

Capital accumulation, technical progress and wage flexibility: Keynes' approach to aggregate supply and demand analysis revisited

By

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1.- Introduction

Conventional aggregate supply-aggregate demand (AS-AD) analysis - depicting the economy in a diagram with an upward sloping aggregate supply curve and a downward-sloping aggregate demand curve in price level-real output space - has recently emerged as the preferred framework for teaching macroeconomics at the undergraduate level since it plays a central role in almost all principles and intermediate macroeconomics textbooks. Nevertheless, it has been attacked for 'failing to adequately depict the operation of economies (and perverting the true message of the Keynesian revolution), and for oversimplifying and leading to a conflation of macroeconomic and microeconomic concepts' (Dutt, 2002, p.322). As a result, a growing chorus of scholars recommends its suppression as a teaching device (see, for instance, Barro, 1994 and Colander, 1995). By contrast, the AS-AD framework posited by Keynes (1936, ch.3) in the *General Theory* and elaborated mainly by Weintraub and Davidson does not possess the weaknesses and inconsistencies attributed to conventional AS-AD analysis but, paradoxically, it has almost disappeared from scholarly journals and macroeconomic texts (Dutt, 2002, pp. 328-330). The purpose of this paper is to revisit Keynes' AS-AD framework to analyse the effects on the level of employment and the price level of changes in a range of variables, the focus being the effects of capital accumulation, technical change and money wage rate variations. To do so, we build on the AS-AD analysis elaborated by Weintraub and Davidson. The expositions by these authors tend to leave the production function of firms unspecified so that precise formal results are rarely provided. To some extent, we aim at filling this vacuum. In particular, we insert a constant elasticity of substitution (CES) production function and solve a system of linear equations in order to perform a comparative statics analysis. We show results

regarding the effect on the equilibrium level of employment, the price level and the real wage of changes in a range of variables and parameters. We find that the effects of cuts in the money wage rate on the equilibrium level of employment and the price level are ambiguous particularly when due account is taken of the effect on the debt burden of firms of changes in the price level. The content of the paper is as follows. Section 2 briefly introduces the AS-AD model developed by Weintraub and Davidson. We display the 'basic' AS-AD model in section 3. The aggregate supply and aggregate demand functions are set out and their properties analysed. This is followed by a comparative statics analysis where the level of employment and the price level act as endogenous variables. Section 4 contains the 'extended' AS-AD model. It takes account of the effect on investment of changes in the debt service of firms expressed in real terms. This is one of the factors that Keynes (1936, ch.19) identified as making wage flexibility undesirable for macroeconomic stability. Section 5 concludes.

2.- Keynes' approach to AS-AD analysis

This section introduces what we call Keynes' approach to AS-AD analysis. Though this approach is posited in chapter 3 of the *General Theory* (Keynes, 1936), it was developed in Weintraub (1956, 1957, 1958) and elaborated in Davidson (1962, 1967, 1972), Davidson and Smolensky (1964) and Chick (1983). We start off with the aggregate supply function $Z(N)$. Firms produce in order to maximise expected profit and 'it is in the nature of the business of producing for sale on the market that the choice of what and how much to produce, and how to price things, must be made on the basis of estimates of costs and a forecast of demand' (Chick, 1983, p. 62). This is the central fact on which the aggregate supply curve is based. Profits are reckoned in money terms: revenue (or sales) minus costs. In a market economy, these decisions must be made in advance of actual sales because production takes time. As a result, there will be some quantity of workers that each firm will seek to hire for each level of expected sales. In the aggregate, therefore, there will be a systematic relationship between the number of workers (N) that firms want to hire and the expected total volume of sales (Z). This relationship is called the *aggregate supply curve* and is drawn as the Z-curve in figure 1 below. It is upward sloping because the more firms expect to sell, the larger the number of workers firms will want to hire. Its shape depends upon the costs of production, the degree of market power and the composition of output (Vickers, 1987, p. 91). If we assume that the degree of market power is constant and that the composition of output

and demand does not change with the overall volume of output, then its shape will be determined only by technological factors.

Hiring decisions based on firms' expectations of sales give rise, in turn, to a flow of money payments to the owners of productive factors. For instance, there will be a flow of money-wage payments to workers, a flow of interest payments to rentiers and a flow of money payments to profit recipients. These money income flows provide the funds with which households can purchase the goods and services produced by firms. The greater the level of employment is, the greater will be the flow of income payments to households and total spending on consumption goods. However, the government, foreigners and firms themselves also purchase the products of the industry so that, at any level of employment, the sum of expenditures by all these sectors on goods and services produced domestically is called aggregate demand. Since, as employment increases, the money payments to households as well as the profits accruing to firms also rise, we may assume that, in general, total spending grows as employment expands. As a result, the *aggregate demand function* is upward sloping as in figure 1 below.

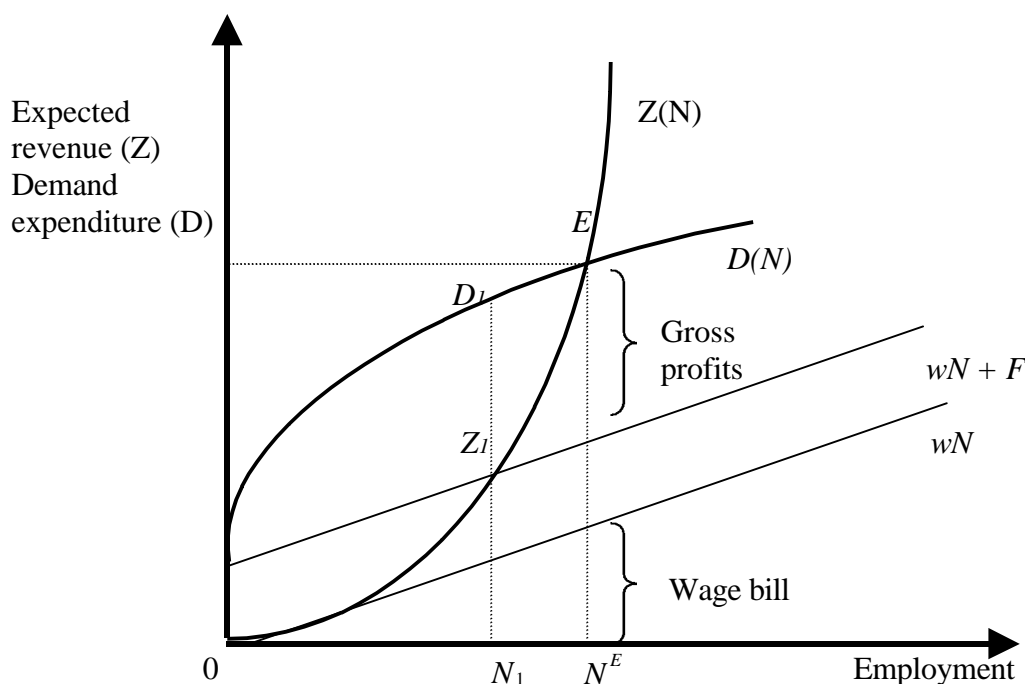


Figure 1: Keynes' aggregate supply and demand model

Given the aggregate supply and demand curves, it is possible to determine the equilibrium level of employment and revenue. The equilibrium position in figure 1

