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The Role of Capacity Utilization in Long-Period Analysis

Edward J. Amadeo *

1. INTRODUCTION

The objective of this paper is to critically discuss two recent contributions to the theory of distribution, accumulation, and capacity utilization, namely, the analyses by Vianello and Ciccone¹. The aim of both works is to deny the existence of a trade off between accumulation and distribution in long-period analysis. In this paper we wish to consider some aspects which, if not taken into account, could undermine the conclusions reached by the authors. Vianello's conclusions depend on the possibility of the actual and normal degrees of capacity utilization being different in the short period. However, he disregards the problems associated with the stability of the adjustment process through changes in capacity utilization. Ciccone's conclusions are based upon the argument that the actual and normal rates of utilization may differ in the long period. However, in face of the exogeneity of the actual degree of utilization in the analysis, there is no reason why the adjustment of the latter to changes in the rate of accumulation should be such as to leave distribution unaffected.

2. VIANELLO'S ANALYSIS

In a recent article published in this journal, Vianello presents a model in which capacity utilization is allowed to vary (and, indeed, to play the

* I am grateful to Amitava Dutt, Stephen Marglin, Murray Milgate and Lance Taylor for useful and interesting discussions, and to the Editorial Committee of *Political Economy* for the comments to the first two versions of the paper.

¹ F. VIANELLO, "The Pace of Accumulation", *Political Economy*, Vol. 1, N. 1, 1985; R. CICCONE, "Accumulation and Capacity Utilization: Some Critical Considerations on Joan Robinson's Theory of Distribution", *ibid.*, Vol. 2, N. 1, 1986.

role of the adjustment variable) in the transition between “fully adjusted situations” as characterized by uniform rates of profit and normal degree of capacity utilization. By allowing utilization to adjust, Vianello provides an interesting and innovative discussion of the movements of proportions of labour and capital employed in the “corn” and “iron” industries between steady states given a change in data. His argument is that a temporary over-utilization of productive capacity is sufficient to make faster accumulation compatible with the same real wage. Moreover that, “the more room a normal utilization of productive capacity leaves for production to expand to a rise in demand, the more the above conclusion becomes relevant from a practical point of view”². Vianello concludes that “steady-state models, based on the hypothesis that productive capacity is *continuously* kept at its normal degree of utilization, should be regarded as seriously misleading”³.

Vianello makes the “reasonable supposition” that the “productive capacity... does not tend to remain either systematically under-utilized or systematically over-utilized”⁴; and that “under-utilization, as well as over-utilization, of productive capacity is by its very nature a temporary phenomenon”⁵. These suppositions constitute the only reason for Vianello’s assumption that in fully adjusted situations the degree of capacity utilization corresponds to its normal degree. His analysis is restricted, therefore, to temporary changes in capacity utilization, and does not consider the problems of instability associated with the adjustment process between steady states.

In what follows we shall consider the possibility of capacity utilization being different from its normal degree even in fully adjusted situations. We shall develop a model in which effective demand may have an effect on utilization in the long period. In connection with Vianello’s contribution, we wish to argue that, once capacity utilization is allowed to vary in the short period — i.e. between steady states — we should be prepared to examine the possibility of utilization being an *endogenous* variable even in the long period, and the stability conditions which make the model compatible with a long-period analysis.

Before we proceed, a word is in order to discuss the plausibility of different-from-normal utilization in fully adjusted situations. The problem, although difficult, must be faced and, from the start we claim no definitive answer. What follows is no more than some preliminary reflections on the issue. It is important to begin by noticing that a central

² F. VIANELLO, *op. cit.*, p. 72.

³ *Ibid.*

⁴ *Ibid.*, p. 76.

⁵ *Ibid.*, p. 82.

element in the "endogeneization" of capacity utilization in growth models is the interaction of the behaviour of the individual firm with movements of aggregate demand. If the examination of this interaction can be made into an argument for firms being unable to achieve their utilization target, it seems safe to argue that the supposition that utilization is always at its normal degree in steady states begs the (plausibility) question.

