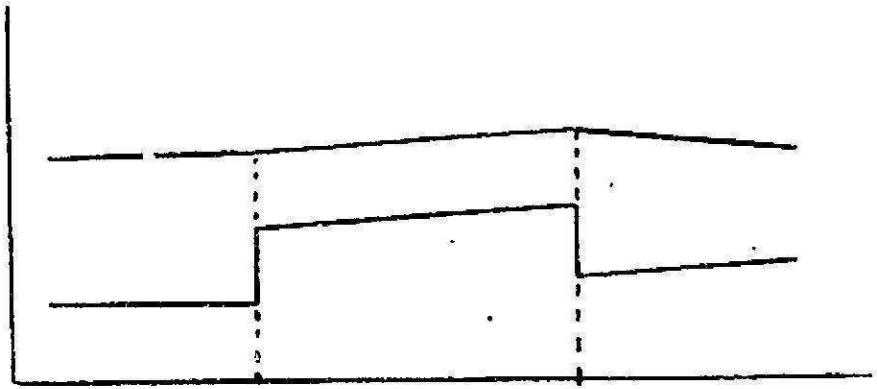
Stated in simple terms the acceleration theories of investment function are concerned with the basic relationship that size of firm's capital depends upon the level of demand for its final product. As there is an increase in the demand for final product there will be a corres-

*The first part of this article appeared in the May-August, 1969 issue (Vol. II No. 2) of Business Analyst.

ponding increase in capital investment. In Keynesian theory such investment dependence on the demand for the product of a firm is implicitly assumed to come for consideration in the estimates of expected yields of capital asset. But under the acceleration theories an explicit constant functional relationship is assumed between the rate of output growth and the rate at which the investment increases in response to increases in consumption function or demand for output from period to period. The aggregate investment consists of both replacement and additional investment arising out of increased demand for output. To take a simple numerical example if there is an initial capital stock of 100 units of capital goods and if the annual replacement rate is 10%, the productive capacity of capital goods industry will be just enough to produce the repuired 10 units of replacement demand. Then supposing there is a 10% net increase in capital stock necessitated by increase in consumption function and this increases the capital stock units from 100 to 110. Now, a 10% increase in capital stock would result in 100% increase in the output of capital goods industries, because they have to produce 20 units—10 for replacement and 10 for net investment—instead of the regular 10 units. But if the increase in capital stock growth ceases in response to a stoppage in the growth in consumption function then the capital goods industries have more or less to revert to their old position. (Of course, the capital goods industry will be producing 11 units instead of 10 units unless the capital stock also reverts to the original level of 100 units). This hypothetical numerical example, although very crude and does not completely represent the real world situation because during any given time the gross investment will form a very small proportion of total capital stock, indicates the underlying processw hich accounts for the violent fluctuations in capital goods industries. J.M. Clark has depicted this relationship graphically as shown on p. 208.

To the original acceleration principle affecting the demand for capital goods, expounded by J.M. Clark, several modifications and elaborations were made by authors in later years. Some times the principle and its working was disputed without adhering to all the limitations and enabling conditions specifically mentioned by Clark in his original exposition. The various aspects of the Acceleration Principle as a theory for determining investment function will be discussed now.

Thus "the exposition of the acceleration principle related the investment of the single firm to the rate of growth of its output."[41] Further, it should be pointed out that "the acceleration principle is said to tell us what will be the behavior of that part of this investment which is net and induced."[42] This means that the acceleration



theory is concerned only with explaining the changes in the rate of net investment arising out of changes in the rate of final output. Thus all induced investment is considered as a constant function of changes in final output. The simple acceleration principle as applied to investment determination is expressed in the form of a simple equation by A.D. Knox which is given below:—

$$C_t = K_t - K_{t-1} = a\,(O_t - O_{t-1})$$

Where:

C=Current output of capital goods

K=Stock of capital equipment

O=Output of finished products

a=Accelerator coefficient which is assumed to be constant

t, t_{-1}=time periods.

The above equation says that the current output of capital goods is equivalent to the difference in the current period capital stock as compared with an earlier period. Such increase (or decrease) in capital stock is equivalent to some constant times the change in output.

