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ON THE THEORY OF INVESTMENT FUNCTION—I

INTRODUCTION

INVESTMENT is considered a critical variable in macro-economic models. The significance of investment function runs through the entire macro-economic literature. In classical theory, in Keynesian macro-economic models as well as in the business cycle theories and economic growth models, the investment function figures prominently. Thus Ackley says : "Investment has been assigned a position of cruicial importance in almost all macro-economic theories. This is true not only of modern Keynesian and post-Keynesian theories but as well of most earlier business cycle theories."[1]

In the ever growing economic literature on underdeveloped economies, the investment function is given great prominence. While from a theoretical point of view the significance of investment function in macro-economic studies is beyond all doubt, some authors like Colin Clark pointed out to the too much pre-occupation with investment in the post-war concern about economic growth. Colin Clark says that "in recent years all the emphasis in the discussion of growth has been concentrated on one of the factors concerned namely investment."[2] According to him that much of the concern about investment function as a crucial factor in any economy has developed "in the years immediately following 1945, when the outstanding problem for most countries was shortage of capital equipment and stocks as a result of war." He contends that investment while essential, is not the only crucial factor for economic growth. Although he shows some statistical evidence in support of his arguments, he seems to have based his arguments in what he says that "Economists are not yet in a position to analyse this matter fully."[3]

Not going into the details of the controversy whether investment is crucial or not for economic growth, it can certainly be maintained that investment is one of the most important variables of any economic system. For example, Keynes maintains "that employment can only increase *pari passu* with investment....."[4]. He further goes on to say that in an extreme case where "the marginal propensity to consume is not much above zero, small fluctuations in investment will lead to correspondingly small fluctuation in employment; but, at the same time, it may require a large increment of investment to produce full employment." [5] The importance of investment function gets magnified when it is recognised that this is also the most volatile variable in any economic system. Thus Haavelmo observes: "Since investment is an important part of total economic activity, variations in the rate of investment would naturally affect other variables such as consumption, employment, wages etc. The result could be cyclical in various ways." [6] Problems of economic growth and the behaviour of any economy can be more thoroughly explained when once the economists succeed to build a comprehensive theory of investment function.

Thus while there is due recognition of the importance of investment function, still the present stage of investment theory falls far short of the real world requirements. Thus Haavelmo remarks: "Economic theory can give a reasonably good account of how the level of investment activity influences effective demand and employment, if only we knew more about the determinants of investment." [7] Despite the fact that several economists devoted great attention to theoretical model building and a large number of empirical studies were carried out with respect to investment function, it still remains an economic riddle to be solved. As Meyer and Kuh observe that "of the various domains of economics, one of the most confused and controversial has been the theory of the demand for assets." [8]

As mentioned earlier investment function transcends into several areas of macro-economic theory. Particularly on the subject of investment function in addition to several theories and theoretical discussions, there are a large number of empirical studies. While some of these latter type of studies attempted to test the various theories, other studies could lead to modifications of the theories and still other studies attempted to explain investment with an integrated approach. In view

of such a broad scope of the subject this paper will make an attempt to critically consider some of the important theories of investment function. According to Haavelmo investment theories can be subdivided into " (1) theories of the effects of rate of investment, (2) theories of the determinants of the level of investment activity and (3) theories of the determinants of variations in this level." [9] However, this paper will be mainly confined to the latter two types of theories which explain the investment process and the determinants of investment in an economy. While a complete survey of all the empirical studies is beyond the scope of this paper, the empirical evidence pertaining to each theory will be considered generally. Some of the important recent approaches to the theory of investment function will also be reviewed. Finally it will be attempted to bring out some thoughts on the complex nature of investment function.

INVESTMENT FUNCTION — SOME DEFINITIONS

In the various theories of investment function that follow, several concepts will be used. These concepts are frequently used in the economic literature dealing with investment function. Hence instead of clarifying these concepts in connection with the discussion of each theory it is attempted to group them together and give the generally accepted definition of each of these concepts. A definitional clarity seems to be the first step in a systmatic understanding of any economic problem.

WHAT IS INVESTMENT ?

