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A KEYNESIAN THEORY OF THE RATE OF PROFIT

by

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B.A., University of Leicester, 1968
M.A., University of Warwick, 1969

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ABSTRACT

The two most widely accepted theories of the rate of profit are the Neo-Classical and the Neo-Keynesian theories. Both these theories are based on the concept of 'Dynamic Equilibrium'. Unfortunately, this is very restrictive. Dynamic equilibrium requires that all variables in the system, including the capital stock, conform to their equilibrium values. It employs the highly unrealistic assumption of capital malleability. There is a significant difference between the real world and any theories restricted to an equilibrium capital stock.

The concept of 'Keynesian Equilibrium' is less restrictive than dynamic equilibrium in that it requires only that the product market be in equilibrium. Since dynamic equilibrium is a special case of Keynesian equilibrium and in view of the problems noted above concerning the assumption of capital malleability, a theory based on Keynesian equilibrium includes and goes beyond a theory based on dynamic equilibrium. Its less restrictive basis implies that it is potentially superior. The major objective of this thesis is to develop a theory of the rate of profit based on the concept of Keynesian equilibrium.

A 'Rate of Profit Schedule' is derived under the condition of Keynesian equilibrium. This schedule is a relationship between the rate of profit and the level of aggregate investment. The schedule is first derived under the assumption that the capital stock is fixed and its slope is shown to be non-negative for various specifications of the labour market. Since the location of the marginal efficiency of capital schedule is determined by the rate of profit schedule, changes in the level of investment will shift the marginal efficiency of capital schedule. In consequence, the analysis of the determination of aggregate investment is rather more complex than is usually suggested. This raises doubts about the conclusions derived from the Hicksian IS-LM analysis (which assumes that the marginal efficiency of capital schedule is fixed) and so an alternative analysis to include the monetary market is developed. This suggests an instability in capitalist economies and the possibility of the existence of unemployment 'traps' where market forces serve to increase the level of unemployment. It is argued that the nature of these conclusions is more in keeping with those that Keynes drew in the 'General Theory' than are the conclusions of IS-LM analysis.

The assumption of a fixed capital stock is removed and two methods for analyzing the effects of capital accumulation are developed. The immediate impact of the addition to the capital stock of new investment goods is incorporated into the rate of profit schedule and the resulting 'intermediate run' schedule is shown to retain the non-negative slope. Then the impact of a complete change in the capital stock over a long period of time is included through the analysis of long run exponential paths of capital accumulation. The 'long run' schedule also has a non-negative slope. However, the slope of the long run schedule is less steep than that of the intermediate run schedule and the latter has a lesser slope than the short run schedule. Furthermore, the three schedules are related in a hierarchical fashion; the long run schedule determining the position of the intermediate run schedule and the intermediate run schedule determining the position of the short run schedule.

A number of conclusions are drawn which differ significantly from those derived from the perspective of dynamic equilibrium. The most important and general result is the demonstration of a non-negative relation between the rate of profit and the level of aggregate demand. Whilst the introduction of the installation of capital

goods into the analysis reduces the size of the slope of the rate of profit schedule, in no case was the slope of this schedule negative. Under exactly the same conditions which lead to this non-negative relationship, it is shown that the relationship between the rate of profit and an aggregate measure of the capital/labour ratio can be either positive or negative. Hence the former relationship may be considered analytically more reliable than the often postulated negative nature of the latter. The nature of the rate of profit schedule implies that market forces will cause instability in capitalist economies. This instability is not eliminated when monetary factors and the influence of capital accumulation are included into the analysis. The schedule provides an explanation for the existence of Keynes' unemployment traps and of the business cycle.

ACKNOWLEDGEMENTS

I would like to acknowledge the impact on this work of my thesis committee, Professors Cliff Lloyd and Peter Kennedy. They have both given valuable guidance, a great deal of encouragement and have spent a considerable amount of time helping the development of the ideas of this thesis.

Parts of this thesis have been presented at the Simon Fraser University Department of Economics seminar and at several economic theory workshops organized by Professor Cliff Lloyd. The comments and constructive criticisms of several of the participants have added to the final product. Richard Pomfret deserves special mention.

I would also like to thank Nancy Petersen for her superb typing which was executed at a remarkably fast pace.

TABLE OF CONTENTS

CHAPTER I

INTRODUCTION

The theoretical explanation of the rate of profit is one of the most controversial areas of economic theory. In recent years, there has been a considerable amount of criticism of the Neo-Classical Theory of the rate of profit (surveyed in Harcourt 1972). There has also been the development of an alternative theory, the Neo-Keynesian Theory. However, both theories are seriously weakened by their reliance on a dynamic equilibrium framework. Both these theories can only operate if the stringent conditions required for dynamic equilibrium are met.

The aim of this thesis is to go beyond the strictures of dynamic equilibrium analysis and to develop a theory of the rate of profit in a framework which can allow for the existence of disequilibrium in some markets. The requirement that all variables correspond to their equilibrium magnitudes is extremely demanding and also unrealistic. Dyanamic equilibrium requires that the capital stock be the equilibrium or optimal stock. If the nature of capital goods is that they are non-malleable and that it is costly to convert the capital good needed for one technique into the capital good needed for a neighbouring technique, then it follows that time and economic resources are needed to change the nature of the capital stock. During such a change, the capital stock will not be the optimal stock. Furthermore, it may be the case that during the

change the disequilibrium in the capital market will "spill over" and affect other markets. This, in turn, will affect the rate of profit, the level of investment and other aggregate magnitudes. Indeed, the impact of the adjustment process may be sufficiently disruptive to prevent a passage to a new dynamic equilibrium.

Instead of starting with the assumption that all markets are in equilibrium, the theory developed here will start with the assumption that only the product market need be in equilibrium. This latter equilibrium requirement is, of course, the basis of Keynesian economics and thus the theory developed here will have many implications for Keynesian Economics. Since dynamic equilibrium is a special case of Keynesian equilibrium, i.e. the condition that all markets be in equilibrium includes the condition that one market be in equilibrium, a Keynesian theory of the rate of profit can be analyzed in a situation of dynamic equilibrium. Hence the theory developed here will have implications for the "long run." Furthermore because the theory is applicable to both dynamic equilibrium and Keynesian equilibrium, it can be used to shed light on the nature of adjustment paths between states of dynamic equilibrium.

Chapter II presents an exposition of the two most widely accepted theories of the rate of profit, the Neo-Classical Theory and the Neo-Keynesian Theory. It is shown

that both these theories are based on the concept of dynamic equilibrium. In Chapter III, the concept of dynamic equilibrium is examined. It is argued that the concept is restrictive and unrealistic. The concept of Keynesian equilibrium is argued to have a wider field of application.

Chapter IV develops the theory of the rate of profit from the concept of Keynesian equilibrium under the assumption that the capital stock is exogenously fixed. In Chapter V, the theoretical conclusions of Chapter IV are used to examine the determination of aggregate investment and to construct a short run macro-economic model which is comparable to IS-LM analysis.

Chapters VI and VII extend the theory developed in Chapter IV by relaxing the assumption of a fixed capital stock. Chapter VI considers the impact of new capital of the rate of profit and Chapter VII analyzes the effect on the rate of profit of altering the entire stock of capital.

In Chapter VIII, the major conclusions of the work are drawn together.

CHAPTER II

ALTERNATIVE THEORIES OF THE RATE OF PROFIT

The two most widely accepted and used theories of the rate of profit are the Neo-Classical Theory and the Neo-Keynesian Theory. In this chapter, these theories are described and compared.

Both the Neo-Classical and Neo-Keynesian theories have been worked out under the assumption of a steady-state theoretical framework. This somewhat confining framework is criticized in Chapter III and replaced with an alternative methodology which leads to a richer theory. This theory will be developed in the remainder of the thesis.

The Neo-Classical Theory of the rate of profit is part of the Neo-Classical Theory of general equilibrium. Due to its general equilibrium framework it is misleading to say that this or that variable determines the rate of profit. The causality in the model is not unidirectional; any single variable has an influence, albeit of varying quantitative significance, on each of the other variables in the system. Thus, instead of saying that one variable determines another, the Neo-Classical approach is to say that a value of one variable is consistent in full general equilibrium with the value of another variable.

In view of the comments above, the best way of describing the Neo-Classical Theory of the rate of profit is that

each technique of production is associated with a particular rate of profit, i.e. that a technique of production will only be consistent with general equilibrium if there is a particular value of the rate of profit. A "technique" may be viewed as a particular stream of outputs and inputs, e.g. a point on an isoquant.

The relationship between techniques and the rate of profit can be seen by considering the factor price curve of each technique. A factor price curve for a technique plots the maximum rate of profit consistent with each wage rate. (Consistent in the sense that wage payments and profit payments just absorb the net output of the technique.) This is shown in Figure 1 as a downward sloping line which reflects the fact that the lower the wage rate the higher the rate of profit.

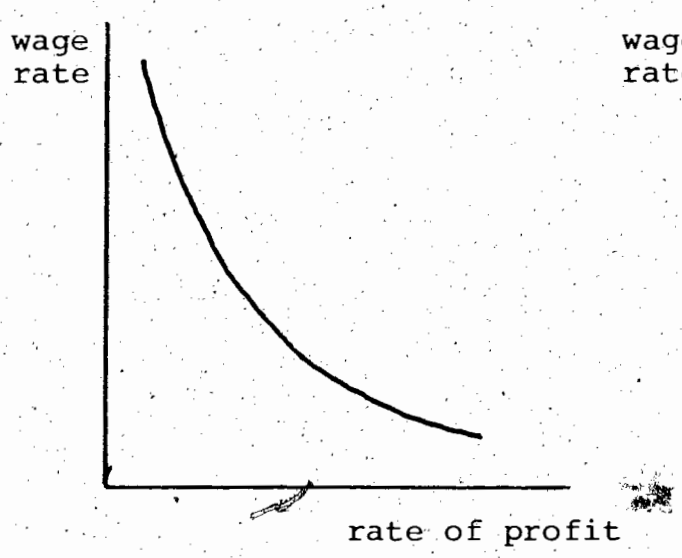

Figure 1

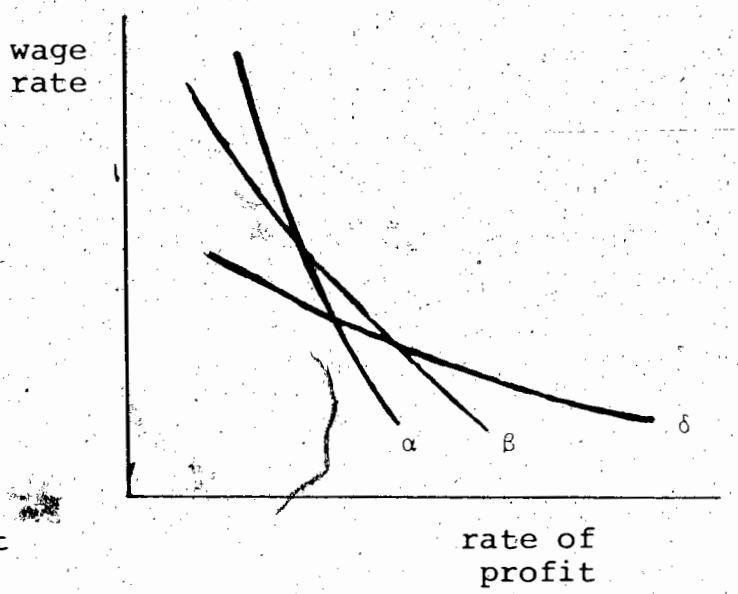

Figure 2

Now let us suppose there are many techniques and plot the factor price curve associated with each technique on the same diagram. (Figure 2, in which three factor price curves are drawn, one for each of the three techniques, α, β and γ) The envelope of all the factor price curves is called the factor price frontier. The significance of the factor price frontier is that it shows, for any wage rate, the highest possible rate of profit open to the economy when all techniques are considered.

Now suppose that there are an infinity of techniques. Provided that techniques are such that there are no reswitching points (Burmeister, Sheshinski, and Levhari 1966, Harcourt 1972), each technique's factor price curve will only touch the factor price frontier at one point. Thus, each point on the factor price frontier is associated with just one technique of production. The factor price frontier represents the relation between the technique of production and the rate of profit which was described above as the Neo-Classical Theory of the rate of profit.

For the Neo-Classical Theory of the rate of profit to hold, it is necessary that the economy be on the factor price frontier. In Figure 3 this requires that if the economy is using technique α as its method of production, then the rate of profit is equal to ρ_α and the wage rate is equal to w_α.

To demonstrate that the economy will in fact be on the Factor Price Frontier, Neo-Classical writers argue that the combination of technique α and w_α and ρ_α is the only combination

consistent with steady state equilibrium, or more specifically with capital market equilibrium. Any other combination of the wage rate and rate of profit will induce a change in the technique of production. For example, if w_β and ρ_β^α and technique α is considered, entrepreneurs will be able to increase their rate of profit by selecting technique β and thus being able to earn at rate of return equal to ρ_β. In fact in general any position to the left of the factor price frontier is inferior to at least one position on the factor price frontier in the sense that either the wage rate or the rate of profit or both can be raised by moving to the factor price frontier.

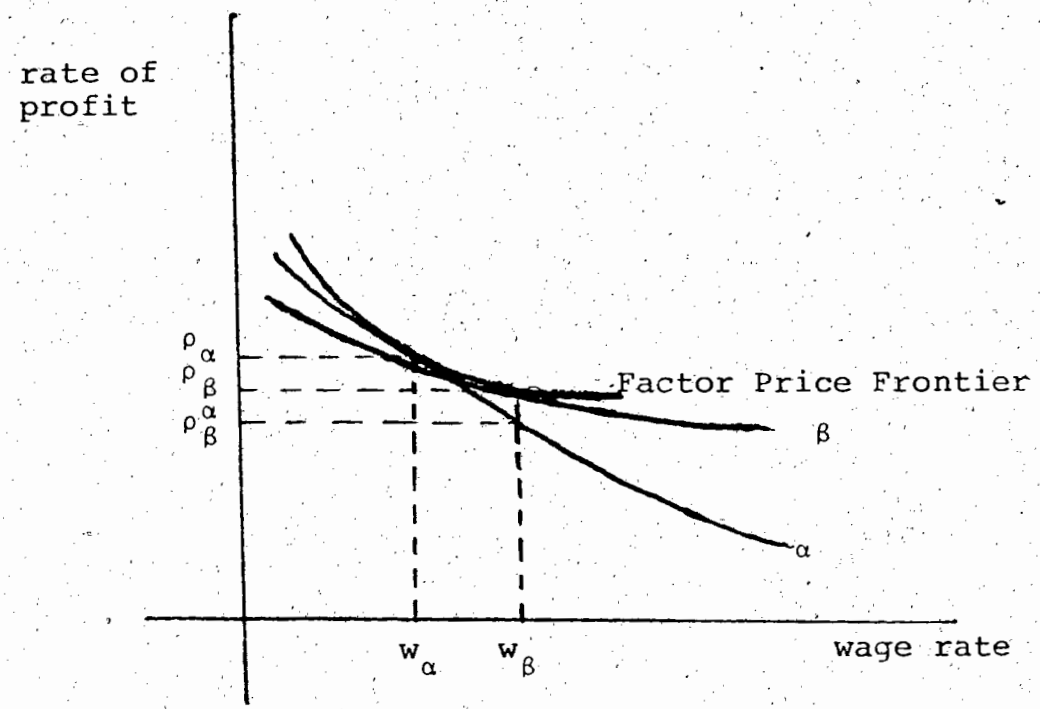

Figure 3

The economy moves to the factor price frontier by the process of substituting techniques of production. In the example above, there was a substitution of technique β for technique α in order to increase the rate of profit from ρ^{α}_{β} to ρ_{β}. Since Neo-Classical capital theory depends upon the economy being on the factor price frontier, it depends on the process of the substitution of techniques. However, in the example presented above it was only stated that the combination of technique β, ρ_{β} and w_{β} was superior to technique α, ρ^{α}_{β} and w_{β}. This does not settle the question that if the economy is endowed with technique α, is it worth actually substituting technique β for technique α? That is whilst the economy would be in a better position having made the substitution it does not necessarily follow that it will be worth actually making the substitution. To determine whether it is worthwhile to entrepreneurs to substitute technique β for technique α, it is necessary to analyze the rate of return for such a substitution.

The return to a substitution of one technique for another has only been analyzed for a substitution from one point on the factor price frontier to another point which is an infinitely small distance away. This analysis is an approximation of the process of substitution described above. The argument is based on the following proposition. The economy starts in a position of general equilibrium using technique α. i.e. the rate of profit is equal to ρ_{α} and the wage rate is equal to w_{α}. The proposition is that, from this position, the

rate of return of substituting technique β, which is a technique within an arbitrarily small neighbourhood of technique α and shall be called the neighbouring technique, for technique α is equal to the rate of profit that is associated with technique β in general equilibrium, which is ρ_β. If this proposition is true, then, if the economy is using technique α and if the wage rate is equal to w_β and the rate of profit is equal to ρ_β^α, then entrepreneurs will surely switch to technique β since $\rho_\beta^\alpha < \rho_\beta$ and the rate of return from switching is equal to ρ_β. It pays to switch.

To prove the proposition consider two techniques α and β. Define;

Y_α Y_β = Output of consumption good from each technique.

K_α K_β = Input of capital needed for each technique.

L_α L_β = Input of labour needed for each technique.

P_α P_β = Price of capital good used for each technique.

w = Wage rate.

ρ_α ρ_β = Rate of return from each technique.

P = Price of consumption good.

The rates of return for each technique are defined as;

N1 $$\rho_\alpha = \frac{PY_\alpha - wL_\alpha}{P_\alpha K_\alpha}$$

N2 $$\rho_\beta = \frac{PY_\beta - wL_\beta}{P_\beta K_\beta}$$

The rate of return of a switch from technique α to technique β, which will be labelled $\rho_{\alpha\beta}$, is;

$$N3 \qquad \rho_{\alpha\beta} = \frac{(PY_\beta - wL_\beta) - (PY_\alpha - wL_\alpha)}{P_\beta K_\beta - P_\alpha K_\alpha}$$

From N1, N2 and N3

$$N4 \qquad \rho_{\alpha\beta} = \frac{P_\beta K_\beta \rho_\beta - P_\alpha K_\alpha \rho_\alpha}{P_\beta K_\beta - P_\alpha K_\alpha}$$

Now consider the limiting case where techniques α and β are neighbouring techniques. For neighbouring techniques;

$$\rho_\alpha = \rho_\beta = \rho^*$$

Thus:

$$N5 \qquad \rho_{\alpha\beta} = \rho^* \frac{(P_\beta K_\beta - P_\alpha K_\alpha)}{P_\beta K_\beta - P_\alpha K_\alpha}$$

$$N6 \qquad \therefore \rho_{\alpha\beta} = \rho^* = \rho_\beta$$

Thus the rate of return from substituting a neighbouring technique is equal to the rate of profit, in general equilibrium, of the neighbouring technique itself. The proposition is proved.

However, implicit in the proof is the assumption that capital goods are malleable. That is to say it is possible to convert the capital good associated with one technique of production into the capital good needed for another technique of production for a cost which is equal to the difference in the cost of the two techniques. In equation N3 the capital cost of switching from technique α to technique β was defined as $P_\beta K_\beta - P_\alpha K_\alpha$. This supposes that there are two feasible ways for an entrepreneur to obtain a machine of technique β and that

the cost of either way is the same. He could directly purchase K_β machines at price P_β and this would cost him $P_\beta K_\beta$. Or he could purchase K_α machines at price P_α at a cost of $P_\alpha K_\alpha$ and then convert these machines into K_β machines at a cost of $P_\beta K_\beta - P_\alpha K_\alpha$. The total cost of the latter way is $P_\beta K_\beta - P_\alpha K_\alpha + P_\alpha K_\alpha = P_\beta K_\beta$ which is equal to the total cost of the former way.

For an individual entrepreneur facing perfect markets for his second hand capital goods the cost of conversion may be $P_\beta K_\beta - P_\alpha K_\alpha$ since he can sell his α technique capital at price P_α and use the proceeds to buy β technique capital.[1] However, in the aggregate different considerations are relevant. A general shift from one technique to another would lead to an excess supply of the first technique and an excess demand for the second. In fact, what becomes important in the aggregate is the physical process of conversion. The assumption of capital malleability is realistic if the actual cost of physically converting K_α of α technique goods into K_β of β technique goods is equal to $P_\beta K_\beta - P_\alpha K_\alpha$. It is extremely

---

[1] Even this example supposes that the capital goods are costless to move and install.

difficult to think of any capital goods which have this property.[2]

If capital is not malleable, then it is easy to show that the proposition proved above is not true. Define the capital cost of switching from K_α units of capital α to K_β units of capital β as;

$$N7 \quad P_\beta K_\beta - P_\alpha K_\alpha + A$$

where A represents the additional cost of conversion. If capital is not malleable then $A>0$. Then the rate of return of substituting β for α capital will be;

$$N8 \quad \rho_{\alpha\beta} = \rho^* \frac{(P_\beta K_\beta - P_\alpha K_\alpha)}{(P_\beta K_\beta - P_\alpha K_\alpha + A)}$$

Since $\frac{(P_\beta K_\beta - P_\alpha K_\alpha)}{(P_\beta K_\beta - P_\alpha K_\alpha + A)} < 1$

$$N9 \quad \rho_{\alpha\beta} < \rho^*$$

Thus $\rho_{\alpha\beta} < \rho_\beta$

Since $\rho_{\alpha\beta} < \rho_\beta$, it is no longer the case that an entrepreneur will necessarily switch to the technique β if, whilst using technique α, a disturbance in, say, the wage rate,

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[2] It might be argued that a technique is a collection of capital goods and that all techniques include some of every capital good and that all techniques can be ranked so that the higher the technique in the ranking, the more of every capital good that technique requires. If "capital" meets this requirement, then it is malleable. This description of capital is that used by Solow 1968 and by Burmeister 1968. In fact, this description is open to precisely the same criticism as that outlined in the text for a one capital good example. The idea that as one technique is substituted for another, no capital goods are discarded appears very unrealistic.

pushes him off the factor price frontier. That $\rho_{\beta}^{\alpha} < \rho_{\beta}$ and $\rho_{\alpha\beta} < \rho_{\beta}$ implies the possibility that $\rho_{\alpha\beta} < \rho_{\beta}^{\alpha}$. So if capital is not malleable, it might be in the entrepreneur's interest to choose to stay at a position off the factor price frontier if he is already using a non-malleable technique of production. In this case, the one to one relation between technique and rate of profit does not hold. The entrepreneur will continue to operate a technique at any rate of profit which is in a range determined by the degree of malleability, or size of the adjustment cost, A.

Pasinetti (1969) has labelled the malleability assumption as the unobtrusize postulate of neo-classical capital theory. Professor Solow in his reply to Pasinetti's attack admits this charge applies to his work (e.g. "I have tacitly assumed that no capital goods ever have to be 'discarded' because they are redundant or appropriate to only one of the two techniques," Solow, 1970) but in this particular exchange makes no attempt to defend such an assumption. However, some years earlier Solow did offer a defense which essentially argued that over time the importance of the malleability assumption is reduced.

> "It is also sometimes said that Neo-Classical capital theory must rests on such obviously absurd assumptions as that capital goods are 'malleable' in the sense that one kind of machine can be instantaneously and costlessly transformed into another kind...Extreme assumptions like malleability make Neo-Classical capital theory easier but they are not essential to it...The

> kernel of useful truth in the John Bates Clark picture of capital as a kind of jelly that transforms itself over time is that, indeed, over time something like this does happen as capital goods wear out and are replaced by different capital goods" Solow 1963, pp. 26-7, my italics.

The operation of the theory over time would go like this. Consider an increase at a particular point in time of the level of investment; this increase being sustained for a long period of time. The increase in the capital stock resulting from the rise in investment will require more men to man and thus the demand for labour will rise, raising the real wage rate. The rise in the real wage rate will alter the "best" technique. If capital were malleable, the entrepreneurs would immediately switch to the best technique and, since the best technique being associated with a higher wage rate would have a smaller labour requirement, i.e. be more capital intensive, the demand for labour would fall. Entrepreneurs would switch techniques until a new equilibrium wage rate were established.

However, if capital were not malleable, then the higher wage "best" technique would only be adopted for new capital. Existing capital embodied in the lower real wage "best" technique would continue to be operated until it wears out. Thus the switching of techniques will take time. But during this time, there will be a higher demand for labour than that associated with the final general equilibrium position. The labour

requirement of the old capital stock combined with the higher rate of new investment would lead to a high labour demand. Only as the more capital intensive technique is adopted will the demand for labour fall. Professor Solow's appeal to the passage of time needed to change the capital stock amounts to assuming that the effects of the disequilibrium will not disrupt the choice by entrepreneurs of a new technique which will be consistent in general equilibrium with the higher level of investment when the whole capital stock is embodied in this technique. That a new equilibrium exists does not mean that the economy will get to it. The excess demand in the labour market could force the real wage so high as to lead to the choice of a technique which is more capital intensive than the general equilibrium technique. The disequilibrium in the product market could have the opposite effect, raising the price of output and actually lowering the real wage rate. This would induce the selection of a less capital intensive technique and then lead the economy away from the high investment general equilibrium position.

The Neo-Classical theory is based on the concept of general equilibrium. The relationship derived between the rate of profit and techniques of production is one that only holds in general equilibrium when the capital stock has adjusted to its general equilibrium value. To present a more convincing

explanation of the theory, the concept of malleable capital is introduced. To drop this assumption is to allow the possibility that at least the economy will not be in general equilibrium for significant periods of time. At most it may be that the economy never even approaches general equilibrium. The concept of general equilibrium will be returned to in Chapter III.

An alternative theory of the rate of profit is the Neo-Keynesian Theory. This theory has been developed out of the writings of Kalecki (1935) and Keynes (1936) by Kaldor (1956, 1957, 1958, 1962, 1966) and L. Pasinetti (1961, 1966). Essentially the Neo-Keynesian approach is to put the classical ideas of saving behavior and the importance of capital accumulation into a Keynesian income accounting framework. The result has been an extremely interesting and powerful theory.