The same relationship is expressed by Samuelson in his "Accelerator-Multiplier" model as below:—

$I_t = \beta\ (C_t - C_{t-1})$

Where:

I_t=Current induced investment

C_t=Consumption goods output

β=Acceleration Coefficient

In such simple form, the adjustment required between the investment change and output change should be instantaneous. This would be clearly impossible as the speed of adjustment implicit in the relationship can never be achieved in the real world. To obviate this difficulty some have lagged the accelerator effect and the equation may be rewritten as below:—

$I_t = \beta\ (C_{t-1} - C_{t-2})$

In the above equation only the change in the consumer goods output is taken into consideration. By extending the same analogy to total output which will include both added output of capital goods and government goods, the simple and "lagged" accelerator equations can be written as below:—

$I_t = \beta\ (Y_t - Y_{t-1})$

Or

$I_t = \beta\ (Y_{t-1} - Y_{t-2})$

There is an extensive literature dealing with the limitations and problems of using "accelerator theory of investment function." Besides, there are a large number of statistical studies which came out with mixed results. Here an attempt will be made to survey some of the important criticisms and modifications of the acceleration theory of investment function.

Much of the controversy regarding the ability of "accelerator theory" to explain and predict the induced investment centre round the following aspects:

1. Surplus capacity condition.
2. Replacement investment.
3. Essentially a mechanical relationship and devoid of motivational content.
4. Financial considerations are not considered.

The simple acceleration principle says that the increases in the rate of growth of output is accompanied by simultaneous rise in ne

investment. This creates a problem of determining which occurs first. In other words, if we assume that growth in output occurs first then it means that such increased output is met by surplus capacity. Alternately, if we assume that the economy is working at full capacity, output cannot rise until additional capital is added. But either in its simple form or in its complex forms with lags, the acceleration principle does not imply that investment should occur first to facilitate the output growth. This aspect gives rise to the controversy whether full capacity utilization is a necessary assumption for the working of acceleration principle or not. While J.M. Clark in his additional note regarding Kuznet's statistical findings which dispute the acceleration principle argues that the principle is compatible with the existence of surplus capacity in the economy, many subsequent writers note that full capacity is a prerequisite for the working of acceleration principle. This difference about full capacity prerequisite according to Knox,[43] is due to the fact that capacity can be viewed in different ways. He takes the full capacity definition as one where the output is at a firm's minimum average total cost and concludes that "there is no incentive for investment before the least cost point is reached and an increasing incentive the further beyond that point output goes."[44] However, it can be said that this vagueness about full capacity prerequisite limits the usefulness of acceleration principle to explain the timing of investment. Other considerations for the inability of the principle to explain timing include what Kuznets points out that the output growth and growth of stock of capital are not divisible in the same units so as to bring such perfect matching between these two. On this issue Knox concludes saying that "it is not possible to devise a definition of capacity that is both realistic and precise," and that "the acceleration principle is unsatisfactory as an explanation of the timing of investment."[45]

The acceleration principle is concerned only with net investment as a function of output. But in actuality replacement also influences the acceleration process for investment goods. In the first place, more often from an empirical point of view the replacement and net investment blend together in such a way that it is hard to maintain a clear distinction. This is because of the changing nature of investment goods. Secondly as Pigou notes that with a fall in investment replacement may rise and offset the depressing effects of this fall.[46] In this connection

there are two schools of thought, one arguing that replacement depends on the level of output and the other arguing that it depends on age distribution of capital stock. While Kuznets through his extensive studies stresses the place of replacement cycles in the investment theory, Hicks considers that replacement cycles after a time become so damped and hence can be ignored. On this issue Knox says that "the acceleration principle is discussing net investment where it should discuss gross."[47] He further discusses at length the replacement behaviour in terms of cost differentials between new and old equipments and its relationship with profits to the firm. By bringing in such profit considerations, he says that replacement can be considered neither a simple function of time nor of the level of output. Because of all these considerations it is finally concluded by Knox that it is "unlikely that gross investment will slavishly follow the pattern suggested by the acceleration principle."[48]

Another criticism of the usefulness of acceleration principle as a predictor of induced investment is that it is generally devoid of motivational content and is essentially a technical relationship. Thus Meyer and Kuh observe: "Like the quantity theory of money, the acceleration principle has little or no motivational content—a circumstance which must, particularly at the individual firm level, be counted as a substantial weakness."[49] It may be recalled here, that Keynes stresses the significance of these entrepreneurial expectations as an important factor influencing the investment activity. While there is agreement about the effect of these expectations on acceleration principle, different economists take different approaches about the nature of such effect. Tinbergen stresses that entrepreneurial expectations lead to errors in judgment and thereby lead to distorting effects on investment activity. Consider, for example, the stand taken by A.S. Manne that entrepreneurs are gifted with certain measure of foresight and will be able to distinguish between the transitory changes in demand and "those changes that justify extension or contraction of his plant."[50] A third attitude is expressed by Wright who completely rejects the principle and considers that investment should be treated as depending on changes in entrepreneurial expectations or on innovations. However, as Knox says: "The position has been summed up very aptly by Bissell: Only when we have a workable theory of expectations shall we know just how far the acceleration principle must

