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Expectations in a steady state model of capacity utilization[*]

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Abstract

This paper was inspired by Committeri's recent comments on the steady-state model which he refers to as the "Rowthorn and Amadeo's model". We examine the role of expectations in a steady-state model of distribution, accumulation and capacity utilization. In particular, we explore the explanatory factors for discrepancies between the normal (or desired), expected and actual (or observed) degrees of capacity utilization. Also, we discuss the differences and similarities between the notion of steady-state equilibrium and the Classical notion of "centers of gravitation".

Resumo

Este artigo foi inspirado pelo recente comentário de Committeri ao modelo a que ele se refere como "modelo de Rowthorn e Amadeo". Examinamos o papel desempenhado pelas expectativas em um modelo de crescimento, distribuição e utilização da capacidade. Em particular, exploramos os fatores explicativos de disparidades entre os graus de utilização normal (ou desejado), esperado e observado. Discutimos ainda as diferenças e similitudes entre a noção de steady-state e a noção clássica de "centros de gravitação".

1. Introduction

This paper was inspired by Dr. Committeri's interesting "comments on recent contributions on capital accumulation, income distribution, and capacity utilization"[1] and, in particular, on the steady-state model which he refers to as the Rowthorn and Amadeo's model[2]. In what follows I shall discuss the points raised by Dr. Committeri which I consider central to his analysis, namely, the (in)adequacy of steady state models for the determination of long-period capacity utilization, and the role of expectations in long-period models. In the second section of the paper a steady state analysis of capacity utilization which explicitly considers the role of long-period expectations will be discussed.

1.1. On Steady State Models

The first central point raised in Dr. Committeri's comments refers to the identification of steady state models; with long-period analysis and, in particular, the adequacy of these models for the study of the determination of long-period capacity utilization. He argues as follows:

> In the approach of both authors (Rowthorn and Amadeo), 'long-period analysis' is predominantly based on steady states, also called 'equilibrium positions' of the economy. The identification of long-period analysis with steady states appears to be unduly restrictive, given the highly artificial features of steady states[3].

There are at 1east two different dimensions in the notion of steady states which should be considered here. The first. (and more general) one refers to an equilibrium positíon characterized by the configuration of the endogenous variables associated with a given set of exogenous variables (data), and the parameters specifying the technological, behavioural and expectational functional relations of the model. In equilibrium, producers and for fhat matter, all the other relevant agents in the economy, must "be content with what they are doing"[4], the conditions specifying the technology must prevail, and expectations must be satisfied[5].

[1] Committeri, M. "Some comments on recent contributions on capital accumulation, income distribution and capacity utilization, *Political Economy*, 1987.

[2] The paper by Bob Rowthorn, "Demand, real wages and economic growth", first appeared in 1981 (*Thames Papers in Political Economy*), and was reproduced in 1982 (in *Studi Economici*, nº 18). A similar model (applied to an open economy) can be found in Lance Tay1or's book *Structuralist Macroeconomics* (New York: Basic books) published in 1983. Taylor cites in his book a draft of what was to become Amitava Dutt's "Stagnation, income distribution and monopoly power", *Cambridge Journal of Economics*, 1984. Dutt was Taylor's student at MIT. My purpose in Amadeo, E. J. "Notes on capacity utilization, distribution and accumulation" (*Contributions to Political Economy*, vol. 5, 1986) was to compare the steady state capacity utilization models with the traditional Keynesian and Marxian models, to explicitly consider the introduction of normal capacity utilization in the desired accumulation function and to discuss the implications of an endogenous degree of utilization for the relation between distribution and accumulation.

[3] Committeri, *Op. Cit.*, p. 6**.** For a 1ist of of "artificial features" of steady states according to Dr**.** Committeri, see note 12 of his comments.

[4] Harrod, R. Towards a Dynamic Economics, London, Macrnillan, 1986, p. 81, quoted by Committeri, Op. Cit., p. 12.