Kaldor's first model (Kaldor, 1956) concentrated purely on aggregate demand relationships. The basic assumption is that the majority of savings comes from profits and that very little savings comes from wages. That is;

$$K1 \quad S \equiv S_w + S_c$$

where

S = Total savings

S_w = Savings out of wages

S_c = Savings out of profits

letting

s_w = Propensity to save out of wages

s_c = Propensity to save out of profits

W = Wage bill

P = Total level of profits

K2 $S_w = s_w W$

K3 $S_c = s_c P$

$s_w < s_c$

Denoting national income by Y

K4 $Y = W + P$

Due to the use of Keynesian concepts of savings and investment the equilibrium condition of the model is;

K5 $I = S$

where

I = Investment

using K1, K2 and K3, K5 becomes

$$I = s_w W + s_c P$$

From the definitions of national income

$$I = s_w (Y-P) + s_c P$$

$$= (s_c - s_w)P + s_w Y$$

K6 $$\therefore \quad P = \frac{1}{(s_c - s_w)} I - \frac{s_w}{(s_c - s_w)} Y$$

or alternatively

K7 $$\frac{P}{Y} = \frac{1}{(s_c - s_w)} \frac{I}{K} - \frac{s_w}{(s_c - s_w)} \frac{Y}{K}$$

$$K8 \quad \frac{P}{K} = \frac{1}{(s_c - s_w)} \frac{I}{K} - \frac{s_w}{(s_c - s_w)} \frac{Y}{K}$$

Of course, expressions K7 and K8 are derived from the accounting definitions K1, K4 and K5 and so, on their own, do not represent a theory of the level and share in national income of profits and of the rate of profit. However, Professor Kaldor has taken the ("Keynesian") position that the causality runs from investment to savings, i.e.: that the level of savings is determined by the level of investment. Kaldor sees the construction presented above as complementary to the standard Keynesian model, i.e.: the Hicksian IS-LM framework. The standard model operates at less than full employment levels of income whilst the distribution model operates only at full employment levels of income. Thus, the effects of a change in investment depend upon whether the economy is at full employment or not. At full employment changes in investment will have purely distributional effects, the magnitude of which is determined by the equation derived. At less than full employment levels of income, changes in the level of investment will lead to changes in the level of income. In other words, in order that desired savings adjust to equal actual investment, the distribution of income adjusts if the economy is at full employment, whilst the level of income adjusts if the economy is at less than full employment.

To justify this dichotomy of the Keynesian theory into a theory of income distribution in some cases and a theory of the level of output in all other cases, Kaldor assumes that the marginal and average cost curve of a "representative" firm, i.e.: all firms are the same, are horizontal up to the point where the optimum utilization of capacity is reached and then begin to rise. That is the MC and AC curves in Figure 4.

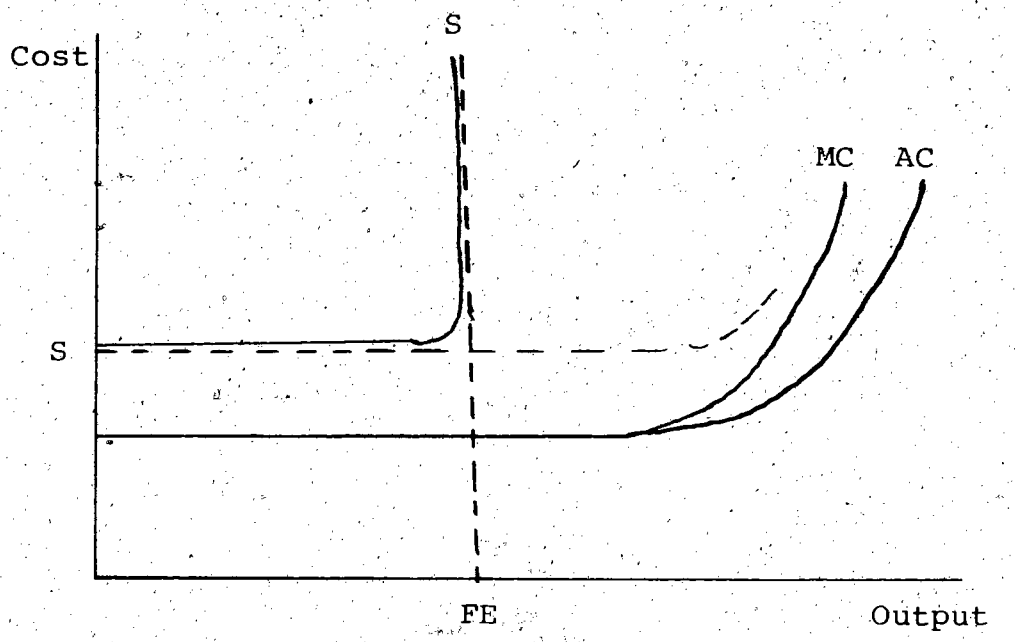

Figure 4

To generate a supply curve for the representative firm, Kaldor assumes that firms add a minimum margin of profit to average cost - this he calls the degree of monopoly. Furthermore, Kaldor adds the feature that, at a certain level of output for the representative firm, the total labour force of the economy

is employed. Thus, there is a maximum level of output shown in Figure 4 by the vertical dashed line. When the firm finds that it cannot hire any more labour to increase output, it instead raises price to clear the market. Thus the supply curve of the representative firm is the solid line SS.

It is clearly seen that changes in the level of demand to the left of the full employment level of output do not affect the ratio of average price cost (i.e. wage cost) to price and thus the share of profit in national income. However, once full employment is reached the ratio is affected and the distribution of income between profits and wages becomes a key variable.

The reason for introducing the dichotomy would seem to be for purely expositional purposes. Thus, Kaldor states "I should like to translate our results into terms that are in accord with the Keynesian techniques of analysis." There is no empirical support for the proposition that the distribution of income is unaffected by changes in the level of income at less than full employment positions. In fact, the general concensus would seem to be that as an economy approaches full employment, the share of profits in income rises and the share of wages falls. (cf. Samuelson 1967)

In fact, there are compelling arguments to suggest that for aggregate analysis, it is more realistic to assume

upward sloping marginal and average cost curves. So long as the degree of market imperfection does not vary drastically between firms, one would expect in the face of variations in demand that competition (not necessarily "perfect competition") and profit maximizing behavior would ensure that the more efficient a plant, the more it would be used. Thus, an increase in demand would be met by bringing less efficient machinery into operation (or even less efficient labour). The electricity generating industry in the U.K. is a good example of this phenomenon (see Meek 1968).

Cost curves which are upward sloping throughout would clearly be inconsistent with the dichotomication of the Keynesian model favoured by Kaldor, but would also, in the opinion of the author, bear a closer resemblance to the actual operation of industrialized economies. The Keynesian model would be a distribution model at all levels of income.

The analysis presented above in equations K1-K8 contains what Pasinetti (1961) has called "a logical slip." Although workers save, they do not receive any profits, implying that they give away the capital they accumulate by saving, clearly a ridiculous assumption. However, Pasinetti showed that when worker's holdings of capital are included in the analysis, two important results emerge. Firstly, the expressions derived above refer to the share of profits received by

capitalists. And secondly, that the share of all profits in income (that is profits received by capitalists plus profits received by workers) is unaffected by the size of the propensity to save of workers.

Thus to equations K1 and K4 must be added the identity;

$$K9 \quad P = P_c + P_w$$

where P_c and P_w stand for profits which accrue to capitalists and workers respectively.

Then, the savings functions become;

$$K10 \quad S_c = s_c P_c$$

$$S_w = s_w (P_w + W)$$

Thus, the equilibrium conditions becomes;

$$K11 \quad I = s_w (W+P_w) + s_c P_c$$

$$= s_w Y - (s_c - s_w) P_c$$

$$K12 \quad \frac{P_c}{Y} = \frac{1}{(s_c - s_w)} \frac{I}{Y} - \frac{s_w}{(s_c - s_w)}$$

and

$$K13 \quad \frac{P_c}{K} = \frac{1}{(s_c - s_w)} \frac{I}{K} - \frac{s_w}{(s_c - s_w)} \frac{Y}{K}$$

The right hand sides of these expressions are identical to the right hand sides of expressions K7 and K8. However, the left hand side of K7 and K8 refer to the total share of

profits and the aggregate rate of profits whilst K12 refers to the share of profits which accrue to capitalists, and K13 refers to a concept which has no useful or interesting meaning, i.e.: a portion of profits to total capital. To find the aggregate share of profits and rate of profit, we need expressions for $\frac{P_w}{Y}$ and $\frac{P_w}{K}$, for

$$K14 \quad \frac{P}{Y} = \frac{P_c}{Y} + \frac{P_w}{Y}$$

$$K15 \quad \frac{P}{K} = \frac{P_c}{K} + \frac{P_w}{K}$$

Letting K_w stand for capital owned by workers and i for the rate of interest, K15 becomes K16, using K13;

$$K16 \quad \frac{P}{K} = \frac{1}{(s_c - s_w)} \frac{I}{K} - \frac{s_w}{(s_c - s_w)} \frac{Y}{K} + \frac{i K_w}{K}$$

An expression for $\frac{K_w}{K}$ can easily be found.

In dynamic equilibrium;

$$K17 \quad \frac{K_w}{K} = \frac{S_w}{S} = \frac{s_w(Y - P_c)}{I} = \frac{s_w s_c}{(s_c - s_w)} \frac{Y}{I} - \frac{s_w}{(s_c - s_w)}$$

Substituting into K16

$$K18 \quad \frac{P}{K} = \frac{1}{(s_c - s_w)} \frac{I}{K} - \frac{s_w}{(s_c - s_w)} \frac{Y}{K} + i \left(\frac{s_w s_c}{(s_c - s_w)} \frac{Y}{I} - \frac{s_w}{(s_c - s_w)} \right)$$

By an analagous procedure, K14 becomes

$$K19 \quad \frac{P}{Y} = \frac{1}{(s_c - s_w)} \frac{I}{Y} - \frac{s_w}{(s_c - s_w)} + i \left(\frac{s_w s_c}{(s_c - s_w)} \frac{K}{I} - \frac{s_w}{(s_c - s_w)} \frac{K}{Y} \right)$$

To be able to say anything about the share of and rate of profit, one needs a theory of the rate of interest. In dynamic equilibrium, Pasinetti asserts that it is reasonable to postulate that the rate of interest is equal to the rate of profit, i.e.: $i = \frac{P}{K}$. Substituting $i = \frac{P}{K}$ into K18;

$$\frac{P}{K}\left(1 - \frac{s_w s_c}{(s_c - s_w)}\frac{Y}{I} + \frac{s_w}{(s_c - s_w)}\right) = \frac{1}{(s_c - s_w)}\frac{I}{K} - \frac{s_w}{(s_c - s_w)}\frac{Y}{K}$$

$$\frac{P}{K}\left(\frac{(s_c - s_w)I - s_w s_c Y + s_w I}{I}\right) = \frac{I}{K} - \frac{s_w Y}{K}$$

$$\frac{P}{K}\left(\frac{s_c I - s_w s_c Y}{I}\right) = \frac{I - s_w Y}{K}$$

$$\text{K20} \quad \frac{P}{K} = \frac{1}{s_c}\frac{I}{K}$$

By an analogous procedure;

$$\text{K21} \quad \frac{P}{Y} = \frac{1}{s_c}\frac{I}{Y}$$

These results are amongst the most important results to be derived from economic theory. Without making any assumption whatever about the saving propensity of workers, they show the dominance of the capitalists, as expressed in their savings and investment behavior, in the determination of income distribution and the rate of profit. For example, they imply

that any plan to redistribute income will fail unless it influences s_c or I.

In the development by Kaldor and Pasinetti of Keynesian theory both writers have insisted on a dichotomy between the theory as a theory of output and as a theory of distribution. Thus Kaldor has written:

> "The Keynesian technique, as I hope to show, can be used for both purposes (i.e. as a theory of output and a theory of distribution), provided that one is conceived as a short run theory and the other as a long run theory - or rather, the one is used in the framework of a static model, and the other in a framework of a dynamic growth model." (Kaldor 1956, p. 82)

Pasinetti clearly accepts the restriction of the model as a theory of distribution to cases of full employment when he concludes:

> "I should look, therefore, at the...analysis simply and more generally as a logical framework to answer interesting questions about what ought to happen if full employment is to be kept over time." (Pasinetti 1969, p. 109)

Pasinetti's reasons for his conclusion are fairly straightforward. He wishes to interpret the theory as an accounting framework which will answer the questions as to how much investment is required to maintain full employment.

> "If full employment is to be maintained, that amount of investment must be undertaken. And if it is undertaken; there is - for any given proportion of capitalists income which tends to be saved - only one rate of profit, i.e. one distribution of income between profits and wages, that keeps the system in a dynamic path of full employment." (Pasinetti 1961, p. 110)

Such an interpretation recommends itself to Pasinetti because the:

> "results do not depend on any behavioral assumption whatsoever. They are true whatever individual behavior may be; as a simple matter of logic." (Pasinetti 1961, p. 110)

Kaldor raises the concern that by developing a theory of distribution using Keynesian techniques, one might emasculate the Keynesian theory of output.

> "And its use as one (i.e. a theory of output) appears to exclude its use for the other (i.e. as a theory of distribution). If we assume that the balance of savings and investment is brought about through variations in the relationship of prices and costs, we are not only bereft of a principle for explaining variations in output and employment, but the whole idea of separate 'aggregate' demand and supply functions - the principle of 'effective demand' - falls to the ground; we are back to Say's Law, where output as a whole is limited by available resources, and a fall in effective demand for one kind of commodity (in real terms) generates compensating increases in effective demand (again in real terms) for others." (Kaldor 1956, p. 228)

Kaldor argues that the pitfall of Say's Law can be avoided by making the assumption that only in the long run are profit margins completely flexible. Thus, in the long run, full employment will be attained. In the short run, profit margins are assumed completely inflexible and hence unemployment can result and exist as a short run phenomena. It is because of these assumptions that Kaldor feels that the model only operates as a theory of distribution in the long run.

As a theory of the rate of profit there is another reason why a long run dynamic equilibrium framework is required.

In deducing the behavior of the rate of profit, the technique adopted by both Kaldor and Pasinetti is to divide aggregate profits by a measure of the aggregate capital stock, K. In view of the criticisms of both these writers of the neo-classical procedure, this appears a rather surprising approach. Indeed, Kaldor has admitted:

> "In fact, the whole of the Keynesian and post-Keynesian analysis dodges the problem of the measurement of capital." (Kaldor 1960, p. 88, footnote 9)

However, by using this procedure the theory is restricted to steady state equilibrium.

The value of old capital is determined by the profits or quasi-rents that capital is expected to earn discounted by the rate of profit. Its value will adjust until its rate of profit is equal to the rate of profit that is expected to be earned on capital currently being built. Only capital in the later category has a supply price given independently of the rate of profit. On a steady state growth path, this is not a problem because the rate of profit is always constant on such a path. The value of existing capital will never change from its historical cost since expectations of profits never change. The future is known with certainty. Thus, the rate of profit can be calculated from any capital good by using its historical cost or supply price. But if an economy is not on a steady state growth path, the rate of profit on

new capital will change and thus the value of old capital will adjust to the new rate of profit. Thus, capital values will diverge from historical cost and a rate of profit based on historical cost may differ from the economy-wide rate of profit. Thus, to determine the rate of profit, capital which is currently being produced should be the focus of attention. The Neo-Keynesian theory, by calculating the rate of profit from all capital, restricts its area of operation to a steady state growth path.

These, then, are the two most widely accepted theories of the rate of profit. It is interesting to note the differences in emphasis of the two theories, the Neo-Classical Theory being based on technological factors, whilst the Neo-Keynesian Theory stresses the componenets of aggregate demand. However, as theories of the rate of profit, both rely heavily on the concept of steady-state or dynamic equilibrium. It is to considerations of the equilibrium framework which the next chapter discusses.

CHAPTER III

THE FRAMEWORK OF ANALYSIS

In both the theories of the rate of profit presented in Chapter II, the method was to determine the level of profits associated with either a technique when the wage rate is given (the Neo-Classical approach), or with a level of aggregate investment (the Neo-Keynesian approach), and then to divide this level of profit by a measure of capital, i.e.: the "cost" of the technique or a measure of the aggregate capital stock. The resulting magnitude was then called the "rate of profit."

Joan Robinson (Robinson 1953) has criticized such an approach for being circular; the rate of profit must be known to calculate the cost of producing a capital good and then this magnitude is used to determine the rate of profit. The Neo-Classical retort to such a criticism is that the system is a general equilibrium one and that, indeed, determination of the variables is circular or simultaneous. A debate over the merits of circularity versus simultaneity does not seem very worthwhile for the purposes of this paper. What does seem worthy of comment is that both theories can only make sense or work in a fully fledged golden age, or dynamic equilibrium.

For the value of a capital good to be equal to its cost of production throughout the life of the capital good, the state of the economy must remain unchanged. An entrepreneur

would only buy a new capital good if its expected proceeds, when divided by its price, yielded a rate of return which was at least as high as the rate of return on alternative uses of the capital outlay. Thus, in a perfectly competitive economy, there will exist one rate of return throughout the economy. All investment activities will be exploited until their rates of return are equalized. Given then, that at each point in time, all new investment opportunities must yield a common rate of return, for their value to remain the same over the future the rate of return must remain the same over time. If the aggregate rate of return rises, and the productivity of previous investments remains constant, then the market value of previous investments will fall and vice versa.

Thus, there is a crucial difference between old and new capital. New capital has a value, in perfect competition, which is its price or cost of production. However, the value of old equipment can change due to the "bygones are bygones" principle, and will in fact fluctuate to bring its rate of return into line with the rate of return of investments. Only if the rate of profit is unchanging will the value of a capital good be constant and equal to its cost of production throughout its life.

In other words, the two theories described above only apply to steady-states. A discussion of the realism and usefulness of a steady-state approach, and a presentation of an alternative framework for analysing the rate of profit is the subject matter of this chapter.

The concept of a steady state has also been described in Chapter II as "general equilibrium" and "dynamic equilibrium." Throughout this thesis, these three expressions will be used interchangeably to describe the same concept. The important feature of them all is that they require that all markets and all economic variables, including the capital stock, be in equilibrium. This is, of course, the literal meaning of "general equilibrium." That general equilibrium necessarily implies dynamic equilibrium or a steady state might not appear so obvious. However, this equivalence follows from the assumption that capital is not malleable. General equilibrium requires, among other things, that the capital stock be in equilibrium. This means that every capital good be that capital good associated with the equilibrium technique. If capital is not malleable, substitution of techniques takes time. So in order that all capital is of the equilibrium technique, it is necessary to assume that the equilibrium technique has been ruling for a long period of time, i.e. for as long as the age of the oldest capital good in existence. For this to be the case, it is necessary to assume that the rate of profit has been constant for this period of time. Ruling out the unlikely possibility that variation in the rate of accumulation have been precisely, and coincidently, offset by exogeneous changes in technology (the shape of the factor price frontier), the

requirement of a constant rate of profit over time requires a constant rate of accumulation, of labour force growth and of Harrod Neutral technical progress. The stipulation that all variables grow over time at a constant exponential rate is the requirement of a steady state or dynamic equilibrium. Thus, general equilibrium that covers non-malleable capital is equivalent to steady state or dynamic equilibrium.

The requirement of a general equilibrium is a far more restrictive requirement than the requirement of Keynesian short run equilibrium. The latter requires only that the product market clear;[1] the labour market and the capital market are allowed to be in disequilibrium. General equilibrium requires all markets to be in equilibrium. Hence, whilst general equilibrium is a special case of Keynesian short run equilibrium, the converse is not true. Thus, the range of applicability of general equilibrium can be no wider than that of short run equilibrium.

Is the additional area of application of Keynesian short run equilibrium over general equilibrium significant for economic analysis? The answer would seem to be in the affirmative, especially if capital is non-malleable. Since the lifetime of capital goods in western industrial societies is

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[1] If a monetary sector is included, then it too is required to clear for Keynesian short run equilibrium.

about 15 to 20 years, the time taken to change the technique of the capital stock is also 15 to 20 years. This is a considerable length of time. During the change, general equilibrium is violated. Only short run equilibrium holds. Furthermore, since rates of accumulation are never observed as constant over such long periods of time, it is likely that the economy is never in general equilibrium.

Of course, economists who use the concept of general equilibrium as a basis for their theories would recognize the limits of its application. The defense of its use would be that the real world is always approaching a general equilibrium state and thus, general equilibrium theories represent a good approximation of the real world. However, the supposition that non-general equilibrium states approach general equilibrium relies on the proposition that disequilibrium is distributed between the markets in such a way as to generate such an outcome. The range of validity of this proposition is open to doubt. Until its validity is established, the generality of general equilibrium theorems remains an unresolved issue.

To relax the assumption of general equilibrium entails meeting the issue of the distribution between markets of disequilibrium. The Keynesian approach to this problem is to assume, as noted above, that only the product market clears.

Disequilibrium in the labour market and the capital market is allowed to exist. This might be described as an assumption that the product market is more flexible or that disequilibrium forces in the product market are more powerful and have a greater immediate impact than disequilibrium in the labour market and the capital market. Thus, an increase in aggregate demand will lead to a rise in the price of output due to excess demand in the product market, but to a fall in the real wage rate. The excess demand in the labour market is met by a change in the level of employment, perhaps a change in the money wage rate but no independent effect on the real wage rate. Product market equilibrium ensures that the real wage rate falls. It is this ranking of the product market over the labour market which explains the Keynesian position that an excess supply of labour (unemployment) will not necessarily be eliminated by the operation of conventional market forces and why the remedy to unemployment involves a government policy directed at the product market.

Throughout the remainder of this thesis, the Keynesian "ranking" of markets will form the basis of the attempt to develop a theory of the rate of profit. This theory will be developed firstly for a given capital stock and secondly, under conditions of alteration in the size of the capital stock.

Thus, the theory will be comparable with both the analysis of short-run macro-economic models and of the longer run models of economic growth.[2]

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[2]Whilst steady state theories may not hold outside of steady state in short run equilibrium, theories based on the later concept of equilibrium may be applied to steady state situations.

CHAPTER IV

THE DETERMINATION OF THE RATE OF PROFIT IN THE SHORT RUN

Chapter III argued that the rate of profit on existing capital goods, i.e. capital goods installed in the past, is determined by the rate of profit on new capital goods, i.e. capital goods currently being produced and installed. Whilst in a steady state, where there is an identity of the past and the present, it is legitimate to base a theory of the rate of profit on the analysis of capital goods installed in the past; in a non-steady state framework this procedure is incorrect. If the current levels of activity of an economy are allowed to differ from levels of activity experienced in the past then the primacy of the rate of profit on new investment goods, i.e. investment goods currently being built, must be recognized. The analysis of the rate of profit must be based on such a magnitude.

The definition of the rate of profit suggested by the discussion above is that rate of discount which equalizes the expected stream of profits from operating a machine with its supply price. That is, if only one good is produced which can be used as either an investment good or a consumption good (but not both) then the rate of profit is derived from the following relation.

$$1 \qquad P_I = \int_0^{t=T^*} (P_t^* a_t^* - w_t^* b_t^*) e^{-\rho t} dt$$

where

P_I = Supply price of capital good.

P_t^* = Expected price of the output of the capital good at time t.

w_t^* = Expected money wage rate paid to labour operating the capital good at time t.

a_t^* = Expected level of physical output from the capital good at time t.

b_t^* = Expected quantity of labour used to operate the capital good at time t.

T^* = Expected lifetime of the capital good (which can in principal be thought of as the physical lifetime or the economic lifetime of the capital good, whichever is the shorter).

ρ = Rate of profit.

It should be noted that these definitions are precisely the same as that used by Keynes for the marginal efficiency of capital in the General Theory. Keynes' definition was;

> "I define the marginal efficiency of capital 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." (General Theory, p. 135)

One of the most striking features of this definition is the importance it places on the expectations of the future course of prices, of the physical efficiency of the investment good and of the lifetime of the investment good.

This is a direct contrast with the definitions used in the theories presented in Chapter II, where expectations played no role at all. Of course, this is the result of abandoning a steady state frame of analysis; once a steady state is left then expectations become important.

In a non-steady state framework, a hypothesis is needed to describe the formation of expectations by entrepreneurs. The entrepreneur desires to accumulate capital and yet "knows" nothing of the future return the capital will bring. To resolve the conflict in this situation the entrepreneur has to theorize about the nature of future events so that he can compare the gains from accumulation with its cost. One hypothesis describing the nature of entrepreneurs theorizing about the future was introduced by Keynes and gained widespread recognition, e.g. Hicks 1939, p. 205.

Keynes described the nature of the entrepreneurs theorizing in the following fasion:

> "In practice, we have tacitly agreed, as a rule, to fall back on what is, in truth, a 'convention.' The essence of this convention - though it does not, of course, work out quite so simply - lies in assuming that the existing state of affairs will continue indefinitely, except in so far as we have specific reasons to expect a change." (Keynes 1936, p. 152). Original italics.

Thus, Keynes argued that, as a general rule, entrepreneurs expectations of the future are based on the present. Applying this hypothesis to prices leads to the proposition that expected prices are related to current prices,

the nature of the relationship reflecting Keynes' "specific reasons." This can be written;

$$2 \qquad P_t^* = f_1(P, t)$$

$$3 \qquad w_t^* = f_2(w, t)$$

where

P = today's price of output.

w = today's wage rate.

Today's price and wages are market phenomena and are, in consequence, observable. As long as the lifetime of the capital good is known, the values of t relevant for calculating the rate of profit are also known. However, the precise nature of the functional relationships f_1 and f_2 are not so easy to observe. And yet, in principle, the functional relationships could take any form. In fact, the nature of expectations is such that it seems unlikely that a general theory will ever be worked out which will imply a precise functional form. There are a few restrictions which may be reasonable. Very complex forms of the expectational relationship may be ruled out on the basis that the relationship represents entrepreneurs' projections into the future. Furthermore, the relationship at any particular moment in time may reflect the nature of price movements in the past. But even if these restrictions are accepted there are a wide variety of functional forms which remain

admissable as a specification for the formation of expectations.