be qualified."[51] Once the importance of expectations is brought into any theory of investment function, it leads us to consider the nature of such expectations. These expectations are broadly related to future profitability of present investment. However, these profitability expectations are conditioned by sales expectations. Generalization and constructing a theory of expectations is almost an impossible task. This is particularly so when we want to test any such theory by empirical studies. The basic problem seems to be how to lay down criteria which would enable us to decide the direction in which these expectations are running. One such criterion is that present experience will form the basis for future expectations. But then risk taking is a part of the business game. This means that future expectations are based not only on present experience but also on the risk taking nature of the entrepreneur. In other words future expectations cannot be simply extrapolated on the basis of present experience only. However, it can broadly be said that success reinforces high risk taking behaviour on the part of the entrepreneurs whereas the reverse is true with firms whose past and present experience is comparatively disappointing. The problem gets more complicated when we observe empirically that highly successful growth firms make present investment for distant future which cannot be explained in terms of either present changes in output or immediate future profit expectations. In this connection we can cite the example of research and development investments, whose results are surrounded with great uncertainty and the results of such investment are often reaped in the distant future.

This discussion on expectations takes us into considering profit as a major factor influencing investment. Besides, the simple accelerator does not take into consideration the availability of funds for investment. In considering the Keynesian theory of investment function, it is pointed out that entrepreneurs have a psychological preference for internal finance in their investment decision. Since the sources of such internal funds are both profits and accumulated depreciation and other reserves, profits and the incoming flows of liquidity are considered as important factors affecting investment. "As a consequence S.C. Tsiang has suggested incorporating profits into acceleration theory. Tsiang accepts as a truism the basic accelerator notion that more productive capacity will usually be desired when demand presses against capacity, but feels that other factors, particuarly financial

availability and constraints will obscure or modify this motivation."[52] On the same lines giving importance to profits and retained earnings Duesenberry develops a profit equation and derives an investment equation based on the former. Duesenberry suggests that profits depend positively on national income and negatively on the stock of capital and his profit equation is as below:—

$$\pi t = aY_t - bK_t$$

or with lags $\pi t = aY_{t-1} - bK_{t-1}$

Where π = Profit

Y = National income

K = Capital Stock

a, b = Constants

t, t_{-1} = Time periods

On the basis of the above profit equation, Duesenberry's investment equation is as below:—

$$i_t = aY_{t-1} - BK_{t-1}$$

While the above investment function can be derived purely on financial considerations Ackley suggests that the above theory is extremely similar to the theory based on acceleration principle. Ackley formulates the following equation for such a comparison:—

$$i_t = \beta \left(\frac{a}{\beta} Y_{t-1} - K_{t-1} \right)$$

Where:

i_t = Present induced investment

$\frac{a}{\beta} Y_{t-1}$ = Optimum capital Stock

$\frac{a}{\beta}$ = The Capital to output ratio

β = (outside parentheses) the rate at which the gap between optimum stock (a Yt-1) and the actual stock (Kt-1) is closed.

K_{t-1} = Actual capital Stock

In the light of above equation Ackley says: "If β has a value of .25 it means that investment is at a rate which would make up one quarter of any such gap within a single time period. If $\beta = 1$, we have the case of the strict accelerator principle (with a one period lag): investment occurs in whatever amount is necessary to raise actual

capital stock to its optimum level. (of last period)."[53] However, unless the actual and optimum capital stocks are defined clearly it is difficult to test the above theory empirically. Besides the idea of optimum stock seems to be more conceptual than one lending itself for empirical verification.

After considering the various limitations and criticisms, A.D. Knox suggests the following investment equation:—

$$I=\beta(K_D - K_A)$$

Where:

"(a) β is the inverse of the gestation period. Hitherto we have been able to treat the decision to invest and the actual investment as one. The introduction of the gestation period makes it necessary to have a distinction; and I here refers to the process of investment.

(b) K_d is, for want of a better term, the desired level of capital stock.

(c) K_a is that part of the existing equipment that is considered efficient enough to be kept in operation."[54]

The above equation suggested by Knox is different from acceleration principle. This is in line with his extensive discussion on gestation period involved in new investment and the cost differentials between the old and new equipment. According to Knox the "I" in the above equation "refers to gross investment the timing and amount of which are strongly influenced by profits." However, he himself concedes saying that "$I=B(K_d-K_a)$ meets the criticism of the acceleration principle; but it is no more than a summary behind which lie some very complex relationships."[55]

