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*Unemployment Persistence and Loss of Productive Capacity: A Keynesian Approach**

Empirical evidence suggests that the European unemployment problem is somehow connected with a capital shortage. The paper introduces a Keynesian model to deal with this issue. In this model the rate of capacity utilization plays a central role in two simultaneously operating mechanisms thus exhibiting hysteresis: price adjustment and capital accumulation. The implications for employment and unemployment are discussed. It is demonstrated that equilibrium unemployment may be caused by adverse demand shocks.

1. Introduction

In the discussions on long-term unemployment in Europe, the possibility of a capital shortage has been mentioned regularly. The main idea is that insufficient capital accumulation creates a situation in which not enough jobs are available for the existing working force. Quite often also the existence of a capital shortage is rejected. Different arguments are presented to substantiate this claim. For instance, Layard and Bean (1988) argue that the number of workers per machine can be varied on any shift and that the number of shifts can be varied, too. Under these circumstances there can be no capital constraint. What really matters then are supply constraints originating in the labor market. In Layard and Nickell (1986), Nickell (1987), and other publications by the same authors, this argument is elaborated upon. It is assumed that capital accumulation or decumulation has no effect on (equilibrium) unemployment because changes in productivity are fully reflected in changes in real wages. In our view this argument may hold in a structural sense. Otherwise, unemployment would steadily rise or decline, which is clearly unrealistic. Nevertheless, deviations from the trend growth rate could have a lasting impact on unemployment if real wages are rigid to some extent.

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The consequences of a reduction in the capital stock on impact of adverse demand and supply shocks therefore deserve proper attention. It should be noted that the problem has been analyzed to some extent in a neoclassical setting (for example, Bruno and Sachs 1985; Van der Ploeg 1987; Burda 1988). In the neoclassical model structural unemployment is explained as a result of the controversy between employers and employees within an equilibrium context; product markets clear as a result of flexible prices. Therefore, structural or equilibrium unemployment is caused by push factors such as union militancy, mismatch on labor markets, the wedge between real consumers' and real producers' wages, etc. Actual unemployment may deviate from equilibrium unemployment in the short run because of nominal wage or price inertia. Nominal inertia is then modeled in a complementary way by assuming that price or wage expectations of economic agents may deviate temporarily from their actual values. Production and investment decisions are still based on price signals. Therefore, once price expectations catch up with actual prices, the neoclassical equilibrium structure is again fully applicable.

In a recent and useful review of economic theory behind the papers at the Chelwood Gate conferences on unemployment in Europe, Blanchard (1988) criticizes what he calls the false dichotomy between equilibrium and actual unemployment. The main reason for this is that the neoclassical theory, at least in Chelwood Gate Mark I, does not fit the actual experience in Europe in the 1980s.[1] During that period negative aggregate demand shocks induced an increase in actual unemployment followed by a rise in equilibrium unemployment. According to Blanchard, Chelwood Gate Mark II explores two channels which may explain that high actual unemployment induces a high level of equilibrium unemployment and which were already suggested at the first conference. The first channel is capital accumulation. A sustained period of unemployment may lead to capital decumulation and therefore to an increased equilibrium unemployment level. The second channel relates to different aspects of hysteresis on the labor market, implying that the natural rate of unemployment depends upon the actual rate (for example, Sachs 1987).

We agree with Blanchard's critique on the dichotomy between actual and equilibrium unemployment. However, where Blanchard

[1]Proceedings of the first conference on unemployment at Chelwood Gate, Sussex, England, are published in *Economica* 53, supplement (1986).

still analyzes the role of capital accumulation within a neoclassical model we depart from this view of the world. In our opinion, the ultimate consequence of the dichotomy critique should be that behavior of producers is modeled differently from the neoclassical paradigm. For instance, if firms are confronted with a lack of effective demand, this should influence their investments decisions or more generally, it may even endanger the very existence of the firm. Blanchard (1988) suggests that the introduction of monopolistic competition into the neoclassical model takes care of the demand problem. This is not the route we want to follow. Monopolistic competition does not change the neoclassical model in an essential way. On the contrary, the formal results are the same, except for a multiplicative factor determining the monopoly profit of the firm. The stories told sound different, of course, because firms are engaged in active price setting, whereas under perfect competition, firms are price takers. But here again the difference is only superficial. Under perfect competition someone has to set prices, and the dynamic evolution to a state of rest mirrors theories of imperfect competition, as Arrow (1959) pointed out long ago.