To attempt any analysis of the rate of profit in the short run, then, it is necessary to take a particular functional form which can serve as a benchwork for types of expectational behavior not fully described by it. The particular form chosen here will be an exponential pattern. Thus, expected prices will be assumed to be related to current prices in the following fashion:

$$4 \qquad P_t^* = P \cdot e^{\alpha t}$$

$$5 \qquad w_t^* = w \cdot e^{\alpha t}$$

This parameter α can be given any value, positive or negative, depending on hypotheses or observations about the influence of other factors upon entrepreneurs expectations.

It will simplify the analysis to assume that capital goods are expected to retain their technological characteristics forever. Output per machine and the labour requirement per machine are expected to remain constant. Physical depreciation of capital can be easily incorporated into the analysis without qualitatively affecting the conclusions. Furthermore, it will be supposed that there is one production technique (i.e. one pair of values of a and b) which dominate all others at a point in time and that the capital good required for this technique is the same

as the consumption good. The decision over the use of a newly produced good as a capital or consumption good will be considered irreversible. Under these assumptions, relation 1, which determines the rate of profit, becomes;

$$6 \qquad P = \int_0^{t=T^*} (P\, e^{\alpha t}\, a - w\, e^{\alpha t}\, b)\, e^{-\rho t}\, dt$$

Upon integration and rearrangement, relation 7 is obtained;

$$7 \qquad \frac{\rho}{1-e^{-\rho T^*}} = a - b\,\frac{w}{p} + \alpha$$

If the expected life of capital goods B, T^*, remains constant, then the expression $\frac{\rho}{1-e^{-\rho T^*}}$ varies positively with the rate of profit ρ.[1] One case where T^* is constant is when $T^* = \infty$. Under this assumption, the rate of profit is given by relation 8;

$$8 \qquad \rho = a - \frac{w}{p}\,b + \alpha$$

Thus, the result is a very simple relation between the rate of profit and the relative prices of labour and output and their expected rate of change, α. A theory of relative prices is a basic part of the theory of the rate of profit.

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[1] This is easy to demonstrate. Letting; $\bar{\rho} = \frac{\rho}{1-e^{-\rho T^*}}$,

$\frac{d\bar{\rho}}{d\rho} = \frac{(1-e^{-\rho T^*}) - \rho\, T^*\, e^{-\rho T^*}}{(1-e^{-\rho T^*})^2}$. The denominator is positive. So for $\frac{d\bar{\rho}}{d\rho} > 0$, it is sufficient that, $1-e^{-\rho T^*} - \rho\, T^*\, e^{-\rho T^*} > 0$ $\therefore$ $1 > (1+\rho T^*)\, e^{-\rho T^*}$. This holds for all positive values of ρT^*.

It is to the determination of relative prices that we will now turn.

The major objective of this thesis is to develop a theory of the rate of profit which is not constrained to the assumption of a steady state. It was pointed out in Chapter III that a steady state involved the assumption that all markets were in equilibrium. This is highly restrictive, especially since it required the capital stock to be the equilibrium capital stock. The alternative approach put forward in Chapter III is to use a far weaker equilibrium assumption: that is to require that only the product market is in equilibrium and thus only the product market is required to clear. By making product market clearance the only "equilibrium" condition, it is being implicitly assumed that disequilibrium in other markets has little effect on the economy, e.g. an excess supply of labour doesn't, by itself, lead to repercussions which alter the value of any variables - the excess supply is impotent. On the other hand, excess supply in the product market immediately leads to a cutback in the supply of output and/or to a fall in the price of output.

The assumption that the chain of causality for macro-variables runs from the product market to the labour market is reflected in the characteristic of Keynesian analysis that the wage bargain is made in money terms and

that the supply of labour may not be able to affect the real wage rate. As Leijonhufvud has recently emphasized (Leijonhufvud 1968, especially pp. 97-98), this was an incessant theme of Keynes "General Theory." The demand for labour is a derived demand, derived from product market demand. The real wage rate and the level of employment are determined by the level of product market demand.

Thus, the analysis of the product market is of prime importance in Keynesian economics. For aggregate analysis, using Keynesian concepts of national income flows, the product market equilibrium condition is that planned savings is equal to the level of investment. In money terms, this may be written;

$$9 \qquad S = P\,I$$

where

S = Money value of aggregate savings.

P = Price of output.

I = Output of investment goods in physical units.

A form of the Kaldorian specification of savings behavior will be used, i.e. the aggregate savings are a constant ratio, s_c, of aggregate profits, Π. Savings out of wages are zero. Thus;

$$10 \qquad S = s_c \Pi$$

By using this formulation of savings behavior, the rate of profit can be analyzed at both unemployment and

full employment levels of output.

Combining the savings behavior (equation 10) with the equilibrium condition (equation 9), the aggregate level of real profits becomes a function of the level of investment and the propensity to save.

$$11 \qquad \frac{\Pi}{P} = \frac{I}{s_c}$$

The analysis of the product market leads to relation 11. The relative prices of output and labour will be determined by the impact that the product market has on the labour market. The exact nature of this impact will depend to some extent on the nature of the response of the labour supply to the product market determined labour demand. Throughout the remainder of this thesis three specifications of labour supply response will be used; the Keynesian, the Neo-Keynesian, and the Inflation Barrier.

The Keynesian specification is appropriate in cases where the real wage rate exceeds the marginal disutility of labour, that is where involuntary unemployment exists. Under this specification the supply of labour is infinitely elastic with respect to the money wage rate. The effect of the excess supply of labour may reduce the money wage rate but this will not increase the demand for labour because a fall in the money wage rate will affect the level of aggregate demand. As Clower (1965) has emphasized, only if the money wage rate can adjust at an

infinitely fast pace will the problem of the interaction of labour market disequilibrium into the product market be avoided and the economy can remain at full employment. If money wages are not so flexible, due say to inelastic expectations on the part of unemployed labour over the value of their labour services, then unemployment can arise. The creation of jobs will depend upon the level of aggregate demand in the product market and its implications for the position of the demand for labour schedule.

A demand for labour schedule can be constructed from an aggregate production function. In a capital rich economy, i.e. where the labour requirement of the total capital stock is greater than the size of the labour force, a production function relating output to labour input can be written;

$$12 \quad Y = f(L) \quad f'(L) > 0 \quad f''(L) < 0$$

where

Y = Quantity of output.

L = Quantity of labour input.

The existence of a surplus of capital implies that the opportunity cost of the least efficient capital good in operation is zero. Whether the entrepreneur uses a capital good will depend upon whether the receipts from operating

the good will cover its labour cost. There is no alternative use for capital, i.e. it cannot be changed into a consumption good and it cannot be changed into a more productive capital good. Hence, the marginal cost of output will be equal to marginal labour cost, i.e.

13 $$\text{Marginal Cost} = \frac{w}{f'(L)}$$

If markets are perfectly competitive, then, marginal cost will equal price and equation 13 can be rewritten as;

14 $$f'(L) = \frac{w}{P}$$

This is the demand for labour schedule.

It should be noted that the nature of the capital stock enters into the form of the production function rather than as a separate argument. In consequence, the expression 14 refers, not to the conventional concept of the marginal product of labour, but to the output per man of the least efficient machine in use.

The precise position of the labour demand schedule will depend upon the requirements imposed by the product market clearing condition. It was seen above that this condition implied the positive relationship between aggregate profits and investment described by equation 11. But, since the aggregate value of profits in money terms may be defined as;

15 $\Pi = P.Y - w\,L$

The aggregate level of investment will have to be consistent with the following relation;

16 $\frac{I}{s_c} = Y - \frac{w}{p} L$

Clearly, then, product market equilibrium implies the following relationship between investment, the production function and the demand for labour schedule;

17 $\frac{I}{s_c} = f(L) - f'(L)\,L$

Since the first derivative of equation 17, with respect to $\frac{I}{s_c}$, is always positive,[2] it may be written in inverse form as;

18 $L = h\left(\frac{I}{s_c}\right)$

Equation 18 determines the level of employment. By substituting this into the labour demand equation, we get;

19 $\frac{w}{p} = f'\left(h\left(\frac{I}{s_c}\right)\right)$

---

[2] $d\left(\frac{I}{s_c}\right) = f'(L)\,dL - f''(L)\,L dL - f'(L)\,dL$

$\therefore \frac{dL}{d\left(\frac{I}{s_c}\right)} = \frac{1}{f'(L) - f'(L) - f''(L)L}$

$= \frac{1}{-f''(L)L} > 0$ since $f''(L) < 0$ by assumption.

It may also be shown that;[3]

$$\frac{d\left(\frac{w}{P}\right)}{dI} = -\frac{1}{s_c L}$$

Thus, the real wage rate is related inversely to the level of investment and the propensity to save out of profits by a functional form which is derived from the production function. As aggregate demand increases, less efficient capital is brought into production. In order that it is worthwhile for entrepreneurs to bring this capital into production, output prices have to rise relative to the money wage. The real wage falls.

---

[3]

$$\frac{w}{P} = f'\left(h\left(\frac{i}{s_c}\right)\right)$$

$$\frac{d\,\frac{w}{P}}{dI} = f''\left(h\left(\frac{I}{s_c}\right)\right)\; h'\left(\frac{I}{s_c}\right)\frac{1}{s_c}$$

$$= f''(L)\; h'\left(\frac{I}{s_c}\right)\frac{1}{s_c}$$

From footnote 2, page 47 above;

$$h'\left(\frac{I}{s_c}\right) = \frac{1}{f''(L)L}$$

$$\therefore \frac{d\left(\frac{w}{P}\right)}{dI} = -\frac{1}{s_c L}$$

Once the economy reaches the full employment level, where the real wage rate is equal to the marginal disutility of labour, some writers, e.g. Kaldor 1956, have postulated that the real wage rate may be driven downwards further by a rise in the price level without leading to a reduction in the level of employment. The real wage rate would be below the marginal disutility of labour. This will be labelled the Neo-Keynesian specification of labour supply behavior. Such action by labour is not so irrational as it may first appear. Whether it pays labour to reduce its services or resist the real wage cut depends upon the cost of so doing. Rigidities in the work week, the cost (and uncertainties) of job searching and the cost of strikes may rule out an immediate response to the fall in the real wage. Furthermore, a rise in the general price level will reduce the real wage of alternative job opportunities and so reduce the incentive to job search.

The Neo-Keynesian specification implies the possibility that the aggregate level of profits may be capable of increasing further in the face of further attempts by entrepreneurs to increase investment. Increases in aggregate demand are met by entrepreneurs raising prices above marginal cost, since they can no longer increase output because of the employment restraint. Only when profits

are sufficiently high to equate savings with investment, will profit margins be stabilized. The behavior of the real wage rate can be deduced by substituting full employment magnitudes into equation 16;

$$20 \qquad \frac{I}{s_c} = \bar{Y} - \frac{w}{P}\bar{L}$$

where

$\bar{Y}$ = Full employment level of output.

$\bar{L}$ = Full employment.

$$21 \qquad \therefore \frac{w}{P} = \frac{\bar{Y}}{\bar{L}} - \frac{1}{s_c\bar{L}}$$

Clearly, the relationship between the level of investment and the real wage rate is negative, i.e.;

$$22 \qquad \frac{d\left(\frac{w}{P}\right)}{dI} = -\frac{1}{s_c\bar{L}}$$

It is reasonable to postulate that there is a minimum level to the real wage that is acceptable to labour if labour is to be induced to offer its full employment level of labour services. When the real wage reaches this low level, labour will decide that it does indeed pay to search for alternative jobs or indeed to strike. Any more price rises are matched by wage demands. This is the Inflation Barrier region, e.g. Robinson 1956. Attempts by entrepreneurs to increase the level of investment when the real wage rate is equal to the minimum will lead to inflation.

Whether higher levels of investment can be sustained depends upon whether there is a disequilibrium adjustment process which will lead to forced savings out of profits. Forced savings out of wages are ruled out by the assumption of a minimum real wage. Thus, if the economy is at the Inflation Barrier;

$$23 \qquad \frac{w}{p} = \left(\frac{w}{p}\right) \text{min.}$$

$$24 \qquad \frac{d\left(\frac{w}{p}\right)}{dI} = 0$$

Having determined the behavior of the relative prices of output and labour, we are in a position to determine the behavior of the rate of profit. From the analysis of the labour market, it follows that the rate of profit will be related to the level of investment. Furthermore, the nature of the relationship will depend upon the level of investment since the level of investment determines which labour supply hypothesis is appropriate. Thus, for each labour supply hypothesis, we get a relation between investment and relative prices. By substituting these relations into the rate of profit equation, 8, we get a relation for each region, the Keynesian, Neo-Keynesian and Inflation Barrier.

Keynesian:

$$25 \qquad \rho = a - b\, f'\left(h\left(\frac{I}{s_c}\right)\right) + \alpha$$

$$\frac{d\rho}{dI} = \frac{b}{s_c L} > 0$$

Neo-Keynesian:

$$26 \qquad \rho = a - b\left[\frac{\bar{Y}}{\bar{L}} - \frac{I}{s_c \bar{L}}\right] + \alpha$$

$$\frac{d\rho}{dI} = \frac{b}{s_c \bar{L}} > 0$$

Inflation Barrier:

$$27 \qquad \rho = a - b\left(\frac{w}{P}\right)_{min.} + \alpha$$

$$\frac{d\rho}{dI} = 0$$

These results may be represented in a rate of profit schedule which connects the rate of profit to the level of investment. This schedule is drawn in Figure 1. The slope of the schedule is positive in both the Keynesian and Neo-Keynesian regions, but in the Keynesian region, the value of the slope falls as investment rises whilst in the Neo-Keynesian region profit margins are linearly related to investment. The existence of a minimum value to the real wage rate in the Inflation Barrier region puts an upper bound on the rate of profit.

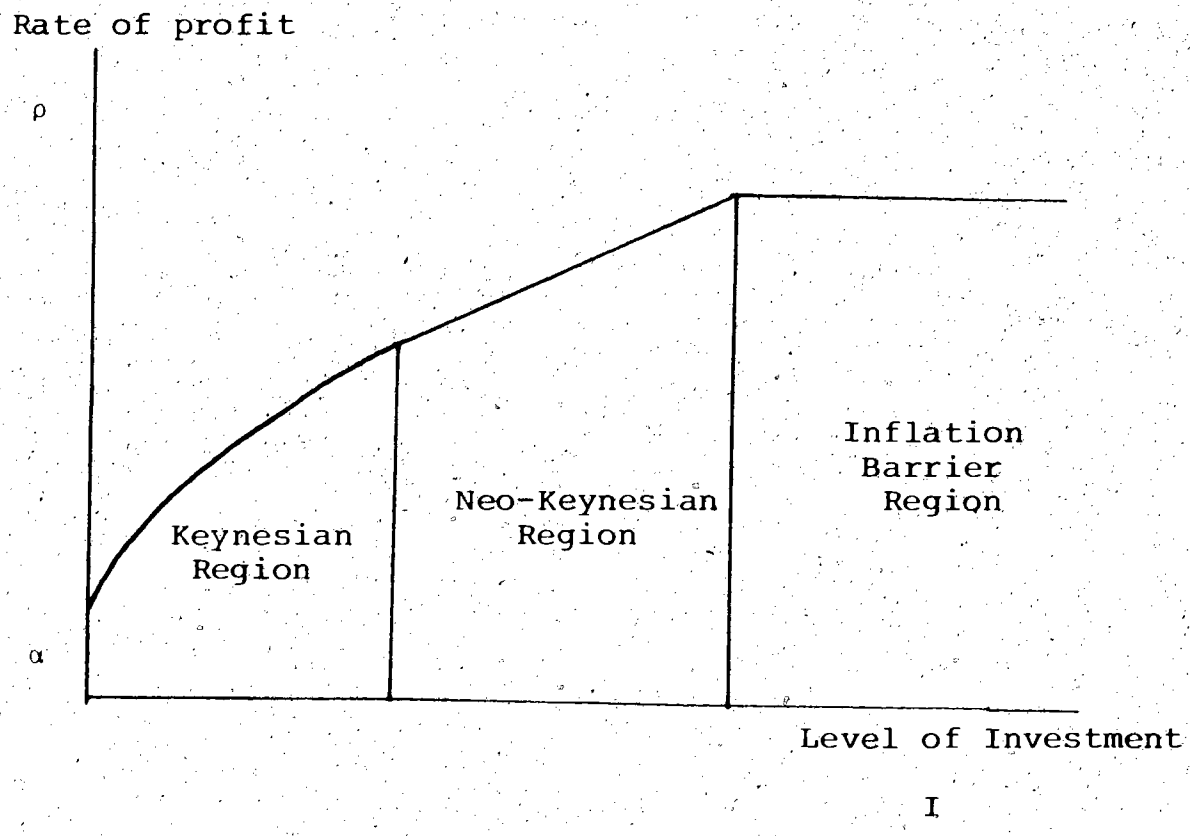

Figure 1

Implicit in the construction of the rate of profit schedule is the assumption that the trend rate of price expectations, α, remains constant as investment alters. Since the responsiveness of this parameter to the level of investment, and, indeed, to other variables, is an open question, clarity is best served by this procedure. The effect of an increase (decrease) in α will be to shift the whole schedule upwards (downwards). Thus the shape of the schedule as drawn in Figure 1 reflects the role of current prices on the formation of expectations.

These results may be represented in a rate of profit schedule which shows what value the rate of profit will take for every exogenously determined level of investment.

CHAPTER V

THE RATE OF PROFIT SCHEDULE AND THE MARGINAL EFFICIENCY OF CAPITAL SCHEDULE

The most striking feature of the short run rate of profit schedule derived in Chapter IV is its positive slope which suggests that the rate of profit increases as investment rises. This is, of course, quite the opposite to the marginal efficiency of capital schedule, which Keynes hypothesized as downward sloping. However, that is not to say that the two schedules are inconsistent. The marginal efficiency of capital schedule is an ex ante schedule which is constructed by aggregating entrepreneurs' investment demand schedules. Thus, it reflects entrepreneurs investment plans for each value of the rate of interest. On the other hand, the rate of profit schedule is an ex poste schedule, which shows what value the rate of profit will be if entrepreneurs, in the aggregate, actually undertake a certain level of investment.

The difference between the two schedules reflects the difference between constructs based on micro-economic analysis and those based on macro-economic analysis. However, there is a link between the two schedules. Keynes argued that the marginal efficiency of capital schedule would be downward sloping because of entrepreneurs expectations about what would happen if they increased or decreased

investment. But the expectations of entrepreneurs are relative to their initial position and it is this initial position that is needed in order that the location of the marginal efficiency of capital schedule can be determined. In terms of the analysis presented here, the "initial position" will be a point on the rate of profit schedule, since, so long as savings is equal to investment, the economy will always be on the rate of profit schedule.

The rate of profit schedule can be used as a basis for drawing the traditional marginal efficiency of capital schedule. Each point on the rate of profit schedule represents a state of product market equilibrium. Each point is a potential "initial situation" for the economy. Thus, at each point on the rate of profit schedule, a marginal efficiency of capital schedule can be drawn. Suppose that, in the aggregate, entrepreneurs are undertaking a level of investment equal to I_A (Figure 1). Then the ruling rate of profit will be ρ_A. If at this initial position (ρ_A, I_A), the rate of interest is equal to the rate of profit, then a marginal efficiency of capital schedule can be constructed by determining what level of investment entrepreneurs plan to undertake for each level of the rate of interest. Of course, at a rate of interest equal to ρ_A, entrepreneurs will plan the level of investment I_A. At rates of interest less than ρ_A, entrepreneurs will, in the aggregate, undertake higher levels of investment if Keynes' hypothesis

about the slope of the marginal efficiency of capital schedule is correct. If the rate of interest is greater than ρ_A, entrepreneurs will undertake lower levels of investment. The result will be a downward sloping marginal efficiency of capital schedule, labelled MEC_A in Figure 1.

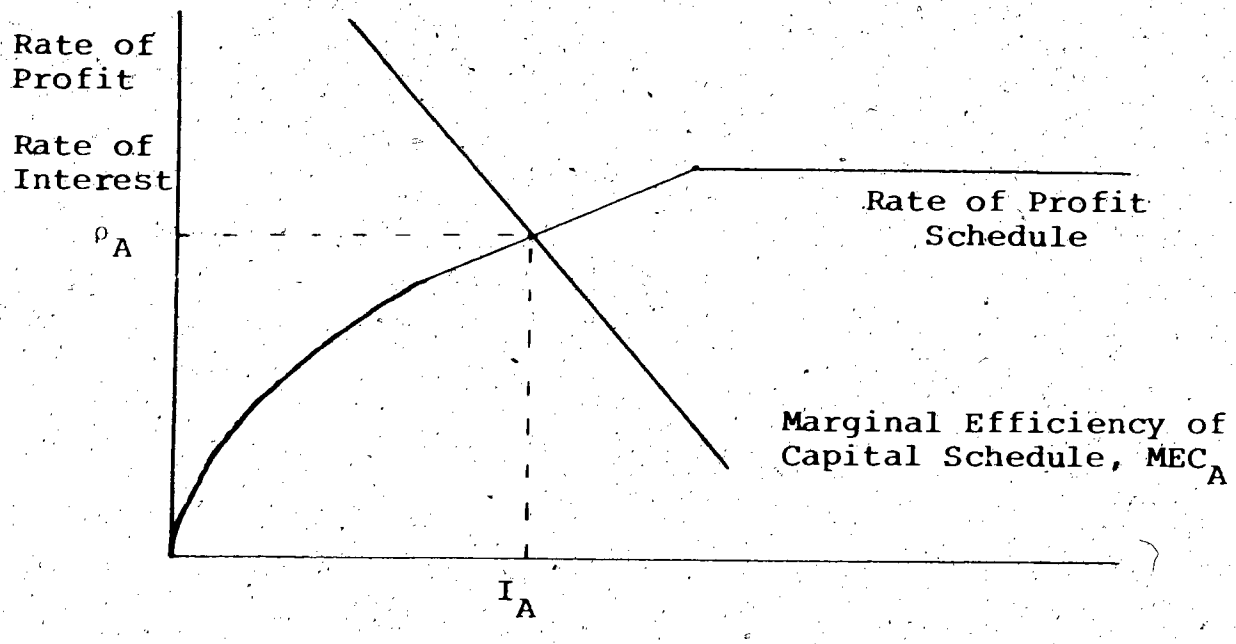

Figure 1

The effect of changes in the level of investment is to alter the position of the marginal efficiency of capital schedule. When investment is high, the schedule shifts to the right and entrepreneurs expect a high rate of profit whilst when investment is low, the schedule shifts to the left reflecting entrepreneurs low expectations of profits. The idea that the marginal efficiency

of capital would behave in this fashion is present in some of the Keynesian literature, e.g. Keynes 1936, Chapter 22; Robinson 1971, p. 83. However, in other parts of the literature, the possibility is not considered. In most of the IS-LM literature, for example, it is the marginal efficiency of capital schedule which is treated as though it were a rate of profit schedule and thus reflected, not just entrepreneurs individual expectations, but also what actually happens as a result of aggregate changes in investment. Thus, in IS-LM analysis, the equilibrium level of income is determined by using a fixed marginal efficiency of capital schedule. The level of employment and the real wage rate adjust so that this level of income can be supplied. Any feedback effect of the real wage rate onto the marginal efficiency of capital is ignored.

In the process of the determination of the aggregate level of investment, the two schedules will interact. For example, in Figure 2, suppose the initial position of the economy is at $\rho_A I_A$. Since the Keynesian investment decision is the choice between monetary and physical assets, the return on monetary assets, the rate of interest, has be to introduced. Let the rate of interest be equal to $i_A < \rho_A$. Then entrepreneurs will increase the level of investment to the point where they expect the marginal

efficiency of capital to be equal to i_A - that is to the level I_B. However, this increase in aggregate investment will result in a change in the rate of profit according to the rate of profit schedule, that is to ρ_B. The marginal efficiency of capital schedule will be shifted to MEC_B. The investment plans of entrepreneurs will now be based on this new marginal efficiency of capital schedule.

If the rate of interest were greater than the rate of profit in the initial position, i.e. $i > \rho_A$, then, there would be a tendency for entrepreneurs to reduce the level of investment and substitute monetary assets for new physical assets. This would have a downward effect on the rate of profit and shift the marginal efficiency of capital schedule to the left.

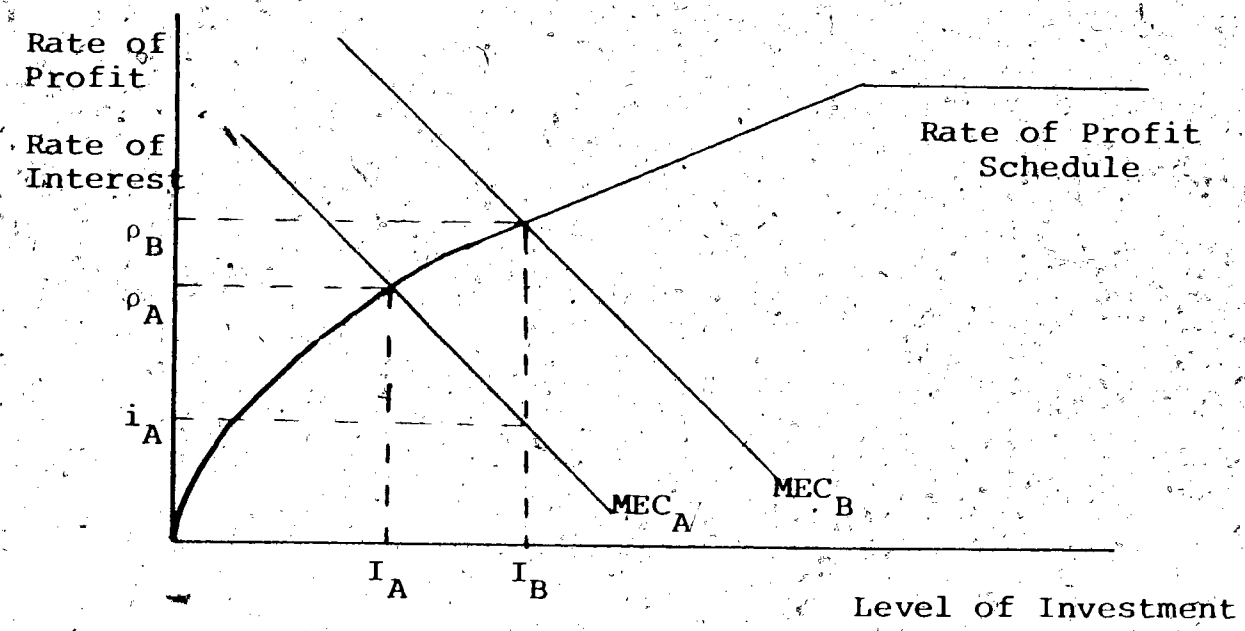

Figure 2

In the debate over the issues raised by the "General Theory", a great deal of attention has been given to the responsiveness of investment to changes in the rate of interest. Some writers have sought to determine the extent of investment opportunities by attempting to identify investment projects which are very capital intensive and are of a long duration, arguing that these projects will be undertaken at low rates of interest (e.g. Bailey 1962). However, the returns from these projects will be affected by the level of aggregate demand. The position of the marginal efficiency of capital schedule reflects the relative prices of output and labour. In a depression, it is relative prices that are "wrong" and that lead to a lack of perceived investment opportunities. Since the level of relative prices will affect, though not perhaps to the same extent, all investment opportunities, the profitability of the traditional "low return" projects will also be depressed below their full employment rates. Thus, even if there were information on the number of projects which would yield a low rate of return, say x percent, when the economy is at full employment, this does not mean that at a less than full employment position when the interest rate has fallen to x percent, these projects will be undertaken. Their rate of return will have fallen with aggregate demand. Thus, the existence of a wide spectrum of investment

opportunities will not necessarily guarantee recovery from recessions. Nor is the lack of "low return" investment opportunities, or "elasticity pessimism," necessary to generate unemployment.