From the above discussion of the acceleration theory of investment, it is clear that while there is an element of truth in the basic relationship propounded by acceleration principle, the theory fails to explain various aspects of investment and cannot be considered a comprehensive theory of investment function. What is originally considered a simple relationship becomes very much complicated and confused. Its main weakness lies in its inability to explain the timing of new investment. Seeondly, it fails to take into account the entrepreneurial expectations which should logically form a part of any investment theory. Finally, since the acceleration principle does not take into

consideration the financial aspects of investment, it leads to profit and liquidity emphasis in investment theory. Thus Kisner says: "Many respected economists while rejecting or accepting the acceleration principle in varying degrees, have thought to see in profits, retained profits or internal funds a major determinant of business investment."[56]

There are several statistical studies of accelerator theories of investment function throughout the history of its active existence. The modifications and criticisms are to a large extent based on statistical studies. A chronological list of such statistical studies is given in an appendix to this paper. This list is taken from Meyer and Kuh's book "The Investment Decision."

However, it can be observed from the discussion on acceleration principle that there are three basic forces which might be considered to determine the investment activity on the part of business firms. They are the acceleration relationship, profit and liquidity considerations and the entrepreneurial expectations. However, on the matter of acceleration versus profit-liquidity considerations, there does not seem to be any agreement amongst economists. It is reported that four economists (Robert M. Solow, E. Cary Brown, Albert Ando and John Kareken) who have estimated a distributed lag investment relation for the Commission on Money and Credit) made the following observation on the issue:— "We do not wish to choose once and for all between a profits on one side and an acceleration theory on the other— nor do we believe the two to be necessarily mutually exclusive. We seem to get stabler empirical results when we include corporate profits as an independent variable and exclude rough measure of "capacity" (meant as a surrogate for the stock of capital itself)." [57].

From the above discussion it can be considered that the acceleration, profit-liquidity and entrepreneurial expectations factors tend to influence investment in a complex form. One significant empirical study was carried out by Meyer and Kuh to test what they call as "the acceleration-liquidity-expectations complex hypothesis."[58] In their study they used cross-section data of ten industries which led to a study of 750 firms for each of the years 1946 through 1950. The statistical method was "developed upon least squared multiple regressing and correlation models."[59] They used two models, one basep on absolute sales hypothesis and the other on the profit principle hy-

pothesis, as given below :—

(1) $I_t = f_1 (S_t, D_{t-1}, A_{t-1}, S'_t, C_t, L_{t-1}, u_t) (1/K_{t-1})$

(2) $I_t = f_2 (P_t \text{ or } P_{t-1}, D_{t-1}, A_{t-1}, S_t, C_t, L_{t-1}, u_t) (1/K_{t-1})$

Where :

I = Gross Investment

S = Total Net Sales

P = Net Profits

D = Depreciation Expense

A = Depreciation reserves taken as a measure of relative equipment age

K = Capital Stock as measured by the total of gross fixed assets

S = the change in Sales

C = Total needed capacity as measured by the product of current sales times the minimum gross fixed assets to sales ratio reached between 1946-1949

L = the net quick liquidity stock, that is current assets less inventories and current liabilities

u = A stochastic term representing the influence, assumed random of unincluded variables

t = the time period.

Within the above mentioned methodological framework the authors, to express in their own words, "have attempted a fresh assessment of liquidity, accelerator and expectational theories of investment behavior. "Basically, we have tried to find independent variation in these influences by the process of disaggregation."[60] With regard to the influence of liquidity the empirical results of this study support the view that "money becomes scarce in downturn because of restricted profit inflows and tougher credit requirements and conversely plentiful in a boom because of opposite conditions."[61] Secondly, while there is poor correlation between sales and investment activity which the authors consider "mediocre and rather patternless results for sales changes", the capacity variable yielded good results when the underlying assumptions of acceleration principle were satisfied. Regarding the profit-investment relationship it is concluded that such relationship is based more on liquidity rather than expectational considerations. Finally with regard to acceleration vs profit inflows, it is concluded that when profit inflows were substantial, the accelerator was operative. But when the liquidity stock had fallen

or the profit itself has fallen, the profit rate became a better variable for explaining investment.

The results of Meyer and Kuh's empirical studies broadly indicate that profitability-liquidity and acceleration, operate from time to time as factors influencing investment. Thus when demand was expanding and liquidity was plentiful, the acceleration principle expressed through capacity formulation was operative. On the other hand when conditions got stabilised and with increasing competition, the profit and liquidity considerations were crucial. Further the study also indicates the crucial nature of liquidity-investment relationship. While in the study it was attempted to separate the influence of each of these factors and measure, still it can be maintained that while some one factor is more active other factors are also there as forces influencing investment. This then suggests that there is no single factor or any particular combination of factors which can explain investment behaviour through time. Meyer and Kuh's study generally indicates if we can correctly describe the business conditions at any given time, it might be possible to say which factors will be more influential determinants of investment.