To cope with the issue of demand shocks and capital decumulation we present a model which is more Keynesian in spirit. It is assumed that price adjustment is sluggish. The reasons for price inertia are not spelled out. Small menu cost (for example, Blanchard and Kiyotaki 1987; Ball and Romer 1987) may be a cause, but we would prefer microeconomic theories focusing on informational aspects (for example, Stiglitz 1984; Van de Klundert and Peters 1988). In an economywide recession, firms may increase sales by lowering the price of output, but they may be highly uncertain whether this would entail a rise in revenue as competitors may lower their prices, too. Under these circumstances it could be rational for risk-averse firms to stick to the prevailing price level.

In our model, sluggish price adjustment is associated with uncertainty about the outcome of the competitive process if the economy is hit by aggregative shocks. Firms may then behave rationally by adjusting quantities. In the short run this takes the form of a reduction in output on impact of an adverse demand shock. As the recession proceeds there will be an increase in company failures, and some large firms may close plants, scrapping capital and making workers redundant. Once this has happened, once a factory has been demolished, it cannot suddenly begin production again if demand for its product increases. Hysteresis connected with capital decumulation induces a decline in employment. If there are sufficient substitution possibilities and if real wages are flexible enough, full employment could of course be attained within a reasonable time span. Following Blanchard (1988) there is an obvious loose end in the argument that a capital shortage leads to high unemployment. We agree that the argument is not complete. In addition, something should be assumed about the functioning of the labor market. Even so, it may be important to give a proper analysis of the "physical capital story" (Blanchard and Summers 1986). We think our paper may shed some new light on this issue.

Turning to the stylized facts, it could be maintained that during the protracted recession of 1980–1982, demand-deficient unemployment developed into equilibrium unemployment, especially in Europe. Capacity utilization rates reflect the impact of the recession. For instance by OECD, it is a well-documented fact that after a year of rapid recovery in 1983–1984 the rates of capacity utilization in manufacturing in European countries returned to normal levels, and thereafter on the average have stayed at the peak level of 1979. Thus, empirical evidence suggests that potential output was adjusted downward to actual output.

The paper proceeds as follows. Our Keynesian approach to the problem of capital accumulation and unemployment persistence is introduced in Section 2. In Section 3 an analytical solution of the dynamic system emerging out of the Keynesian model is presented. The system has one zero root, reflecting hysteresis, and two negative roots, which stabilize the development over time. The long-run solutions give rise to a number of interesting observations. The paper closes with conclusions and suggestions for further research.

2. A Keynesian Model

The central assumption of our Keynesian type of model is that (nominal) output prices and (nominal) wages are fixed in the short run. As a consequence it becomes necessary to distinguish between demand or actual output, X, and potential output or notional supply, Y, on the one hand and between actual employment, N, and notional labor demand or the availability of jobs, L, on the other hand, although these concepts are given a somewhat different content than in the standard literature on rationing (for example, Malinvaud 1977; Benassy 1982). It is assumed that firms expect to be in a situation of Keynesian unemployment most of the time. The possibility of repressed inflation is not excluded, but may be less relevant as prices adjust fast in such a situation. With demand constrained in this way, short-run profit maximization is not an issue, but it may pay to produce at minimal costs. Suppose that the production function relating notional output to notional labor demand and capital, K, is given by

$$Y = \epsilon L^{\lambda} K^{1-\lambda}, \qquad 0 < \lambda < 1, \qquad \epsilon > 0. \tag{1}$$

The first-order condition for a cost minimum can then be written as

$$\frac{K}{L} = \frac{1-\lambda}{\lambda} \frac{W}{R}, \tag{2}$$

where W stands for the real wage rate, and R denotes the real user cost of capital. The latter is assumed constant throughout the analysis. It should be stressed that cost minimization, according to Equation (2), is a long-run concern of firms. Factor substitution is considered for a situation where demand equals potential output ($X = Y$). In such an equilibrium situation, firms want to produce at the lowest cost, given factor remunerations. Cost minimization therefore constitutes an element of *strategic* behavior in the arrangements firms have to make.

For commodity demand we employ a simple quantity formula (compare Blanchard 1988):

$$X = \frac{A}{P}, \tag{3}$$

where the parameter A is codetermined by monetary factors (that is, the supply of money and the velocity of circulation). Total expenditure equals consumption, investment, and government spending: $X = C + I + G$. Consumption depends on income and real cash balances: $C = C(X, M/P)$. Investment is explained by Equation (6) below, and government spending is exogenous. Combining these assumptions, the aggregate demand function may be written like that in Equation (3). To simplify further, government spending will be ignored in the sequel of this paper. Aggregate demand may adjust to aggregate supply by changes in the price level (Pigou effect). Because interest rates are fixed there is no Keynes effect in the present model.