In terms of the analysis presented here, the responsiveness of investment to a change in the rate of interest is a more complex question than is usually suggested involving not only the elasticity of the marginal efficiency of capital schedule, but also the shifts in this schedule caused by changes in aggregate demand. These shifts are determined by the nature of the rate of profit schedule. The steeper the slope of the rate of profit schedule, the greater will be the shift of the marginal efficiency of capital schedule for a given change in the level of investment.

In both the Keynesian and Neo-Keynesian regions, the slope of the rate of profit schedule is affected by the propensity to save out of profits. The higher this propensity, the smaller will be the effect of a change in investment upon relative prices and so the smaller will be the slope of the rate of profit schedule. In the Neo-Keynesian region, the value of the propensity to save will be the only effect on the slope (see Chapter IV, p. 52). In the Keynesian region, however, relative prices are affected by the production function as well as by aggregate demand and so the degree of the diminishing returns to employment will

also have an effect. The greater the diminishing returns, the greater will be the slope of the rate of profit schedule.

If the production function (equation 12, p. 45) is interpreted as a vintage production function (of the type analyzed by Solow, et. al. 1966), then the degree of diminishing returns to employment can be related to the level of investment in each vintage of the capital stock. The higher the level of investment in the past in every vintage, the greater the output from any particular vintage and so the smaller the number of vintages that have to be brought into or taken out of production for a given change in aggregate demand. Thus, the smaller the change in relative prices. It follows that the greater the level of capital accumulation that the economy has experienced in the past, the smaller are the fluctuations in the marginal efficiency of capital schedule.

The analysis of this chapter suggests that the role of the marginal efficiency of capital schedule is to determine the speed of the response of investment to a change in the rate of interest. The more elastic the schedule, the greater will be the initial change in investment for a change in the rate of interest and so the greater will be the initial shift in the schedule. The extent of subsequent shifts in the marginal efficiency of capital schedule

and thus, the overall change in investment will depend on the rate of profit schedule. This suggests that even if the marginal efficiency of capital schedule is very inelastic, it is possible for a fall in the rate of interest to lead to a large change in investment. The small initial increase in investment will lead to a small rightward shift in the marginal efficiency of capital schedule leading to a further increase in investment. Thus, the marginal efficiency of capital schedule will "climb up" the rate of profit schedule at a relatively slow rate.

The speed of the changes in investment and thus, of other aggregate variables is a very important question for macro-economic analysis and, of course, for public policy. The formation by entrepreneurs of expectations of future prices may be sensitive to the speed of adjustment of current prices. In terms of the rate of profit schedule, the expectations trend parameter, α, may be influenced by the speed of adjustment. Whether the speed of adjustment causes expected future prices to change by more or less than the change in current prices would seem to be an open question.

Keynes discussed another way in which the speed of adjustment will affect the extent of adjustment. He argued that,

> "It is the nature of organized investment markets, under the influence of purchasers largely ignorant of what they are buying and of speculators who are more concerned with forecasting the next shift of market sentiment than with a reasonable estimate of the future yield of capital assets, that, when disillusion falls upon an over-optimistic and overbought market, it should fall with sudden and even catastrophic force." (Keynes 1936, p. 316)

Thus, in terms of the constructs of this paper, the marginal efficiency of capital schedule would tend to move ahead of the position dictated by the rate of profit schedule (the latter represents "a reasonable estimate of the future yield of capital assets"). Thus, a rapid initial change leads to the marginal efficiency of capital schedule overshooting its "reasonable" position and so magnifies the extent of the fluctuation.

The fluctuations in the marginal efficiency of capital schedule induced by changes in the level of aggregate demand imply the possibility of the existence of low level income traps. A decline in investment due, say, to the effects of a decrease in the rate of technological improvement on the profitability of new investment goods, leads to a change in relative prices, which exacerbates the leftward shift in the marginal efficiency of capital schedule. This will then cause further declines in the level of investment which will then shift the marginal efficiency of capital schedule even further to the left.

Thus, because of the flexibility of relative prices and their impact on expected future prices, the economy tends towards a position of low investment, low employment, and a low rate of profit. In order that such a contraction be halted, it is necessary for the rate of interest to fall below the rate of profit so that investment in physical assets will pick up. But if, as Keynes argued, the long rate is "sticky" and the adjustment of the rate of interest lags behind the rate of profit on physical assets, then, it is possible for the economy to be "trapped" in a position of low employment and low investment. This will be returned to below.

If the absolute price level if flexible, then, the depressing influence on the marginal efficiency of capital schedule of a fall in aggregate demand may be even greater. If the decline in aggregate demand leads to a fall in absolute prices and if this induces entrepreneurs to expect further falls in prices, then, the expectational trend parameter, α, will become negative and will thus, exert a downward effect on the rate of profit. Indeed, it is conceivable that the rate of profit on investment goods could become negative. Even if the ruling rate of profit remains positive, the possibility that the full employment level of investment would appear, from the standpoint of a depressed economy, to require the maintenance of a negative rate of profit remains. Thus, price flexibility can

have a destabilizing influence on the economy. In such circumstances, the stimulation of aggregate demand by the real balance effect would be a slender reed on which to rest hopes for a recovery in view of the forces operating in the opposite direction.[1]

It was noted above that IS-LM analysis is deficient because it does not take into account the shifts in the marginal efficiency of capital schedule that result from changes in the level of investment. However, it is possible to analyze the influence of the money supply on aggregate economic activity by the construction in (ρ, I) space of a schedule which shows the values of ρ and I consistent with money market equilibrium. This will be called the money market schedule (MM schedule).

In Keynesian analysis, the demand for real balances is positively related to the level of real income and negatively related to the rate of interest. This may be written;

$$1 \qquad \frac{M_D}{P} = f(i, Y)$$

where

M_D = Demand for nominal money balances.

P = Price level.

---

[1] Slender indeed since, in as far as price falls are expected the expenditure effect of a stock of real wealth will be reduced.

i = Rate of interest.

Y = Level of real income.

$f_i < 0, \quad f_Y > 0$

In the Keynesian region, there is a one to one relation between the level of investment and the level of income which depends on the nature of the production function and the propensity to save out of profits. Since this relationship is positive, it follows that investment may be subsituted for income in the money demand function and that the first derivative of this function with respect to investment is positive.

$$2 \qquad \frac{M_D}{P} = f(i, I)$$

$$f_i < 0, \quad f_I > 0$$

Equilibrium in the money market requires that money demanded is equal to money supply. Assume, for the moment, that the government keeps the real money supply fixed by varying the nominal money supply in response to changes in the price level. A positive relationship between the rate of interest and the level of investment can be derived. At high levels of investment, income and thus, the transaction demand for money will be high. In order that money demand will be equal to the money supply in the aggregate, a high rate of interest will be required to

reduce the speculative component of the demand for money. The converse will have to hold at low rates of interest.

Once full employment is reached, real income is invariant to changes in the level of investment. Thus, at full employment, the transactions demand for real balances will be constant.[2] Money market equilibrium will require a constant speculative demand for real balances in the face of a constant money supply. In consequence, the money market schedule will be horizontal in the Neo-Keynesian and Inflation Barrier regions. The nature of the money market schedule is shown in Figure 3.

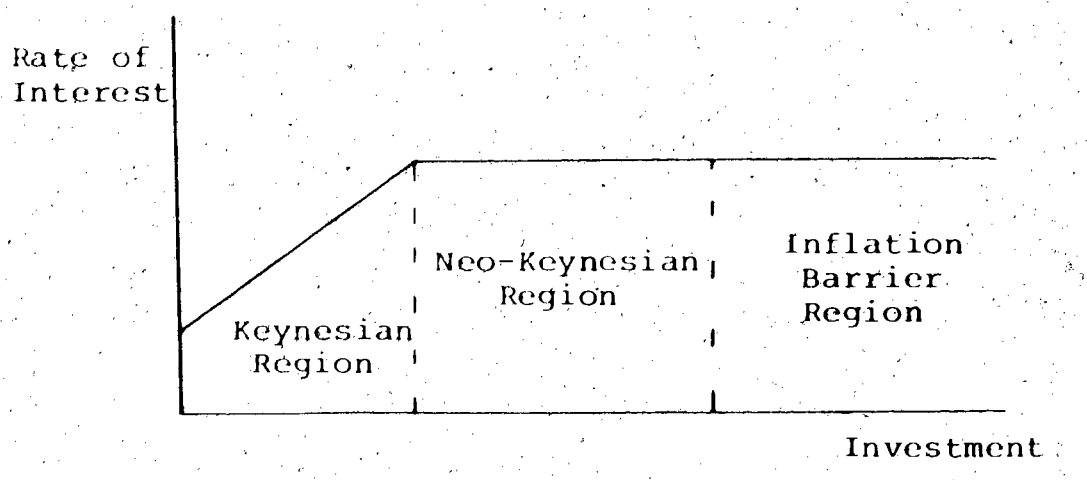

Figure 3

[2]Assuming no distributional differences in the demand for money. In the Neo-Keynesian region, a change in investment will change the distribution of income. If firms have a higher demand for real balances than households, an increase in investment will increase the demand for money. It is worth noting that in reality, a distributional difference may exist. In Canada, the money supply is roughly a half of G.N.P. Assuming that speculative balances aren't enormous, it would appear likely that firms hold large transactions balances. Few households are in a position to hold a half of their annual income in cash.

The size of the real money supply affects the position of the money market schedule. The greater the real money supply, the lower is the money market schedule reflecting the fact that, for a given level of investment, a lower rate of interest is needed to equate the demand for real money with the supply.

To demonstrate the determination of aggregate investment, it is necessary to add the rate of profit schedule and the marginal efficiency of capital schedule to the money market schedule. Assume, for the moment, that the R.O.P. schedule cuts the MM schedule as illustrated in Figure 4. If the economy starts with a level

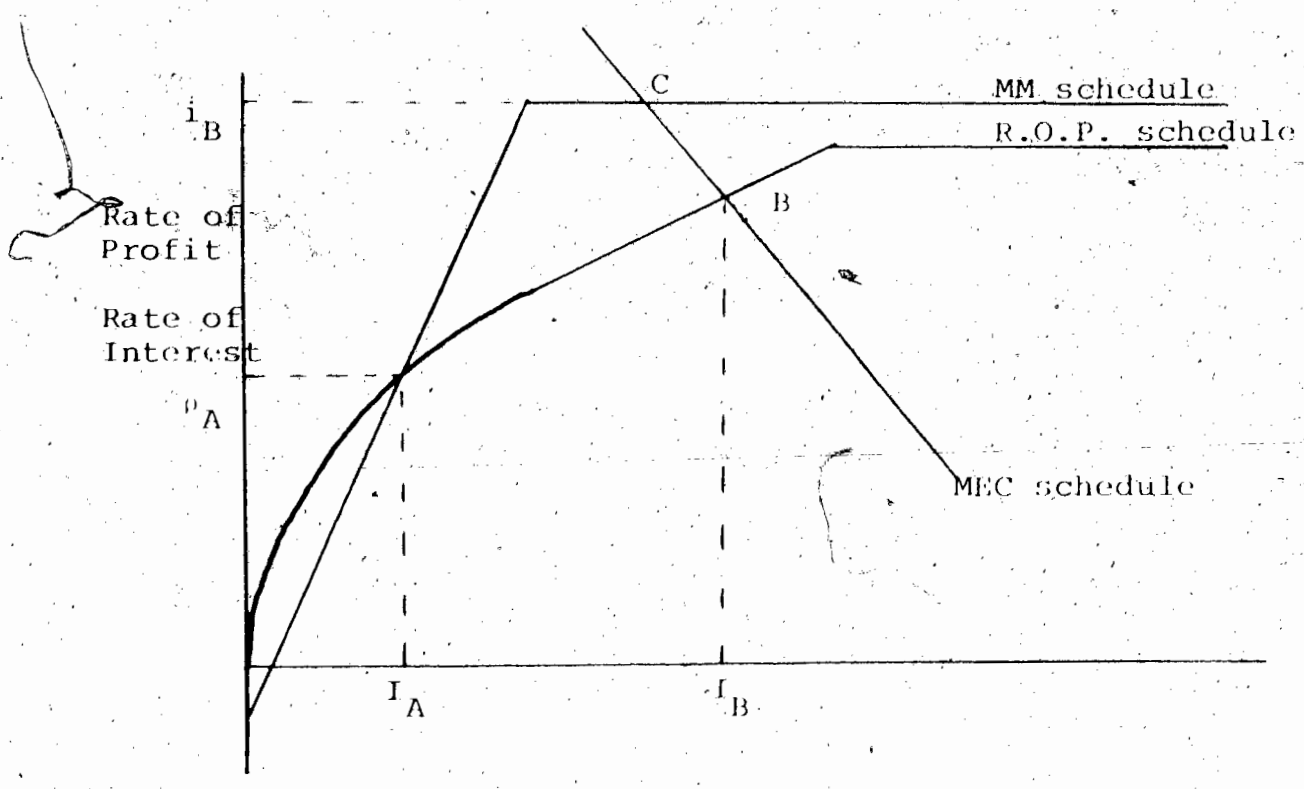

Figure 4

of investment equal to I_B, then the MEC schedule will cut the R.O.P. schedule at B. At I_B the demand for money is high enough to drive the rate of interest up to i_B. Since the rate of profit on physical assets is less than i_B, entrepreneurs will attempt to cut back investment along the marginal efficiency of capital schedule at point C (the point C representing the level of investment at which entrepreneurs expect to earn a rate of profit equal to the ruling rate of interest on bonds). Of course, when investment is cut back, the marginal efficiency of capital schedule will shift to the left and there will be further cutbacks in investment. For any negative slope of the MEC curve, investment will fall to I_A where the MM schedule cuts the R.O.P. schedule. As noted above, the steepness of the slope of the MEC schedule will affect the speed of adjustment.

In Figure 5, a level of investment associated with the MM schedule lying below the R.O.P. schedule is

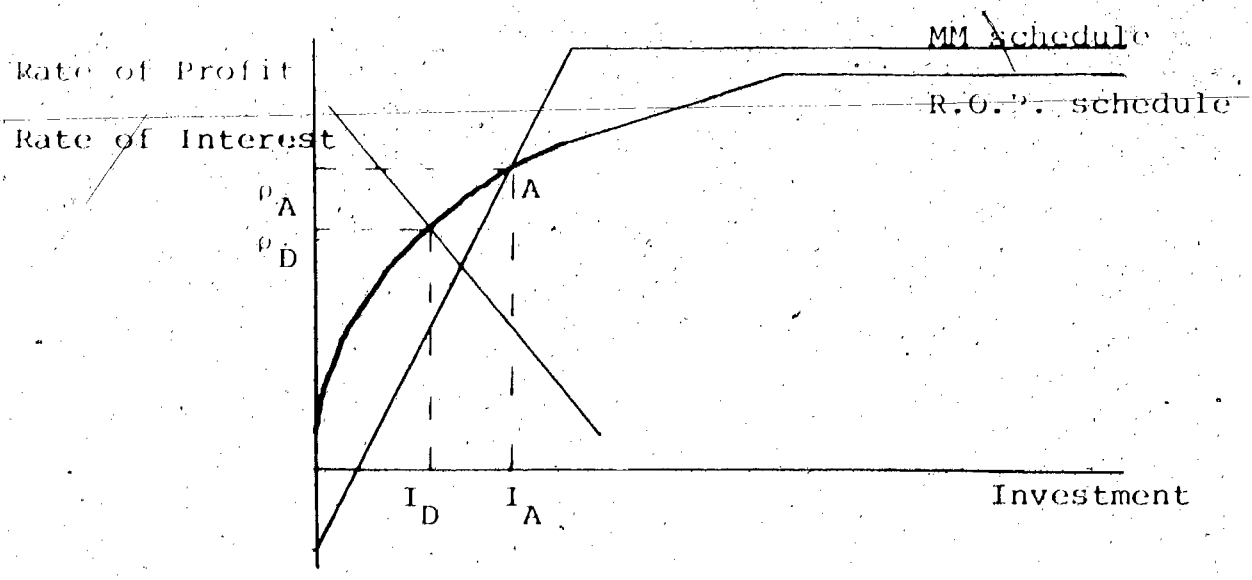

Figure 5

considered. Inspection of Figure 5 will reveal that investment will tend to increase from I_D to I_A.

From these two cases, it may be concluded that whenever the money market schedule lies above (below) the rate of profit schedule, investment will fall (rise).

The position of equilibrium depicted in Figures 4 and 5 depended on an arbitrarily determined location of the two schedules and on the unrealistic assumption of the behavior of the monetary authority. In fact, these two factors are related. To drop the assumption concerning the change in the nominal money stock means that movements in the absolute price level will affect the position of the money market curve and thus, the position of combined money market and product market equilibrium. In order that the impact of price flexibility may be isolated, it will be assumed that the nominal money supply is fixed.

If the nominal money supply is fixed, then an increase in the price level will reduce the real money supply. In order that demand for real balances be reduced to this level, it is necessary that for any level of investment, the rate of interest be higher. Thus, inflation will raise the money market schedule. Conversely, deflation will lower the schedule. (It should be noted that the price changes referred to here are not expected price changes.)

The practice of relating changes in the price level to the level of employment and aggregate demand will be adopted here. If aggregate demand is below the full employment level, i.e. the economy is in the Keynesian region, then the price level will be assumed to fall. If aggregate demand is greater than the minimum level necessary to generate full employment, i.e. the economy is in the Neo-Keynesian or Inflation Barrier regions, then it will be assumed that the price level rises. At the "just full employment" position, i.e. on the boundary of the Keynesian and Neo-Keynesian regions, the price level will be assumed constant. This is, of course, a polar case of the Phillips curve analysis of inflation.

Using the rule of inflation described above, there are a number of possible positions of the MM and R.O.P. schedules which need to be analyzed. The first case to be considered is where the MM schedules lies below the R.O.P. schedule. This is illustrated in Figure 6. Investment will tend to rise from whatever position the economy starts from and so the economy will move into either the Neo-Keynesian region or the Inflation Barrier region. The price level will rise, reducing the real money supply and raising the MM schedule. The MM schedule will rise until the rate of interest exceeds the rate of profit. If the

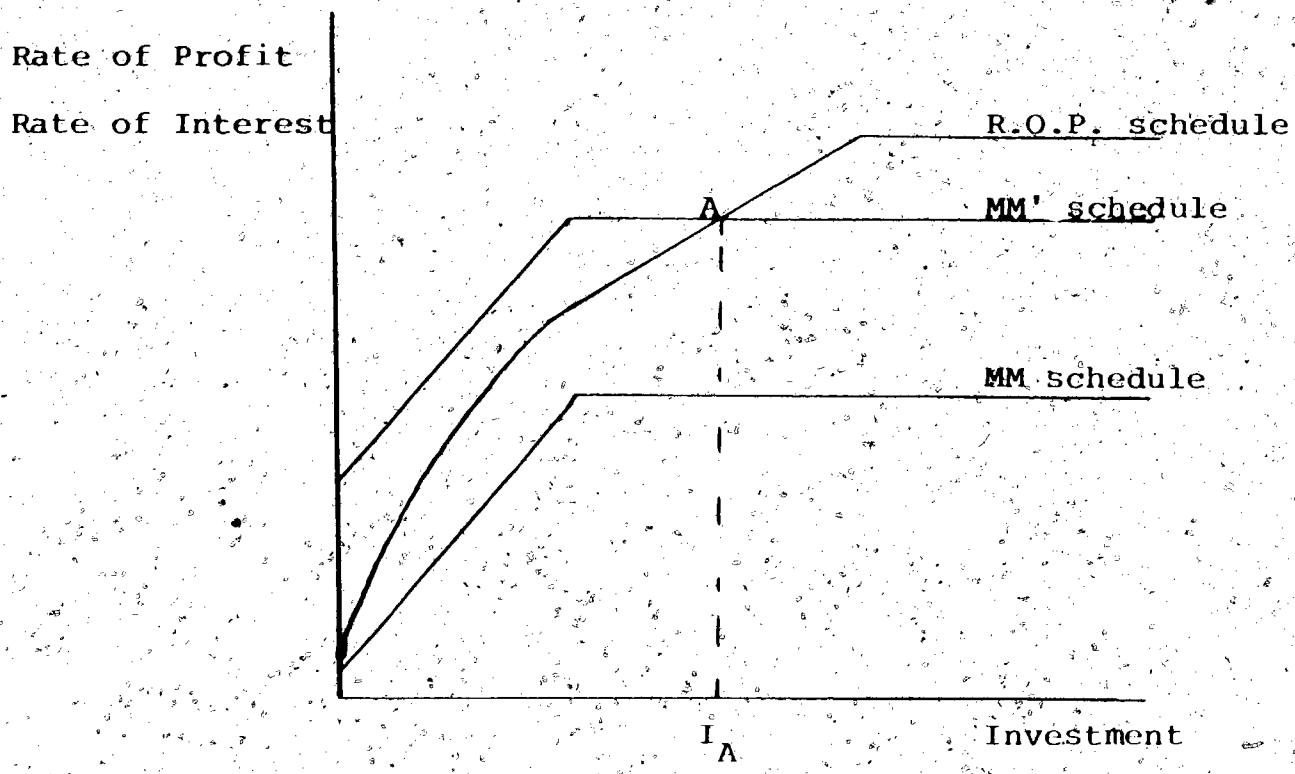

Figure 6

MM schedule rises rapidly relative to the increase in the level of investment, i.e. if the rate of inflation is high, then at a position like point A in Figure 6 where investment is less than I_A, the rate of interest will exceed the rate of profit. Investment will cease to rise and start to fall. If investment increases rapidly relative to the shift in the MM schedule, it will still be the case that eventually, if the nominal money supply is fixed, the rate of interest will exceed the rate of profit because of the

upper limit that the Inflation Barrier region puts on the rate of profit.

Thus, from a position where the MM schedule lies below the R.O.P. schedule, market forces lead to a rise in the MM schedule to a position where the MM schedule is above the R.O.P. schedule. Then the aggregate level of investment will start to fall and the economy will approach the Keynesian region. Once the Keynesian region is reached, the price level will start to fall and thus, the MM schedule will fall. This can lead to several different results depending on the relative slopes of the MM and R.O.P. schedules.

One possibility is illustrated in Figure 7, where the MM schedule has fallen to a position tangential to the R.O.P. schedule at the just full employment position (point A). If investment is less than I_A, then there will be a tendency for investment to rise. That is, as soon as the MM schedule falls below the R.O.P. schedule at the current level of investment, investment will rise. Since it is necessary for the MM schedule to pass through a position like MM' to get to the tangential position, investment will have started to rise before the tangential position is reached. The MM schedule will still be falling since there is a positive level of unemployment. In consequence,

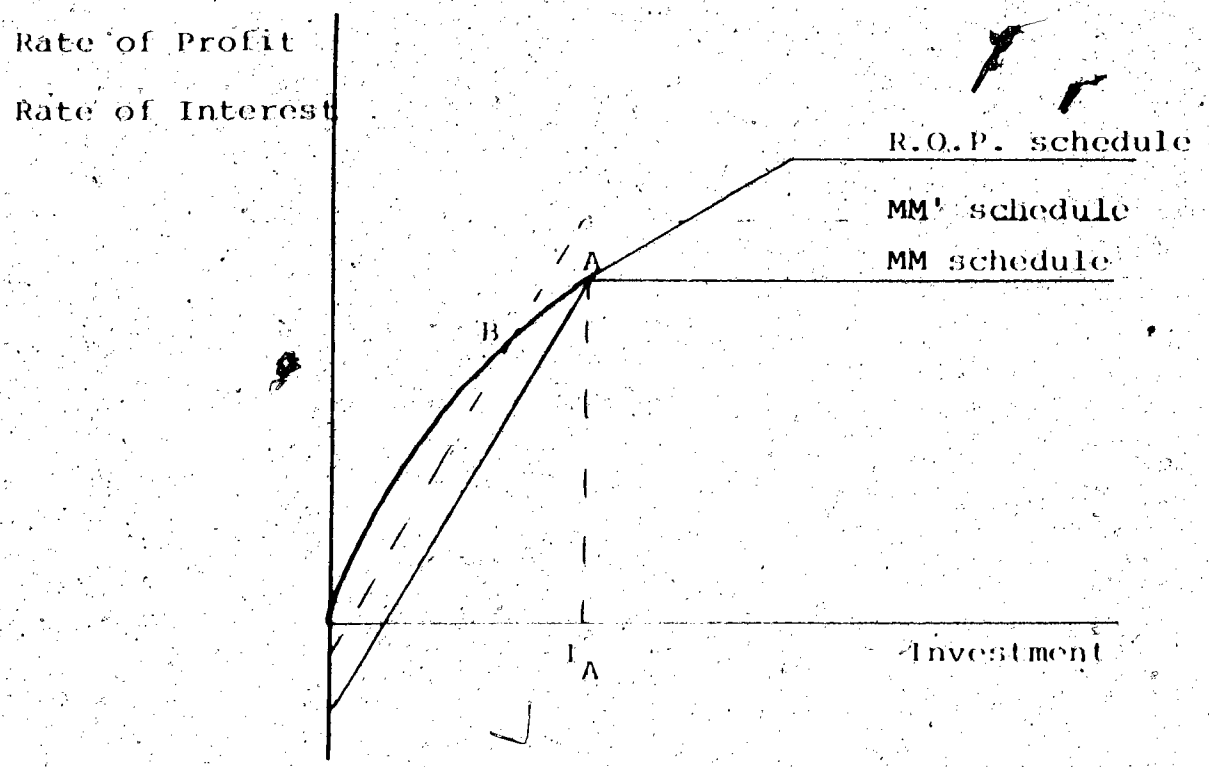

Figure 7

it is possible that investment just reaches the full employment level I_Λ as the MM curve reaches the tangency position. Then the rate of price change would be zero, the MM curve will be stationary and the fluctuations in the aggregate variables will have stopped. However, this is only a possibility. If investment increases slowly, it may be less than I_Λ when the MM schedule reaches the tangency position and so the MM schedule will continue to fall. When investment eventually reaches the full employment level, the MM schedule will be below the R.O.P.

schedule and the economy will move into the Neo-Keynesian region. The subsequent course of events will be described by the process analyzed above, i.e. the case where the MM schedule lies completely below the R.O.P. schedule.