SOME LATER APPROACHES ON INVESTMENT FUNCTION

Apart from the Keynesian and acceleration theories, there are other attempts to explain investment process and investment behaviour. While some of these theories are attempts to explain investmnet behaviour as a part of business cycle behaviour, other attempts signify further modifications to acceleration theory and still other attempts are only different points of view in looking at investment function or some methodological aspects relating to empirical studies on investment function.

The first in these series, which is also very important, is the capital accumulation model developed by Richard Goodwin. In this model the key factor is a particular level of optimum capital stock for a given amount of output currently demanded. The changes that might come about in this optimum capital stock is not necessarily induced by optimum growth only, but might result from technological changes as well. Otherwise the capital goods industries will always be producing for replacement purposes. Under such equilibrium situation in which

there is an optimum capital, capital goods industries will be producing only for replacement purposes. This equilibrium condition may be disturbed leading to a shortage of capital goods. This would result in increased orders to capital goods industries resulting in a chain reaction of increased income, increased consumption and still more demand for investment goods resulting in an upward shift of optimum stock. When once such increase ceases, eventually the shortage of capital is made up and "at this point optimum stock and actual stock are equal." [62] But now that increase has stopped the demand for capital goods industries reverts to replacement level. This decrease in demand for capital goods results in a chain reaction of decreasing income, decreasing consumption and decreasing investment which means the optimum level of capital is reduced. Because of earlier accumulated capital goods the demand for capital goods further shrinks and may even reach a zero where no replacement will be taking place. But at some stage the capital stock will no more be redundant even with low aggregate demand. This then starts the upswing once again. Such change as described above creates a cyclical behaviour of ups and downs in demand for capital goods industries. In such simple model, the capital goods are produced, under equilibrium conditions, for replacement purposes only and there will be zero net investment. In such equilibrium situation it is profitable to replace at the going rate of interest. The equilibrium would be stable, so long as the net investment proves unprofitable at the going rate of interest.

Although other modifications were made by Goodwin to the model by substituting Keynesian rising cost schedule instead of fixed capacity limit in capital goods industries, this capital accumulation model essentially traces the path of investment in terms of cyclical behaviour, rather than explaining the determinants of investment which should form the core of any investment theory. In the business cycle theories developed by Samuelson, Goodwin and Hicks, the implicit assumption seems to be the working of the acceleration principle— "that of a relationship between output and required or desired capital stock."[63] Hicks considers the differences in the working of acceleration principle in the upward and downward directions of changes of demand particularly when such changes are larger. Earlier in this paper, the limitations, problems and modifications with regard to acceleration principle were pointed out. Since these business cycle theories do not go into the

determinants of investment function, no further consideration of these theories will be given in this paper.

Another recent attempt to explain investment function is that of Robert Eisner.[64] Eisner's approach in a sense is an attempt to resolve the acceleration vs profit controversy. Although his empirical findings and his arguments are in favour of rehabilitating the acceleration principle as opposed to profit principle, he also makes a modification to acceleration principle, saying, that the principle holds good only when the changes in output are of a permanent nature. He says: "The innovation that I have particularly in mind involves the hypothesis that consumption is a stable function of "permanent" income and that its relation to measured or observed income is an unstable proxy relation which depends in turn upon relative size of variances of observed and permanent incomes. With regard to the nvestment function we shall now argue that investment is a stable function of "permanent" changes in output and that the enigmatic results of many past investigations have stemmed from attempts to estimate the unstable proxy relation including large elements of "transitory" changes in output. And even more particularly, as in the case of previous work with consumption we shall support this view of analysis of variance and covariance involving a comparison of between group and within group regression coefficients."[65]

Thus Eisner takes lead from studies on consumption function and attempts to apply in explaining the investment function. For purposes of this empirical study the data was taken from Mcgraw Hill Capital Expenditure Survey for years 1955 to 1958. In this connection he makes use of three equations which he calls as investment function, anticipations function and realizations function. With these three equations he conducts a statistical testing of what is called as "permanent acceleration hypothesis" which, according to Eisner is analogous to permanent income hypothesis. According to this hypothesis "the firms will invest to the extent that they believe increases in demand are permanent. Hence for given increases in sales, investment will be less the greater the proportions of the increases which are deemed transitory."[66] Here the permanent change for statistical testing purposes is taken as the average experience of the industry as a whole rather than the deviations from the average of individual firm. In other words, the firm's investment plans are supposedly based on

industry sales changes than their own sales changes. This means that from the individual firm's point of view, a sales change consists of two components—a permanent change and a temporary change. His statistical findings show that there is high correlation between the sales change and investment as well as between anticipations and investment. However with regard to profits the results do not support the view that there is much signfiicant relationship between profits and investment.