As capital is given in the short run, firms will produce output (effective demand) with the minimal amount of labor necessary. This gives the equation for actual employment:[2]

$$N = \left(\frac{X}{\epsilon}\right)^{1/\lambda} K^{(\lambda-1)/\lambda} . \tag{4}$$

The output gap is closed over time by two simultaneously operating mechanisms. First, it is assumed along traditional lines that prices decrease as a function of the rate of capacity utilization ($Q = X/Y$):[3]

$$\frac{\dot{P}}{P} = \beta(Q - 1) , \qquad \beta > 0 . \tag{5}$$

Second, we assume that the stock of capital also changes with the degree of capacity utilization:

$$\frac{\dot{K}}{K} = \alpha(Q - 1) , \qquad \alpha > 0 . \tag{6}$$

Such an investment equation may seem restrictive, but there are indications that capital decumulation has occurred in Europe because of underutilization of capital due to a fall in aggregate demand (for example, Hudson 1988).

Substitution of Equations (1) and (2) into Equation (6), taking account of the definition of Q, yields the Keynesian investment function:

$$\frac{\dot{K}}{K} = \alpha\left\{\frac{A}{KP}\frac{1}{\epsilon}\left[\frac{(1-\lambda)}{\lambda}\frac{W}{R}\right]^{\lambda} - 1\right\} .$$

The real user cost of capital is negatively related to investment. An increase in real wages pushes capital deepening. In the Keynesian model it is assumed that firms make their investment decision conditioned on a given level of output. The theory of investment has

[2]Equation (4) follows from ex post profit maximization supposing that $(\delta X/\delta N) \geq W$ (compare Malinvaud 1989).

[3]A possible effect of nominal wage changes on nominal price setting is not taken into account because we ignore the leapfrogging of prices over wages and vice versa.

to fit in the effective demand framework (compare Hall and Taylor 1988). In the neoclassical theory there is no demand constraint, and profitable investment projects may lead to an expansion in output.

From a neoclassical perspective the present Keynesian model may perhaps seem ad hoc. The relevant question, however, is whether the model has something to say about a world where uncertainty in the sense of risk prevails; information may be asymmetrically distributed, and competition may take different forms, which calls for strategic behavior. If this is indeed the real world, a model like the present one may be useful as a first step for understanding such a world. This does not imply that we should abandon the rationality postulate, which is at the heart of our science. But the assumption of representative agents with full information may stretch the postulate too far. Anyhow, as shown by Malinvaud (1980, 1989), investment functions which give the rate of capacity utilization a role to play can be derived from profit maximization under uncertainty with respect to demand.[4]

Here we want to emphasize that a lack of effective demand may force firms to reduce their production capabilities or to close down in case of bankruptcy. Hudson (1988) provides empirical evidence of the association between company failures and the business cycle. It should be noted that bankruptcies are not possible in the neoclassical model in which the Modigliani-Miller theorem holds. However, the real world seems more like a model which allows for equity rationing as discussed in Greenwald and Stiglitz (1987, 1988). In this model with circulating capital, firms go bankrupt if what they promise to pay exceeds their income from producing commodities. With fixed capital it is optimal to liquidate an insolvent firm if the liquidation value exceeds expected net discounted revenue, adjusted to exclude any revenue in excess of current debts (Hudson 1988).

Turning to the labor market, we assume that unions and firms bargain over wages. Union welfare depends on both the level of real wages and the employment rate (compare Oswald 1985). The result of the bargaining process can be summarized by a wage-set-

[4]Malinvaud (1989) derives two conditions for (ex ante) profit maximization: (1) the capital cost of a unit of capacity must be covered exactly by the expected value of the (marginal) gross profit; (2) the (ex ante) marginal rate of substitution between capital and labor, corrected for the expected rate of capacity utilization, should be equal to the factor price ratio. These two conditions determine the desired capital stock. An investment equation could be derived in the usual way by assuming that the actual capital stock gradually adjusts towards its desired level.