In the event that the slope of the MM schedule is not less than the R.O.P. schedule and thus lies below the R.O.P. schedule in the Keynesian region when the two schedules are in the tangency position, it was shown above that cyclical behavior of aggregate variables can result. In these circumstances then, the theory becomes a theory of the business cycle. The ceiling or upper turning point is caused by the demand for money bidding up the rate of interest above the rate of profit. It was argued that this result was likely to emerge because the Inflation Barrier region put an upper limit on the rate of profit. The lower turning point or floor was caused by the rate of interest falling by more than the rate of profit and thus, stimulating investment. Thus, the business cycle is caused by the effect of the rate of profit and the rate of interest on the aggregate level of investment.

There are forces which may weaken or even completely remove the upper and lower turning points. For the upper turning point, two major factors come to mind. Firstly, there is the possibility that entrepreneurs expectations

of future price changes are increased by the positive rate of inflation experienced in the Neo-Keynesian and Inflation Barrier regions. An increase in the expected rate of inflation will shift the R.O.P. schedule upwards and, because of the increase in the opportunity cost of holding money, shift the MM schedule downwards. This will prolong the upswing. However, the positive rate of inflation will continue to reduce the real value of the money supply and so force up the rate of interest. The effect of inflation on the money supply is continual. The effect of expected inflation on the R.O.P. and MM schedules is a once and for all effect. Thus, the adjustment of expectations will only prolong the boom temporarily. Eventually, there will be a downturn, since eventually the rate of interest will exceed the rate of profit.

The monetary authority can prevent the rise in the rate of interest by increasing the money supply. A continual increase in the nominal money supply will prevent the MM schedule from rising and thus, prolong the boom. Such a policy would be difficult to follow in practice because of the problems of predicting changes in price expectations. Thus, in a boom situation, a positive rate of inflation will gradually influence the expected rate. The consequent shifts in the R.O.P. and MM schedules will

lead to increases in the level of investment and aggravate the inflationary situation. If the monetary authority could predict these shifts, then it may be able to offset them by reducing the rate of increase of the nominal money supply. If, on the other hand, the monetary authroity acts too late, then its reduction in the rate of increase of the nominal supply will occur at the time when the higher rate of inflation has been allowed to reduce the real money supply. The upward effect on the rate of interest would be larger than anticipated and could be large enough to exceed the rate of profit and lead to a downturn. Only if the expected rate of inflation, the actual rate of inflation and the rate of increase of the money supply are all equal will an inflationary solution to the R.O.P. and MM schedules be constant over time.

At low levels of income, the upturn described above was caused by the fall in the rate of interest to a point below the rate of profit. The extent of the fall in the rate of interest was a result of the assumption that the MM schedule fell to a position where it was completely below the R.O.P. schedule when the two schedules were tangential at the full employment position, i.e. the position depicted in Figure 8. However, it is possible that the slope of the MM schedule be less steep in the Keynesian region and this could affect the upturn.

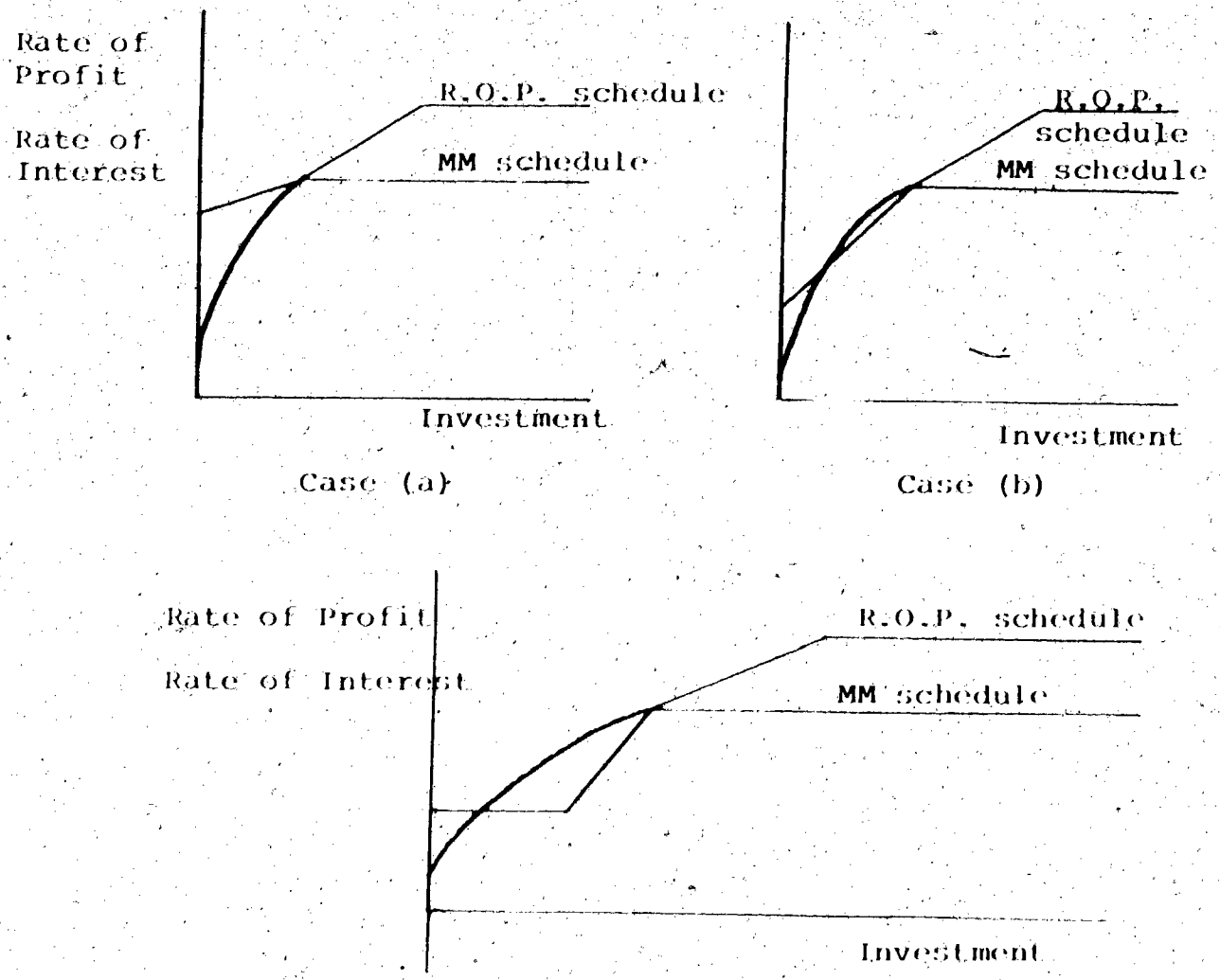

Figure 8

The slope of the MM schedule in the Keynesian region is affected by the interest elasticity of the demand for money. The greater this elasticity, the less steep the slope of the MM schedule. If the elasticity is infinite, i.e. a liquidity trap exists, then the slope of the MM

schedule becomes horizontal. In figure 8, three cases are presented. In case (a) the elasticity of the demand for money is sufficiently high for the MM curve to lie above the R.O.P. curve throughout the Keynesian region. In case (b) the elasticity of money demand is slightly lower and so the MM schedule lies above the R.O.P. schedule for only part of the Keynesian region. In case (c) the MM schedule includes a liquidity trap - it is horizontal at a low level of the rate of interest.

It was demonstrated above that if the MM schedule is above the R.O.P. schedule, then the level of investment will fall. If the schedules have these position in the Keynesian region, then the economy will collapse at low levels of income. In case (a) the collapse will occur if investment falls below the "just full employment" level. As soon as unemployment appears, a major recession results. Such a high degree of instability is most probably unusual for capitalist economies. Cases (b) and (c) are more realistic in that there is a "point of collapse" which exists at a positive level of unemployment. Provided unemployment doesn't fall below this critical level, the downswing will be halted by interest rate flexibility. However, if this level of unemployment is exceeded, then the relative inflexibility of the rate of interest will lead to a major depression.

Cases where the MM schedule lies above the R.O.P. schedule for some part of the Keynesian region correspond to the cases Keynes analyzed in the "General Theory." Investment is low, the rate of profit is low, the marginal efficiency of capital is depressed, unemployment is high, and there is an excess demand for money. The effectiveness of an expansion in the money supply, whether caused by the actions of the monetary authority or the effects of deflation, will depend on how far it lowers the MM schedule. The lower the MM schedule, the further to the left is the point where it intersects the R.O.P. schedule and so the higher unemployment has to be for investment to fall. As the MM schedule falls, the "point of collapse" shifts to the left. However, the existence of a liquidity trap may bring the fall of the MM schedule to an end and thus, prevent the "point of collapse" from moving to the left. Monetary expansion would be ineffective.

In as far as a rate of deflation induces expectations of further price level changes, the situation is aggravated. The R.O.P. schedule will shift down if expectations of falls in the price level are increased and the MM schedule will shift upwards. The "point of collapse" will move to the right increasing the area where market forces tend to reduce the level of investment and intensify the depression. The only conceivable offsetting force will be the real balance effect. It would appear unlikely that this would be strong enough.

A change in the propensity to save out of profits will clearly affect the rate of profit schedule. An increase (decrease) in the propensity will lower (raise) the slope of the schedule. This clearly follows from the equation of the schedule on Page 52. Thus, in as far as the wealth effect stimulates expenditure when there is a fall in the price level, the ROP schedule will be raised and investment will be stimulated. As noted above, this positive impact on the level of expenditure has to compete with the negative impact due to the adjustment of expectations concerning the future course of prices.

The impact of a change in government spending, or indeed a change in any other exogenously determined element of aggregate demand, eg. exports, will be to shift the entire ROP schedule. An increase (decrease) in expenditure will raise (lower) the schedule. Furthermore, it should be noted that it has been implicitly assumed that the rate of profit referred to on the vertical axis is that rate expected to be earned from investment. If taxes were incorporated into the model, then it would be the rate of profit after tax that would appear on the vertical axis.

A government policy designed to alter the rate of tax paid out of profits will have two effects on the ROP schedule. Firstly, a tax reduction will raise the expected

rate of profit to be earned from a given stream of future gross profits. Secondly, if the propensity to save is less than one, a reduction in taxes on profits will reduce the withdrawals from the circular flows of income (since some of the previously taxed profits will be spent) and act as a stimulus both to income and profits. Thus, for two reasons a reduction in profit taxes will stimulate the rate of profit.

The Keynesian view that in a depressed economy, fiscal policy is a more powerful tool than monetary policy for ending a depression would appear to be supported by the analysis presented here. Monetary expansion will lower the money market schedule and will thus, push the threshold point to the left. However, whether this point will move sufficiency far to guarantee recovery is open to doubt. The existence of a liquidity trap will tend to reduce the size of the leftward shift. On the other hand, a government deficit emerges as a powerful tool. Not only are there the direct effects due to the multiplier process, but there is also a stimulation in demand due to a rise in the rate of profit. A unit of government deficit spending is equivalent to a unit of investment spending in its ability to raise the rate of profit by a movement along the rate of profit schedule. Thus, investment will

be stimulated by an increase in the government deficit and this will lead to additional multiplier effects.

Monetaristis have argued that the money supply is a determinant of the level of consumption expenditures. In as far as this effect exists, an increase in the money supply will have a stimulative effect on aggregate demand and will raise the level of income associated with a given level of investment. The rate of profit schedule will be raised. This would tend to increase the power of monetary policy.

The analysis presented here is a distinct improvement upon the IS-LM analysis. The explicit analysis of the determinants of the rate of profit provides a superior analytical basis. Furthermore, the conclusions appear more in accord with Keynes' original analysis. Keynes went to great lengths to demonstrate the instability of a capitalist economy. He argued that in a depression, market forces were such as to intensify the economic chaos. The conclusion of instability and of the existence of forces whose depressing tendencies remain unabated is not the conclusion of IS-LM analysis. IS-LM analysis has a rather static nature when compared with Keynes' original analysis. Its positions of equilibrium are fixed. Once the economy reaches them, there are no forces tending to disrupt further

the level of economic activity. The analysis presented here suggests that the attainment of a short run equilibrium which lasts for any length of time is not guaranteed. At both high and low levels of aggregate demand, the likelihood exists that there are forces which will change the level of economic activity. Fluctuations appear as the major conclusion. Whether these fluctuations are damped or not, emerges as somewhat of an open question for downward fluctuations and rather more likely for upward fluctuations.

In more sophisticated versions of IS-LM analyses, an accelerator specification is included in the investment function, eg. Dernburg and Dernburg. The inclusion of a positive relationship between investment and the level of income goes some way towards capturing the effects of the analysis of this chapter. If the accelerator coefficient is very high, it is possible for the IS curve to slope upwards and intersect the LM curve from below. Under such a configuration of curves, the intersection point will be unstable. However, the economy will be in a knife edge position and income levels, in response to a disturbance, will rise to infinity or fall to zero. The knife edge result is very different from the fluctuations which result from the ROP analysis. Fluctuations could be derived from a sophisticated IS-LM model if the accelerator coefficient was allowed to vary as income varied. But how could such

variations be justified? Only by an appeal to the behaviour of the rate of profit. Without an explicit analysis of the rate of profit, it must be argued that such variations would represent "ad hoc" theorizing.

The shape of the rate of profit schedule relies heavily on the negative relation between the level of income and the real wage rate. Recent theoretical and empirical work, Solow and Stights, Darro and Grossman, Kuh, Dodkin, has cast doubt on the speed with which real wage rates will adjust to a change in income. Solow and Stights have introduced the concept of monetary equilibrium which is of shorter run derivation than short run equilibrium. In monetary equilibrium, they argue that the real wage rate is fixed. It follows that the rate of profit schedule for monetary equilibrium will be horizontal. Changes in investment will have no initial impact on the rate of profit. However, as the new short run equilibrium position is approached, the horizontal schedule will be shifted along the short run ROP schedule. Thus, the inclusion of monetary equilibrium will tend to slow down the speed of response of the rate of profit to changes in the level of investment.

The implications for the rate of profit schedule/MM schedule analysis of allowing for a lagged response of real wages to changes in the level of income are as follows.

If the economy is at any position other than the just full employment position, then, because of changes in the absolute price level, the MM curve will be either rising or falling. This will cause fluctuations in income even if a momentary horizontal ROP schedule exists. The only difference will be that fluctuations will be slower. There is no reason to think they will be of a smaller size. If the economy is at the "just full employment" position as depicted in Figure 7, then the conclusion that such a position is stable from below but not from above remains. The momentary ROP schedule is horizontal and is thus coincident with the MM schedule at levels of investment which are greater than the "just full employment" inducing level. Thus, an exogenous increase in investment from the just full employment position will leave both the rate of interest and the rate of profit unchanged. They remain equal to each other and so entrepreneurs will be content to maintain the higher level of investment. But if this higher level is maintained, the wage rate will eventually be affected and the momentary run ROP schedule will rise (i.e. move up the short run schedule). The rate of profit will rise and exceed the rate of interest. Entrepreneurs will now attempt to increase investment further and the economy will move further away from the just full employment position.

Recent empirical studies have cast doubt on the existence of an instantaneous negative relation between the level of income and the real wage rate. However, two points can be raised. Firstly, these studies often use the consumer price index as a wage deflator. But this is not the real wage referred to in the rate of profit equation. The relevant price index is that of all goods produced, not just consumer goods. The use of the latter price index yields results which are more consistent with the hypothesis of a negative relation between income and the real wage. Secondly, none of the tests used a lagged specification of the relationship. From the argument above, it would appear that if there is a lagged response of real wages to income, then the use of a momentary run schedule is suggested. The use of this schedule was shown to not alter the conclusions of the ROP/MM analysis in a qualitative sense.

CHAPTER VI

THE INSTALLATION OF CAPITAL

The theory of the rate of profit developed in Chapters IV and V followed the conventional "Keynesian" practice of ignoring the impact on aggregate variables of the installation of new investment goods. The relation between the rate of profit and investment was derived from the effect on aggregate demand of the level of aggregate investment. Clearly, once investment goods are installed, they will make a contribution to aggregate output and thus affect the other aggregate variables and the rate of profit. It is the aim of this chapter to analyze the consequences for the rate of profit of an incremental change in the capital stock. Changes in the nature of the whole capital stock will be dealt with in Chapter VII.

The analysis of capital accumulation is usually conducted from a long run, steady-state perspective. That is to say, only paths of exponential growth of the capital stock are considered. In short run models, where variables are usually allowed to fluctuate and are not restricted to exponential paths, the effect of capital accumulation is ignored. This situation could well be described as a dichotomization of macro-economics between the long run and the short run. In the long run, it is the aggregate supply schedule which dominates whilst in the short run, it is the aggregate demand schedule which receives all the attention.

The weakness of this dichotomization is that there is no way of determining whether the theories are consistent. It is conceivable that the short run behavior predicted by a short run theory is such that the long run factors never assert themselves. For example, consider Professor Samuelsons' conception of the "Neo-Classical Synthesis" which is asserted to reconcile Neo-Classical economics and Keynesian economics. The central proposition is that if the government keeps the economy at the full employment level of output by the judicious use of Fiscal and Monetary Policy, then, the long run neo-classical theorems hold. But since the proposition has not received any systematic attention, it is impossible to assess the realism of its central assumption. How accurate does the government have to be? Assuming it does not have to be "spot on" and keep employment exactly at the full employment level, what are the ranges of government action? Is it the case that neo-classical theorems are less appropriate, the greater the fluctuations in employment or is there a boundary effect? - outside of which neo-classical analysis is rendered useless and inside of which neo-classical theory emerges unscathed.

The elegance of long run growth theory has lead to its use in the analysis of short run problems. In Chapter IV, it was demonstrated that the attempt to approach short run problems from a long run perspective can give misleading results.

In this chapter, it will be shown that the long run approach yields false conclusions even for the intermediate run. (The intermediate run is where the capital stock is allowed to vary but only the immediate impact of the variations are considered. Only marginal changes in the capital stock are considered. The final long run consequences of a permanent change in the rate of accumulation will be analyzed in Chapter VII.) The intermediate run corresponds to adjustment paths between steady state growth paths. Most of the analysis of these adjustment paths has assumed that the long run neo-classical theory of the rate of profit holds along these paths. e.g. Solow 1956, Purvis 1973. This assumption is unwarranted and, by the explicit analysis of the intermediate run, is shown to be misleading.

In terms of the real world, it would appear that the intermediate run is the most appropriate. The capital stock does change in size but not at a constant rate. The concepts of short run and of long run are extremely useful, especially as a way of ordering ideas. However, as descriptions of the real world, their value is mitigated by the extreme nature of their assumptions. A more realistic theory would allow for some capital accumulation, but not necessarily at a rate which is constant over long periods of time. The concept of the intermediate run is a step in this direction.

The Demand Effect and the Installation Effect

When an order for an investment good is placed, this leads to the employment of men and machines to produce the investment good. This, in its turn, leads to an increase in consumption and changes in other aggregate variables which reach their new levels when planned savings is equal to the new level of investment. This is the "demand effect of investment." Its implications for the rate of profit were explored in Chapters IV and V. However, there comes a time when the investment good is installed and used, with labour, to produce output. By making a contribution to aggregate output and by changing the pattern of employment, the machine will affect aggregate price relationships and then, the rate of profit. This effect will be called the "installation effect of investment."

Every investment good has associated with it, at the beginning of its life, a demand effect and an installation effect. The relation between these two effects for an aggregate level of investment depends on the speed with which investment goods are produced and installed. Investment is a flow variable and so, implicit in its definition is a unit of time. During this unit of time, a certain proportion of the investment goods demanded in the aggregate will be installed. This proportion is labelled B (where $0 < B \leq 1$). If B were one, then investment goods would be installed as soon as they

were demanded - production would be instantaneous. The longer it takes to produce and install machines, the smaller is B.[1] The analysis of Chapters IV and V was conducted on the assumption that B equalled zero. i.e. the installation effect was excluded.

The introduction of a positive quantity of newly installed capital implies an analytical distinction between labour employed and output produced on new capital and output and labour associated with older capital in existence before the time period under consideration. If the subscripts (o) and (n) are used to appropriately designate variables, then, formally;

L_n = Labour employed on new capital.

L_o = Labour employed on old capital.

Y_n = Output produced on new capital.

Y_o = Output produced on old capital.

Aggregate profits, Π, can also be split between profits earned on new capital and profits earned on old capital. Thus;

$$1 \qquad \Pi = \Pi_n + \Pi_o$$

Since it will be assumed that the propensity to

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[1] If B is less than one, then, in any time period some of the investment goods ordered in previous time period(s) will be installed. However, in this chapter, past levels of investment and thus the existing capital stock are taken as datum. Previously ordered investment goods which are currently being installed can be considered as part of the existing capital stock. Their effect on the rate of profit is thus part of the effect on the rate of profit of the existing capital stock and will be analyzed in Chapter VII.

save out of profits is the same regardless of which capital the profits are earned from, then;

$$2 \qquad S = s_c \Pi = s_c (\Pi_n + \Pi_o)$$

The savings investment equality;

$$3 \qquad P\ I = S$$

Thus;

$$4 \qquad P\ I = s_c (\Pi_n + \Pi_o)$$

Profits earned on old capital will be equal to the output of old capital less the wage bill paid to labour on old capital. In real terms;

$$5 \qquad \frac{\Pi_o}{P} = Y_o - \left(\frac{w}{p}\right) L_o$$

Similarily for new capital;

$$6 \qquad \frac{\Pi_n}{P} = Y_n - \left(\frac{w}{p}\right) L_n$$

Output on new capital is equal to the number of investment goods installed (B I) times output per investment good, a. Labour on new capital is equal to the number of investment goods installed times men required to operate a new investment good, b. Thus, 6 becomes;

$$7 \qquad \frac{\Pi_n}{P} = B\ I\ a - \left(\frac{w}{p}\right) B\ I\ b$$

Thus, the investment-saving equality implies;

$$8 \qquad I = s_c \left(B\ I\ a - \left(\frac{w}{p}\right) B\ I\ b + Y_o - \left(\frac{w}{p}\right) L_o\right)$$

This general expression can now be used for the analysis of the Keynesian, Neo-Keynesian, and Inflation Barrier

region in a similar fashion to Chapter IV in order to derive a relation between the rate of profit and the level of investment.

In the Keynesian region, output on old capital is related to the labour employed on old capital by the production function;

9 $\quad Y_o = f(L_o)$

The real wage rate is determined by the marginal product of this production function (i.e. by the output per man of the oldest capital good in use).

10 $\quad \frac{w}{p} = f'(L_o)$

Substituting 9 and 10 into 8;

11 $\quad I = s_c(B\ I\ a + f'(L_o)B\ I\ b + f(L_o) - f'(L_o)L_o)$

12 $\quad \therefore I(1 - s_c\ B\ a + s_c\ B\ b\ f'(L_o)) = s_c(f(L_o) - f'(L_o)L_o)$

13 $\quad \therefore \frac{I}{s_c} = \frac{f(L_o) - f'(L_o)L_o}{1 - s_c\ B\ a + s_c\ B\ b\ f'(L_o)}$

Totally differentiating expression 13;

14 $\quad dI\{1 - s_c\ B\ a + s_c\ B\ b\ f'(L_o)\}^2 = dL_o s_c\{(f'(L_o) - f''(L_o)L_o - f'(L_o))(1 - s_c\ B\ a + s_c\ B\ b\ f'(L_o)) - (f(L_o) - f'(L_o)L_o)(s_c\ B\ b\ f'(L_o))\}$

15 $\quad \frac{dL_o}{dI} = \frac{(1 - s_c\ B\ a + s_c\ B\ b\ f'(L_o))^2}{s_c\{-f''(L_o)L_o\ (1-s_c\ B\ a+s_c\ B\ b\ f'(L_o)) - (f(L_o) - f'(L_o)L_o)\ s_c\ B\ b\ f''(L_o)\}}$

Since $f(L_o) - f'(L_o)L_o = \Pi_o > 0$, then, by inspection of equation 13 it follows that if investment is positive;

$$1 - s_c B a + s_c B b f'(L_o) > 0;^2$$

Futhermoré, $f''(L_o) < 0$ by assumption. From these considerations, it follows that;

$$\frac{dL_o}{dI} > 0$$

Since the total derivative, $\frac{dL_o}{dI}$, of equation 13 is positive, it follows that the inversion of the function 13 is monotonic and may be written;

$$16 \qquad L_o = g(I)$$

where

$$17 \qquad \frac{dL_o}{dI} = g'(I) > 0$$

From the relation between the level of investment and the level of employment on old machines, the real wage rate can be determined. From the marginal productivity condition (expression 10);

$$18 \qquad \frac{w}{p} = f'(L_o) = f'(g(I))$$

$^2 1 - s_c B a + s_c B b f'(L_o)$ may be written as $1 - s_c B(a-b f'(L_o)$. $a-b f'(L_o)$ are the one period quasi rents expected to be earned by a new machine. Since this is a one good world where the one good serves as either a consumption good or an investment good, the expression $a-b f''(L_o)$ determines one period quasi rents measured in terms of the machine earning the quasi rents. It would be unrealistic to consider new machines which earned more than their total value per period - such high rates of return are not very common. Thus it is reasonable to assume that; $a-b f'(L_o) < 1$ from which it follows that; $1 - s_c B(a-b f'(L_o)) > 0$ since; $s_c B < 1$.