above is *stable* since the intercept of the aggregate demand function is positive and the slope of the latter is lower than the slope of the aggregate supply function at their intersection (Chick, 1983, p.64). Suppose firms expect sales of Z_1 . Thus, firms hire N_1 workers. However, if N_1 workers are hired, aggregate demand is D_1 , which exceeds firms' sales expectations. As a result, there is an incentive to firms to increase employment up to the value for which Z is equal to D , i.e. up to N^E in figure 1, so that

‘The volume of employment is given by the point of intersection between the aggregate demand function and the aggregate supply function; for it is at this point that the entrepreneurs' expectation of profits will be maximised. The value of D at the point of the aggregate demand function, where it is intersected by the aggregate supply function, will be called *the effective demand*' (Keynes, 1936, p.25).

Similarly, if we start from a level of employment to the right of the intersection of the aggregate supply and aggregate demand functions, then firms' expectations are disappointed as they find that actual aggregate demand falls short of expected sales. The disappointment induces them to cut back on employment and this process continues until the economy reaches N^E (see Davidson and Smolensky, 1964, p.145). Therefore, the point of *effective demand* represents an equilibrium level of spending where firms' expectations are just being fulfilled so that there is no further inducement to vary the amount of employment. At any level of employment the profit share on gross national income or, alternatively, the difference between total revenue and total variable costs for all firms in the economy, is determined by the position of the aggregate supply function relative to the wage bill line. The latter is a *linear* ray from the origin whose slope is the money wage rate. Further, since aggregate gross profits are obtained by subtracting total costs from aggregate total revenue at each level of employment and total costs for fully integrated firms are the sum of wage payments (wN) plus total fixed costs (F), we have that the vertical difference between the aggregate supply function $Z(N)$ and the $wN + F$ line represents aggregate gross profits. At employment levels above N_l firms are, on average, making profits and employment levels below N_l are only temporary and can thus be discarded for, in that range, firms are going bankrupt (Weintraub, 1957, p. 459).

3.- The ‘basic’ AS-AD model

In this section we describe the ‘basic’ AS-AD model. It is to be contrasted to the ‘extended’ AS-AD model presented in section 4. Unlike the ‘basic’ AS-AD model, the ‘extended’ AS-AD model takes into consideration the effect on investment of changes in the ratio of firms’ debt service to nominal aggregate output. First, we address the derivation of the aggregate supply curve. Second, we derive the aggregate demand curve. Finally, we show formal results and discuss their policy implications.

3.1.- The aggregate supply function

This subsection describes the supply side of the economy and the derivation of the aggregate supply function. This supply relation is posited in chapter 3 of Keynes’ *General Theory* (Keynes, 1936). The economy consists of a large number n of identical and fully integrated firms using equal amounts of capital and similar technology. The output in firm i is equal to

$$y_i = \Omega_i^{\frac{1}{r}} = \left(\mathbf{a} (\Lambda_N N_i)^r + (1 - \mathbf{a}) (\Lambda_K K_i)^r \right)^{\frac{1}{r}} \quad \mathbf{r} < 0 \quad (1)$$

where N_i is employment, K_i is physical capital and Λ_N and Λ_K are indices of productive efficiency. Labour-augmenting and capital-augmenting technical progress are indicated by an increase in Λ_N and Λ_K respectively. As a result, technical progress has a labour-augmenting bias if Λ_N increases faster than Λ_K , and a capital-augmenting bias if the reverse is the case. The elasticity of substitution between labour and capital is denoted by $\mathbf{s} = 1/(1 - \mathbf{r})$. Following results reported in Rowthorn (1999), let us assume that $\mathbf{s} < 1$ or $\mathbf{r} < 0$. The marginal product of labour M_i and the average product of labour A_i for firm i are equal to

$$\frac{\partial y_i}{\partial N_i} = M_i = \mathbf{a} \Lambda_N^r N_i^{r-1} \Omega_i^{1/r-1} > 0 \quad (2)$$

$$\frac{y_i}{N_i} = A_i = \frac{1}{N_i} \cdot \Omega_i^{1/r} \quad (3)$$

The ratio of the average to the marginal product of labour for firm i is equal to

$$\frac{A_i}{M_i} = 1 + \left(\frac{1-a}{a} \right) \cdot \left(\frac{\Lambda_K K_i}{\Lambda_N N_i} \right)^r \quad (4)$$

and it converges to a constant as $r \rightarrow 0$.

Each profit-maximising firm sets its price according to the expression

$$p_i = m_i \cdot \left(\frac{w}{M_i} \right) \quad (5)$$

where

$$m_i = \left(\frac{1}{1 - 1/e_i^d} \right) \geq 1 \quad (6)$$

and w is the economy-wide money wage rate, p_i is the price of output of firm i , e_i^d is the price-elasticity of demand faced by firm i and m_i is one plus the mark-up set by firm i and represents its degree of market power. Let us assume that m_i is constant. It is equal to unity under perfect competition and higher than unity otherwise. If the absence of the subscript i denotes an economy-wide variable, then the relative wage share WS is

$$WS = \left(1 - \frac{1}{e_d} \right) \cdot \left(\frac{M}{A} \right) \quad (7)$$

the natural rate of growth of the economy g_n is

$$g_n = l + I_N - I_K \quad (8)$$

the general price level p is

$$p = m \cdot \left(\frac{w}{M} \right) \quad (9)$$

and the aggregate supply function $Z(N)$ is

$$Z(N) = py = \left(\frac{A}{M} \right) \cdot mwN \quad (10)$$

and substituting (4) into (10) we have

$$Z(N) = mwN + \left(\frac{1-a}{a} \right) mw \Lambda_K^r K^r \Lambda_N^{-r} N^{1-r} \quad (11)$$