While Eisner's approach to acceleration principle with a distinction between permanent and transitory changes in sales, is a noteworthy one, his entire hypothesis is again based on what the entrepreneurs believe whether a change in sales is a permanent one or a temporary one. As a basis for their beliefs Eisner generally suggests that industry deviations can be considered as permanent changes and not changes in the sales of an individual firm. Here the firm's resource factor, both human and financial is not given any explicit consideration. In other words, even when there is a favourable change on inudstry level, which is deemed to be permanent, the resulting investment is conditioned by the experience of the individual firm. Some firms might have succeeded better than average industry performance and their investment plans will not be restricted because the over-all industry performance is far below their performance. On the other hand, those firms whose performance is far below, the industry performance will attempt to make a very moderate investment although the industry as a whole is expanding faster. This is particularly so when there are wide size differences of firms with unequal resource bases and market strength in an industry. While it is true that an industry-wide favourable change definitely reinforces the favourable investment atmosphere, the reference point for individual firm's investment is its own ability to expand which depends on its past performance, present resources and future expectations. Furthermore, what is a permanent change depends to a certain extent upon the expectations of entrepreneurs. Here, of course, Eisner himself says that investment activity is undertaken to the extent that changes in demand are deemed to be permanent. If a change or a part of it to be considered permanent or not depends on beliefs, then there can be a wide spectrum of these beliefs even in the matter of interepreting industry sales changes. Additionally, the industry changes might as well be fluctuating making it more difficult

to decide what portion of a change is permanent and what portion transitory. Because, a "permanent change" should be characterised by a long run favourable or unfavourable expectation, so as to justify expansion or contraction of investment, problems of deciding what is a permanent change and how much of change can be considered permanent, seems to differ from firm to firm. These problems need to be solved before Eisner's "permanent acceleration hypothesis" can be accepted. Even if we accept the permanent change hypothesis, the problem persists in the form of deciding as to how did the permanent change take place without investment preceding such change. In other words, whether the investment follows or precedes the change in sales is an important consideration in determining the timing of investment. Whether investment decisions are based on anticipations of change in sales or on the basis of already observed changes? Given the gestation period involved in any long term investment, it can be safely assumed that long run expectations govern investment decisions.

Jorgensen develops a theory of investment function based on neoclassical optimum capital stock theory. He considers the ratio of factor prices to the prices of output as the central feature of neoclassical theory which determines the demand for capital goods. And he further considers that "this feature is entirely absent from econometric literature on investment."[67] Two factors considered as primary determinants of investment are the changes in the underlying market conditions and in the tax structure. He makes further assumptions with regard to the time form of lagged response to changes in the demand for capital as fixed and that replacement investment is proportional to capital stock. Within the framework of these assumptions and taking lead from neoclassical optimum capital stock theory, his hypothesis is that the "demand for capital stock is determined to maximise networth. Networth is defined as the integral of discounted net revenues; all prices, including interest rate are taken as fixed. Net revenue is defined as current revenue less expenditure on current and capital account including taxes. Let revenue before taxes at time "t" be R (t) direct taxes D (t) and "r" the rate of interest. Networth, say W, is

$$W = e^{-rt} \quad [R(t) - D(t)]\, dt \quad [68]$$

With the above equation the investment is determined through a process of maximisation of networth as defined above. He further

calculates the elasticities of investment with respect to price of output, price of capital goods and the rate of interest. Given the nature of such elasticities the long term response of investment depends on changes in the underlying market conditions and the tax structure and the time pattern of response of investment depends on changes in demand for capital.

In the above approach characterised by maximizing inputs the implicit assumption seems to be that future input and output relationships could be calculated which gives the method of calculating the maximizing networth. This approach does not seem to take into account the uncertainty of future which really decides whether the networth is being maximised or not. The present elasticities of investment with respect to output, prices of capital goods and the rate of interest, are supposed to provide clues to the future investment pattern.

In the above approach characterised by maximizing inputs the implicit assumption seems to be that future input and output relationships could be calculated which gives the method of calculating the maximizing networth. This approach does not seem to take into account the uncertainty of future which really decides whether the networth is being maximised or not. The present elasticities of investment with respect to output, prices of capital goods and the rate of interest, are supposed to provide claues to the future investment pattern considering that future structure of output as well as the structure of capital goods industries might change, the predictive ability of these elasticities is open to question. The time dimension and futurity aspect of investment function does not seem to have been given their due consideration in this approach.