[5] For a detailed discussion of the notion of equilihrium and its re1ation to the neo-Ricardian notion of 1ong-period position or center of gravitation, see Amadeo, E. J. and Dutt, A. "The neo- Ricardian Keynesians and the post-Keynesians",

The second dimension of the notion of steady state is associated with a configuration of the relevant variables of the analysis towards which the system converges or around which the system gravitates. The process of adjustment is emphasized in this dimension. This particular characterization of steady states requires two conditions to be satisified. First, the stability conditions associated with the adjustment process of the system (including those asociated with the expectational functions) must be satisfied. The second condition refers to the role of expectations. Expectations are affected by two sets of factors. Past and current events naturally affect expectations: agents take these events as an approximation for what is to come in the future. Expectations, whem formed this way, are not always fulfilled during the adjustment process, and this is why they influence the path of the system (although not the equilibrium position). The other set of factors is essentially composed of new informations not captured by the past and current values of the relevant variables. In steady state models, only the first set of factors are allowed to change over the adjustment process. The determinants of the second set of factors are assumed to be frozen during this process and, therefore, are part of the data[6]. One can reasonably argue that these two conditions are too restrictive. However, one will have to admit that they are imposed on the system with the objective of studying the path and the tendentional values of the endogenous variables of the syatem associated with the data. Once they are determined, the elements of the data can be altered, and the effect of these changes on the equilibrium position can be analysed.

The notion of steady states (or equilibrium position) is simply an organising concept which provides "an organized and orderly method of thinking out particular problems"[7]. In this sense it plays the same role as the Classical notion of centers of gravitation. According to the latter, "long~period positions are significant as centers of gravitation of prices and quantities produced, and as such they need never coincide with actual situations"[8]. Furthermore, according to this notion, "there is ... room for the fluctuations in quantities and prices and disappointment of expectations that occur in reality"[9]. It should be noted – and, indeed, the model deveLoped in the second section of the paper will try to argue in this direction – that these characteristics of centers of gravitation are not inconsistent with the notion of steady states.

In comparing the notions of centers of gravitation and steady states, there are two aspects which should be considered. In the first place, why are the assumptions sorrounding the notion of steady states more restrictive than those associated with the notion of center of gravitation? In particular,

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[6] For an example of the role of expectations applied to Keynes' multiplier adjustment mechanism, see Amadeo, E. J. "Keynes's principle of effective demand and its relationship to alternative theories of distribution and accumulation", unpublished PhD dissertation, Harvard University, 1986.

[7] Cf**.** Keynes, J. M. *The General Theory of Employment, Interest and Money*, London, Macmillan, 1936, p. 297.

[8] Cf. Ciccone, R. "Accumulation and capacity utilization: some critical considerations on Joan Robinson's theory of distribution", *Political Economy*, 1986, p. 6.

[9] Ciccone, *Op. Cit.*; p. 9.

what makes the gravitational movement of the system around the long-period position stable? Or, what are the specific conditions which prevent the Classical mechanism of competition from being explosive? The second point is related to the fírst, but it refers particularly to the role of expectations. The question is: how are the entrepeneurs' or producers' expectations assumed to be formed? Is it through an expectation functicn, or is it through an assumed stable trial-and error process?[10] These are questions which are usually faced in steady state models, and should be faced in centers of gravitation models as well.

The differences between models based on the notions of steady state and centers of gravitation are not that great. The former can be seen as a particular case of the 1atter in which the functional relations of the system (including expectational relations) are explicitly specified. This particular characteristic of steady state models allow them to yield definite configurations of the dependent variables associated with a given set of data variables. The resulte of centers of gravitation models may be more general, but they tend to be less conclusive[11].

1.2. On the role of 1ong-period expectations in capacity utilization mnodels

The second point raised by Dr. Committeri refers to the role of expectations in capacaty utilization models. His position is summarised in the following passage:

> In both versions of the model (Rowthorn's and Amadeo's), there is the possibility of utilization being different from its normal degree, even in states of equilibrium... This result appears to be in contrast with the features traditionally atributed to steady states, where normal utilization degree is assumed to prevail... and to be maintained over time... owing to the assumption of self-sustained fulfilement of expectation... The systematic under – or over – utilization of productive capacity that characterizes Rowthorn's and Amadeo's steady states leads us to ask what kind of expectations are implicit in their investment functíons, and whether their fulfillment can be made consistent with situations of systematic non-normal utilization of capacity[12].