Two elements are involved in the endogeneization of capacity utilization. The first is the recognition that firms operating in oligopolized markets tend to avoid price movements as a competitive weapon⁶. Instead they will make use of other strategies to increase their share of the market (such as, e.g., product differentiation) and adjust to changes in demand through movements in capacity utilization⁷. Second, since in highly concentrated and oligopolized industries firms are able to control profit margins and, at least to a certain extent, the rate of profit, capacity utilization becomes the central signalling variable for short and long term decisions. As for the latter, this only implies that investment decisions may be more sensitive to changes in utilization than in the (expected) rate of profit.

If we start from a fully adjusted situation in which each firm is operating at its utilization target, a reduction in aggregate expenditure will, in the first instance, lead to a reduction in capacity utilization. If firms react by reducing investment demand, there seems to be no endogenous mechanism that would bring them back to their normal degree of utilization. Quite the contrary, a cumulative process, leading to lower utilization would develop. Formally, a position of repose would only be achieved if the stability of the adjustment process is postulated.

It is worth noticing that this adjustment process does not deny the plausibility of the general principle that in the long period capacity adjusts to demand. It only means that if capacity utilization is not fixed *ex-hypothesis*, the interaction of an investment function based on the degree of utilization with the behaviour of firms trying to accommodate utilization to a new level of demand makes utilization move away (rather than towards) the normal degree.

In what follows a simple one-sector model⁸ is presented to illustrate

⁶ See, e.g., P. SWEEZY, "Demand under Oligopoly Conditions", *Journal of Political Economy*, 1933, and J. ROBINSON, *The Economics of Imperfect Competition*, London, Macmillan, second ed., 1969 (first ed.: 1933).

⁷ Steindl makes this point by arguing that although in a competitive market (with many firms and a wide prime cost dispersion among firms) cut-throat competition via price reduction is a reasonable strategy for low cost firms, in a concentrated industry all firms would probably loose with a "price war". The latter tend to engage in tacit agreements and adjust to changes in demand through changes in capacity utilization: cf. J. STEINDL, *Maturity and Stagnation in American Capitalism*, New York, Monthly Review Press, 1952, p. 122.

⁸ This model is discussed in great detail in E. J. AMADEO, "Notes on Growth, Distribution and Capacity Utilization", *Contributions to Political Economy*, 1986. Other contributions to one-sector

the role of endogenous capacity utilization in the theory of accumulation. It will be argued that the Classical relation, according to which there is an inverse relation between the rate of profit and the real wage, does not necessarily hold in a model in which utilization is endogenously determined. The model is also meant to be a first — and admittedly incomplete — step towards the interaction between the “surplus approach” and Keynes’ principle of effective demand.

We start with the following equation of production:

$$p = \frac{w}{\pi} + p \frac{r}{u}$$

where p is the price of a unit of output, w is the wage rate, r is the gross rate of profit, $\pi = X/L$ where X is the level of aggregate output and L is the level of employment and $u = X/K$ is the degree of capacity utilization. From the equation of production we can derive a profit rate equation given by:

$$r = \left[1 - \frac{w}{\pi} \right] u \quad [1]$$

where w is the real wage and w/π is the share of wages in output. When the actual degree of capacity utilization (u) is equal to the full utilization degree (u_f), equation [1] describes the capacity distribution frontier depicted in figure 1.

For $u < u_f$, the frontier becomes the upper bound for the distribution set represented by the shaded area on the graph. The line inside the capacity frontier ($u = u_n$) corresponds to the normal utilization frontier. The following expenditure equation provides the second equation of the model:

$$pX = c_w wL + c_k [pX - wL] + pI$$

where c_w and c_k are, respectively, workers and capitalists propensities to consume. Dividing this equation through by pK and assuming that workers do not save and capitalists do not consume, we get a simplified version of the Cambridge equation:

$$b^s = r \quad [2]$$

where b^s is the saving: capital stock ratio.

growth models in which utilization is endogenous are: A. DUTT, “Stagnation, Income Distribution and Monopoly Power”, *Cambridge Journal of Economics*, 1984; B. ROWTHORN, “Demand, Real Wages and Economic Growth”, *Studi Economici*, 1979; and L. TAYLOR, *Structuralist Macroeconomics*, New York, Basic Books, 1983.