G. H. Fisher [68] considers the distinction betweeen treating investment as exogenous or endogenous in the economic models. He points out to the importance of having a very few exogenous variables and as far as possible that investment should be treated as endogenous to the system. He also points out to the problems that arise for empirical study in the absence of clear definition of the endogenous nature of induced investment. In this connection, he gives the example of Hick's treatment of investment caused by intentions as exogenous. On this issue Fisher says: "Now it is evident that it would be practically possible to differentiate empirically between endogenous aad exogenous investment as set forth in Hick's

theoretical model."[70]

As far as the investment determinants are concerned he brings out two points. First he considers that induced investment can be made to have wider scope. As an alternative to the change in outor sales which is usually the case with the acceleration theories, he introduces aonther concept which he calls as "level induced investment." The latter refers to the level of aggregate real output in the recent past. The equation for such level induced investment is written as below:—

$$I_t = \beta_1 Y_t + \beta_2 Y_2$$

The above equation says, in the words of Fisher: "Thus in the final analysis, entrepreneurs are assumed to look at a weighted sum of aggregate real output in the past two periods, and from this they arrive at investment decisions."[71] However, he himself considers that the assumption of "level induced investment" rather than "change induced investment", may not be realistic from a behaviouristic view point and hence makes the following modification to the equation:—

$$I_t = a\,(B_1 Y_{t-1} + B_2 Y_{t-2})$$

In the above equation the weighted sum is converted into a weighted average and "a" is called as a "reaction coefficient". "This equation says that entrepreneurs consider a weighted average of the levels of Y in the two previous periods and then "react" to this calculation by the factor "a."[72] While it is a new approach in looking at the investment-output relationship, it is neither realistic, nor does specifically describe the relationship between the level of output and investment. It looks as if Fisher is thinking in terms of some kind of trend thinking on the part of the entrepreneurs in their investment decisions, instead of the usual change in output as a basis for investment decision. If this is the case, then the trend thinking, under which investment decisions can be thought of being based on the level-trend of output over some past periods need not necessarily be confined to two past periods. Further the trend-thinking approach can as well be applied to "Change: induced investment."

The second point made by Fisher is that in any investment equation there should be provision for both endogenous and exogenous variables as well as a provision for a random disturbance variable. This argument is based on the stochastic approach used by Klein. In

view of the above argument the public utility investment function is written as below :—

$$I_t = a_t + a_2 (Y_t - Y_{t-1}) + a_3 P_t + w_t.$$

Where :

I =Aggregate real public utility investment
Y =Aggregate real income (endogenous)
P =Population variable (exogenous)
w =A random disturbance variable·
a_t =Parameters

While the above approach might be statistically more appropriate for empirical studies of an intractable problem like investment function, it is highly doubtful whether such definition of investment function can lead to the development of any useful theory.

R.A. Gordon [73] attempts to explain investment behaviour in terms of investment opportunities and inducement to exploit a given stock of investment opportunities. He contends that a distinction should be maintained between stock of investment opportunities and inducement to exploit such opportunities. Change in investment opportunities come about for reasons which are both exogenous and endogenous, e.g., technology, population growth government spending etc. According to Gordon the rate at which given investment opportunities are exploited depends on two factors. Firstly, the current expectations about future profits and sales. Secondly, current attitudes towards liquidity. These two factors are cyclically induced. Gordon says: "The volume of current investment is a function of the (changing) state of investment opportunities, of other variables which also influence profit and sales expectations and of the variables influencing liquidity attitudes."[74] He also says that there are a variety of time lags between the creation of investment opportunities and their exploitation by entrepreneurs, and imperfections of capital markets. These lags and imperfections persist even when other inducing conditions are very favourable for investment.

In the first place from an empirical view point, it would be difficult to maintain such distinction between the stock of investment opportunities and inducement for investment. It is doubtful whether investment opportunities exist as such or they are created by entrepreneurs. Even if we can conceptualise the existence of a stock of investment opportunities for a theory of investment, only the exploited oppor-

tunities are relevant. It is not clear about the significance of unexploited opportunities. It can be said that if the stock of opportunities is far in excess of ability to exploit then more favourable conditions prevail for induced investment. But so long a measure of such changing levels of stock of opportunities cannot be clearly visualised, its effect on induced investment cannot be established. While Gordon's approach is an attempt to explain the investment behaviour by bringing in the concept of "stock of investment opportunities", he relies on cyclically induced forces for determining the level of induced investment.

Conclusion

In the previous pages a survey of various theories and approaches to investment function has been attempted. The classical treatment of investment function is characterised by demand-supply-price approach with investment-saving-interest assuming the respective roles. While Keynesian theory brings out the cost of capital and marginal efficiency of capital, it also relies predominantly on interest rate for determining equilibrium level of investment. Keynes can also be credited with bringing the "entrepreneurical long term expectations" into main focus in connection with his treatment of investment function. But as Ackley says: "despite some sparkling observations, he provided no theory of how business expectations are formed and revised. He stressed only their sensitivity and volatility, and their tendency to sharp and simultaneous revision by many businessmen."[76] However, much of the empirical study in this connection disproved the interest elasticity hypothesis of investment.