It emerges from (11) that, with a Cobb-Douglas production function ($r \rightarrow 0$), the aggregate supply function is represented by the projection of a *linear* ray from the origin (Vickers, 1987, p. 92). In addition, it must be noted that the assumption that all firms are fully integrated implies that aggregate total revenue is equal to the value of aggregate gross output, i.e., the gross national product (GNP) of the economy, which is also equal to the aggregate gross money income of the economy. ‘Thus, the aggregate supply function relates expected levels of GNP to employment’ (Davidson and Smolensky, 1964, p. 123). The partial derivatives of the $Z(N)$ function with respect to N , K , Λ_K , Λ_N and w are

$$\frac{\partial Z(N)}{\partial N} = pM \cdot \left[1 + (1-r) \left(\frac{1-a}{a} \right) \Lambda_K^r K^r \Lambda_N^{-r} N^{-r} \right] \succ 0 \quad (12)$$

$$\frac{\partial Z(N)}{\partial K} = rmw \left(\frac{1-a}{a} \right) \Lambda_K^r K^{r-1} \Lambda_N^{-r} N^{1-r} \prec 0 \quad (13)$$

$$\frac{\partial Z(N)}{\partial \Lambda_K} = rmw \left(\frac{1-a}{a} \right) \Lambda_K^{r-1} K^r \Lambda_N^{-r} N^{1-r} \prec 0 \quad (14)$$

$$\frac{\partial Z(N)}{\partial \Lambda_N} = -rmw \left(\frac{1-a}{a} \right) \Lambda_K^r K^r \Lambda_N^{-r-1} N^{1-r} \succ 0 \quad (15)$$

$$\frac{\partial Z(N)}{\partial w} = mN + m \left(\frac{1-a}{a} \right) \Lambda_K^r K^r \Lambda_N^{-r} N^{1-r} \succ 0 \quad (16)$$

and the employment-elasticity of aggregate supply e_{ZN} is

$$e_{ZN} = \frac{\partial N}{\partial Z} \cdot \frac{Z}{N} = \frac{1 + \left(\frac{1-a}{a} \right) \cdot \Lambda_K^r K^r \Lambda_N^{-r} N^{-r}}{1 + (1-r) \left(\frac{1-a}{a} \right) \cdot \Lambda_K^r K^r \Lambda_N^{-r} N^{-r}} \prec 1 \quad (17)$$

Expression (12) shows that $Z(N)$ slopes upward in expected nominal aggregate revenue-employment space. Since $r \prec 0$, expressions (13), (14), (15) and (16) tell us respectively that an increase in K or Λ_K shifts the $Z(N)$ function outward whereas a rise in Λ_N or w shifts it inward. These formal results roughly confirm the predictions

that emerge from the discussion in Weintraub (1958, pp. 80-85). Finally, expression (17) tells us that a 1 per cent rise in expected revenue fosters a rise in employment of less than 1 per cent so that the aggregate supply function is *convex* (Weintraub, 1957, p. 459; Vickers, 1987, p. 94) as long as $r < 0$. However, if the technology available to firms is of the Cobb-Douglas type ($r \rightarrow 0$), then $e_{ZN} = 1$ and, as argued above, the aggregate supply function becomes the projection of a *linear* ray from the origin.

3.2.- The aggregate demand function

A detailed derivation of the aggregate demand function $D(N)$ can be found in Weintraub (1958, ch.2), Davidson and Smolensky (1964, ch. 10) and Chick (1983, ch. 6). Our presentation relies heavily on the first two contributions. As argued above, at each level of employment there is a flow of money payments from firms to households. These payments, which are the incomes of individuals, the propensities to consume of the different income groups, and the price level, determine the consumption outlays of the household sector. Let us identify three different income groups: wage earners, rentiers and profit recipients. First, at any level of employment there is a flow of money-wage payments (wN) to workers. Second, most firms have outstanding debts as a consequence of having borrowed in the past. The resulting payments (F) to the holders of the debt contracts are the fixed costs of firms. The ultimate holders of the debt contracts are called rentiers. Let us assume that firms are net debtors and the household sector is a net creditor. This assumption is realistic for most economies. Finally, if we subtract total costs from total revenue at each level of employment we obtain aggregate gross profits R . For fully integrated firms, total costs are simply wage payments plus fixed costs. Thus, total nominal disposable income Y_d is equal to

$$Y_d = wN + kR + F \quad (18)$$

and aggregate gross profits are

$$R = p\Omega^{1/r} - wN - F \quad (19)$$

where k is the proportion of gross profits that is regularly disbursed as income to profit recipients. Aggregate consumption in nominal terms is

$$C(Y_d) = c_w \cdot wN + c_d(k \cdot (p \Omega^{1/r} - wN - F)) + c_r F \quad (20)$$

where c_w is the propensity to consume by wage earners, c_d is the propensity to consume by profit recipients and c_r is the propensity to consume by rentiers. Re-arranging terms, we get

$$C(Y_d) = c_w \cdot wN + c_p(p \Omega^{1/r} - wN) + (c_r - c_p) \cdot F \quad (21)$$

where $c_p = c_d \cdot k > 0$ and $(c_r - c_p) \cdot F$ is a component – along with the nominal flow of investment - of the intercept on the vertical axis of the aggregate demand function. The level of investment in nominal terms is

$$I = p \cdot \Delta K = I((1 - k)R; r; y) \quad (22)$$

where $(1 - k) \cdot R$ is retained aggregate gross profits, r is a measure of the cost of capital and y is the expected profitability of investment. The introduction of Ψ in (22) recognizes the possibility, as Keynes (1936) certainly does, that long-period profit expectations may shift independently of strictly economic results like, for instance, gross profits. Lastly, $I_{gp} > 0$ is the propensity to invest out of gross profits whereas $I_p = (1 - k) \cdot I_{gp} > 0$ is the propensity to invest out of retained profits. The aggregate demand function $D(N)$ is obtained by adding total consumption by households and investment by firms

$$D(N) = c_w wN + c_p(p \Omega^{1/r} - wN) + (c_r - c_p) \cdot F + I((1 - k)R; r; y) \quad (23)$$

The partial derivatives with respect to N , K , ΔK , ΔN and w are

$$\frac{\partial D(N)}{\partial N} = pM \left[(c_w - c_p - I_p) \frac{1}{m} + (c_p + I_p) \right] > 0 \quad (24)$$

since $c_p + I_p < 1$ and $c_w < 1$ by assumption

$$\frac{\partial D(N)}{\partial K} = p(1 - \mathbf{a})(c_p + I_p) \Lambda_K^r K^{r-1} \Omega^{1/r-1} \succ 0 \quad (25)$$

$$\frac{\partial D(N)}{\partial \Lambda_K} = p(1 - \mathbf{a})(c_p + I_p) \Lambda_K^{r-1} K^r \Omega^{1/r-1} \succ 0 \quad (26)$$

$$\frac{\partial D(N)}{\partial \Lambda_N} = p\mathbf{a}(c_p + I_p) \Lambda_N^{r-1} N^r \Omega^{1/r-1} \succ 0 \quad (27)$$

and

$$\frac{\partial D(N)}{\partial w} = (c_w - c_p - I_p) \cdot N \begin{matrix} \leq \\ \geq \end{matrix} 0 \quad (28)$$

Expression (24) confirms that the aggregate demand curve $D(N)$ slopes upward in total revenue-employment space. Expressions (25), (26) and (27) tell us that an increase in K , Λ_K and Λ_N shifts the $D(N)$ curve upward thereby raising the equilibrium level of employment other things constant. This is because a rise in any of these variables raises gross profits and this, in turn, raises consumption and investment demand. Lastly, expression (28) indicates that the effect of a change in the money wage rate on the aggregate demand curve is ambiguous and depends on the relative values of the propensity to consume by wage earners and profit recipients and the propensity to invest out of retained profits.