To begin with investment itself needs to be clearly defined. Investment generally refers to the capital accumulation process in any economy. But when it comes to precisely defining what constitutes investment goods, there seems to be always some difficulty, because investment goods can be defined from two perspectives. One is the *use perspective* and the other is *liquidity perspective*. From the point of view of the latter, Fraser defines investment as the "use of monetary resources of wealth of a relatively illiquid type."[10] Keynes divides output into two forms — (*a*) "the flow of liquid goods and services which are in a form available for immediate consumption and (*b*) the net

flow of increments (after allowing for wastage) to capital goods and loan capital.....'...which are not available for consumption." [11] The degree of liquidity or the physical from does not really matter in making a distinction between investment goods and consumption goods. In other words the use concept seems to be more realistic as Hayek says, investment is "the act of applying a unit of input in any process of production." [12]

A distinction needs to be maintained between real investment and financial investment. As a matter of fact all financial investment is undertaken for purposes of real investment and the latter is always measured in money terms. However, the distinction has significance as the lack of matching between real and financial investment, with the latter outrunning the former, will lead to building up in active money holdings which will have important economic consequences.

Another important aspect of investment is the need to maintain a distinction between the stock and flow concepts. Investment by its very nature is a flow concept. Investment goods flow through time and add to the total stock of capital goods which are an accumulation over time. Thus Meyer and Kuh observe that "investment is a time rate of change in a stock of durable assets...." [13]

Another closely associated concept is the distinction between the gross and net investment. It is already mentioned that investment is a flow of additions to the existing capital stock. Such flows of additional investment goods may simply replace a part of the existing capital stock or it may result in a net addition to the stock. Since the capital goods do not have an indefinite life they need to be replaced periodically. Such replacement may be due to sheer physical deterioration of the capital goods over time or may be due to technological obsolescence factor. However, to the extent the current flows of investment goods simply replace a portion of the existing stock no net addition will be really taking place. Only when the current flows of investment goods are in excess of the replacement requirements that a "net addition" to the stock takes place. Such net addition to the stock is termed "net investment" whereas the overall flows of investment goods (consisting of replacement and net investment) is called as "gross investment."

AUTONOMOUS VS. INDUCED INVESTMENT

In the scheme of macro economic studies investment is usually treated as a variable dependent upon the level of income. But some investment may take place which is not dependent on the level of income. This type of investment may be due to technological factors or public policy. This type of investment is called as autonomous investment. In other words this autonomous investment is constant at all level of income and an upward shift in autonomous investment takes places only when the investment opportunities are considered favourable. The conditions for such favourable opportunities are outside the changes in income level. Again the upward shifted autonomous investment level is the same for all income levels. The following is a graphic presentation of such autonomous investment.

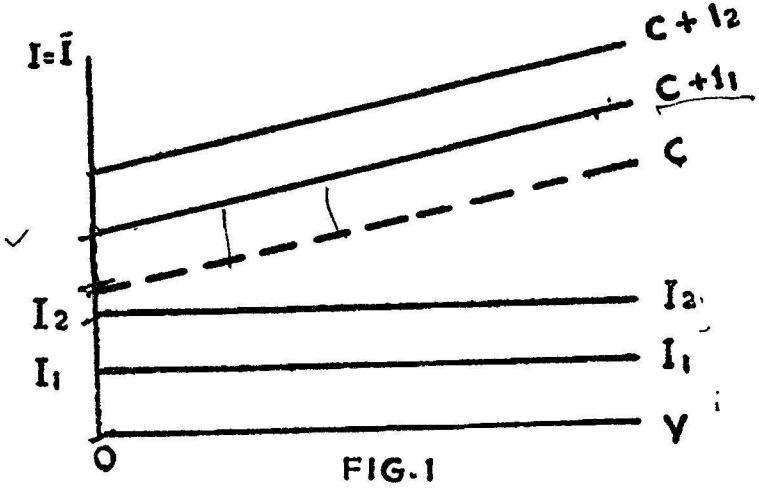


FIG. 1

However, in reality some kind of relation between investment and the level of income exists. Hence all such investment which is a variable function of income is called as "induced investment". Actually all the theories of investment are mainly concerned with induced investment and are attempts to explain the nature of functional relationship between the induced investment and level of income or any other suitable variable or variables. As Kurihara says : "The basic assumption involved is that profit fluctuations roughly parallel income fluctuations, the latter presumably inducing changes in the volume of current private investment." [14] A graphic presentation of the sim-

ple relationship between induced investment and the level of income is given below. [15]