Having determined the behavior of the real wage rate, the rate of profit may be evaluated. Since;

19 $\rho = a - b\left(\frac{w}{p}\right)$ (from Chapter IV)

By substituting 18 into the definition of the rate of profit, 19, a relation between the rate of profit and the level of investment can be obtained;

20 $\rho = a - b\, f'(g(I))$

Clearly,

21 $\frac{d\rho}{dI} = -b\, f''(g'(I))$

Since $g'(I) > 0$ and $f''(L_o) < 0$, $\frac{d\rho}{dI} > 0$.

Thus the rate of profit is still positively related to the level of investment when the effect of the installation of capital is taken into account. To attempt a better understanding of the independent effect of capital accumulation, consider the parameter β. If β were zero, there would be no capital installation and so the rate of profit equation should reduce to the expression derived in Chapter IV. If β is greater than zero, capital is installed - the higher is β, the greater the amount of capital installed out of a given level of investment demand.

To analyze the effect of β on $\frac{d\rho}{dI}$ substitute 14 into 21;

$$22 \quad \frac{d\rho}{dI} = -b \frac{f''(L_o)}{s_c} \frac{(1 - s_c B(a-b f'(L_o))^2}{-f''(L_o) (L_o(1 - s_c B(a-b f'(L_o) - s_c B b (f(L_o) - f'(L_o)L_o)}$$

$$= \frac{+b}{s_c} \frac{(1 - s_c B}{+L_o(1 - s_c B(a-b f'(L_o)) + \frac{(a-b f'(L_o))^2}{s_c B b(f(L_o) - f'(L_o)L_o)}}$$

$$23 \quad = \frac{b}{s_c} \frac{1 - s_c B(a-b f'(L_o)}{L_o + \frac{s_c B b (f(L_o) - f'(L_o)L_o)}{1 - s_c B(a-b f'(L_o))}}$$

As β increases, the numberator falls, i.e.;

$$24 \quad \frac{d(1 - s_c B(a-b f'(L_o))}{d\beta} = -s_c(a-b f'(L_o))$$

Rewriting the denominator as;

$$25 \quad L_o + \frac{s_c b(f(L_o) - f'(L_o)L_o)}{\frac{1}{\beta} - s_c(a-b f'(L_o)}$$

Then, as β rises the denominator rises, i.e.;

$$26 \quad \frac{d\left[L_o + \frac{s_c b(f(L_o) - f'(L_o)L_o)}{\frac{1}{\beta} - s_c(a-b f'(L_o)}\right]}{d\beta}$$

$$= \frac{+s_c b(f(L_o) - f'(L_o)L_o)\beta^{-2}}{\left[\frac{1}{\beta} - s_c(a-b f'(L_o))\right]^2}$$

$$= > 0$$

Thus, as β rises, the value of the derivative of the rate of profit with respect to the level of aggregate investment falls. Furthermore, if β were equal to zero, equation 22 becomes;

27. $$\frac{d\rho}{dI} = \frac{b}{s_c \bar{L}_o}$$

Obviously, if $B = 0$, $L_o = \bar{L}$, i.e. there can be no employment on new machines if none are installed. Thus, if $B = 0$, then the rate of profit equation becomes the same as in Chapter IV. This constitutes a useful check on the results. Furthermore, it may be concluded that in the Keynesian region the impact of investment of the rate of profit is positive but is smaller if the effect of the installation of capital goods is included.

In the Neo-Keynesian region, the relationship between investment and profits implies;

28 $$\frac{I}{s_c} = \Pi = f(\bar{L}_o) - \frac{w}{p}\bar{L}_o + B\,I\,a - \frac{w}{p}B\,I\,b$$

29 $$\therefore \frac{w}{p}(\bar{L}_o + B\,I\,b) = f(\bar{L}_o) + B\,I\,a - \frac{I}{s_c}$$

30 $$\therefore \frac{w}{p} = f(\bar{L}_o) + I\left(B\,a - \frac{1}{s_c}\right)$$

Clearly;

31 $$\frac{d\left(\frac{w}{p}\right)}{dI} = \frac{\left(B\,a - \frac{1}{s_c}\right)(\bar{L}_o + I\,B\,b) - I\left(B\,a - \frac{1}{s_c}\right)B\,b}{(\bar{L}_o + I\,B\,b)^2}$$

$$= \frac{\left(B\,a - \frac{1}{s_c}\right)(\bar{L}_o + I\,B\,b - I\,B\,b)}{(\bar{L}_o - I\,B\,b)^2}$$

$$32 \quad \therefore \quad \frac{d\left(\frac{w}{p}\right)}{dI} = \frac{\left(B\,a - \frac{1}{s_c}\right)\bar{L}_o}{(\bar{L}_o - I\,B\,b)^2}$$

$$\therefore \quad \frac{d\left(\frac{w}{p}\right)}{dI} \quad 0 \text{ if } \frac{1}{s_c} \quad B\,a$$

Since 'a' is the output per machine of new machines and 'B' is the proportion of new machines installed, 'Ba' can be considered as the output effect of a certain level of current investment. That is, Ba represents the addition to output of a unit of investment demand. $\frac{1}{s_c}$ is the demand effect of a unit of investment. For an increase in investment to have a downward effect on the real wage, it is necessary that the installation effect does not completely outweigh the demand effect. This reduces to the requirement that output per machine is less than $\frac{1}{s_c B}$. The lowest value that $\frac{1}{s_c B}$ can take is one. i.e. when both s_c and B take their highest values, one. Since it is a one good model, the requirement can be interpreted as the output from an investment during one unit of time must be less than the equivalent of the investment good itself. i.e. the capital/output ratio must be greater than one. This is consistent with the empirical evidence of industrialized capitalist societies (see e.g. the evidence in Hill 1964).

Using expression 19, the rate of profit schedule for the Neo-Keynesian region becomes;

$$33 \qquad \rho = a - b\,\frac{f(\bar{L}_o) + I\left(B\,a - \frac{1}{s_c}\right)}{\bar{L}_o + I\,B\,b}$$

$$34 \qquad \frac{d\rho}{dI} = -\,\frac{\left(B\,a - \frac{1}{s_c}\right)\bar{L}_o}{(\bar{L}_o - I\,B\,b)^2}$$

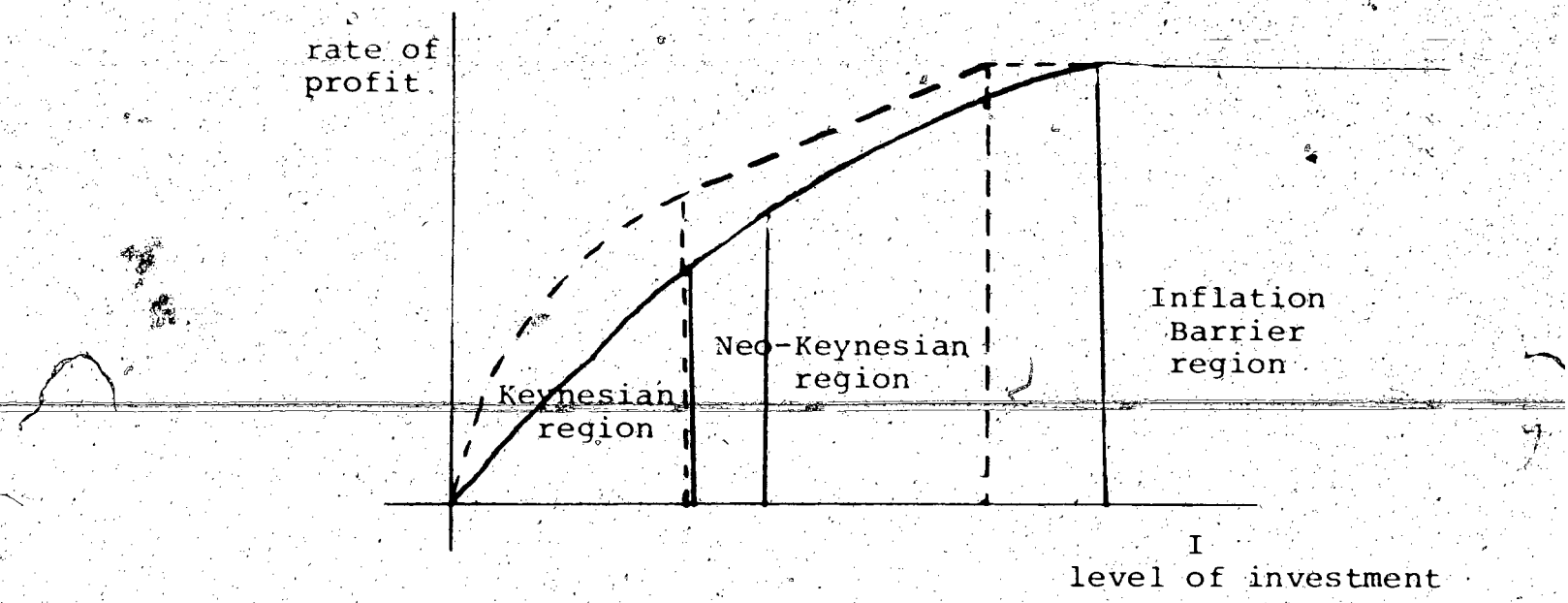
Clearly, $\frac{d\rho}{dI} > 0$ if $\frac{1}{s_c} > Ba$.

If B = 0, then it is easy to see that equations 33 and 34 reduce to the Neo-Keynesian region equations with no installation effect derived in Chapter IV, P. Since $\left(Ba - \frac{1}{s_c}\right) < 0$ the greater is B; the smaller is the rate of profit for a given level of investment and the smaller is the increase in the rate of profit for a given increase in the level of investment.

The Inflation Barrier region is characterized by a real wage rate which is inflexible downwards - the real wage rate has reached its minimum and is invariant to changes in the level of investment. When capital installation is introduced, there is a possibility that an increase in investment would so raise productive capacity as to raise the real wage rate and bring the economy out of the inflation barrier region into the Neo-Keynesian region. However, for this to happen, it would be necessary that output per machine were greater

than $\frac{1}{s_c B}$ - the same condition which was necessary for the derivative of the real wage with respect to investment to be negative in the Neo-Keynesian region and which was rejected for being unrealistic.

Thus, the effect of introducing the installation of capital goods into the analysis is for the rate of profit to be lower for any level of investment, except where the rate of profit reaches its maximum in the inflation barrier region. As investment increases, the upward effect on the rate of profit is reduced because the installation of new machines reduces the increase in the number of old machines necessary to meet the increase in aggregate demand and thus, reduces the fall in the real wage rate. The installation effect, taken on its own, is negative. Furthermore, the greater the quasi-rents earned by new capital, the greater the negative installation effect. If the quasi-rents per machine in the Keynesian region, or the output per machine in the Neo-Keynesian region are greater than unity, then the installation effect will more than offset the demand effect and the rate of profit schedule will be downward sloping in the Keynesian and Neo-Keynesian regions. However, it was argued above that rates of return and incremental output-capital ratios are never observed high enough to lead to such a case. Thus, we can conclude that for the intermediate run the rate of profit schedule is upward sloping.



The dashed line represents the R.O.P. schedule with no installation effect, i.e. B = 0.

It may also be noted that by allowing for the installment of capital, the R.O.P. schedule has a diminishing slope in the Neo-Keynesian region (when B = 0, it is a constant slope) and that the boundaries the regions are moved to the right (In Figure 1, the dashed boundaries refer to the "no installation effect" curve and the solid boundaries to the curve which includes the installation effect).

In Neo-Classical Theory, the rate of profit is determined by the relative quantities of capital and labour. In the theory presented here, it is the level of investment demanded and installed which is the determining variable. It is important to inquire at this stage whether the two theories are consistent. Does an increase in investment, which in the short run model here implies an increase in the rate of profit, lead to a fall in the capital labour ratio?

Firstly, let us consider the Neo-Keynesian region. Here, employment is invariant to changes in the level of investment and so the question above becomes "does the 'size' of the aggregate capital stock fall as investment rises?" Such a result would seem paradoxical but it is still worthwhile to check. An increase in investment of ΔI will lead to the installation of $B\ \Delta I$ new machines. To man these machines, some old machines will be scrapped. The number of old machines scrapped will depend on the labour requirement of old machines. If the labour requirement is greater on old than on new machines (i.e. if the labour/capital ratio has fallen over time) then the aggregate machine labour ratio will rise as investment rises. A falling labour/capital ratio is observed for industrialized economies. Of course, if the reverse were the case and old machines were more capital intensive than new machines, the aggregate capital/labour ratio will fall as investment rises. Of course, this

approach assumes that old and new machines can be added. If their market value is used instead, the impact on the aggregate capital/labour ratio depends on the capitalized value of profits per man on old and new machines. This will be greater on new machines for two reasons.

1. New machines have a longer expected life than old machines.

2. Quasi-rents on new machines are greater.

Thus, measured at historic cost, the relationship between the capital/labour ratio and the current level of investment is ambiguous for the Neo-Keynesian region. When measured at its present value cost, the relationship is positive.[3] Furthermore, if the empirical experience of industrialized economies is appealed to, it is likely that the capital/labour ratio increases with investment.

In the Keynesian region, an increase in investment will lead to an increase in employment, so a somewhat different argument will be necessary. The number of old machines scrapped is determined, not by the labour constraint, but by the savings-investment identity. An increase in

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[3] It is possible that Wicksell effects could reverse the result in the case of the present value approach, i.e. the rise in the rate of profit might offset the increase in expected quasi rents and reduce the capital/labour ratio. Since the change in machine life is included, it seems extremely unlikely that the Wicksell effect would be that strong and so this possibility will be ignored. In view of the comments below and Harcourt 19[72], it would be intriguing if the Wicksell effect were that strong.

investment (ΔI) will lead to a rise in savings and thus, a rise in profits $\left(\frac{\Delta I}{s_c}\right)$. Part of the rise in profits will be generated by the installation of new machines $\left(\Delta I \; B \left(a-b \; \frac{w}{p}\right)\right)$. The remainder will be generated by a fall in the wage rate and the reintroduction of old machines into the productive process. Given that some old machines are reintroduced, they will have an effect on the aggregate capital/labour ratio. Whether the aggregate ratio falls depends on the capital/labour ratio of old and new machines and their relation to the average capital/labour ratio. If the present value measure is used, old capital will be worth little (by the argument used above) and will have a depressing effect whilst new capital will be worth a lot. If historic cost is used, then the figures are datum. The overall effect on the aggregate capital/labour ratio is ambiguous for both measures. The rate of profit definitely rises.

Thus, in the intermediate run, the nature of the relation between the rate of profit and the capital/labour ratio is:

1. Either positive or ambiguous in the Neo-Keynesian region depending on the method of evaluating the aggregate capital stock.

2. Ambiguous for the Keynesian region.

3. For the Inflation barrier region, the rate of profit is constant whereas the capital/labour ratio varies

because of the same arguments that apply to the Neo-Keynesian region.

These resuls cast considerable doubt on the validity of the Neo-Classical approach of determining the rate of profit by using a measure of the capital stock. The relation between the capital/labour ratio and the rate of profit can be positive in all three regions. Only by chance will it be negative. The conclusion one must draw from this is that the Neo-Classical analysis of the rate of profit is inappropriate for the analysis of intermediate run problems. This is, of course, a reflection of the argument of Chapter III. The Neo-Classical theory is derived from the assumption of general or dynamic equilibrium. When an attempt is made to derive the theory from different equilibrium assumptions, i.e. those of the intermediate run, it is possible that different results will emerge. The argument of this chapter shows this possibility to be a probability.

CHAPTER VII

THE ACCUMULATION OF CAPITAL

A positive relationship between the rate of profit and the level of investment was demonstrated in Chapters IV and V. This relationship was shown to be positive even when the initial impact of the installation of capital goods is taken into account. However, it was also shown in Chapter VI that the installation effect of capital goods, taken on its own, has a negative effect on the rate of profit. The use of the intermediate run in Chapter VI allowed the analysis to take into account some degree of variation in the capital stock - specifically the addition of new capital and the scrapping of old capital, which may also be described as the effect of the substitution of new capital for old capital. As is clear from the analysis of Chapter VI, the impact on the rate of profit of the installation of new capital depended, to some extent, on what was called old capital stock. It will be remembered that the concept of the level of aggregate profits earned on old capital was crucial to the argument of Chapter VI. The nature of the old capital plays a role, then, in determining the rate of profit. For this reason, it is valuable to investigate this role. That is the purpose of this chapter.

It was argued above (Chapter II) that the Neo-Classical Theory of the rate of profit was dependent upon the assumption of capital malleability. This assumption was considered highly restrictive and emerged as a major reason for the need to develop an alternative theory of the rate of profit. This theory, developed in Chapters IV, V, and VI, was not dependent upon the assumption of malleability. Thus, the non-malleability of capital is a key assumption of this thesis.

If capital is not malleable, then its technological characteristics are fixed once it is produced. Throughout its life, the output and the labour requirement of a machine remain constant (ignoring depreciation) and thus, the entrepreneur is incapable of changing them. This feature of capital goods implies that if there is any improvement over time in technology, then for these improvements to be realized, new machines embodying them have to be built. If a machine of a particular degree of capital intensity cannot be changed to a machine (or even part of a machine) of a different capital intensity, then it is reasonable to argue that a machine cannot be changed to a newer machine (or even part of a newer machine) over time. Thus, the technological characteristics of machines reflect the state of the arts at the moment they are built. At any point in time, the capital stock will be composed

of a number of machines of different ages and thus, different productivities. This is, of course, the vintage model of capital accumulation.

If the capital stock is composed of a set of vintages or layers of capital goods, then the level of aggregate output capable of being produced and the aggregate quantity of labour needed to man the capital stock will depend upon the number of machines of each vintage and their technological parameters. The number of machines of a vintage will depend on the level of investment in the time period that vintage was constructed. Thus, in the aggregate, output and employment will be affected by the profile of investment over time, or the history of investment. Formally, this may be written;

$$1 \qquad Y_t = \int_{t-T}^{v=t} a(v)\, I(v)\, dv$$

where

Y_t = Aggregate output at time t.

$a(v)$ = Output per machine of vintage v.

$I(v)$ = Number of machines of vintage v.[1]

T = Age of oldest (least productive) vintage in use.

The level of employment may also be related to the capital stock by;

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[1] Or level of investment at time t-v.

$$2 \qquad L_t = \int_{t-T}^{v=t} b(v)\ I(v)\ dv$$

where

L_t = Aggregate level of employment at time t.

$b(v)$ = Labour requirement to operate one machine of vintage v.

The existing capital stock affects the aggregate variables via the nature of the time profile of investment, $I(v)$, and by the nature of the technical coefficients, $a(v)$ and $b(v)$. In Chapters IV, V, and VI, the effect of the current level of investment on the rate of profit was examined. In this chapter, the effect of a whole history of levels of investment, i.e. past and present levels of investment, will be examined. This will give this chapter a longer run perspective relative to previous chapters. Instead of comparing different levels of current investment only, different levels of both current and past investment will be analyzed. The question to be answered is what is the effect on the rate of profit of different levels of capital accumulation? This is the natural continuation of earlier chapters where only the short run and intermediate run effects of changes in the level of investment were considered. Now the long run effects of permanent changes in the level of investment will be considered.

Since a long run framework of analysis is being used in this chapter, a statement of the time profiles of aggregate variables must be made. As an approximation of the empirical experience of industralized societies, a long run trend rate of increase of investment, population growth and output per man will be assumed. This will make the results comparable with the results of growth theory. The trend rate of increase of investment will be assumed constant and equal to g. Investment at any time, v, I(v), will be given by the following relation;

$$3 \qquad I(v) = I_o \, e^{gv}$$

where

I_o = Aggregate level of investment at time zero.

g = Rate of growth of investment.

The comparison will be between different levels of capital accumulation, not different rates of accumulation. Thus, the exogeneous variable will be I_o. The technique of analysis will be "comparative dynamic" in that values of the rate of profit for different steady state paths of investment will be compared (cf. Hahn and Mathews 1964, p. 781. Definition - "What must the values of the variables be if steady state equilibrium is to be achieved?... These are questions of comparative dynamics.") The assumption of an exponential path of investment is used because

it will simplify the analysis. Since the theory of the rate of profit developed here is not restricted to steady state paths, the consequences of relaxing the assumption of a constant growth rate can and will be examined. The use of a constant growth rate is made because it can be a benchmark for the analysis of more complex time paths, e.g. the analysis of the business cycle path of investment will be undertaken at the end of this chapter.

The time paths of the technological characteristics of investment goods, that is of output per machine at time v, a(v), and of the labour requirement per machine at time (v), b(v), for all v, must be specified. Here again, constant exponential rates will be assumed. The labour requirement per machine will be assumed to fall at a constant exponential rate, λ, i.e.;

$$4 \qquad b(v) = b_o e^{-\lambda v}$$

To attach a time trend rate of increase to the output per investment good parameter would imply that quasi rents earned in one time period from the investment good would exceed unity at some future time period. This would conflict with the experience of industrialized economies (remember that in the first time period of the machine's life, its output can have the same characteristics as the machine itself - that is, the machine's output can be more

machines which are exactly the same as the machine itself. Thus, if quasi rents per machine were greater than unity, the machine would more than pay for itself in one time period.) So it will be assumed that output per machine is invariant with respect to time, thus;

$$5 \qquad a(v) = a_o$$

Under these assumptions about the nature of technical progress and the time path of investment, the aggregate level of output at any time t can be written;

$$6 \qquad Y_t = \int_{t-T}^{v=t} a_o I_o e^{gv} dv$$

$$7 \qquad \therefore Y_t = \frac{a_o I_o}{g} e^{gt} (1-e^{-gT})$$

Similarly, aggregate employment at time t will be;

$$8 \qquad L_t = \int_{t-T}^{v=t} b_o e^{-\lambda v} I_o e^{gv} dv$$

$$9 \qquad \therefore L_t = \frac{b_o I_o}{g-\lambda} e^{(g-\lambda)t} (1-e^{-(g-\lambda)T})$$

The equation for the rate of profit has to be modified to take into account the existence of technical progress. The definition of the rate of profit is still that rate of discount which equalizes the present value of a new investment good with its price. If it is assumed

that entrepreneurs expect the prices of output and labour ruling at time t to remain constant over the future, then the rate of profit at time t will be the solution value of ρ_t for the following expression;

$$10 \quad P'_t = \int_t^{v=t+T^*} (P_t a_o - b_o d^{-\lambda t} w_t) e^{-\rho_t (v-t)} dv$$

$$= (P_t a_o - b_o e^{-\lambda t} w_t) \int_t^{v=t+T^*} e^{-\rho_t (v-t)} dv$$

$$= P_t a_o - b_o e^{-\lambda t} w_t \quad \frac{1-e^{-\rho_t T^*}}{\rho_t}$$

For notational convenience, P_t will be set equal to unity (this practice will be followed for the remainder of this chapter). Then;

$$\frac{\rho_t}{1-e^{-\rho_t T^*}} = a_o - b_o e^{-\lambda t} w_t$$

Provided it is assumed that the expected life of new investment goods, T*, is unaffected by the level of investment, it makes no difference to the argument to allow T* to approach infinity. Then, $e^{-\rho_t T^*}$ approaches zero, and;

$$11 \quad \rho_t = a_o - b_o e^{-\lambda t} w_t$$

Thus, the variable to be determined in order that the rate of profit be calculated is w_t, the real wage rate at time t. To analyze the real wage rate, the labour market analysis of Chapters III, IV, and V will be cast into the long run growth context of this chapter. Thus, the three specifications, the Keynesian, Neo-Keynesian and the Inflation Barrier specifications, will be maintained.

It will be seen that the three specifications are rather less convincing as descriptions of labour supply and labour demand behavior for long periods of time than for short periods of time. The weaknesses that emerge when the change in time horizon is made will be noted. Furthermore, the implications of adopting assumptions which are more realistic when a long period of time is considered will be drawn.

It will be remembered that the Keynesian region exists when there is involuntary unemployment. Under such circumstances, the assumptions of the Keynesian literature were used, that is, that the labour supply is infinitely elastic at the money wage rate and that, due to individual worker's efforts to maintain their standard of living relative to other workers and/or inelastic expectations about the future course of wages, the money wage rate is

inflexible downwards. This latter assumption is questionable in a long run context and will be returned to later. Under these assumptions, the demand behavior of entrepreneurs dominates the labour market. If entrepreneurs are profit maximizers and are in a perfectly competitive product market, they will set the price of their output equal to its marginal cost. In consequence, the wage rate will be equal to the output per man of the least efficient machine in use. Thus, the wage rate will be determined by the following relation;

$$12 \qquad w_t = \frac{a_o}{b_o \, e^{-\lambda(t-T)}}$$

In this relation, it is seen that the real wage rate is a function of the year of construction, t-T, of the oldest machine in use at time t.

By substituting equation 12 into the equation for the rate of profit, 11, the following equation is obtained;

$$13 \qquad \rho_t = a_o - \frac{b_o \, e^{-\lambda t} \, a_o}{b_o \, e^{-\lambda(t-T)}}$$

$$= a_o - a_o \, e^{\lambda T}$$

14 $$\therefore \rho_t = a_o(1-e^{\lambda T})$$

Thus, the rate of profit at any moment in time varies only as the age of the oldest machine in operation varies. In consequence of this, the only way a change in the capital stock following from a change in the initial level of investment can affect the rate of profit is by affecting T, the age of the oldest machine in use. In fact, it is easy to show that T is invariant in the long run to changes in I_o provided there is never an excess demand for labour, i.e. provided the economy is always in the Keynesian region.