Finally, we address the important issue of the stability of the equilibrium of the model. A determinate and stable equilibrium is a necessary condition to perform the comparative statics analysis. As shown in figure 1 above, the point of effective demand is stable if the $D(N)$ curve cuts the $Z(N)$ curve from above (Weintraub, 1957, p. 466; Davidson and Smolensky, 1964, p.146; Chick, 1983, p.70). In turn, this is the case if the $D(N)$ curve has a positive intercept *and* its slope is lower than the slope of the $Z(N)$ curve at the intersection point. Thus, the stability condition is:

$$(c_r - c_p) \cdot F + I \succ 0 \quad (29)$$

$$\frac{dD(N)/dN}{dZ(N)/dN} = \frac{(c_w - c_p - I_p)(1/m) + (c_p + I_p)}{\left[1 + (1 - r) \left(\frac{1 - \mathbf{a}}{\mathbf{a}} \right) \left(\frac{\Lambda_K K}{\Lambda_N N} \right)^r \right]} \prec 1 \quad (30)$$

It is clear that condition (30) is fulfilled. As for condition (29), let us assume that it is also fulfilled. Thus, we can move on to the comparative statics analysis.

3.3.- Comparative statics analysis in the ‘basic’ AS-AD model

The comparative statics analysis below assumes implicitly that individual short-period expectations are always realised so that the system moves *instantly* to the point of effective demand E in figure 1 above. Thus, the model resembles what Kregel (1976) calls the ‘Model of Static Equilibrium’ suggested by Keynes in his 1937 Lectures. In order to perform the comparative statics analysis we set up the E and P equations as

$$E = D(N) - Z(N) \quad (31)$$

$$\text{or } E = c_w wN + c_p (p \Omega^{1/r} - wN) + (c_r - c_p)F + I - mwN \left[1 + \left(\frac{1-a}{a} \right) \left(\frac{\Lambda_K K}{\Lambda_N N} \right)^r \right] \quad (32)$$

$$\text{and } P = p - \left(\frac{mw}{a} \right) \Lambda_N^{-r} N^{1-r} \cdot \Omega^{1-1/r} \quad (33)$$

We choose the price level p and the level of employment N as the endogenous variables and the remaining variables are deemed exogenous. Results are obtained by applying the theorem of existence of implicitly expressed vector fields and performing algebraic transformations. They are summarized in table 1 below. We next comment on the results. As for the effect of an increase in physical capital K , we know from (13) that the aggregate supply curve shifts outward and from (25) that the aggregate demand curve shifts upward so that the final equilibrium level of employment N^E must be located at the right of the initial one. Therefore, whenever the net rate of investment in real terms is positive N^E will keep on rising. A rise (fall) in the money wage rate w reduces (raises) N^E . As shown in (16), a rise in w shifts the aggregate supply curve inward whereas, as indicated in (28), the net effect on the aggregate demand curve is ambiguous. However, our results show unambiguously that, no matter what the effect on the aggregate demand curve is, a rise (fall) in w reduces (raises) N^E in the ‘basic’ AS-AD model. This suggests that, given enough time to let all adjustments work themselves out money wage reductions drive the economy to its full employment

equilibrium. It also suggests that, unless there is downward money wage rigidity, the long-run level of economic activity will be supply-side determined. Needless to say, this result is in conformity with Classical theory.

A rise in the average degree of monopoly reduces N^E . This is because a rise in m shifts the aggregate supply and demand curves inward and upward respectively, but the former effect is stronger than the latter. Capital-augmenting technical progress has a positive effect on N^E . On the one hand, as shown in (26), a rise in Λ_K increases gross profits thereby shifting the aggregate demand curve upward. On the other hand, as reflected in (14), the rise in Λ_K shifts the aggregate supply curve outward. Unlike capital-augmenting technical progress, labour-augmenting technical progress has a negative impact on N^E . As expression (27) reflects, a rise in Λ_N increases the volume of profits thereby raising aggregate demand and shifting the aggregate demand curve upward. However, according to (15), its rise shifts the aggregate supply curve inward. Our interpretation of this result is the following: labour-augmenting technical progress raises, via its effect on profits, aggregate demand and output thus increasing the demand for labour but, simultaneously, the rise in Λ_N reduces the amount of labour that is necessary to produce the initial level of output, the net effect on employment being negative. Therefore, this suggests that labour-augmenting technical progress will reduce N^E unless the effect of the growth of physical capital, capital-augmenting technical progress and aggregate demand offset it.

Table 1 below also portrays the effect on N^E of changes in the parameters and arguments of the aggregate demand function. A rise in the propensity to consume by wage earners c_w or profit-recipients c_d increases N^E . A rise in the cost of capital to firms r and an improvement in profit expectations Ψ lead to a fall and a rise in N^E respectively. Finally, the effect on N^E of an increase in the nominal volume of fixed payments by firms resulting from outstanding debt F or an increase in the proportion of gross profits disbursed to profit recipients k have an ambiguous effect on N^E . In particular, the effect depends ultimately on the relative values of the different propensities to consume and invest. Interestingly, if the propensity to consume by rentiers is higher than the sum of the propensity to consume by profit recipients and the propensity to invest out of retained profits, then a rise in F will raise N^E .