Dr . Committeri's comments raises very important questions. First, what kind of expectations are implicit in the investment functions of the steady state capacity utilization models? Second, if the long-period expectations are fulfilled in equilibrium, is it still the case that the equilibrium (realized) degree of utilization and the normal degree will not necessarily coincide? Raising these two questions is one of the great meríts of Dr. Commiteri's (and also F'rof. Ciccone's) analyses. Indeed, in the original steady state models expectations were never allowed to be different from the actual degrees

[10] Take the Classical example of the gravitation of market prices around natural prices due to differences between the expected demand (which determines supply) and effectual demand. What guarantees that the way expectations are formed will make the market prices gravitate around the natural prices?

[11] See my comments of Prof. Ciccone's analysis in Amadeo, E. J. "The role of capacity utilization in long-period analysis", *Political Economy*, 1987.

[12] Committeri, *Op. Cit.*, p. 7.

of capacity utilization which means that the role of expectations was left out of the picture. In the model discussed in the second section of the paper these points will have to be taken into account.

Before turning to the model, however, there is a conceptual point which must be discussed. It refers to the notions of "normal", "planned", "expected" and "actual" degrees of capacity/utilization. In Amadeo (1986) the notions of normal and planned degrees have a very similar meaning, that is, the degree of utilization which firme fíx as a target degree. Usually the normal degree will be smaller than one so that firms will always be able to respond to unexpected changes in their products. According to this meaning of the term, the normal degree once decided upon never changes. In Amadeo (1987) both terms are still used more or less inerchangably but I there give them a slightly different connotation. It still refers to the normal degree in the sense that firms chose it as a precautionary measure against unexpected changes in demand. But it also had the meaning of an expected (and in this sense the term "planned" is much better than "normal") degree of utilization[13]. In my interpretation, Prof. Ciccone (as well as Dr. Committeri) use the terms normal and expected to rnean the "expected degree". In what follows a suggestion will be made that there is a conceptual difference between the two terms.

The normal degree is determined by precautionary motives associated with the competitive strategy of firms. Therefore it depends upon structural factors more than on factors related to the movement of demand, expected or actual. A central determinant of the normal degree is the creation of barriers to entry in an industry. Spence[14] arques that the existence of idle capacity may be a powerfull weapon against the entrance of new competitors who feel threatened by the possibility of the established firms using the extra capacity. If the established firms start using their capacity more intensively – which must the effect of depressing prices – the estrants, who would have to go through costly initial investments, will feel discouraged. For the established firms there is an optimal degree of utilization which balances the costs of maintaining idle capacity and the benefits of limiting the entry of new competitors.

The other precautionary motive which influences the determination of the normal degree is associated with the oscillations of demand. Firms have as one of their objectives the ability to respond to unexpected increases in the demand for their products and for this reason are willing to maintain part of their capacity idle. Again, there is a trade-off between the costs of maintainíng resouses under-utilized and the benefits of maintaining (or increasing) the share of the market. It is reasonable therefore to assume that producers will determine the degree of normal utilization having in mind the oscillations of demand over time. Essential for the determination of the normal degree are the

[13] It is for no other reason that I explore the nature of the equilibrium position in Amadeo, E. J. "The role of capacity utilization..." *Op. Cit.*, p. 10 of the manuscript.
[14] Spence, M. 1977. "Entry, capacity, investment and oligopolistic pricing", *Bell Journal of Economics*, New York, 8(2); pp. 534-44.

frequency and amplitude of the pattern of changes in demand, or the variance of these changes. One would expect that for an average rate of actual utilization, the greater the amplitude of changes in demand and the more frequent they are (and therefore the greater the probability of demand reaching the rate of full capacity) , the smaller will be the degree of normal utilization chosen by firms.

The expected degree of utilization, as noted in the discussion of the formation of expectations in steady state rnodels, depends on two sets of factors: current and past events as captured by the variables relevant for the decision (the actual rate of utilization in our case), and new informations which may affect the decision being made. The actual degree of utilization results from the interaction of decisions made in the economy, in particular those associated with saving and investment, that is, expenditure decisions. The actual degree may or may not coincide with the expected degree. In equilibrium, by definition, they will be equal to each other – otherwise entrepeneurs will revise their expectations thus changing the trajectory of the system. In equilibrium there cannot be systematic differences between the two rates of utilization. Over the transverse, however, except in the cases in which perfect forsight is assumed, there will be discrepancies between the expected and actual rates.