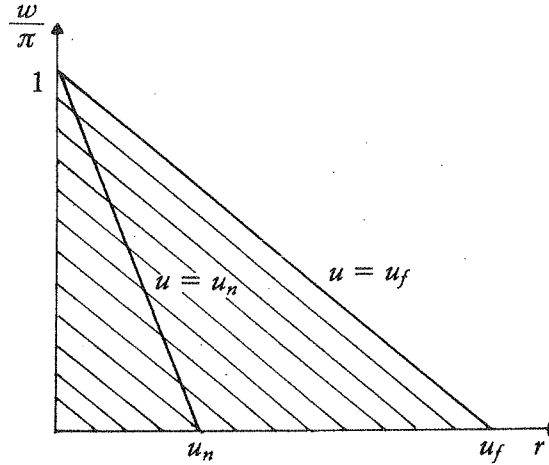


Fig. 1

For a given real wage rate and assuming that capacity utilization is always at its normal degree ($u = u_n$) in fully adjusted situations, the position of the rest of the system will be characterized by:

$$b^* = r^* = \left[1 - \frac{w}{\pi} \right] u_n$$

The long-period configuration is depicted in figure 2.

As in the first exercise developed by Vianello⁹, the Classical relation between growth and distribution obtains: a lower wage rate is always associated with higher rates of profit and accumulation.

We may now introduce the alternative hypothesis, namely, that capacity utilization is endogenously determined. We assume an investment demand function according to which the demand for capital goods will increase whenever the actual degree of utilization is greater than the normal degree. This function can be written as follows:

$$b^i = \alpha + \beta (u - u_n) \quad [3]$$

where α stands for “animal spirits” and β measures the speed of adjustment of investment to changes in capacity utilization. For a given wage rate, equations 1 - 3 yield the following long-period configuration¹⁰:

⁹ F. VIANELLO, *op. cit.*, pp. 79-81.

¹⁰ The stability condition of this system is given by $\beta - (1 - w/n) < 0$ which means that the investment function must be less sensitive to changes in capacity utilization than the saving function.

$$u^* = \frac{\alpha - \beta u_n}{\lambda} \quad \text{and}$$

$$b^* = r^* = \alpha + \beta \left[\frac{\alpha - \beta u_n}{\lambda} - u_n \right]$$

where $\lambda = 1 - (w/\pi) - \beta$.