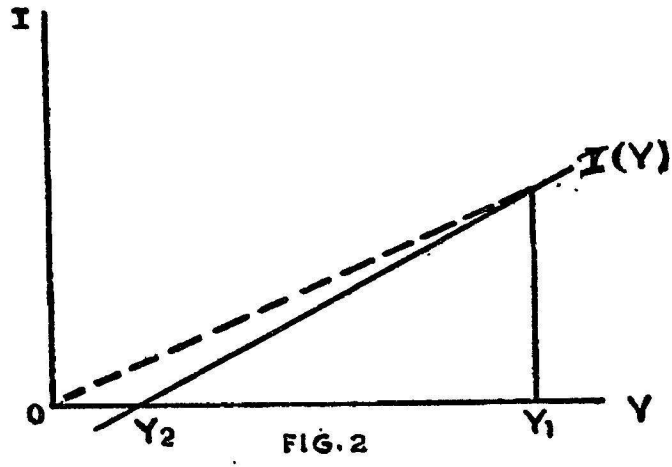


FIG. 2

In Fig. 2 induced investment is shown as an increasing function of Y. In other words it says that induced investment increases with increases in the level of income. It can be observed in the diagram that I (Y) curve cuts the Y axis from below. This indicates a negative investment below a certain level of income. According to Kurihara "It is assumed, in other words that the entrepreneurs as a whole interpret any exceedingly low level of national income as an ominous sign of future sales and so attempt to sell out of the existing inventory or produce with the present productive facilities that is to "disinvest."[16]

Two other concepts which will be useful in understanding the movement of induced investment with the level of income are the average propensity to invest and the marginal propensity to invest. If we define induced investment as a function of income (I) (Y) then the average propensity to invest will be I/Y which is the ratio of investment to income. The marginal propensity to invest which represents the rate of change of investment as income changes, will be represented by dI/dY or I/Y. Regarding economic significance of these concepts again to quote Kurihara, "the concept of average propensity to invest is useful in explaining the proportion of income invested in new capital goods or the percentage of given total resources allocated to the production of capital goods, while the concept of the marginal propensity

to invest helps to explain the extent to which private investment may be expected to fluctuate as national income changes."[17]

ENDOGENOUS AND EXOGENOUS FACTORS AFFECTING INVESTMENT FUNCTION

The investment process in any economy is a complex process influenced by a large number of variables. But in building a theoretical model these several variables may be conveniently grouped into two types— exogenous and endogenous — for purposes of conceptual clarity. The effect of these exogeneous and endogenous variables is to bring about a shift in the investment schedule. In the following table these variables affecting investment function are grouped under two categories, namely endogenous and exogenous. This listing of variables is done without reference to any particular theory of investment. While mostly the items in the table are taken from Kurihara's book "Introduction to Keynesian Dynamics" a few more are added to the original list.

Factors affecting the Investment Schedule

Endogenous	*Exogenous*
The level of income or rate of change of income	Inventions and innovations
The rate of interest	Growth and composition of population
Entrepreneurial expectations about future yield on investment	Natural resources
Entrepreneurial liquidity considerations	Consumer psychology
The existing stock of capital	Government fiscal-monetary policies.
The level and trend of consumer demand	Political climate
Stock Exchange activity as reflected in quotations	Labour movements
Money wage rates and other factor prices	Socio-legal institutions
	Foreign trade
	Wars, revolutions and other man-made catastrophies
	Weather and other acts of God.

SOME IMPORTANT THEORIES OF INVESTMENT FUNCTION

INVESTMENT FUNCTION IN CLASSICAL MACRO-ECONOMIC THEORY

In classical theory investment is defined as a simple function of interest rate (I=I (r)). The whole approach is in terms of demand (investment) and supply (savings), both being controlled by a price factor (interest) to bring about an equilibrium condition. Investment is conceived as having an inverse relationship with interest rate. It is also assumed that there will be a perfect interest elasticity of investment so that the equilibrium condition that savings equal investment can be satisfied.