ting equation, showing that the final level of real wages will depend on the variables in the firm's labor demand function, the employment rate, and proxies for relative bargaining strength (for example, Layard and Nickell 1986). Here we adopt a simplified version of this equation, which gives the long-run labor supply as

$$\gamma\left(\frac{N}{S} - 1\right) = \theta\left(1 - \frac{\Omega}{W}\right),$$

where S denotes the labor force, and Ω denotes the target real wage rate. The extreme case of a completely rigid long-run real wage corresponds to $\gamma = 0$. Full labor market clearing obtains if $\theta = 0$. In accordance with empirical investigations it will be assumed that the time path of real wages corresponds to an error-correction mechanism of the type estimated by Sargan (1964):

$$\frac{\dot{W}}{W} = \theta\left(\frac{\Omega - W}{W}\right) - \gamma\left(\frac{S - N}{S}\right). \tag{7}$$

The model has three state variables: K, P, and W. Performing the appropriate substitutions, the dynamic system can be summarized by the following three equations:

$$\dot{K} = \alpha\frac{A}{P}\frac{1}{\epsilon}\left(\frac{1-\lambda}{\lambda}\frac{W}{R}\right)^{\lambda} - \alpha K, \tag{8a}$$

$$\dot{P} = \beta\frac{A}{K}\frac{1}{\epsilon}\left(\frac{1-\lambda}{\lambda}\frac{W}{R}\right)^{\lambda} - \beta P, \tag{8b}$$

$$\dot{W} = \theta(\Omega - W) + \gamma\left[\left(\frac{A}{\epsilon PK^{1-\lambda}}\right)^{1/\lambda}\frac{1}{S} - 1\right]W. \tag{8c}$$

The implications of the model may be sketched by discussing the effects of a demand shock. A more formal analysis will be presented in the next section. Suppose that there is a long-run equilibrium initially. The long-run equilibrium is attained at point F on the isoquant I_0 in Figure 1. The labor market is in equilibrium, $N = S$, so that the real wage rate equals its aspiration level, Ω. A decline in the parameter A shifts the isoquant downward to I_1. On impact of the shock, firms operate at point G (for a given P), laying off all

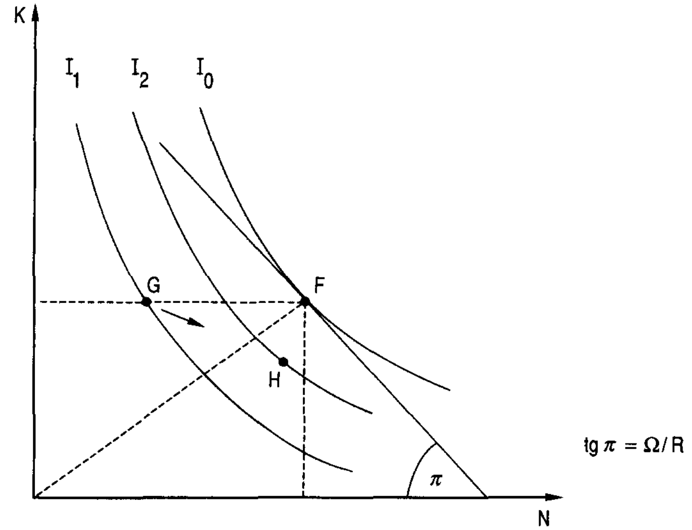

Figure 1.

the labor they do not need to produce the reduced level of output. The dynamics of the model induce a movement as shown by the arrow starting from point G. Excess capacity forces firms to lower prices, while in the meantime, some firms may have to close down because they become insolvent. Real wages fall as there is an excess supply of labor, and aspirations can no longer be realized. In the long run (with $\dot{K} = \dot{P} = \dot{W} = 0$, and $Q = 1$) the economy might settle at a new steady-state equilibrium, indicated by point H on the isoquant I_2 in Figure 1. Unemployment appears to be an equilibrium phenomenon resulting from a negative aggregate demand shock. There could of course be full employment if, given sufficient substitution possibilities, real wages decline by the right amount. As observed before, setting $\theta = 0$ in Equation (8c) would do the job. However, labor unions will trade off a lower level of employment against a lower level of real wages in case of an adverse demand shock.