The aggregate level of profits is defined as;

15 $$\Pi_t = Y_t - w_t L_t$$

Each of these magnitudes, aggregate output, Y_t, the real wage rate, w_t, and aggregate employment, L_t, can be related to the capital stock. This has, in fact, been done above in equations 7, 9, and 12. By substituting these expressions into 15, the aggregate level of profits can be related to the capital stock.

$$\Pi_t = \frac{a_o I_o}{g} e^{gt} (1-e^{-gt}) - \frac{a_o}{b_o} \frac{I_o b_o e^{(g-\lambda)t}}{e^{-\lambda(t-T)}(g-\lambda)} (1-e^{-(g-\lambda)T})$$

$$= \frac{a_o I_o}{g} e^{gt} \left[1-e^{-gT} - \frac{g}{(g-\lambda)e^{\lambda T}} + \frac{g e^{-(g-\lambda)T}}{(g-\lambda) e^{\lambda T}} \right]$$

$$16 \quad \therefore \Pi_t = \frac{a_o I_o e^{gt}}{g} \cdot \frac{(g-\lambda+e^{-gT}(1-g+\lambda)-e^{-\lambda T})}{(g-\lambda)}$$

However, not only are profits related to the capital stock, but they are also related to the current level of investment via the savings-investment identity. Since a fixed proportion, s_c, of profits are saved, there is a linear relation between profits and the level of investment, i.e.;

$$17 \quad \Pi_t = \frac{I_t}{s_c} = \frac{I_o e^{gt}}{s_c}$$

This relation is derived independently of expression 16 above. However, in any position of long run equilibrium, both must hold. Thus, the right hand sides of both expressions may be equated;

$$18 \quad \frac{I_o e^{gt}}{s_c} = \frac{a_o I_o e^{gt}}{g} \cdot \frac{(g-\lambda+e^{-gT}(1-g+\lambda)-e^{-\lambda T}}{g-\lambda}$$

$$19 \quad \therefore e^{-gT}(1-g+\lambda)-e^{-\lambda T} = (g-\lambda)\frac{1-s_c a_o}{s_c a_o}$$

From 19, it is seen that the age of the oldest machine in use is related to g, λ, s_c, and a_o, and is independent of the level of investment in the base year, I_o.

The reason that T is independent of the level of investment in long run equilibrium is that, by only allowing I_o to vary arbitrarily and keeping the subsequent rate of growth constant, the effect of generating a new time profile of the capital stock can be described as just changing the position of the economy on the old time profile. Consider Figure 1 where the function $I(v) = I_o e^{gv}$ is plotted.

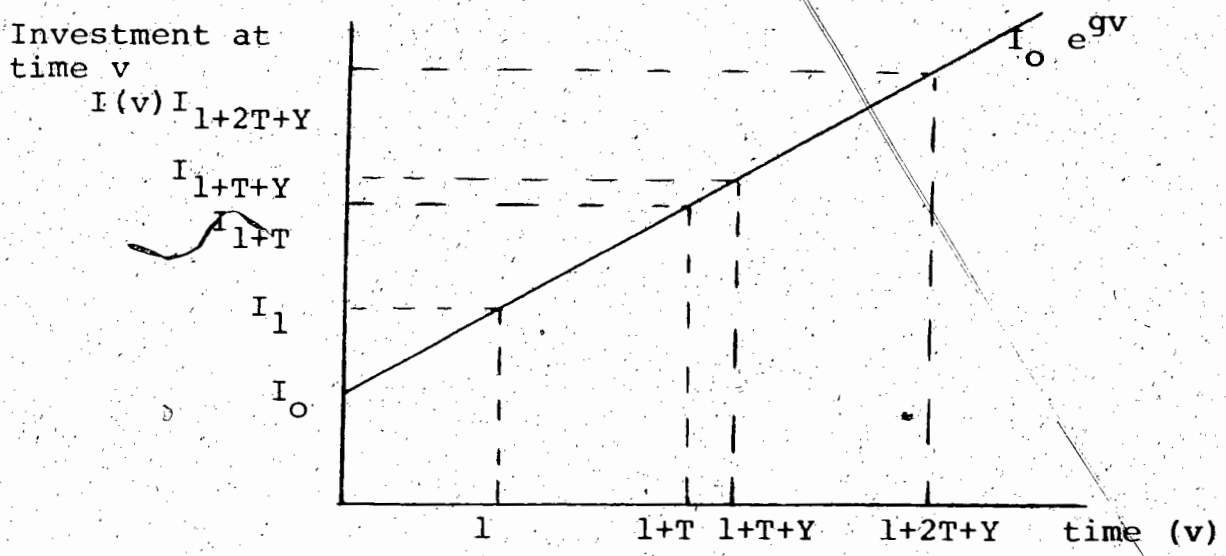


Figure 1

A capital stock profile is T time periods of that path, e.g. the segment from I_1 to I_{1+T}. Clearly, all time profiles of capital stocks that grow at rate g will lie somewhere on the graph of $I_o e^{gv}$ whatever their base year

level of investment. Thus, to move from one profile to another is to move along the path; to move to another segment of the path. For example, an increase in the base period investment from I_1 to I_{1+T+Y} will lead to a change in the capital stock profile from the segment between 1 and 1+T to the segment between 1+T+Y to 1+2T+Y. If at time 1+T, there were an increase in the level of investment, over and above the trend rate g, to I_{1+T+Y}, then, by time 1+2T, i.e. T periods later, the economy would have a capital stock represented by the segment between 1+T+Y and 1+2T+Y. Thus, the net effect of the increase in investment would be that the economy would arrive at 1+2T+Y, Y periods in advance of when it would have got there with no arbitrary increase in investment.

It is a well known property of a vintage model, that on a steady state growth path where technical progress is Harrod neutral, the age of the oldest machine in use is constant (Solow, et. al. 1966 and Bliss 1968). It is this proposition which was demonstrated on pages 114 and 115. Since T is unaffected, in the long run, by a change in the base year level of investment, the rate of profit will also be unaffected in the long run. This is apparent from inspection of equation 14. Thus, wherever the economy is in the Keynesian region, i.e. whatever the level of aggregate demand, the long run value of the rate of profit

is constant. In the long run, when there is an excess supply of labour, the rate of profit is determined by the parameters that determine T, i.e. from equation 19, g, λ, s_c, a_o.

It was shown in Chapters IV and VI that the initial effect of an increase in the aggregate level of investment is to raise the rate of profit when there is an excess supply of labour. It has now been shown that in the long run, when there is an excess supply of labour, the rate of profit is independent of the level of investment. These conclusions may be combined to give a complete picture of the impact over time of an increase in the level of investment. Initially, the rate of profit will rise in response to the increase in aggregate demand. This is shown in Figure 2 as the initial jump at t_1 of the rate of profit from ρ_o to ρ_1. Following this initial jump, the installation of capital at the higher rate will have a negative effect on the rate of profit, even although the level of aggregate demand is sustained at the new high level by the high level of investment. This was demonstrated in Chapter V. The final outcome resulting from the juxtaposition of these two effects is that the rate of profit returns to its original level, ρ_o. This will occur exactly T time periods after the initial disturbance since T time periods

will be taken for that part of the capital stock that is in use to be replaced at the new higher level of investment. This follows directly from the argument of this chapter.

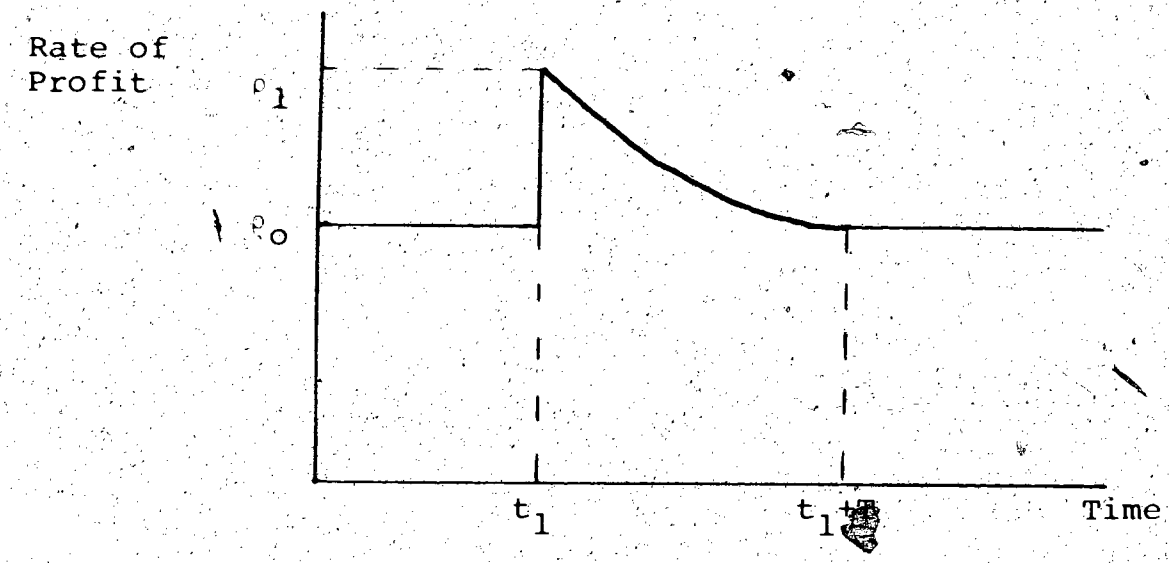


Figure 2

These conclusions are dependent on an excess supply of labour. This amounts to assuming that not only must the labour force exceed the demand for labour at any particular time, but also that the rate of growth of the labour force(n) must be at least as great as the rate of growth of investment(g), less the rate of growth of output per man(λ). That is;

$$n \geq g - \lambda$$

where

n = Rate of growth of the labour force.

This puts an upper limit on the growth rate of investment if the economy is to stay in the Keynesian region. If g exceeds $n+\lambda$, then the demand for labour will eventually outrun the supply. The resulting situation of an excess demand for labour will put the economy in the Neo-Keynesian region. The Neo-Keynesian region will be examined below.

If g were less than $\lambda+n$, then the proportion of the labour force unemployed would grow. As time approached infinity, the unemployment rate would approach 100%.

In a long run framework, then, the consequences of allowing the rate of growth of investment to differ from the rate of growth of the labour force plus the rate of growth of output per man are to take the economy out of the Keynesian region or to lead to a continual expansion in the proportion of the labour force unemployed. For the former case, the analysis of the Neo-Keynesian region becomes relevant - for the latter case, the existence of an ever increasing pool of unemployed would lead either to changes in other parts of the model, e.g. in the labour market, which would eliminate the difference between g and $\lambda+n$ or to the demise, via revolution, of profit maximizing entrepreneurs. This is the rationale when dealing

with long run questions for using capital stock profiles which have the same rate of growth of investment.

If there is an excess demand for labour, then the economy is in the Neo-Keynesian region. In this region, the constraint of the labour force means that excess demand in the product market cannot be eliminated by an increase in supply. Only prices are free to vary. In consequence, prices of output are bid up over and above marginal cost. The resulting increase in profits leads to an increase in savings which tends to reduce the excess demand in the product market. Prices will be bid up above marginal cost until the profits so generated are sufficiently high to eliminate the excess demand. Thus, for an economy in the Neo-Keynesian region, the real wage rate will be below the output per man on the least efficiency equipment in use.

On the other hand, in contrast to the negative effect on the real wage rate of the forces of aggregate demand, there is a positive effect on the real wage rate due to the higher rate of growth of the capital stock. The higher level of investment leads to a larger number of machines of each vintage. Because of the full employment constraint, the existence of more machines of each vintage means that the number of vintages in use must fall. Thus,

the age of the oldest machine in use will be lower, the higher the rate of investment and, its output per man, higher. Also, of course, the average age of the capital stock will fall and the average productivity (as measured by output per man) will rise. This effect, a supply side effect, will tend, on its own, to raise the wage rate.

Thus, there are two forces operating in opposite directions, on the wage rate. The overall effect, or net effect, can be deduced by considering the following argument. If supplies of labour were unlimited and did not represent a constraint on output, then the economy would be in the Keynesian region and the real wage rate would be unaffected, in the long run, by the level of investment. In other words, the demand and supply effects on the real wage rate would exactly cancel each other out. Now, taking the Keynesian case as a benchmark, suppose the supply of labour is reduced so that it becomes a constraint on output, which puts the economy in the Neo-Keynesian region. If the real wage stayed constant, there would be a reduction in aggregate profits since the (exogenous) reduction in the labour force entails the retirement of machines earning positive quasi rents (profits). This is the meaning of the full employment constraint. Some profitable equipment is left lying idle because there are no men to man it. Since the aggregate level of profits falls, the aggregate level of savings fall. But this means that

investment exceeds savings and so violates the product market clearing condition. The excess demand so generated will lead to a rise in product prices and a fall in the real wage. Thus, for the Neo-Keynesian case, the net effect on the real wage must be negative for equilibrium to hold in the product market. Thus, the net effect, in the long run, on the rate of profit will be positive.

This process is illustrated in Figure 3 which represents a "snapshot" of the economy at a particular moment in time. The graph of output per man is drawn under

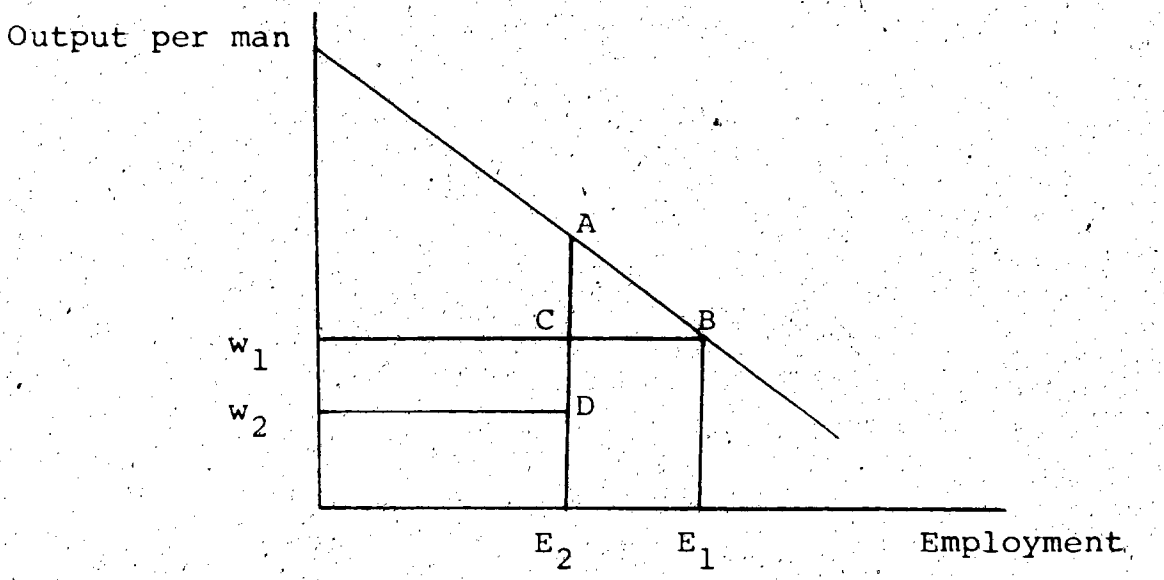


Figure 3

the assumption that the whole capital stock corresponds to a certain initial level of investment, I_o, which has

been growing at the exponential rate g. If there were no employment constraint, the mixture of perfect competition and the saving behavior of entrepreneurs would lead to a level of employment E_1 and a real wage rate of w_1 (this would be the Keynesian case at a moment in time). Now, suppose that instead of there being plenty of labour, there is a maximum level of employment imposed on the economy exogenously equal to E_2. The level of investment is kept the same. If the real wage rate remained at w_1, then aggregate profits would fall by the area ABC, which is the profits earned on machines which are now lying idle because there is no one to run them. But saving will have fallen by a proportion s_c of ABC and would be less than investment if the real wage rate w_1 prevails. Hence, output prices and profit margins will be bid up until savings equals investment. The real wage will fall. It will fall until the area w_1w_2DC is equal to the area ABC. This represents the addition to aggregate profits due to a fall in the real wage rate necessary to offset the loss of aggregate profits due to the reduction in employment.

Thus, the long run position of the real wage rate is lower in the Neo-Keynesian case than it would have been had there been no employment constraint and the Keynesian results had prevailed. Inspection of equation 11, the

definition of the rate of profit will reveal the conclusion that the rate of profit will be higher in the Neo-Keynesian case than in the Keynesian case. Furthermore, by an extension of the argument, it is easy to see that the higher the level of investment, the higher will be the rate of profit in the long run.

The time profile or complete history of the behavior of the rate of profit following a sustained increase in the level of investment will be slightly different in the Neo-Keynesian region than the Keynesian region (the Keynesian case was described above). The Neo-Keynesian case is illustrated below in Figure 4. The initial impact

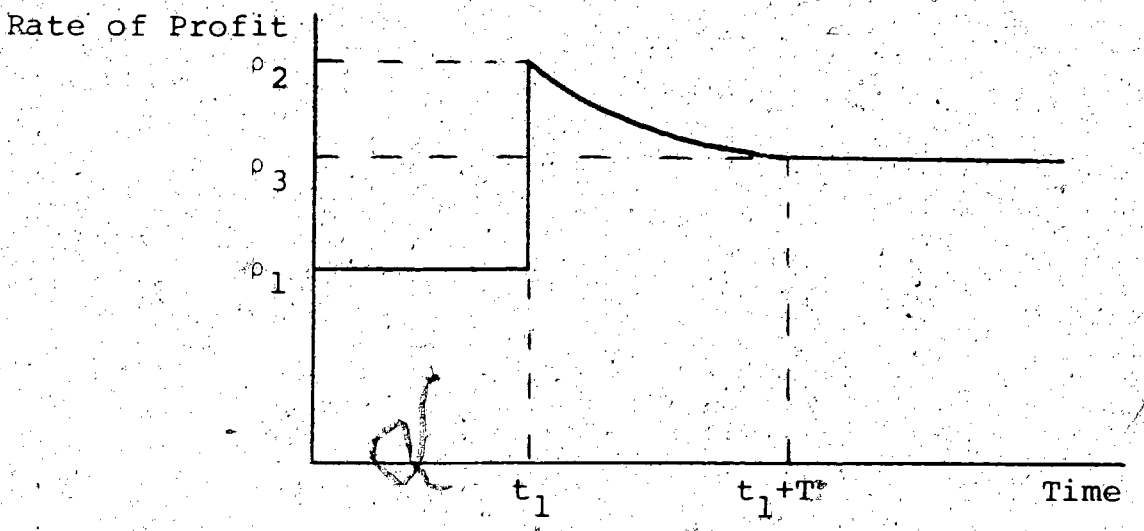


Figure 4

on the rate of profit will be positive. Thus, at time t_1, an increase in the level of investment will raise the rate of profit from ρ_1 to ρ_2. Then the higher rate of

installation of capital will reduce the rate of profit from ρ_2 down to ρ_3^* which is the long run rate which will be reached T time periods after the initial increase. At t_1+T, the capital stock has fully adjusted to the higher rate of accumulation. The difference between this profile and the Keynesian case is that the final long run value of the rate of profit is higher than the long run Keynesian case. In the Keynesian case, the final long run rate of profit is the same as the initial long run rate of profit. In the Neo-Keynesian case, it is higher.

The boundary of the Keynesian and Neo-Keynesian regions is well defined in the growth context so long as the sum of the growth of the labour force and the rate of Harrod neutral technical progress is equal to the rate of growth of investment. However, the specification of the rate of labour force growth and Harrod neutral technical progress is not sufficient to define a boundary between the Neo-Keynesian and Inflation Barrier regions which is invariant to time. In the Inflation Barrier region, the real wage is postulated to have hit its minimum - workers will cut back on the supply of labour if the real wage falls below this minimum. This minimum real wage rate puts an upper limit on the rate of profit. However, over a period of time, the impact of capital accumulation which embodies

technical progress is that the productive capacity of the economy will increase. Thus, the economy will be able to support a higher level of investment at the minimum real wage. At the old level of investment (or rather at a lower point on the time path of investment), the real wage will have risen because of the increase in productivity. Because the real wage would be above its minimum, the economy will have moved into the Neo-Keynesian region. If the minimum wage rate is given for all time, then the outer boundary of the Neo-Keynesian region is continually moving to the right (in ρ-I space).

The postulate that labour's minimum wage is constant over time is questionable in the context of an expanding capitalist economy. In fact, the evidence for very long periods of time would seem incontravertible. Would labour today work for the real wages that ruled at any time in the 19th century? The minimum wage is, for industrialized societies, not purely determined by the needs of physical survival, but also by expectations of a minimum standard of living which is determined by sociological forces. It is reasonable to suggest that for present day North America, workers in general consider the ownership of an automobile a necessity, as a part of the minimum subsistence level. An attempt by entrepreneurs to increase

the level of investment to a height which entailed a fall in the real wage sufficient to eliminate automobile ownership for many people would be met with a great deal of resistance. Work patterns would not be unaffected.

In capitalist society, the direction of the pressures on consumers' expectations seem very clear. The large expenditures on sales efforts by corporations exert a powerful force. These are reinforced by a political process in which the promise of higher material comforts is considered by its agents as an essential part of the vote-gathering effort. This imparts into people an expectation of material comforts which will then affect their behavior patterns. These features of an industrialized economy suggest that the minimum wage level, the sociological subsistence level, will increase over time. If they increase at the same rate as output per man, then the boundary of the Inflation Barrier region and the Neo-Keynesian region will remain fixed over time. If the rate of increase is greater (less) than that of output per man, the boundary will move to the left (right).

The long run results for the three regions can now be combined and a long run rate of profit schedule can be drawn. This is shown in Figure 5. The horizontal axis is the base period level of investment, I_o. Of course, the curve is drawn under the assumption that the whole

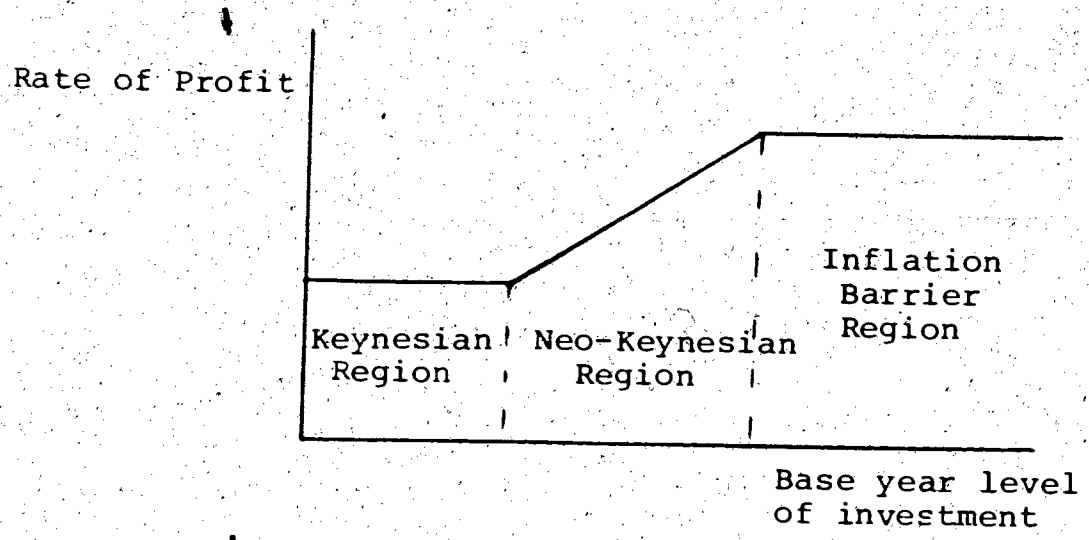
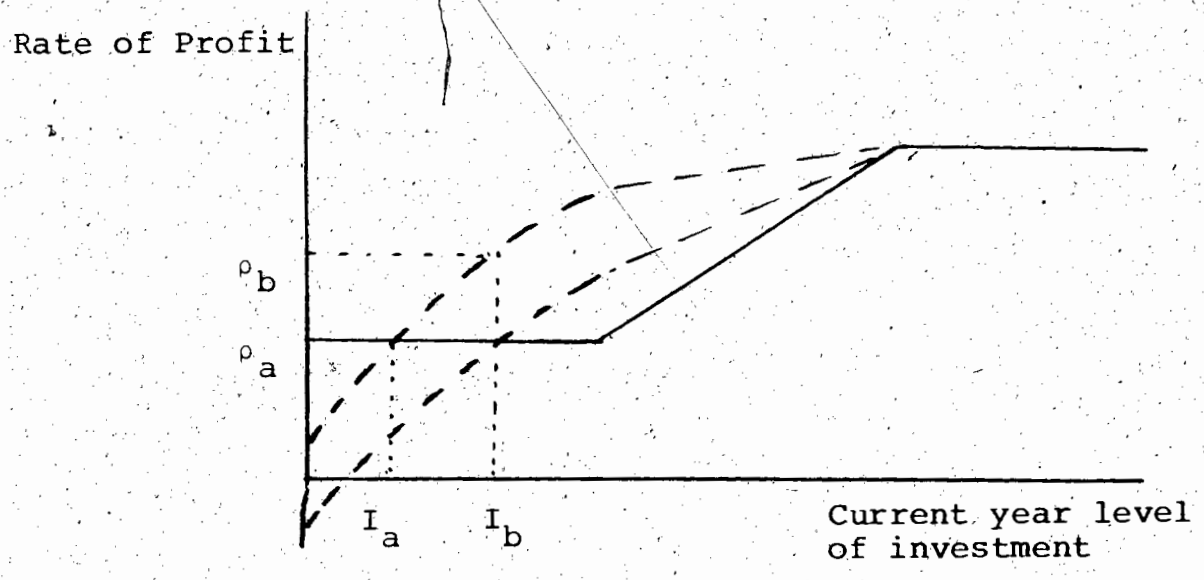


Figure 5

capital stock has adjusted to the base period level of investment. In order that the boundary between the Neo-Keynesian and Inflation Barrier regions can be shown at one base year level of investment, it is necessary to assume that the rate of increase of output per man is equal to the rate of increase of sociological subsistence.