Comparative statics analysis results for the price level and the real wage are shown in the second and third row respectively of table 1 below. A rise in the average degree of monopoly m , the propensity to consume by wage earners c_w and profit recipients c_d and an improvement in profit expectations Ψ pushes up the price level and pushes down the real wage, whereas a rise in the cost of capital r has just the opposite effect. With the exception of the effect of a variation in the money wage rate, the effect on the real wage of variations in any of the remaining exogenous variables and parameters is ambiguous. As for the effect on the price level of a variation in the money wage rate w , we know from (35) that a rise in w reduces N^E . Expressions (34) and (35) below - where (35) is the result of re-arranging (9) - show that a rise in the level of employment lowers the marginal productivity of labour M and the real wage.

$$\frac{\partial M}{\partial N} = (1 - r) \Omega^{1/r-1} \cdot a (\Lambda_N N)^r \cdot N^{-2} \left(\frac{a (\Lambda_N N)^r}{\Omega} - 1 \right) < 0 \quad (34)$$

$$\frac{w}{p} = \frac{M}{m} \quad (35)$$

Therefore, we have that a rise (fall) in the money wage rate pushes up (down) the real wage i.e. that $dp/dw < 1$, this being compatible, in turn, with either a fall or a rise in the price level as long as the latter rises (falls) by less than w . Expression (36) below shows that this will be the case because $J < 0$ and the inverse of the average product of labour A is well below unity. Clearly, if $dp/dw < 0$ this will be associated to a larger fall in the real wage and a larger increase in N^E as compared to the case when $dp/dw > 0$ since, in this latter case, the real wage will hardly fall and N^E will hardly increase. What is more intriguing is the fact that, since $B < 0$ and $J < 0$, a rise in the money wage rate may end up lowering the price level and vice-versa, i.e. $dp/dw < 0$. The reason for this ‘paradox of cost’ is that, although a rise in w initially raises marginal costs, the latter will fall subsequently as a result of the rise in the marginal product of labour brought about by the reduction in the level of employment. Thus, the final impact on the price level depends on the behaviour of marginal costs of firms which may raise or fall depending on: (i) the size of the increase in the level of employment brought about by the fall in w and (ii) the fall in the marginal product of

labour M brought about by the increase in the level of employment. Looking at (36) and J below, it can be seen that it is unlikely that dp/dw be negative. However, it cannot be ruled out.

$$\frac{dp}{dw} = \left(\frac{1}{A}\right) \cdot \left[m + \left(\frac{r}{B}\right) \left(\frac{1-a}{a}\right) \left(\frac{\Lambda_k K}{\Lambda_N N}\right)^r \cdot J \right] < 1 \quad (36)$$

where $J = [(c_w - m) + (m - 1)(c_p + I_p)] < 0$

This leads to the distinction in table 2 below between a Classical regime and a mixed Classical-Keynesian regime. Under a Classical regime, money wage reductions are effective in increasing N^E and this is reflected in a double positive sign in parenthesis in table 2 below. By contrast, under a mixed Classical-Keynesian regime money wage reductions hardly lead to higher N^E . This is reflected in table 2 by a single positive sign in parenthesis. Since it is unlikely that dp/dw be negative, the most likely scenario in the ‘basic’ model is one characterized by the mixed Classical-Keynesian regime.

	dK	dw	$d w^b$	dm	$d \Lambda_K$	$d \Lambda_N$	$d c_w$	$d c_d$	dk	dr	dy	dF
dDN	+	-	?	-	+	-	+	+	?	-	+	?
dDp	?	?	?	+	?	?	+	+	?	-	+	?
$d(w/p)$?	+	?	-	?	?	-	-	?	+	-	?

Table 1: Summary of comparative statics analysis
(The superscript b denotes results for the extended AS-AD model)

3.4.- Labour market dynamics in the ‘basic’ AS-AD model

As shown above, money wage rate variations lead to variations of the real wage in the same direction. In turn, the inverse relation between the real wage and the level of employment that results from (34) and (35) indicates that the aggregate demand for labour curve in real wage-employment space is downward-sloping as shown in figure 2 below, although this arises from the assumption of a diminishing marginal product of labour. Thus, its negative slope is determined exclusively by the technology available to firms – since the mark-up is constant by assumption – so that aggregate demand does not play any role in the determination of the *size* of its slope.

Of more substance in the ‘basic’ AS-AD model is the fact that money wage cuts eventually push the economy to its full employment equilibrium where the aggregate supply and demand for labour intersect. An implication of this result is that, as long as the money wage rate is not rigid downwards, the long-run level of output is determined in the labour market or, equivalently, it is supply-side determined. For instance, in figure 2 below, if the real wage is $(w/p)_1$, then the aggregate supply of labour exceeds the aggregate demand for labour and the money wage rate tends to fall. As this occurs, the level of employment N^E in figure 3 below increases, as implied by (35). This process continues as long as the real wage remains above $(w/p)^{FE}$. Likewise, if the real wage is $(w/p)_2$, the aggregate demand for labour exceeds the aggregate labour supply and the money wage rate rises thereby reducing N^E . Therefore, the implications of the ‘basic’ AS-AD model are in conformity with Classical theory, i.e. unemployment is caused by real wages that are ‘too’ high and the way to cure it is to cut the money wage rate. In addition, the level of full employment N^{FE} is stable. This result is only subject to the important caveat that, if $0 < dp/dw < 1$, then substantial money wage reductions may be required to bring about a rise in N^E and this may make the former an inadequate policy tool for reducing unemployment.

Although the diagnosis of unemployment that emerges from the ‘basic’ AS-AD model is along the lines of Classical theory, the mechanics of how the economy converges to full employment N^{FE} are not. Within the reinterpretation of Classical theory embodied in the neoclassical synthesis, falling money wages and prices lead overtime to an increase in aggregate demand if the *wealth* or Scitovszky-Pigou-Haberler effect that results from the falling price level is stronger than the *substitution* effect that arises from a falling rate of growth of prices (Patinkin, 1965, pp. 359-65). By contrast, in the AS-AD model posited by Keynes in the *General Theory* the mechanism of convergence to equilibrium does not rely on the existence of a powerful wealth effect (or, alternatively, the ability of the central bank to manage interest rates skilfully) to explain how aggregate demand adjusts to aggregate supply in the long run and, in this sense, we believe it provides a more consistent framework than conventional AS-AD analysis. Let us see how this process occurs. If, as before, the real wage is $(w/p)_1$ in figure 2 and the equilibrium level of employment is N_1^E in figure 3 (corresponding to point E_1) then, as the money wage rate falls the Z-curve shifts outward from $Z_1(N)$ to

$Z_2(N)$ and the D-curve shifts downward from $D_1(N)$ to $D_2(N)$ so that the new equilibrium position is E_2 . Next, for the level of employment N_1^E , the total revenue of firms $D_2(N_1)$ now exceeds $Z_2(N_1)$, i.e. the total costs incurred by firms to produce y_1 . Thus, firms realize that they can raise profits by hiring additional workers and increasing production. However, as employment rises, aggregate demand also increases – as indicated by expression (24) above - so that, as long as $D(N) - Z(N) > 0$, firms keep revising sales expectations and production plans upwards. Thus, the equilibrium level of employment increases from N_1^E to N_2^E in figure 3. In the meantime, as long as $N^E < N^{FE}$ in figure 2, the money wage rate keeps falling and, consequently, the Z and D curves continue to shift outward and downward respectively. This process only ceases when $N^E = N^{FE}$ and the real wage is $(w/p)^{FE}$, at which stage the money wage rate stops falling and firms' sales expectations are just realized. Therefore, a process of revision of sales expectations by profit-maximising firms in the aftermath of changes in actual revenue drives the economy to its full employment equilibrium.