Once the concepts of normal, expected and actual degrees of utilization are defined, we may procede to examine a model in which the formation ot expectations is explicitly considered.

2. A modified model with adaptive expectations

We may start with the investment and saving functions. The saving: capital ratio, as derived in Amadeo (1987), is given by:

$$h^s = \gamma u \tag{1}$$

where

$$\gamma = 1 - (\omega/\pi)(c_w - c_k) - c_w \tag{2}$$

u is the actual or realized degree ot capacity utilization, c_w and c_k are the propensities to consume out ot wages and protíts, respectively, ω is the real wage, π is the output: labor ratio, and ω/π is the share ot wages in output.

The investment function assumes that entrepeneurs decide to invest based on the ditíerence between the expected ($\boldsymbol{u^e}$) and normal (u^n) degrees of utilization. The greater the difference, if the expected degree is greater than the normal degree, the greater the inducement to invest. Otherwise, given the variance of the actual degree, demand will reach the rate of full capacity more frequently and intensively than what is desirable from the entrepeneurs' point of view. Therefore, if the expected degree is greater than the normal degree, there will be an increase in the desired stock of capital. Put in a linear form, the investment: capital ratio would be given by:

$$h^i = \alpha + \beta(u^e - u^n) \tag{3}$$

where u^e and u^n stand for the expected and normal degrees of utilization, respectively and α captures the influence of the institutional base and psychology of the business community on the decision to invest. The equilibrium conditions of the model are two: [a] the equality between the rates of investment and saving in proportion to capital and [b] the fulfillment of expectations. The original steady state models of capacity utilization did not consider the role of expectations and, indeed, assumed that expectations were continuously fulfilled. In short, they assumed perfect forsight. Therefore, according to those models, the investment function [equation 3] would br given by $h = \alpha + \beta(u - u^n)$. The equilibrium degree of utilization is therefore given by:

$$\bar{u}^* = (\alpha - \beta u^n)/(\gamma - \beta) \quad (4)$$

We now consider the case in which the expected degree may differ from the actual degree. We start from an inicial situation in which the expected and normal degrees are equal, but the actual degree differs from them – a shock of any nature gives rise to this situation. The equality between saving and investment in a situation like this gives to a position of pseudo-equilibrium (or temporary equilibrium) in which the actual degree is given by $u^* = \alpha/\gamma$. The situation of pseudo-equilibrium is depicted in figure 1.