Further in the classical theory the amount of investment is determined by the interaction between the marginal productivity of capital and the rate of interest. The marginal productivity of capital is a declining function. In other words as more and more capital is employed the marginal productivity of capital will fall. Hence the amount of capital employed increases upto the point where the marginal productivity of capital is just equal to the current rate of interest. This relationship coupled with profit maximization behaviour of the firm means in effect that greater employment of capital would be possible only with lowering of interest rate.

In classical theory no distinction was maintained between replacement capital and net addition to capital stock. The classical ideas of investment were based on the idea of a revolving stock. In essence the classical theory says that somehow a stock of capital gets accumulated. This stock of capital needs to be replaced periodically because of a limited durability of capital goods. Hence a certain amount of current output needs to be devoted to maintain the capital stock. This means that there is no explicit consideration given to the question of the speed of transition from one amount of capital stock to another. In other words the net rate of investment or the investment schedule of Keneysian type is completely ignored in classical theory. It simply says that under stationary conditions "the annual gross investment (replacement) will be the larger, the lower is the rate of interest." [18]

From the above description of the classical theory of investment function, it is clear that it is based mainly on the unrealistic assumptions of perfect competitition as far as investment activities of firms are con-

cerned. It does not consider the dynamic process of the time rate of change in investment. Nor does it consider what will be the limits on investment— limits imposed by imperfect capital markets and the productive capacity of capital goods industries. Of course, the consideration of entrepreneurical expectations about future and the uncertainty that surrounds the firm's nvestment decisions are completely ruled out in classical theory. "In other words the Classical theory of inves ment is one applicable to a full employment society where there is no question of not actually using available resources. It is a theory of growth in a society where effective demand is no limiting factor."[19] In the end it should be pointed out that many empirical studies bear evidence to the fact that private investment is not interest elastic except in the case of very long term investment such as in public utilities.

KEYNESIAN THEORY OF INVESTMENT FUNCTION

Lord Keynes in his "General Theory" gave a more systematic treatment to the problem of investment function. Keynesian approach is characterised by relating the monetary cost aspects of capital represented by rate of interest with the real yields arising out of any nvestment. In other words, the demand for loanable funds is governed by the real yield on capital investment which is called the "marginal efficiency of capital," while the rate of interest governs the terms on which such funds are made available. Another important departure in Keynesian approach is that the "marginal efficiency of capital" depends upon both the initial cost of capital and the series of future yields of capital investment. Unlike the classical marginal productivity of capital which is concerned at a point of time, Keynesian "marginal efficiency of capital" takes into consideration the future time dimension of capital yield. According to Keynes, this concept of "marginal efficiency of capital" provides the link between the present and future. In this connection he says : "The schedule of marginal efficiency of capital is of fundamental importance because it is mainly through this factor (much more than through the rate of interest) that the expectation of the future influences the present." [20] In chapter 12 of his "General Theory" Keynes deals with the entrepreneur's long term expectations regarding the prospective yields of capital assets. It is

considered that such changes in the long run expectations bring about shifts in the schedule of marginal efficiency of capital.

The three important variables which determine the level of investment under Keynesian theory are the supply price of the capital goods, marginal efficiency of capital and the rate of interest. The supply price of a capital asset, according to Keynes is "not the market-price at which an asset, of the type in question can actually be purchased in the market, but the price which would just induce a manufacturer newly to produce an additional unit of such asset i.e., what is sometimes called its replacement cost." [21] Whereas the marginal efficiency of capital is defined "as being equal to that rate of discount which would make the present value of the series of annuities given by the returns expected from the capital asset during its life just equal to its supply price." [22] This definition in essence says that if the future stream of yields from an asset are discounted at different discount rates, the marginal efficiency of capital corresponds to that discount rate which equates the supply price of the capital asset with the sum of such discounted annual yields over the life of the asset. Symbolically this relation can be represented as below:—

$$C = \frac{Y_1}{(1+e)} + \frac{Y_2}{(1+e)^2} + \ldots\ldots + \frac{Yn}{(1+e)^n}$$