The schedule in Figure 5 is a long run schedule. To move from one position on it to another will take the amount of time needed to rebuild the capital stock. It is the capital stock that is varying along the horizontal axis. If the current level of investment is also plotted along the horizontal axis, then at each point on the long run schedule, a short run schedule as developed in Chapter IV

can be constructed.[2] The latter will show the immediate impact on the rate of profit of a change in the level of investment. In Figure 6, it is assumed that the economy



——————— long period rate of profit schedules

– – – – – – – – – short period rate of profit schedules

Note: The horizontal axis has been transformed by the amount e^{gt} from the base year level of investment to represent the current year level of investment. This is in order that short run rate of profit schedules may be drawn on the same diagram. It makes no difference to the argument.

Figure 6

[2] It should be noted that there is a minor problem here related to the choice of units. To be precise, the current level of investment would have to be divided by a scaler e^{gt} in order that the short run schedule cuts the long run schedule in the correct place.

is initially in the Keynesian region at (ρ_A I_A). The short run rate of profit schedule is the broken line. A change in investment to I_b will lead initially to a change in the rate of profit to ρ_b. Then, as the capital stock changes, the rate of profit schedule will shift to the right. The final equilibrium situation is at (I_b ρ_a).

The same process can be described for the Neo-Keynesian region. It is sufficient to point out here that in the Neo-Keynesian region, the short run rate of profit schedule will be steeper than the long run schedule reflecting the absence of the larger capital stock at the time of the initial impact on the rate of profit.

It is interesting to compare the results of the long run theory with those of the Neo-Classical Theory. Of all the analysis in this dissertation, the analysis of this chapter is closest to the Neo-Classical analysis and in consequence, the results would be expected to bear a closer resemblance to Neo-Classical results. Indeed they do, but there are still significant differences between the two theories. These differences will become apparent.

The capital stock may be defined as the sum of machines of all the vintages in operation. This is the aggregate capital stock measured at historic cost (e.g. R.G.D. Allen 1968, p. 285). That is;

$$20 \qquad K_t = \int_{t-T}^{v=t} I_o \, e^{gv} \, dv$$

In the Keynesian region, it was shown that the age of the oldest machine is invariant, in the long run, to changes in the level of investment. Thus, the capital stock in use increases with I_o. Since the labour force is related to the level of investment by the labour requirement of machines, i.e. equation 9;

$$9 \qquad L_t = \frac{I_o \, b_o}{(g-\lambda)} \, e^{(g-\lambda)t} \, (1-e^{-(g-\lambda)T}),$$

the capital labour ratio is independent of the level of investment. This is easy to show by dividing equation 20 by equation 9;

$$21 \qquad \frac{K_t}{L_t} = \frac{\frac{I_o}{g} e^{gt} (1-e^{-gT})}{\frac{I_o \, b_o}{(g-\lambda)} e^{(g-\lambda)t} (1-e^{-(g-\lambda)T})}$$

This key equation becomes;

$$22 \qquad \frac{K_t}{L_t} = \frac{g-\lambda}{g} \frac{e^{\lambda t}}{b_o} \frac{(1-e^{-gT})}{(1-e^{-(g-\lambda)T}}$$

From relation 22, it can be seen that the capital labour ratio increases over time at the rate of Harrod neutral technical progress, λ. The Neo-Classical theoristis have used the concept of effective labour units (R.G.D. Allen

1968, contains the clearest exposition of this concept) in calculating the capital-labour ratio which is relevant for the determination of the rate of profits. Effective labour units are natural units scaled for their productivity increases. The fact that a procedure has to be adopted to neutralize the forces of time unerlines the static nature of Neo-Classical Theory. If Harrod neutral technical progress is at rate λ, then men employed on new capital have an increase in their productivity at the rate λ. This means that the effective size of the labour force will be greater at any moment in time. Denoting effective labour units by EL, the aggregate size of the effective employment labour force can be determined by modifying equation 9;

$$23 \qquad EL_t = \int_{t-T}^{v=t} I_o \, e^{gv} \, b_o \, d_v$$

$$= \frac{I_o \, b_o}{g} \, e^{gt} \, (1-e^{-gT})$$

Thus, the capital-labour ratio becomes;

$$24 \qquad \frac{K_t}{EL_t} = \frac{\frac{I_o}{g} \, e^{gt}(1-e^{-gT})}{\frac{I_o \, b_o}{g} \, e^{gt}(1-e^{-gT})}$$

$$= \frac{1}{b_o}$$

The capital-labour ratio can be seen from relation 24 to be independent both of time and the age of the oldest machine when measured in effective units. Thus, the capital-labour ratio will be the same in each region. This constancy is the inevitable result of the combination of Harrod neutral technical progress and measuring labour in effective units. Harrod neutral technical progress is defined as an increase in output per man when the capital output ratio remains constant. But by measuring labour in effective units, output per effective man is made constant - technical progress is handled conceptually by an expansion in the effective labour force. If the labour-output and capital output ratios are constant, then so is the capital-labour ratio. This is clearly the case for any vintage and will thus, apply to the aggregate measure, over all vintages of the capital-labour ratio.

Since the rate of profit is constant in the Keynesian and in the Inflation Barrier regions, the Neo-Classical relation connecting the rate of profit with the capital-labour ratio holds in these regions. However, since the rate of profit is higher in the Inflation Barrier than the Keynesian region, the Neo-Classical relation does not hold between the regions. Neither does it hold in the Neo-Keynesian region, where the rate of profit rises whilst the capital-labour ratio remains constant as investment rises.

The aim of this chapter has been to analyze the effects of capital accumulation on the theory of the rate of profit developed in earlier chapters. In order to concentrate on this, the expectations trend parameter for future prices was dropped. The same remarks are relevant for this parameter as for the short run (which were discussed in Chapter IV). All that need be added here is that there is, perhaps, more reason to expect the absolute price level to fall in the Keynesian region and to rise in the Neo-Keynesian region in the long run than the short run. As in the short run case, this will depress the rate of profit in the Keynesian region and inflate it in the Neo-Keynesian region.

The effect of the rate of capital accumulation on the rate of profit is negative if taken on its own. That is to say, the higher the rate of accumulation, or the larger the number of machines of each vintage, the further to the right lies the short run rate of profit schedule. However, the negative effect of a high rate of accumulation on the rate of profit is never (i.e. in no region) greater than the positive impact induced by the aggregate demand effect of the high level of investment necessitated to maintain the high rate of accumulation. Whilst the high rate of accumulation shifts the short run rate of profit schedule

to the right, the level of investment necessitated to maintain this rate of accumulation shifts the position of the economy on the rate of profit schedule to the right.

For steady state growth paths, then, there is never a negative relation between the rate of profit and the level of investment. However, the theory is not restricted to steady state situations, but may be used for the analysis of non-steady state positions. The effect on the rate of profit of the capital stock is in its ability to create profits. This is because the theory is based on the behavioral postulate that all savings come from profits and on the equilibrium condition that planned saving equals investment. So, for a given level of investment, the greater the total amount of profits earned on all the machines of any particular intra-marginal vintage, the smaller the number of older vintages which are needed in operation to generate a sufficient level of savings to satisfy the equilibrium condition. If the number of vintages in use are small, the age of the oldest vintage is low, the wage rate is high and the rate of profit is low.[3]

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[3]Compare the methodology used here with that of Sraffa, for example. In Sraffa's analysis, the rate of profit is that rate which the economy can sustain forever in the face of a given wage rate. That is to say, the rate of profit is that rate which is needed for dynamic equilibrium. Hence, Sraffa's analysis only holds for dynamic equilibrium. The theory developed here is the opposite to this. It is a causal theory. The only reason that steady state growth paths are used is that variables with exponential growth rates are easier to handle mathematically.

An example of a non-steady state phenonemum is the business cycle. A cyclical fluctuation in the aggregate level of activity can be easily explained by the theory developed here if the level of investment is assumed to be responsive to the rate of profit. Starting with an arbitrarily determined increase in the level of investment, there will be an increase in the rate of profit as the economy moves along the short run rate of profit schedule. This will lead to further increases in investment and to further increases in the rate of profit. However, as the high level of investment is installed as output-producing capital, the short run rate of profit schedule will shift to the right and the rate of profit will fall. The fall in the rate of profit will lead entrepreneurs to reduce their investment expenditures from the high level and so the boom will have peaked. The economy will move back along the short run rate of profit schedule as both investment and the rate of profit fall. However, as investment falls off, the installation of new investment goods will fall, the number of old investment goods scrapped in each time period will fall and thus, the upward pressure on the real wage rate will be reduced. The short run rate of profit schedule will shift to the

left. Thus, even as investment falls, the short run schedule starts to shift to the left reducing the negative impact on the rate of profit of the low level of investment. If the leftward shift in the rate of profit schedule "catches up" with the fall in investment, then the fall in the rate of profit will be arrested and the level of investment will start to rise.[4]

The explanation advanced here of the business cycle is not in disagreement with the conclusions and arguments in much of the literature on the topic. Its value lies, not so much in the novelty of the conclusions, as in the explanation and exposition of the analytical foundations of the conclusions. Most analyses of the business cycle are based on the concept of the accelerator (e.g. Hicks 1950, Samuelson 1939, Mathews 1959). But why should there be a positive relation between the level of investment and the level of income? Why do entrepreneurs believe that when they expect aggregate demand to go up, they can also expect to make profits supplying the expected increase? If the fundamental postulate that the primary

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[4] It should be noted that the explanation advanced here of the business cycle depends upon the effect of capital accumulation on the short run rate of profit schedule. In Chapter V, an alternative explanation based on the interaction of the money market was described. A more complete explanation of the business cycle would involve both explanations simultaneously.

impulse of entrepreneurs is to maximize profits, then if the accelerator theory of investment is to be accepted, it is necessary to show that it is consistent with profit maximizing behavior. The only attempt in the literature to derive the accelerator theory of investment from a profit maximizing framework has used the Neo-Classical production function and been based on the concept of dynamic equilibrium. I refer here, of course, to the work of J. Witte 1963 and D.W. Jorgenson 1963. Outside of dynamic equilibrium, these analyses have no meaning (or at least no meaning which has, as yet, been articulated). Thus, they can tell us little about the process of the business cycle, a non-dynamic equilibrium phenomenum. On the other hand, from the analysis presented here, which is not reliant upon the assumption of dynamic equilibrium, a positive relation between the rate of profit and the level of income is a direct implication of the positive relation between the rate of profit and the level of aggregate demand. If an increase in aggregate demand leads to an increase in the rate of profit, then it is reasonable to expect an increase in investment.[5]

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[5] In fact, one could go further and argue that it is essential to the validity of the accelerator that it be shown that an increase in aggregate demand does not lead to a fall in the perceived rate of profit.

The explicit introduction of the short run behavior of the rate of profit into the explanation of the business cycle strengthens the explanation of the turning points as well as the upswing and downswing. Instead of a reliance on the relative lag structure of investment and consumption with respect to income (e.g. especially Samuelson 1939) and of the need to postulate arbitrarily determined "floors" and "ceilings" (e.g. especially Mathews 1959) to explain turning points, the effect of capital accumulation on the rate of profit may be used. Intuitively, this alternative explanation is far more appealing in as far as it rests on the assumption of profit conscious entrepreneurs.

CHAPTER VIII

CONCLUSION

The aim of this thesis has been to construct a theory of the rate of profit based on the concept of Keynesian equilibrium. It was shown in Chapter II that the currently accepted theories of the rate of profit are based on dynamic equilibrium. In Chapter III, it was argued that dynamic equilibrium is a far more restrictive condition than Keynesian equilibrium and so a theory of the rate of profit based on the latter concept would have a wider field of application. Such a theory was developed in the remainder of the thesis.

The behavior of the rate of profit implied by Keynesian analysis is described by the rate of profit schedule. This is a schedule connecting the rate of profit to the level of investment. A rate of profit schedule was constructed for three time horizons, i.e. for the short run, the intermediate run, and the long run. For each time horizon, three specifications of the labour market were used; each specification taken from contemporary economic theory. These were the Keynesian, the Neo-Keynesian and the Inflation Barrier specifications.

The short run rate of profit schedule shows the immediate impact on the rate of profit of changes in the

aggregate level of investment demand. The capital stock is assumed exogenously given for the construction of this schedule. It is depicted in Figure 1 where it can be seen that its shape reflects the three specifications of the labour market.

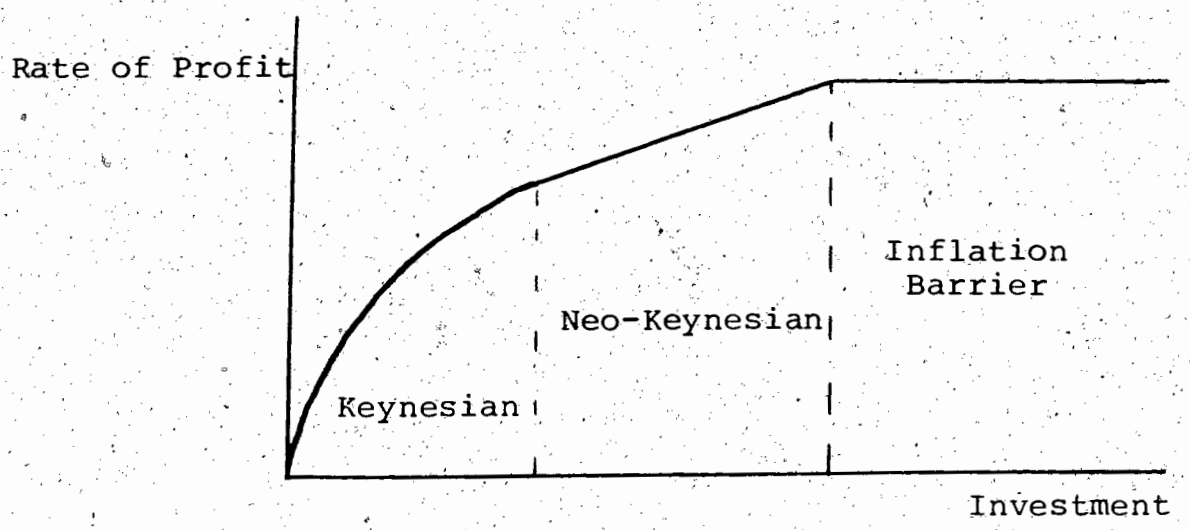

Figure 1

The intermediate run rate of profit schedule takes into account the addition to an exogenously given capital stock of new capital goods. Thus, it reflects the impact of marginal changes in the capital stock. Its slope is similar to that of the short run rate of profit schedule, but is less steep for the Keynesian and Neo-Keynesian regions. The smaller gradient reflects the impact of the installation of current investment on the

rate of profit. The intermediate run schedule is depicted in Figure 2.

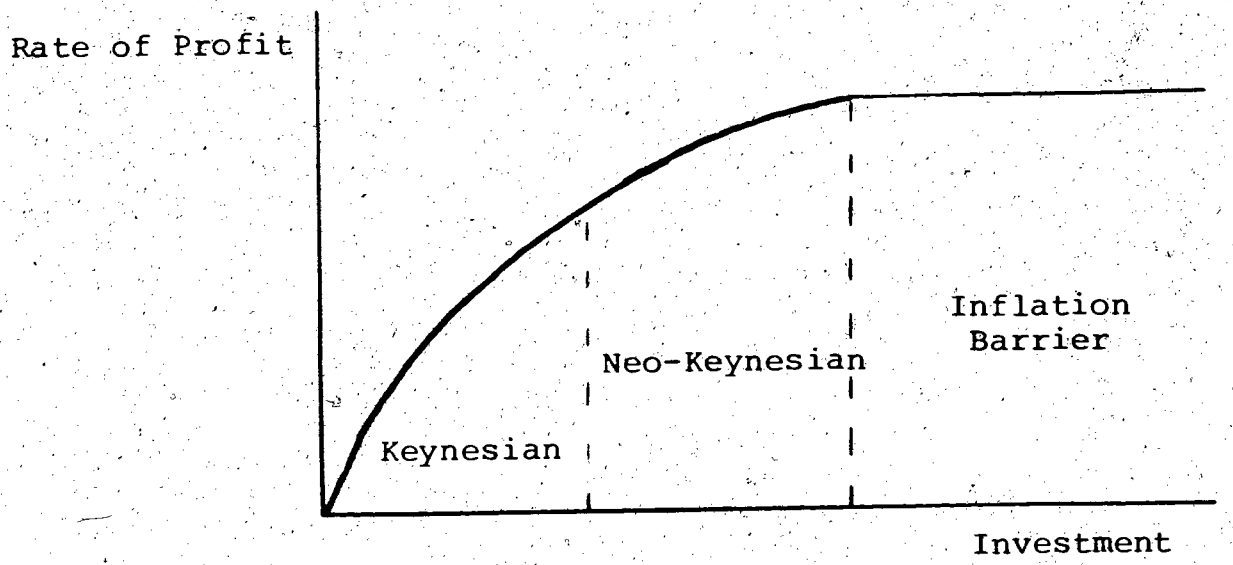

Figure 2

The long run rate of profit schedule is constructed by allowing the capital stock to adjust completely to a change in the level of capital accumulation. It shows the impact on the rate of profit of a change in the level of investment which is sustained for a long period of time. Its construction was based on the techniques of analysis of contemporary growth theory. Figure 3 shows that the long run rate of profit schedule has horizontal sections in both the Keynesian and Inflation Barrier regions and a positively

sloped section in the Neo-Keynesian region.

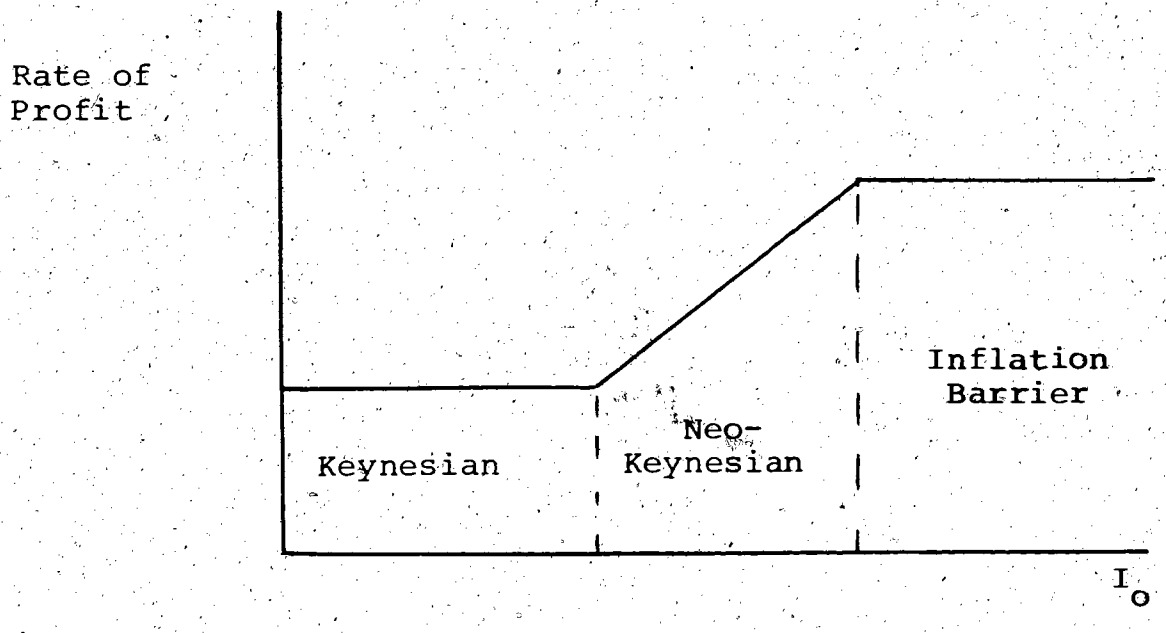

Figure 3

The three schedules are related in a hierachical fashion. The long run schedule affects the position of the intermediate run schedule since the latter is based on an exogenously given capital stock which only changes at the margin. If this capital stock is an equilibrium one described by the long run schedule, then the long run schedule determines the exact location of the intermediate run schedule. In a similar fashion, the intermediate run schedule determines the location of the short run schedule. It may also be noted that the short run schedule determines the position of the marginal efficiency of capital schedule.

The three schedules differ in the degree of flexibility they allow the capital stock. Because it has been assumed throughout that capital is not malleable, it follows that the more the capital stock is allowed to change, the greater the resources needed for a change. To build new machines takes resources. In view of the relative size of the capital stock to the level of investment in each time period, it follows that the greater a change in the capital stock, the longer it will take to make the change. The development of the theory of the rate of profit for various degrees of capital stock flexibility and thus, for various time horizons gives it an element of completeness. A complete analysis of the impact on the rate of profit of an exogenous stock can be drawn. First, the short run schedule will be relevant, then the intermediate run schedule and finally, the long run schedule. The breadth of application of the theory with respect to time horizon is a distinct improvement on the Neo-Classical and Neo-Keynesian theories.

In the Inflation Barrier region, the rate of profit is at a maximum determined by the supply of labour behavior. In the other two regions, the general rule may be deduced from the rate of profit schedules that;

(a) Investment demand has a positive impact on the rate of profit.

(b) The level of accumulation of capital, i.e. the capital stock, has a negative impact on the rate of profit.

The negative effect of the capital stock is only large enough to completely offset the positive impact of investment in the Keynesian region in the long run. In the Neo-Keynesian region, in the long run, and the Keynesian and Neo-Keynesian regions, for the short and intermediate run, the demand effect of an increase in investment more than offsets the effect of the addition of the investment goods to the capital stock. For these regions, the relation between the rate of profit and the level of investment is positive.

The major implication for the operation of capitalist economies of the rate of profit schedules is that they will suffer from some degree of instability. The short run schedule combined with an analysis of monetary market equilibrium was shown in Chapter V to produce the possibility of cyclical behavior. However, it was also shown that the existence of a "floor" to the business cycle was not certain. Cases could arise where, instead of the economy entering an upturn, the levels of investment income and employment collapsed. This possibility was related to the existence of a high interest elasticity of the demand for money and too the effect on expecations of a negative rate

of inflation. It was also shown that monetary policy was ineffective relative to fiscal policy in preventing or curing such a depression. On the other hand, it was shown that a boom was more likely to bring itself to a conclusion. There was more certainty about the possibility of a downturn or ceiling.

The intermediate run and long run analysis of Chapters VI and VII was shown to provide another explanation of cyclical fluctuations in aggregate variables. The interaction of investment demand and capital accumulation was shown to lead to a business cycle. Thus, the theory developed in this thesis suggests very strongly that monetary factors and capital accumulation would combine with aggregate demand to induce cyclical behavior and might even lead to serious depressions. It is important to note that these results are a consequence of the interplay of market forces. Restrictions on market forces, e.g. the introduction of imperfect market structures, the removal of the assumption of profit maximizing entrepreneurs, are not necessary to generate such results.

The analysis throughout the thesis was based on a one good model. At any point in time, only one good was produced which could either be used as a consumption good or an investment good. However, this is not a crucial assumption and was only adopted for analytical convenience.

The major factor in the determination of the rate of profit was the behavior of the relative price of labour and output resulting from changes in the level of investment. In so far as an increase in aggregate demand raises the price of output relative to labour, the results will hold for a multi-good model. Of course, in a multi-good model, an increase in aggregate demand will lead to different amounts of price increases in each good depending upon the elasticities of demand and supply. The rate of profit will increase in the production of some goods by more than in the production of others. It may even fall for some goods. However, this will affect the direction of investment, or the placement of capital goods. The aggregate rate of profit will behave in much the same way as in the one good case.

Whilst the theory of the rate of profit developed here was not based on a spectrum of techniques, it is possible for such a dimension to be added to the analysis. It is easy to show that the addition of a spectrum of techniques will have a positive impact on the rate of profit. Entrepreneurs would only choose a technique instead of the one technique considered so far if it yielded a higher rate of profit. This suggests that the effect a choice of techniques has on the rate of profit is positive.

It was argued in Chapter II that a major weakness of Neo-Classical capital theory is its heavy reliance on the assumption of capital malleability. As a description of capital goods in contemporary industrialized societies malleability is not very accurate. If capital were assumed to be malleable, then it is easy to show that a positive relation between the level of aggregate demand and the rate of profit can be derived. An increase in the level of aggregate demand leads to an increase in output and employment. Under the assumption of a fixed stock of malleable capital, the capital labour ratio falls and the rate of profit will rise.

There are two steps in the above argument that are heavily dependent upon the malleability assumption. It was shown in Chapter VI, pp. 104 - 107, and Chapter VII, pp. 135 - 138, that neither the negative relation between the level of output and the capital-labour ratio nor the negative relation between the capital/labour ratio and the rate of profit will necessarily hold when capital is non-malleable. Thus, the malleability assumption both requires and guarantees that the capital/labour ratio behave in a certain fashion. Such behavior would not necessarily be observed in a world characterized by non-malleable capital goods.

The twists of thought involved in using the malleability assumption are remarkable. Firstly, an unrealistic assumption is employed in order that a relationship between the capital/labour ratio and the rate of profit may be rigourously derived. But having derived this relationship one has to grapple with the definition and measurement of one of the crucial variables, the aggregate capital stock. It is of course tempting to show that the definition and measurement of the capital stock is straightforward if capital is malleable. And it is. If it were not, the negative relation between the capital/labour ratio could not have been derived in the first place.

In the theory of the rate of profit developed in this thesis, it has been assumed that capital is not malleable. Furthermore, the concept of an aggregate capital/labour ratio has not been used as a causal factor in the determination of the rate of profit. The aim has been to break away from the traditional approach. A theory has been developed by on the techniques of analysis associated with Keynesian economics. In this theory, the causal mechanism runs from aggregate demand through relative prices to the rate of profit. In Neo-Classical theory, the causal mechanism runs from the capital/labour ratio through the technical characteristics of the technique used in the production process to the rate of profit. In Chapters VI and

VII the relationship implied by Neo-Classical Theory is derived and its sign is shown to be positive in some cases, negative in others, and ambiguous in still others. The relationship between the rate of profit and the level of aggregate demand has a much higher degree of consistency than the Neo-Classical relation when derived under the same conditions. It is always non-negative.

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