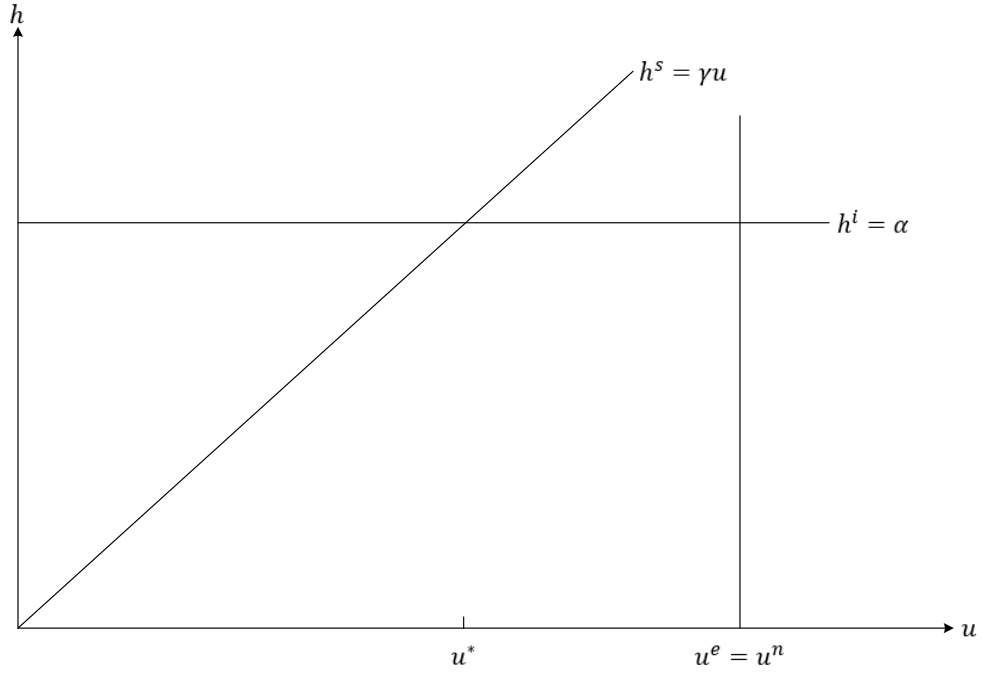

Figure 1

If this situation persists, entrepeneurs will be led to revise their expectations. The informations embodied in current degree of utilization (u^*) willbe taken into account, as well as new informations relevant for the formation of new plans. In order to formalize the effect of these two factors, we assume that the expected degree of utilization in period t given by the following expectation function:

$$u_t^e = u_{t-1}^e + \lambda(u_{t-1}^* - u_{t-1}^e) + e_t \quad (5)$$

where λ measures the speed of adjustment of u_t^e in relation diffences between last period's realized and expected degrees of utilization, and e_t is a random variable with a mathematical expectation equal to 0, that is $E[e_t] = 0$. On average e equals 0. We shall associate the situation characterized by $e_t = 0$ and the fulfillment of expectations with the long-period (average) position (LPaP) of the system. The latter can be thought as an analog of the Classical long-period or center of gravitation position.

2.1. The Long-Period Average Position (LPaP)

In general, if the system is not in the LPaP, the actual (temporary equilibrium degree of utilization will be given by

$$u^* = [\alpha + \beta(u^e - u^n)]/\gamma \quad (6)$$

In order to determine the equilibrium or LPaP degree of utilization, wesubstitute u^* as determined by equation 6 in equation 5. Recalling that in equilibrium $\bar{u}_e = \bar{u}^*$ the solution to equation 5 will be given by:

$$\bar{u}^* = [\alpha - \beta u^n]/[\gamma - \beta] \quad (7)$$

where $\bar{u}^*$ corresponds to the LpaP. It should be noted that the equilibrium degree of capacity utilization is independent from the way in which expectations are formed. In the absence of the assumption of perfect forsight the process of revision of expectations only affects the trajectory of the system, but not the equilibrium position. Since expectational errors are frequent, it is as important to examine the determinants of the adjustment process as it is to study the determinants of the equilibrium position.

The adjustment process associated with the situation of pseudo-equilibrium depicted in figure 1 is depicted in figure 2. In period zero the expected and normal degrees coincide, and the actual (temporary equilibrium) degree of utilization is smaller than the expected degree. According to equation 5, the expected degree in period 1 would fall. In fact, it would be given by:

$$u_1^e = u_0^e + \lambda[(\alpha/\gamma) - u_o^e] = u_o^e - \lambda[u^n - (\alpha/\gamma)] < y^n$$

where α/γ i s the value of u^* in period zero.