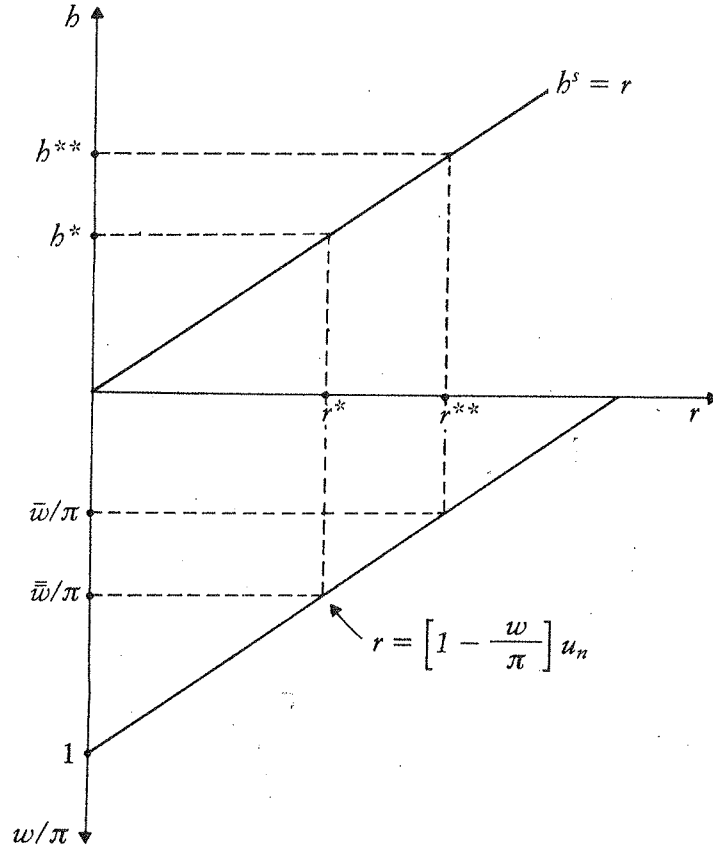


Fig. 2

Figure 3 depicts the long-period configuration. In quadrant II the investment function and Cambridge equation together determine the rate of growth and degree of capacity utilization. For a given wage rate, the profit equation (equation 1) yields a linear relation between the degree of utilization and the profit rate, as depicted in quadrant I. This relation determines the rate of profit associated with the exogenous wage rate and the degree of capacity utilization as determined in quadrant II. Note that the $(w/\pi, r^*)$ configuration lies inside the distribution set, rather than on the capacity distribution frontier.

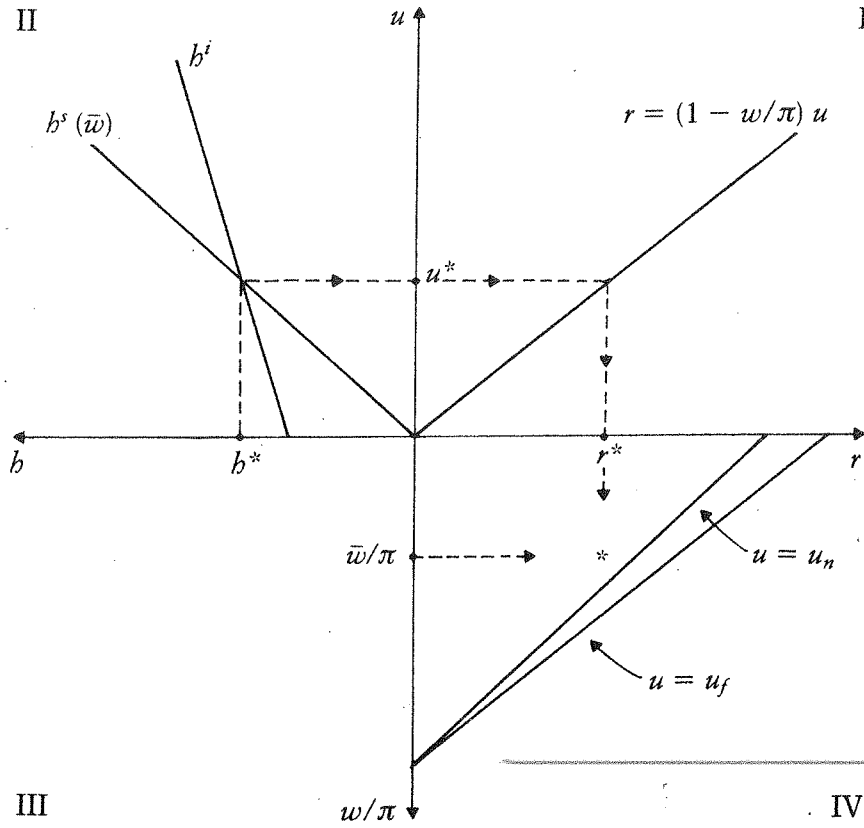


Fig. 3

In figure 4 we depict the effect of an increase in the wage rate; the effects on the rates of growth and profit and the degree of capacity utilization are given by¹¹:

$$\frac{\delta u^*}{\delta w} = \frac{\alpha - \beta u_n}{\pi \lambda^2} > 0$$

$$\frac{\delta b^*}{\delta w} = \frac{\delta r^*}{\delta w} = \frac{\beta (\alpha - \beta u_n)}{\pi \lambda^2} > 0$$

Given the assumption that workers' propensity to consume is greater than that of capitalists, a higher wage rate is associated with a higher degree of capacity utilization which leads to a higher rate of growth given the relation between investment demand and utilization. These effects are

¹¹ The sign of the derivatives is given by the stability condition: for β to be smaller than $1 - (w/\pi)$, $\alpha - \beta u_n$ must be positive.

rate is greater than the original rate. The rather unconventional result of this exercise is that a higher wage rate is associated with higher rates of profit and growth. The Classical trade-off between the real wage and the rate of profit, on the one hand, and the rate of growth and consumption per worker, on the other, gives way to a situation in which all of them can move in the same direction.