Where :

C=supply price of the asset

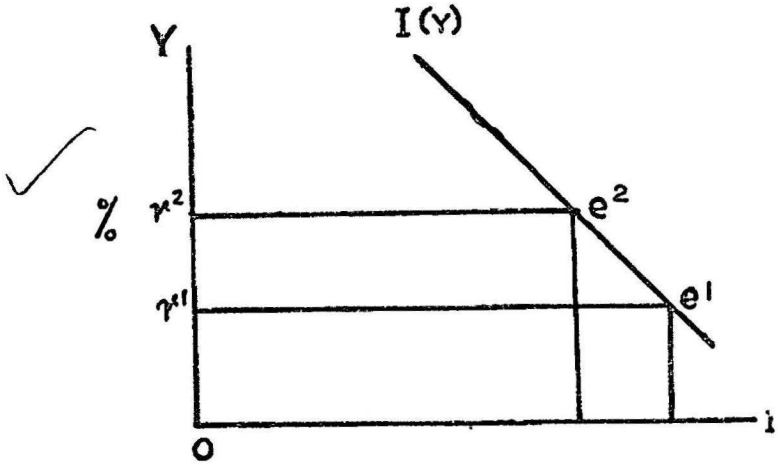
$Y_1, Y_2 \ldots\ldots Yn$= Series of annual yields of the assets

e=the rate of discount or "the marginal efficiency of capital"

The marginal efficiency of capital is defined in terms of expected future yields and the supply price of a capital asset. A schedule of aggregate investment at various levels of marginal efficiency capital can be constructed which is termed by Keynes as the investment demand schedule or the schedule of marginal efficiency of capital. Given such schedule of the marginal efficiency of capital "the actual rate of current investment will be pushed to the point where there is no longer any class of capital-asset of which the marginal efficiency exceeds the current rate of interest. In other words, the rate of interest will be pushed to the point on the investment demand schedule where the marginal efficiency of capital in general is equal to the market rate of interest."[23]

From the above relationship between rate of interest and marginal

efficiency of capital it is clear that the investment is inversely related with the rate of interest. In other words at higher rates of interest there is lesser inducement to invest because a higher marginal efficiency of capital would be required and *vice versa*. Hence given the marginal efficiency of capital which depends according to Keynes on the long run expectations of entrepreneurs, the current investment is essentially interest elastic. Under such circumstances the investment demand function can be graphically presented as below :—



In the above diagram the shape of I (r) curve is determined by the relationship between the level of investment and the marginal efficiency of capital. This relationship between marginal efficiency of capital and the volume of investment is considered as an inverse relationship. Here Keynes brings in the significance of capital. The inverse relationship mentioned above is due to two factors. In the first place with increase in the volume of new capital goods the marginal efficiency of capital will decline because the new capital goods have to compete with the existing capital stock. Another reason is that today's capital goods have to compete in the course of their life, with future capital goods. And these future additions to capital stock may be technically more efficient, thereby depressing the future output prices and resulting profits. In this connection Keynes says that "the entrepreneur's profit (in terms of money) from equipment, old or new, will be reduced, if all output comes to be produced more cheaply."[24] However, these changes in the stock of capital are

considered to have significant effect in the long run, rather than in the short run because in the short run the amount of new additions are considered negligible in comparison with total stock. Keynes also lays stress on the secular decline of marginal efficiency of capital as a result of substantial accumulation of fixed capital over a long period of time. In the short run the investment behaviour, the decline in marginal efficiency of capital comes from the possibility of rising marginal production costs of capital goods along with increased investment. This happens because to meet the increased demand for new investment goods more resources are demanded by capital goods industries which could be secured only at increasing cost. This increase in marginal costs of capital goods industries plays a crucial role in Keynes's explanation of the short period behaviour of investment demand function.