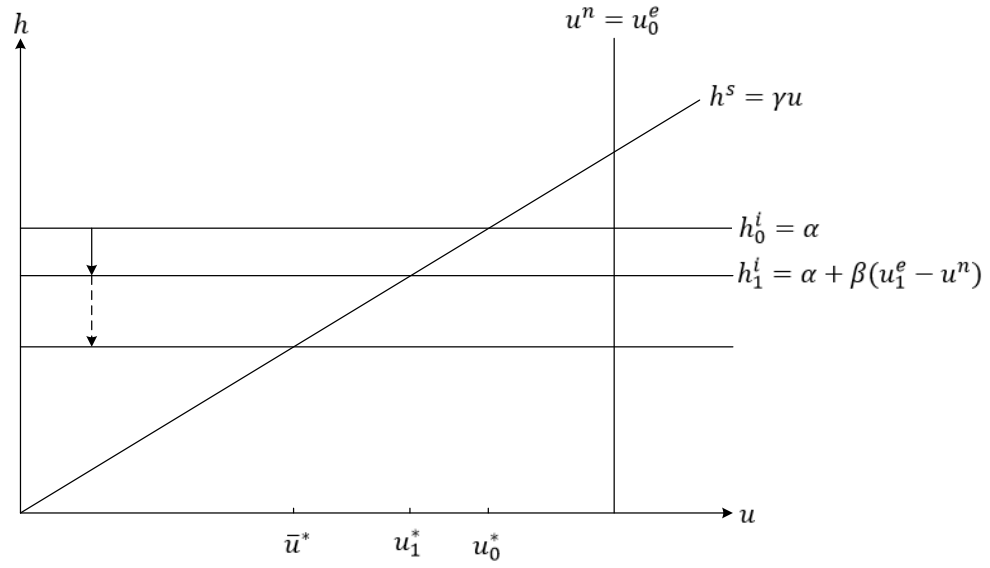

Figure 2

Both the desired rate of accumulation and the rea1ized degree of utilization in period 1 will be affected by the difference between the expected and normal degrees of utilization. They will assume the following values respectively:

$$h_1^i = \alpha - \beta(u^n - u_o^e)$$

and

$$u^* = [\alpha - \beta(u^n - u_0^e)]/\gamma < u^*$$

The adjustment process will continue up until the point in which the expected and realized degrees of utilization are equal to the value given by equation 4. The same process of adjustment can be depicted as in figure 3 where the capacity utilization is represented on the vertical axis and “time” is represented on the horizontal axis. The analysis starts from a situation in which the actual (pseudo-equilibrium) degree of utilization differs from the expected and normal degrees. The adjustment process eventually leads the system to a situation in which the expected and actual (equilibrium) degrees coincide.

It should be noted that any structural change, that is, any change in the parameters of the model will lead the system to a new process of adjustment and a diff erent LPaP, in equilibrium (average) degree of utilization may be greater or smaller than the normal degree.

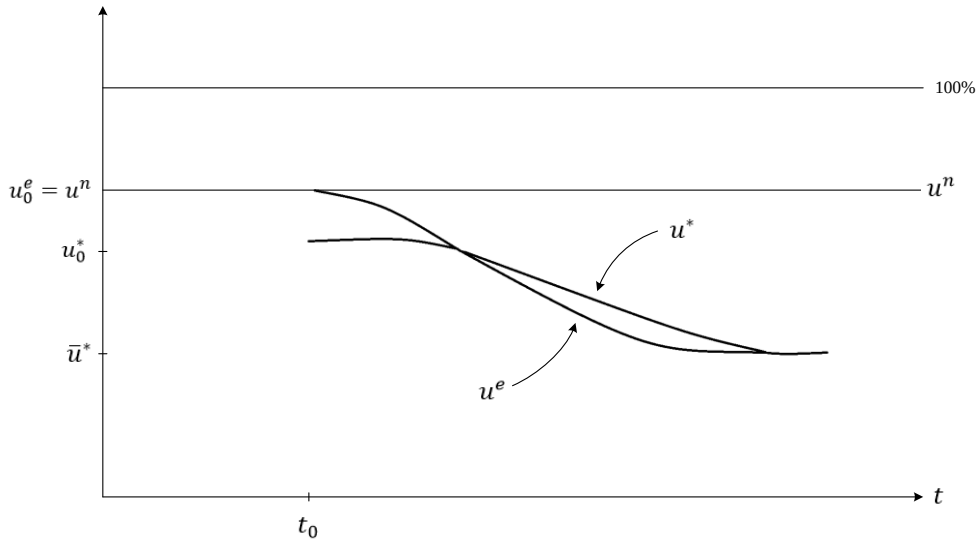

Figure 3

The two main conclusions of the analysis up to this point are the following. First, the positíon of equilibrium (or LpaP) is independent from the transverse, or the way in which expectations are formed. Second, and certainly more interesting, is that, given the definitions of the expected, normal and actual degrees of utilization, there is not. any reason to expect the actual degree to coincide with the normal degree in the LPaP. The latter is determined by structura1 factors associated with the competitive strategy of firms. The actual degree resulte frorn the decision made in the economy by firms, families and the State. Therefore, the actual rate can be systematically above or bellow the normal rate. If it is bellow, it means that the peaks of demand will reach the ceiling represented by the full utilizatíon of capacity 1ess frequently than if the two rates; were equal. If it is above, entrepeneurs will experiment situations in which the cei1ing is reached more frequently than they would have desired. In this case the rate of desired accumulation will be greater than in a situation in which the difference between the two rates was smalller. Obviously there are structural changes which would mitigate this situation. For example, there could be institutionalchanges which could induce entrepeneurs to invest less, independently of their expectations (a reduction in parameter α); or a reduction in the share of wages ían increase in parameter γ). Some of these changes could be brought about by government policies; however, what is important to realize is that there are not endogenous mechanisms which would lead to these changes.