The effect of an increase in profitability (associated with a reduction of the real wage rate), namely, a reduction of the rates of utilization and accumulation, corresponds to what we could refer to as Steindl's "stagnation theorem": "the transition from a competitive to an oligopolistic regime, if it causes an increase in profit margins at a given rate of utilization, will lead to excess capacity and hence to a secular decline in growth"¹².

This same model allows us to study the effects of an increase in the rate of accumulation due to, say, a change in entrepreneurs' animal spirits. The exercise is of interest since it maintains a close relation with Ciccone's analysis. The effects are given by the following equations:

$$\frac{\delta u^*}{\delta \alpha} = \frac{1}{\lambda} > 0$$

$$\frac{\delta h^*}{\delta \alpha} = 1 + \frac{\beta u_n}{\lambda} > 0$$

According to the model, therefore, an increase in animal spirits is associated with an increase in both the rates of accumulation and capacity utilization, while distribution remains unaffected.

At this point it would be convenient to explore the nature of the long-period (or equilibrium) position in this model. Is it a position of rest in the sense that there are not forces in action pushing the system away from it? The question seems reasonable in face of the fact that, even in the long period, the degree of capacity utilization associated with the equilibrium configuration may differ, and only by coincidence will not differ, from the normal or planned degree. Indeed, one may argue that if the equilibrium degree is systematically different from the planned degree of utilization, entrepreneurs will eventually revise their plans, thus altering the planned degree.

If, for instance, the equilibrium degree of utilization is smaller than the planned degree ($u^* < u_n$), it is possible that entrepreneurs will reduce u_n . The reduction of the planned degree would shift the investment function in such a way that the new equilibrium degree will be greater than the initial one. If entrepreneurs keep revising their plans, eventually both degrees of utilization will coincide. Even if this is the case, however, the objective of this model is to show that the equilibrium degree of utilization — be it equal to or different from the planner degree — is endogenously determined¹³.

¹² J. STEINDL, "Distribution and Growth", *Political Economy*, Vol. 1, N. 1, 1985, p. 61.

¹³ I would like to thank Amitava Dutt for calling my attention to this point.

It will be noted that, according to this construction, both output (and capacity utilization) and capacity itself adjust to changes in data. The model seems to contain the elements which Garegnani¹⁴ believes "a satisfactory long-period theory of output" requires, namely, "a) an analysis of how investment determines saving through changes in the level of *productive capacity* (and not only through changes in the level of *utilization* of productive capacity); b) a study of the factors affecting the long-run levels of investment; c) a study of the relation between consumption expenditure and aggregate income". Equation 2 satisfies requirement (c); equation 3 provides a version of requirement (b). Finally, the adjustment to changes in data through changes in the rate of growth (*b*) and capacity utilization (*u*) is no more than the mechanism describing requirement (a).

According to the construction proposed here, to higher wage rates there correspond higher degrees of capacity utilization and rates of profit up to the point where the economy reaches a situation of full utilization of capacity (u_f). Refer to figure 5 where $u_0 < u_1 < \dots < u_n < u_f$.