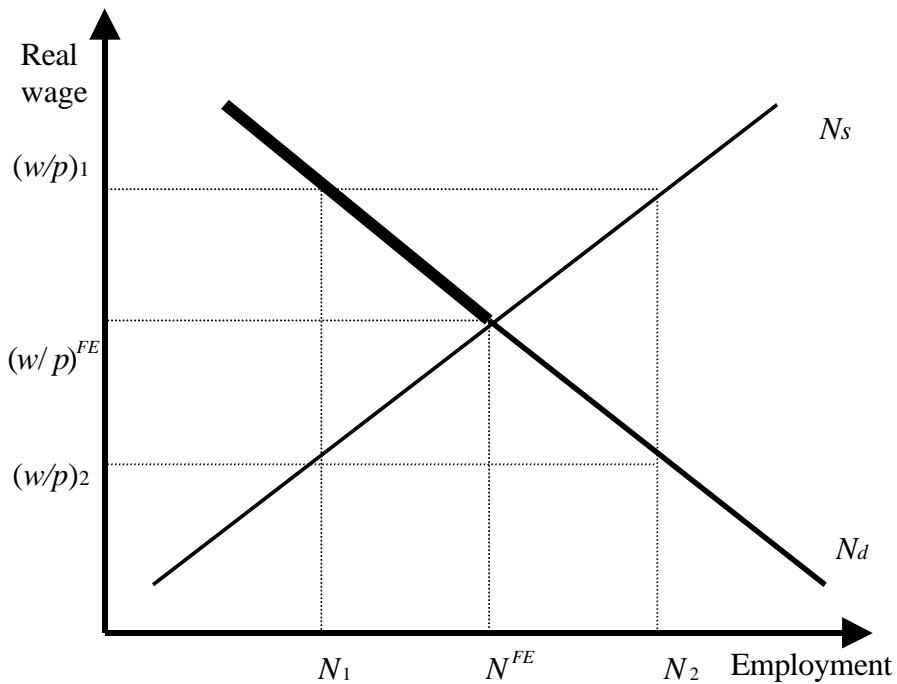


Figure 2: The labour market

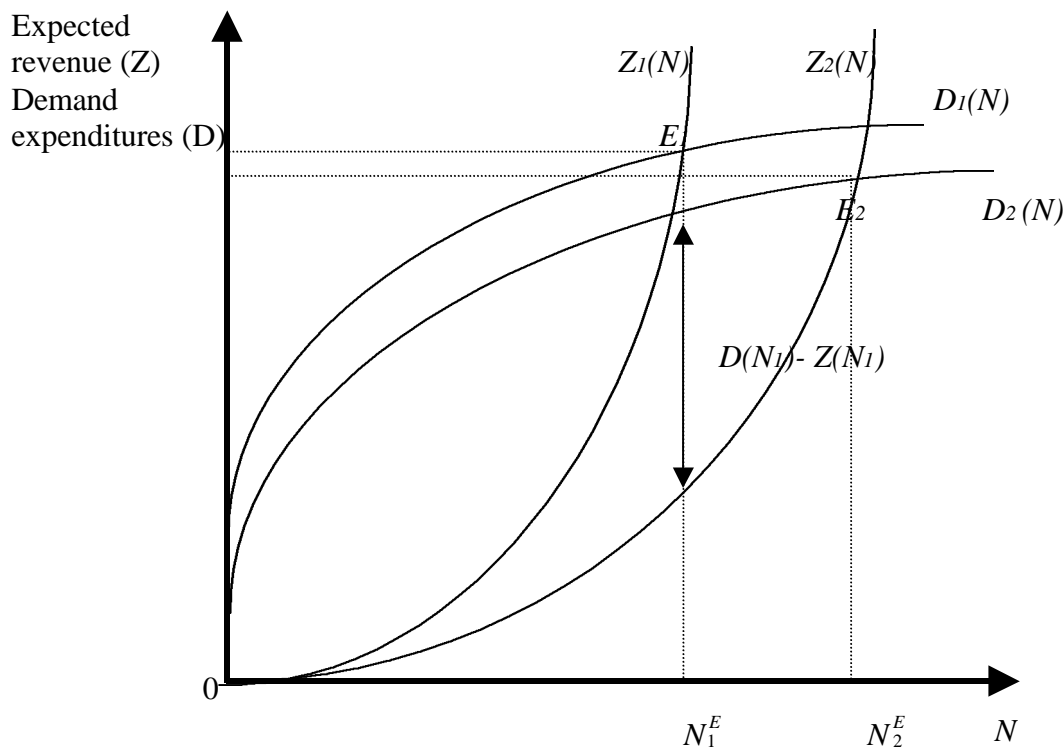


Figure 3: The adjustment mechanism to a falling money wage rate in the Classical and mixed Classical-Keynesian regime

4.- The ‘extended’ AS-AD model

The ‘basic’ AS-AD model displayed above leads somehow to an optimistic view of the self-stabilizing properties of market economies. However, these properties rely heavily on the notion that variations in the money wage rate and the resulting variations in the price level do not affect aggregate demand as a result, for instance, of changes in income distribution, variations in the debt burden of firms in real terms or changes in profit expectations. Indeed, starting with Fisher (1933) and Keynes (1936, ch.19), several authors have pointed to a number of problems posed by a deflationary process. It is not our purpose to review this literature. Rather, we aim at exploring the implications of dropping one of the assumptions in the ‘basic’ model. In particular, in what we call the ‘extended’ AS-AD model, we let the ratio of the debt service of firms to nominal output f change as the price level varies and, in addition, we assume that changes in f affect firms’ willingness to invest as well as their ability to raise external funds. Indeed, the adverse effect on aggregate demand of a falling price level due to a rising debt burden of firms and, in particular, the negative effect on investment arising from some firms becoming insolvent is one of the factors Keynes (1936, p. 268) identified as making downward wage flexibility undesirable.