2.2. Gravitation around the LPaP

We may finally take stochastic change into account, that is, the effect of random changes in the independent determinants of the expected degree of capacity utilization. These changes are associated with (temporary) changes in the value of the random variable e_t. This variable may take either

positive or negative values. Let us assume that e_t assumes a given value, say $\tilde{e}$, which does not change for a period "long" enough for the system to converge to a position of rest. Equation 5 would then be written:

$$u_e^t - u_{t-1}^e + \lambda(u_{t-1}^* - u_{t-1}^e) + \tilde{e}$$

The realized degree of utilization associated with this position of rest would not correspond to its expected analog. In fact, in this hypothetical position of rest, the difference between the two degrees of utilization would be given by:

$$\tilde{u}^* = \tilde{u}^e - \tilde{e}/\lambda \tag{8}$$

Note that $\tilde{u}^*$ would be smaller than $\tilde{u}^e$ if $\tilde{e}$ was positive and vice-versa. From equation 6 we know that whenever u^* differs from u^e, u^* will be given by:

$$u^* = [\alpha + \beta(u^e - u^n)]/\gamma \tag{6}$$

Equations 6 and 8 together yield the value of u^e associated with the case in which e takes a value different from zero:

$$u^e = [\gamma/(\gamma - \beta)] \cdot \{[(\alpha - \beta u^n)/\gamma] + [\tilde{e}/\lambda]\} \tag{9}$$

Note thar for $\tilde{e} = 0$, equation 9 yields the same result as equation 4. In figure 4 a situation is depicted in which the expected and realized degrees of utilization converge to a position of rest (different from the LPaP) associated with a given value of $e_t = \tilde{e}$ greater than zero.