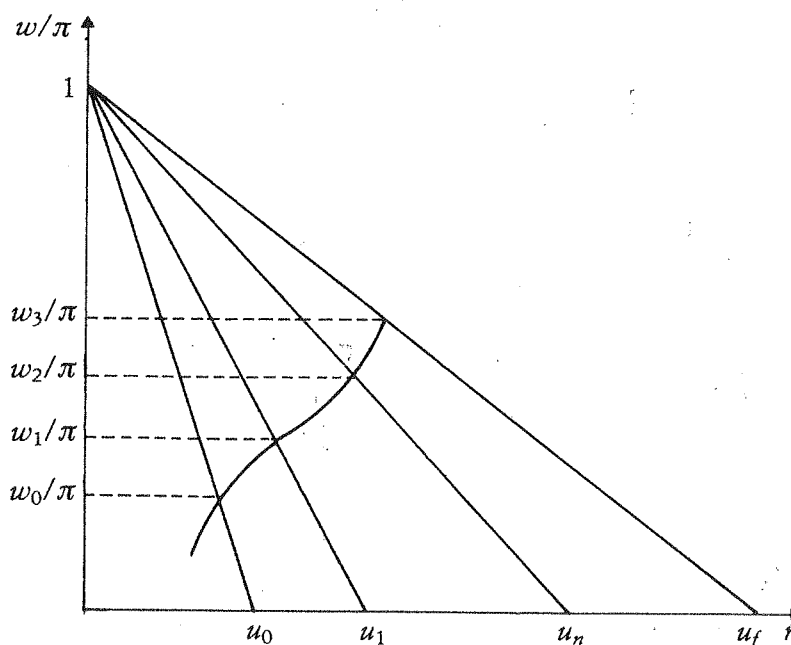


Fig. 5

The inverse relation between the wage rate (or share of wages in income, w/π , for that matter) and the rate of profit does not necessarily hold as long as capacity is less than fully employed.

¹⁴ P. GAREGNANI, "Two Routes to Effective Demand: Comment on Kregel", in I. Kregel (ed.), *Value, Distribution and Effective Demand*, London, Macmillan, 1983.

3. CICCONE'S ANALYSIS

The aim of Ciccone's analysis is to argue that "[t]he presumed necessity that differences in the value of accumulation rate should imply, in the long period, an adjustment of saving per unit of capital *via* the distribution of income"¹⁵ does not hold if it is assumed that the actual and normal rates of capacity utilization are allowed to differ. He also argues that "[o]wing to the flexibility which... characterizes, also in the long period, the actual utilization of capacity, ... the necessary direct relation between investment and profits per unit of capital seems capable of being satisfied independently from changes in the real wage"¹⁶

It is our argument that, although Ciccone provides an explanation as for why the actual and normal degrees of utilization may differ, he does not provide any explanation for the presumed "flexibility" of the actual degree of utilization. The latter explanation would require a theory of the determination of the actual rate of utilization which Ciccone does not provide. Indeed, in the analysis, the flexibility of the actual rate does not follow from any functional relation, and, therefore, can only be considered as part of the data. Hence, the second of the above propositions is not necessarily implied by the analysis. As for the first proposition, we shall argue in what follows that in face of the exogeneity of the actual rate of utilization, it does not seem correct to conclude that distribution is not affected by changes in the rate of accumulation.

Ciccone rejects the notion of long-period positions identified with steady states, and, hence with the fulfilment of long-period expectations on the part of entrepreneurs. He adopts the notion "which seems to have been traditionally adopted in economic analysis, according to which long-period positions are significant as 'centres of gravitation' of prices and quantities produced, and as such they need never necessarily coincide with actual situations"¹⁷. According to this notion, "there is... room for the fluctuations in quantities and prices and the disappointment of expectations that occur in reality..."¹⁸. It is precisely the possibility of disappointment which gives rise to differences between the actual and normal degrees of utilization. Entrepreneurs are assumed to make their investment decisions based upon the expected level of aggregate demand or capacity utilization. The normal utilization of capacity is associated with the "*expected* utilization of new plant which has been or might be installed. The size of this plant would be of course what entrepreneurs

¹⁵ R. CICCONE, *op. cit.*, p. 28.

¹⁶ *Ibid.*, p. 33.

¹⁷ *Ibid.*, p. 21.

¹⁸ *Ibid.*, p. 23.

would consider most appropriate in relation to the expected demand for products"¹⁹.