Since we assumed above that firms are net debtors, this implies that they finance investment, at least partly, from external sources. We will also assume that a rise in the ratio of the debt service of firms to nominal output f leads to higher creditor and debtor risk. In particular, creditor and debtor risk will rise because financial margins of safety decline and bankruptcy becomes more likely as f rises. In turn, this may reduce the net spending of debtors and creditors for, at least, two reasons (see Caskey and Fazzari, 1987). First, as debtors approach technical insolvency, they reduce spending by *more* than what one would expect as a result of falling net worth due to bankruptcy costs. These bankruptcy costs include the difficulties that borrowers with a history of debt repayment problems will have when trying to obtain credit or the costs of explicit bankruptcy and foreclosure resulting from the loss of ownership rights that may again be valuable in the future. Thus, debtors (firms) have an interest in avoiding bankruptcy so they will attempt to remain solvent by cutting (investment) expenditure when there is an unanticipated rise in the real value of their nominal debt obligations (see Bernanke, 1981). Second, bankruptcy costs represent a *net* wealth loss to creditors (households) since they prevent creditors' wealth from increasing as much as borrowers' wealth declines following an unanticipated fall in the price level. This may be the case because (i) bankruptcy and foreclosure can result in significant legal costs, (ii) assets obtained through foreclosure may be out of service for some time while bankruptcy proceedings are carried out, and (iii) if the creditor turns out to be a financial intermediary, it is likely to be ill-equipped to use the assets acquired through foreclosure and this, in turn, may force it into sales of these assets at a time when 'distress' sales are widespread and, consequently, market prices are low (see Caskey and Fazzari, 1987). These arguments suggest that collateral is worth less to creditors than to debtors so that bankruptcy imposes net social costs and, according to us, they justify the presence of f as an argument in the investment function.

4.1.- Comparative statics in the 'extended' AS-AD model

The 'extended' AS-AD model retains all the features and equations of the AS-AD 'basic' model displayed in section 3 except the investment function (22) which now includes the ratio of the debt service of firms to nominal aggregate output f as an additional argument so that

$$I^b = ((1-k)R; r; y; f) \quad I_f < 0 \quad (37)$$

and

$$f = \frac{F}{p \Omega^{1/r}} = 1 - WS - \left(\frac{R}{p \Omega^{1/r}} \right) \quad (38)$$

where the superscript b denotes the expressions of the ‘extended’ AS-AD model. As a result, the E equation becomes

$$E^b = c_w wN + c_p (p \Omega^{1/r} - wN) + (c_r - c_p)F + I^b - mwN \left[1 + \left(\frac{1-a}{a} \right) \left(\frac{\Lambda_K K}{\Lambda_N N} \right)^r \right] \quad (39)$$

so that

$$\frac{dN}{d w^b} = \left(\frac{1}{MB^b} \right) \cdot \left(\frac{N}{p} \right) \cdot H^b \stackrel{\leq}{\geq} 0 \quad (40)$$

where $B^b = \left[(T_8)(1/m) - T_{11} \cdot \left[1 + (1-r) \left(\frac{1-a}{a} \right) \left(\frac{\Lambda_K K}{\Lambda_N N} \right)^r \right] \right] < 0$

$$H^b = \left[(-T_8) + m(T_{11}) \cdot \left[1 + \left(\frac{1-a}{a} \right) \left(\frac{\Lambda_K K}{\Lambda_N N} \right)^r \right] \right] \stackrel{\leq}{\geq} 0, \quad T_8 = (c_w - c_p - I_p) \stackrel{\leq}{\geq} 0 \quad \text{and,}$$

by assumption, $T_{11} = 1 - c_p - I_p + I_f \cdot \frac{f}{p \Omega^{1/r}} > 0$.

Our interest now focuses on the effect on the level of employment and the price level of variations in the money wage rate. It is clear from (40) that the effect on the equilibrium level of employment N^E of a money wage rate change can, in principle, have any possible sign since B^b and H^b can be positive, negative or zero. However, if $B^b > 0$, the ‘extended’ model yields inconsistent predictions since, for instance, a rise in the cost of capital r will raise the level of employment and an improvement in profit expectations Ψ will lower it. Thus, let us assume from here onwards that $B^b < 0$. In turn, this implies that $T_{11} > 0$.

Next, we address the sign of H^b . Since $T_{11} > 0$, we have that if $T_8 > 0$ then H^b can take on any sign thereby making (40) below, in turn, adopt any sign as well. In particular, if c_w takes a much larger value than $c_p + I_p$ and $|r|$ is well in excess of unity, it is even possible that $B^b < 0$ and $H^b \leq 0$ so that $dN/d w^b \geq 0$. This suggests that,

when we incorporate into the AS-AD model the adverse effects on investment brought about by changes in the debt service of firms relative to nominal output, it is not necessarily the case that money wage cuts will lead to a rise in the level of employment. Indeed, they may reduce it. This is because, the initial fall in the price level induced by the fall in the money wage rate may raise the debt burden of firms in real terms and this, in turn, may adversely affect investment, aggregate demand and the equilibrium level of employment. In addition, as expression (41) below shows, the effect of variations in the money wage rate on the price level is also ambiguous since:

$$\frac{dp}{dw^b} = \left(\frac{1}{A}\right) \cdot \left[m + \left(\frac{r}{B^b}\right) \left(\frac{1-a}{a}\right) \left(\frac{\Lambda_k K}{\Lambda_N N}\right)^r \cdot J^b \right] \begin{matrix} \leq 1 \\ \geq \end{matrix} \quad (41)$$

where $J^b = \left[(c_w - m) + (m - 1)(c_p + I_p) - m \left(\frac{I_f \cdot f}{p \cdot \Omega^{1/r}} \right) \right] \begin{matrix} \leq 0 \\ \geq \end{matrix}$.

The ambiguity of (41) can be rationalized along the same terms as in section 3.3 above. The sign of J^b in (41) is the key to know the impact on the price level of money wage rate variations. First, even though the slope of the aggregate demand for labour curve is negative (for the reasons given above) we now have that, since the sign of (41) is ambiguous, the value of (41) may be less, equal or more than unity. If $J^b < 0$ then (62) may well be negative. As explained above, the possible occurrence of this ‘paradox of costs’ affects labour market dynamics when (41) is negative. In any case, as long as $f > 0$ and $I_f < 0$, we have that $J^b > J$ and, therefore, it is even less likely that a ‘paradox of cost’ occurs in the ‘extended’ model. Table 2 below summarizes the effect of money wage reductions in the ‘extended’ model. As before, results are classified in three regimes – Classical, mixed Classical-Keynesian and Keynesian - depending on the final effect of money wage reductions on the equilibrium level of employment. First, if (40) is negative and (41) is positive but lower than unity, money wage cuts may not be an effective way of increasing employment since the price level varies in the very same direction – although to a lesser extent - that the money wage so that the real wage hardly falls and N^E hardly increases (mixed Classical-Keynesian regime). Second, if (40) and (41) are negative, then a money wage cut will be coupled with a rise in the price level so that the real wage will fall to a large extent and N^E will rise substantially (Classical

regime). Finally, if (40) and (41) are positive and (41) is larger than unity, then a money wage cut will raise the real wage since the price level will fall by more than the money wage rate and N^E will fall (Keynesian regime). Thus, we believe these results provide a basis for a theory of involuntary unemployment equilibrium and lend strong support for Keynes' scepticism regarding the possibility of reducing unemployment through money wage cuts. The implications for labour market dynamics are discussed below.