Much of the literature on investment function is concerned with "acceleration principle". The acceleration theory of investment function, although a simple technical relationship between output and investment in the beginning, became more complex with the introduction of time lags, and with efforts to bring in replacement and expectational aspects into its fold. The financial considerations lead to a controversy between acceleration vs profit-liquidity factors in determining investment. A series of statistical studies could not finally decide this controversy without qualifications. The final conclusion seems to be that both types of factors are important investment determinants depending on other circumstances.

The capital accumulation theories mainly depend upon the concept of optimum capital and deviations from such optimum to explain investment process. While some of the later attempts bring out new approaches and new ways of looking at the problem,none of them could provide a testable and comprehensive theory of investment function.

A survey of the various theories makes it clear that a simple theory like the acceleration principle in its simple form, fails to represent the reality of investment function. On the other hand any attempt to include all the variables affecting investment function makes the construction of any meaningful theory an impossible task. The net result seems to be that economic literature on this topic indicates the various factors influencing the investment function, but all the theoretical and econometric effort devoted to this problem could not succeed in weaving a cohesive and comprehensive theory of investment function. Still the nature and behaviour of investment function seems to be intractable from economic theory point of view.

The reasons for such state of affairs in economic theory, as far as investment function is concerned, can be better understood, when we consider the nature of the problem. To begin with there is an underlying technical relationship between investment and output level at any given time as propounded by the simple acceleration principle. But this technical relationship may be changing from time to time because of technological progress, changes in the relative prices and productivity of factors of production and changing structure of output. Further this technical relationship is disturbed by profit or utility maximizing behaviour on the part of entrepreneurs. This maximizing behaviour takes away the essence of simple technical relationship and gives greater latitude to entrepreneurs as well as conditions the entrepreneurial investment decisions.

Secondly investment has a time dimension. As can be seen from various theories that one of the most difficult problems to predict is the timing of investment. The importance of this time aspect is so great that it made Keynes to introduce time element in his treatment of investment function in his model which is, otherwise, essentially a static model. This time dimension of investment function has several facets. In the first place there are a number of time lags in the working of an investment system. Secondly, current investment would run through a series of future time periods. The length of such future

time periods can never be realistically determined because of the random factors such as technological obsolescence and uncertainty that surrounds the future profitability. Many of these time dimension aspects make it difficult to incorporate replacement demand into any investment theory.

Thirdly the investment function is greatly influenced by motivational or expectational considerations of entrepreneurs. The entrepreneurs both react to their present and past experiences and anticipate the future events. Here because of the uncertainty that surrounds any future events, these reactions and anticipations keep changing from time to time in the light of actual experience. If such expectations and anticipations influence the investment decisions, we need a theory of such mental phenomena to decide their impact on investment. So far one cannot say that such a general theory of expectations and anticipations exists.

Added to the above factors, the present theories of investment function do not take into account some of the present day economic realities. For example the present day market structures are predominantly oligopolistic in nature. Then it is difficult to decide whether investment takes place in such oligopolistic industries for profit considerations only, or to maintain the share of the market or to expand the firm's share in the market. It is often difficult to decide the influencing factors behind highly risky long-term investments such as in research and development activities. Besides, in almost all theories of investment function, the implicit assumption seems to be that increases or decreases in demand and the consequent changes in output are a function of national income. This in a sense means that as far as the entrepreneur is concerned the changes in output are autonomous and are not within his control. But in reality, it looks as if the entrepreneurs can influence the demand for their products through extensive advertising and sales promotion activities. This ability to influence demand has significant implications for investment decisions, particularly from the point of view of individual firm. Even in the aggregate, there is some agreement on the matter that advertising and sales promotion activities can influence the aggregate demand for output. Hence an explicit consideration of this ability on the part of entrepreneurs needs to be incorporated into investment theory. This ability to influence (or lack of it) demand for his product seems to enter

actively into investment decision considerations. Other factors remaining constant. this ability to influence demand might prove crucial in investment decisions of individual firm.

In view of the various complex problems surrounding investment function, no comprehensive theory which meets the requirements of empirical testing could be developed so far. Hence the theory of investment function still remains an intractable problem in macro-economic theory. While considering an all-inclusive investment model, it is no wonder to see one author remark : -'What is involved is scarcely less than a complete theory of society embracing the fields of economics, sociology, psychology, politics and so forth.".[77]

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