In the analysis, the actual degree of utilization does not maintain any relation with the determinants of the normal degree, that is, with the determinants of investment demand. It is only reasonable, therefore, that the two rates should differ, even in the long period. It is based upon the possibility of these two rates being different that Ciccone argues that changes in the rate of accumulation need not be associated with changes in distribution. Supposedly changes in the the actual rate of utilization will adjust to changes in the rate of accumulation while the share of wages in income remains the same. However, there is nothing in the analysis which warrants the conclusion that such a change in the actual rate of utilization will take place. From our perspective, therefore, in face of the exogeneity of the actual rate, there must be some relation between the rate of accumulation and distribution.

Our argument can be made in a clearer fashion by means of a simple model. Let $\gamma = 1 - w/\pi$ be the share of profits in output. Assume that, given the expected rate of profits, entrepreneurs make their investment decisions and, therefore, determine the rate of accumulation, say b^* . The saving: capital ratio is given by

$$b^s = r = \gamma u$$

In the long period the saving: capital stock and the investment: capital stock ratios must coincide, that is, $b^* = b^s$. In figure 6 (quadrant I), the equilateral hyperbola $b^* = \gamma u$ represents the locus of all combinations of the share of profits in output and capacity utilization compatible with the rate of accumulation b^* . In quadrant II, we depict the relation between the share of profits in output and the real wage for a given output: labour ratio.

Let us assume an initial situation in which the normal and actual degrees of capacity utilization coincide, that is, $u_a = u_n$. It is obvious that given this assumption both the share of profits and the real wage correspond to their normal levels.

We may now turn to the analysis of a change in the rate of accumulation from b^* to b^{**} , $b^{**} > b^*$. We may also assume that the increase in the rate of accumulation is the result of an increase in the entrepreneurs' expected rate of capacity utilization, given the initial degree of profitability, i.e., $\gamma = \gamma_n^0$. This will shift the hyperbola in quadrant I to the right; refer to figure 7.

We should note that if the expectations of the entrepreneurs were

¹⁹ *Ibid.*, p. 26.