The equilibrium condition in Keynesian investment theory is denoted by equality between marginal efficiency of capital and rate of interest i.e., e (I) = r where "e" represents marginal efficiency of capital "r" the rate of interest and "I" the amount of aggregate investment in new capital goods. This equilibrium may be disturbed by any factors that would influence the value of "e" and thereby bring an inequality between "e" and "r". However, Keynes gives greater importance to the long run expectations of entrepreneurs as an influencing factor in determining the investment activity. In this connection Keynes remarks : "In estimating the prospects of investment, we must have regard, therefore, to the nerves and hysteria and even the digestions and reactions to the weather of those upon whose spontaneous activity it largely depends."[25] These cryptic remarks bespeak of the uncertainty and irrationality that characterise the entrepreneurial long-term expectations.

To summarise in the words of Klein, the Keynesian relationship says : "The demand for capital goods depends upon the real value of national income, the interest rate, and the stock of accumulated capital." [26]

Despite the several improvements in Keynesian treatment of investment as compared with that in classical theory, the implicit assumptions of the theory are still quite unrealistic. Secondly there is no significant empirical evidence to support the contentions of the theory. Some of the important assumptions underlying Keynesian theory of

investment can be summarised as follows :—

1. Rational and profit maximizing behaviour on the part of entrepreneurs which would make them to push investment to its furtherest profitable limits.
2. All future changes with regard to product and factor prices and outputs are known so that future yields from a capital asset can be calculated and taken into investment decision considerations. This in other words means that there will be perfect foresight on the part of entrepreneurs and a complete absence of uncertainty.
3. The investment is interest elastic. No limits for the supply of funds at the going rate of interest exist.
4. Further to attain Keynesian equilibrium condition an assumption regarding perfect mobility of resources need to be made.

From the nature of the above mentioned assumptions behind the Keynesian approach, it is obvious that the theory is to a large extent based upon the perfect competitition assumptions as far as a firm's investment behaviour is concerned. The profit maximization, the perfect mobility of resources, perfect foresight and perfect capital markets are all indicative of perfect competitition assumptions governing the investment beheaviour of a firm. The unrealism of such assumptions needs no further stress.

In the post-Keynesian theoretical and empirical studies of investment function, it was clearly shown that changes in income and other objective conditions are more important determinants of investment rather than interest. This lack of interest elasticity was particularly stressed by L.R. Klein. He considers that in real world where the investment opportunities are surrounded by risks and uncertainties, "the discount rate must account for these risks and uncertainties and hence must be greater than the interest rate. The appropriate discount rate is made up of an interest rate and a subjective-risk component. The latter element belongs as much to the study of psychology as to economics. The non-interest components of the discount variable far outweight the interest component, making any fluctuations in the interest rate of little importance."[27]

The reasons for such interest inelasticity are many. In the first place because of the uncertainty considerations, the businessmen, according to Klein, will act "bearishly" in their investment decisions.

In other words, they would be eager to recover their capital investment in as much shorter time as possible. Hence if this shorter investment planning horizon is considered to be five years, costs other than interest will outweigh interest costs in investment decisions. However, "it may be true that in certain sectors of the economy where the horizon is long, interest changes are more important. Public utilities and transportation are examples of industries with horizons longer than the average." [28] These observations on interest elasticity of investment were validated by several empirical studies amongst which the studies my Meyer and Kuh figure prominently.

Secondly, the capital markets in reality are imperfect. Such imperfections and other related disadvantages of borrowing through capital markets, make the entrepreneurs to resort to internal financing through retained profits. With ever increasing size of modern corporations, the corporate savings are financing a substantial part of total investment in the economy. For example it is reported that corporate savings in England accounted for 58 % of gross capital formation in 1948 [29]. Regarding U.S.A. it is reported that during 1947-57 total capital accumulation was ; 292 billion, of which 60% was internally financed by corporations, 20% by bank credit and 20% through capital markets[30]. In view of such evidence signifying the importance of corporate internal financing in the overall investment in an economy it is highly doubtful whether interest rate can be considered an important determining factor even for long run investments. It can be safely assumed that by and large the average businessman does not impute interest costs when using the internally generated funds. In this connection Klein says : "Businessmen appear to have psychological preferences for financing their investment operations from surplus funds which have been accumulated through undistributed profits, depreciation and other resources. Theoretically the rational entrepreneur should charge himself imputed interest costs when he uses his internal funds for investment, but he does not behave that way, as a matter of fact. The use of internal funds financing will lead investors to ignore fluctuations in the market rate of interest."[31] As a final word on this issue of interest elasticity of demand for investment goods Keynes himself seems to doubt its efficiency as an investment determinant, as is evident from the following quotation which is attributed to him. "I am far from fully convinced by the recent the-

sis that interest rate plays a small part in determining the volume of investment. It may be that other influences, such as an increase in demand often dominate it in starting a movement."[32]