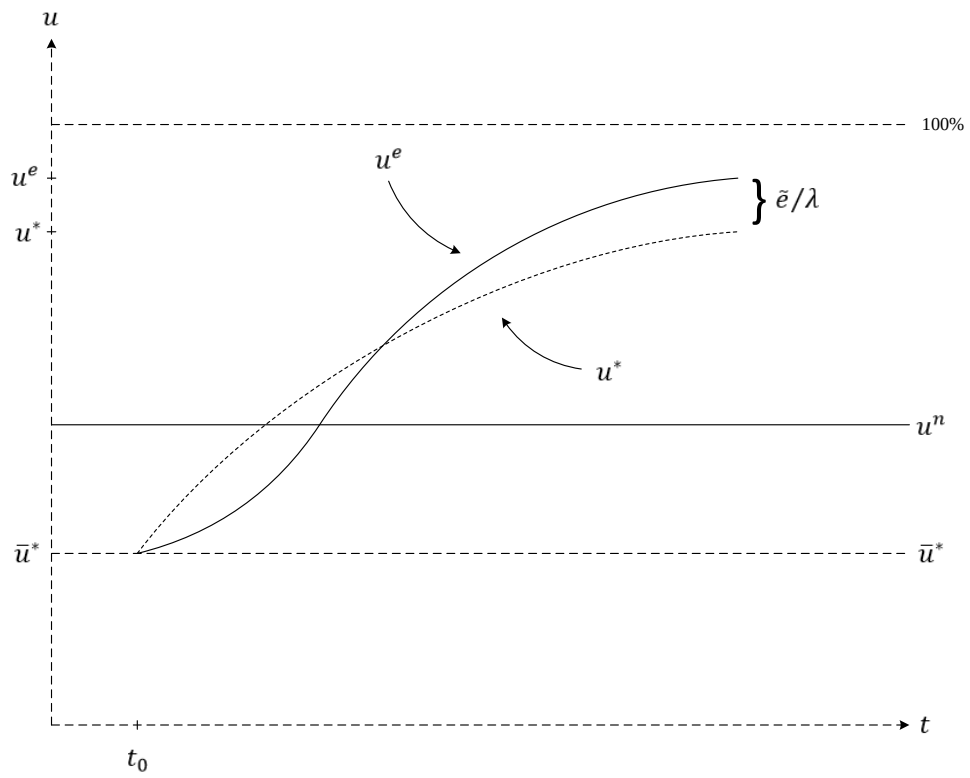

Figure 4

We may finally consider the effect of recurrent changes in the value of the independent determinant of the expected degree of utilization, namely, recurrent changes in e_t. To each new value of e_t, there corresponde a position of rest such as the one depicted in figure 4. We assume that changes in the value of e_t occur at intervals of time which are "smaller" than the "time span" associated with the working of the adjustment processes.

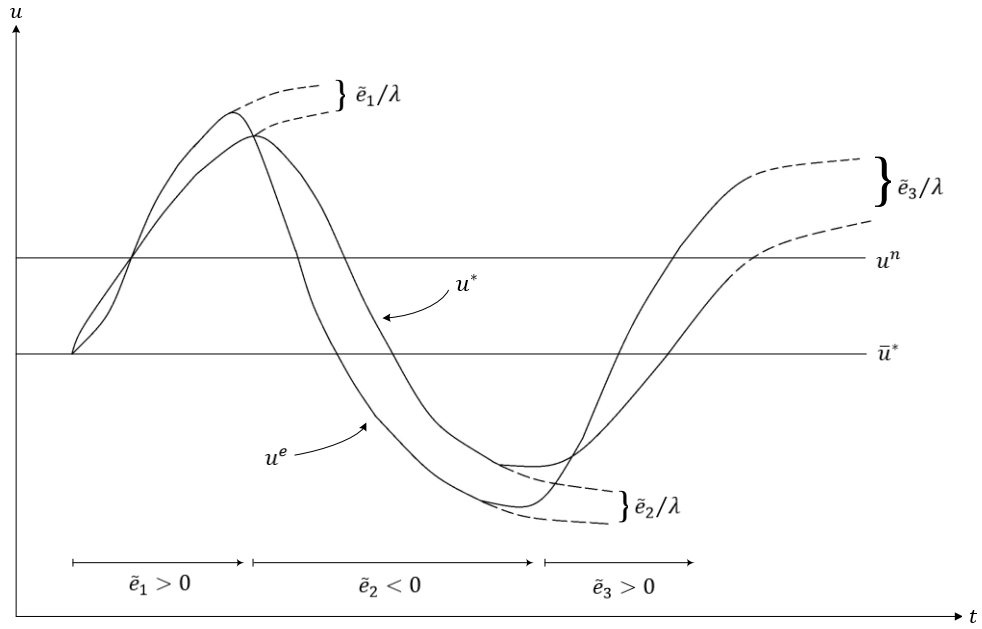

Figure 5

The conclusions which may be taken trom th is exercise are the following. If e_t changes recurrently – as we have reasons to believe it actuaily does – in general, the realized, expected and normal degres of utilisation will not be equal to each other. The realized and expected degrees will be equal on average (since the average value of e_t is zero). However, not even on average the normal and LPaP degree of utilization will be equal.

3. Concluding notes

In general, what we observe is that the actual degree of utilization tends to be different from what entrepeneurs expected it to be, and also different from what they would desire it to be (something around the normal degree). These differences result from different factors. The differences between the average actual degree and the normal degree result from the fact that entrepeneurs are not able to control the trajectory of the actual degree which depends not only on the entrepeneurs' desired accumulation function, but also on decisions made by other agents in the economy.

The differences between the expected and actual degrees result from the way expectations are formed. The path of the actual and expected degrees depends on the “endogenous” determinants of expectations (current events) as well as changes in the “exogenous” factors. When expectations are explicitly the causes of changes in the actual degree of utilization become clear. There are structural determinants (captured by the parameters of the model and the natural rate of utilization) and expectational determinants. Together they explain the determination of the position of rest of the system as well as the oscillation of the actual degree around the position of rest or the center of gravitation.