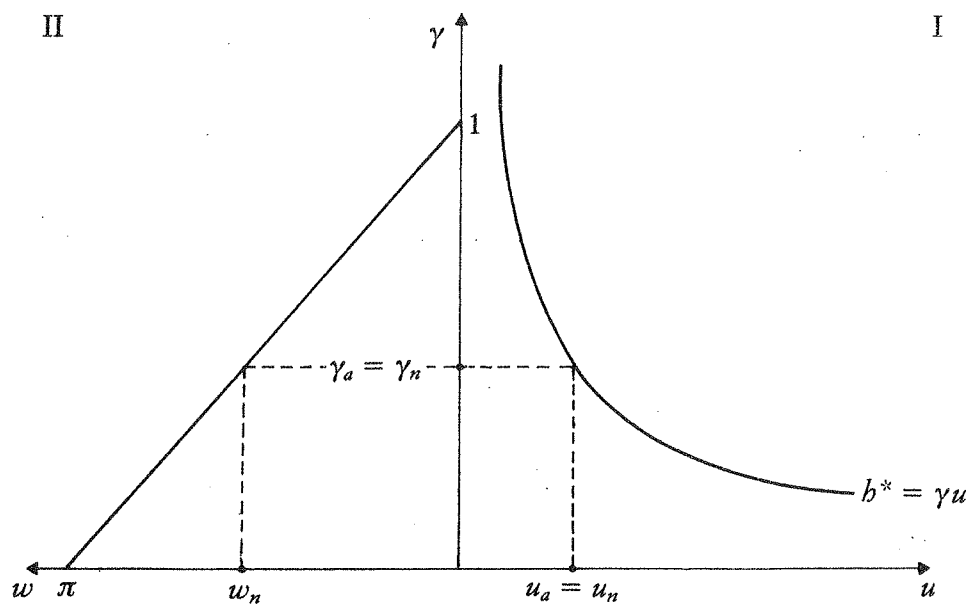


Fig. 6

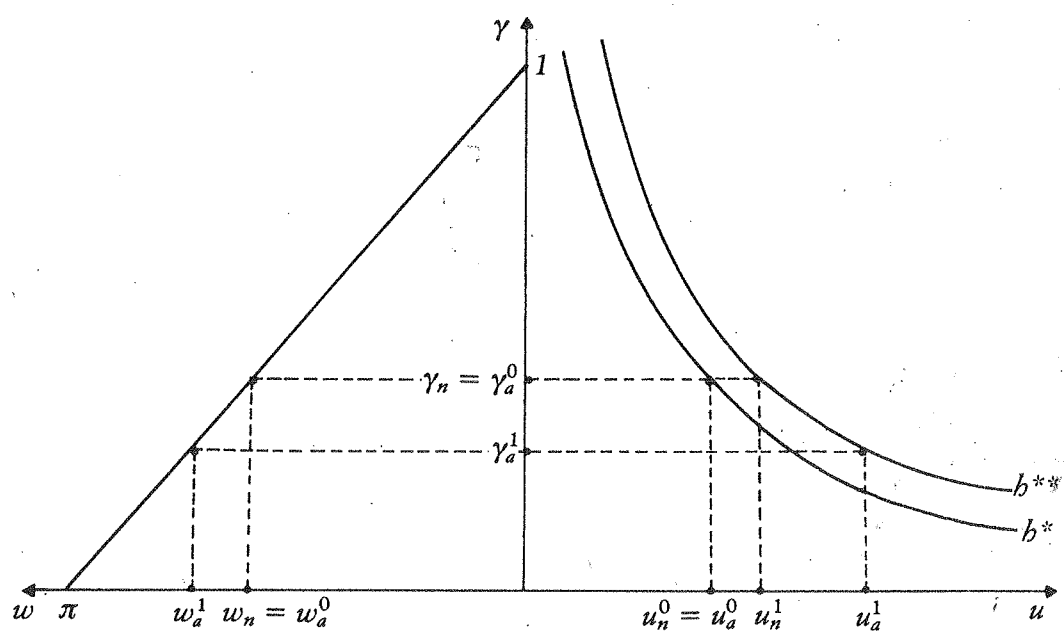


Fig. 7

correct, that is, if the actual degree of utilization was equal to the normal degree ($u_a^1 = u_n^1$), there would be no change in the distribution of income. However, if the entrepreneurs underestimate the new actual degree utilization — that is, if $u_n^1 < u_a^1$, as depicted in figure 7 — the actual share of profits in output will be smaller and the real wage will be greater than their normal counterparts. The opposite would obviously be the case if entrepreneurs overestimate the degree of utilization. The specific relation between these variables derives from the assumption about the propensities to consume out of wages and profits implicit in the simplified version of the Cambridge equation.

If this model is a legitimate representation of Ciccone's analysis, what the latter (correctly) shows is that if the actual degree of utilization is allowed to differ from the normal degree — and, in Ciccone's view, incorrect expectations on the part of entrepreneurs are a plausible explanation for such a discrepancy — distribution will not necessarily accommodate to changes in the rate of accumulation. Therefore Ciccone provides an argument for the *possibility* of distribution not being affected by the changes in the rate of accumulation. However, there is no mechanism which ensures that distribution will not be affected. That is, it may or it may not be affected.

Except for a couple of passages in which Ciccone vaguely relates changes in the investment:capital stock ratio to changes in the actual degree of utilization, the paper does not provide any precise mechanism relating these two variables. Instead, an independent variable, namely, expectations, is brought into the picture to explain the discrepancy between the actual and normal degrees of utilization. It is precisely the independent nature of expectations which makes the argument fragile, and the results of the model uncertain. For erroneous expectations make any result possible: not only the size of the change in the actual degree of utilization is unknown but the direction of the change in relation to changes in the normal utilization is uncertain, which implies that distribution may or may not accommodate to changes in the rate of accumulation.

In sum, the exogeneity of expectations implies the exogeneity of the changes in the actual degree of utilization in relation to changes in the normal degree. From our perspective, there is no argument in the analysis to support the idea that the system *will* accommodate to changes in accumulation *independently* from changes in distribution. The system may indeed accommodate leaving distribution unaffected, but the uncertainty of the results leads one to believe that it will not.

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