In Keynesian theory the marginal efficiency of capital is a declining function in relation to volume of capital stock. The reasons given for such decline in expected yield are the rising units costs and falling output prices because of increased production, increasing prices of capital goods etc. But Ackley argues that while these factors might cause low expected yield from the point of view of a firm, they are not relevant for the economy as a whole. His contention is that for the economy as a whole "these particular sources of declining yield to the capital of an individual firm can be ignored." [33] This is because of the fact that through an adjustment in the number of firms each of which operates at its optimum level and the overall increase or decrease in investment will not be due to changes in unit cost. Similarly if all firms expand or reduce their output, there would be no loss of sales on this account. In view of these considerations Ackley says : "Although increasing unit costs and declining sales prices have sometimes been used to explain the decline in expected yields as the total social ouput expands with the use of more capital, this seems often an illegitimate extension from the firm or the industry to the economy as a whole."[34] However in Ackley's view that "the comparison involved here is between different (known) methods of production."[35]

Whatever may be the causes of such decline there seems to be strong negative correlation between the stock of capital and investment activity. Thus according to Klein; "Statistical investigations reveal a very strong negative correlation between investment activity and the stock of capital. This correlation can be observed in the economy as a whole and all the major industrial groups." [36] However, as is evident from the discussion of Kenynesian theory the place assigned to capital stock by Keynes is of secondary importance. Again to quote Klein: "Keynes own treatment of the capital stock was exceedingly superficial. He neglected this variable on the ground that he was dealing with a short-run theory for which the capital stock cannot vary appreciably." [37]

Another important aspect of Keynesian theory of investment function is the stress laid by him on the entrepreneurial long run expectations. While an interesting treatment of these "long run ex-

pectations" was accomplished in the chapter 12 of his "General Theory" the Keynesian model itself is perhaps devoid of any motivational content. In other words except generally indicating that these long-term expectations are crucial in investment behaviour, the relationship of these expectations with the variables in the model, is not explicitly considered. Here the remarks by Haavelmoare worth noting. "The list of factors that influence investment can be made very extensive. The factors most frequently mentioned are, of course, the rate of interest, the existing amount of capital and the current level of economic activity. But even if the main factors and their specific influence on the average level of investment were clarified, there remains the problem of the short-run variations in investment activity. In this connection the importance of expectations has been strongly emphasised by nearly all the model makers. It is, however, probably fair to say, that the constant reference to the importance of expectations has served more as an excuse for the fact that we know so little about investment behaviour than as the foundation of explicit theories that could make predictions possible. Expectations have to have a known relation to something that is itself known or predictable. Otherwise, the emphasis upon the importance of expectations will serve as a proof of hopelessness for the theory that we are concerned with." [38]

It is pointed out earlier that Keynesian theory of investment assumes rational behaviour on the part of entrepreneurs. Of course, the criteria for rational behaviour is the profit maximizing or utility maximizing behaviour on the part of entrepreneurs. Whatever may be the criteria for rational behaviour, if it is coupled with the problem of uncertainty, which should, logically enter into entrepreneurial calculations of expected yields, the problems of understanding the factors that determine entrepreneurial investment decisions becomes intractable. Thus according to Ackley: "The opinions of well informed observers, plus some scanty evidence from surveys, indicate that, in fact, investment decisions are often based on hunch or whim or prejudice, on non-economic factors, or where calculations are made, on rules of thumb that occasionally cause the selection of unprofitable alternatives or, more frequently, rejection of profitable investment; and in general are systematically biased in their choice of the best among several possibilities."[39].

(to be concluded)

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