	Classical regime	Mixed Classical-Keynesian regime	Keynesian regime
Basic model	$dN/dw < 0$ $dp/dw < 0$ (++)	$dN/dw < 0$ $0 < dp/dw < 1$ (+)	
Extended model	$dN/dw^b < 0$ $dp/dw^b < 0$ (++)	$dN/dw^b < 0$ $0 < dp/dw^b < 1$ (+)	$dN/dw^b > 0$ $dp/dw^b > 1$ (-)

Table 2: Effect of money wage reductions on the equilibrium level of employment and the price level

- (++) indicates that money wage reductions are an effective way of increasing employment
- (+) indicates that money wage reductions may not be an effective way of increasing employment
- (-) indicates that money wage reductions will lead to lower employment

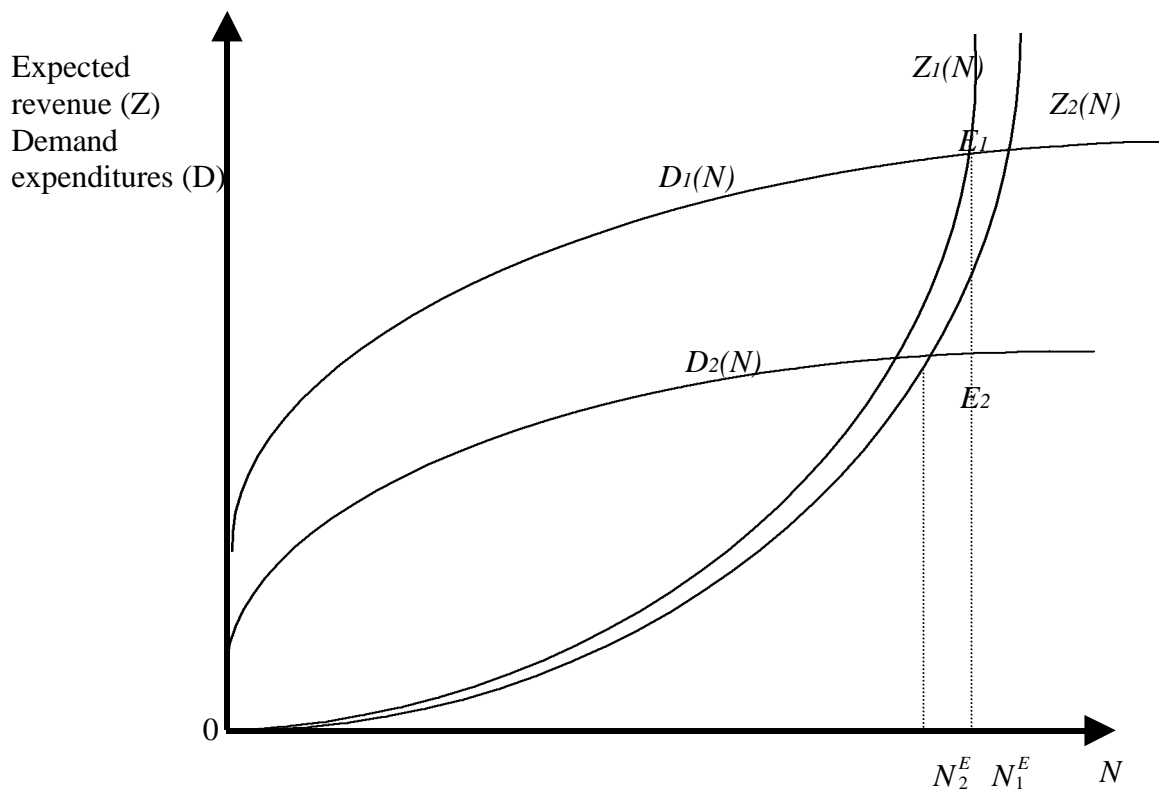


Figure 4: The adjustment mechanism to a falling money wage rate in the Keynesian regime

4.2.- Labour market dynamics in the Keynesian regime

When expressions (40) and (41) are positive and (41) is larger than unity, i.e. in the Keynesian regime, a cut in the money wage rate reduces the equilibrium level of employment N^E . In this scenario N^{FE} becomes *unstable*. For instance, if the initial real wage and level of employment are $(w/p)_1$ and N_1 respectively in figure 2, the supply of labour exceeds the demand for labour and, as a result, the money wage rate falls. However, as shown in figure 4 below, as this occurs, the economy moves from point E_1 to point E_2 and the equilibrium level of employment N^E falls from N_1^E to N_2^E . As a result, in the labour market depicted in figure 2, as the money wage falls, the level of employment also falls thereby pushing it further away from N^{FE} . This analysis shows that, as Keynes (1936, ch. 19) suggested, money wage cuts may aggravate rather than cure unemployment so that downward money wage flexibility may be destabilizing. It also suggests that N^{FE} may not be an attractor and that, as a result, the long-run level of economic activity may be demand rather than supply-determined.

5.- Conclusion

This paper has addressed the effects on the equilibrium level of employment and the price level of a range of factors including capital accumulation, technical progress and money wage changes by building on the aggregate supply and demand (AS-AD) framework posited by Keynes in the *General Theory* and elaborated by Weintraub and Davidson. This was done by inserting in the model a CES production function and performing a comparative statics analysis. Among other results, we found that capital accumulation and capital-augmenting technical progress lead to higher employment whereas labour-augmenting technical progress and a higher degree of market power lead to lower employment. The effects of changes in the money wage rate on the level of employment and the price level were found to be ambiguous when due account was taken of the effect on the debt burden of firms in real terms of changes in the price level. In particular, our results lend support to Keynes' contention that money wage cuts are not an effective way of reducing unemployment and that (downward) money wage flexibility may actually be destabilizing. Finally, we argued that Keynes' AS-AD analysis is more consistent than conventional AS-AD analysis.

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