It should be noted that the model exhibits hysteresis. To make this more lucid let us assume for the time being that W is constant and consider the dynamics implied by Equations (8a) and (8b). As appears from these equations, the two loci $\dot{K} = 0$ and $\dot{P} = 0$ are identical and equal.

$$K = A\frac{1}{\epsilon}\left(\frac{1-\lambda}{\lambda}\frac{W}{R}\right)^{\lambda}\frac{1}{P}.$$

The corresponding phase diagram is given in Figure 2. Inspection of the differential equations shows that the system is stable, but the long-run equilibrium depends on the initial position of both variables. The implications of hysteresis for employment and unemployment in the long run will be discussed in the next section. In that section the log-linear version of the model will be used to present a formal solution of the dynamic system.

3. Hysteresis and Unemployment

The model given in Equations (1)–(7) can easily be transformed into its log-linear equivalent. The logarithm of a variable is denoted by a small letter. Coefficients are evaluated at an initial steady state with $N = S$ and $W = \Omega$. Ignoring irrelevant constants (including the user cost of capital) the linearized model is given by

$$\dot{k} = \alpha(a - k - p + \lambda w)\,, \tag{9a}$$

$$\dot{p} = \beta(a - k - p + \lambda w)\,, \tag{9b}$$

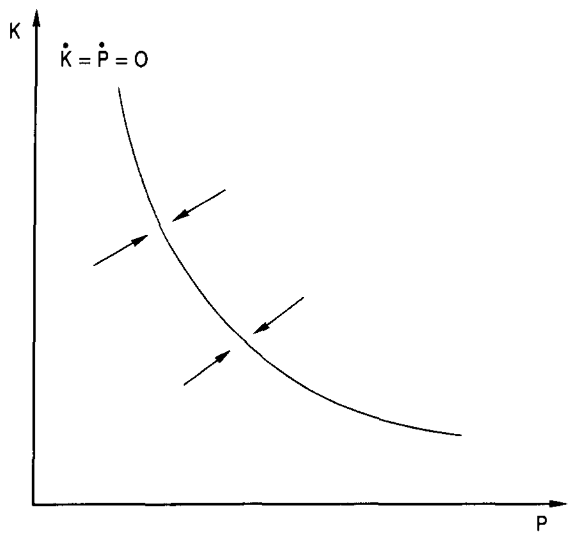

Figure 2.

$$\dot{w} = \theta(\omega - w) + \frac{\gamma}{\lambda}[a - (1 - \lambda)k - p] - \gamma s\,, \tag{9c}$$

$$y = k - \lambda w\,, \tag{9d}$$

$$l = k - w\,, \tag{9e}$$

$$n = \frac{1}{\lambda}[a - (1 - \lambda)\,k - p]\,, \tag{9f}$$

$$x = a - p\,. \tag{9g}$$

It is convenient to rewrite the dynamic system in matrix form.

$$\begin{bmatrix} \dot{k} \\ \dot{p} \\ \dot{w} \end{bmatrix} = \begin{bmatrix} -\alpha & -\alpha & \alpha\lambda \\ -\beta & -\beta & \beta\lambda \\ -\gamma(1 - \lambda)/\lambda & -\gamma/\lambda & -\theta \end{bmatrix} \begin{bmatrix} k \\ p \\ w \end{bmatrix} + \begin{bmatrix} \alpha & 0 & 0 \\ \beta & 0 & 0 \\ \gamma/\lambda & \theta & -\gamma \end{bmatrix} \begin{bmatrix} a \\ \omega \\ s \end{bmatrix}. \tag{10}$$

Determination of the characteristic equation of the state matrix on the RHS of (10) yields

$$\sigma^3 + (\alpha + \beta + \theta)\,\sigma^2 + \{(\alpha + \beta)\theta + \gamma[\alpha(1 - \lambda) + \beta]\}\,\sigma = 0\,.$$

The roots of the system are therefore equal to

$$\sigma_1 = 0$$

and

$$\sigma_{2,3} = \frac{-(\alpha + \beta + \theta) \pm \sqrt{(\alpha + \beta + \theta)^2 - 4\{(\alpha + \beta)\theta + \gamma[\alpha(1 - \lambda) + \beta]\}}}{2} < 0\,.$$

The model has a zero root, reflecting hysteresis implied by Equations (9a) and (9b) and two negative roots, which are stabilizing. As shown in Giavazzi and Wyplosz (1985), singularity of the state matrix does not mean that the model is indeterminate. On the contrary, for any set of initial conditions there exists a unique stationary equilibrium. Here we proceed as follows. The dynamic system (10) can be simplified by noting that the first two differential equations generate a fixed ratio between k and p as a result of a shock in the exogenous variables. This can best be seen by considering a demand shock. A change in the exogenous variable a leads on impact to a change in k/p of magnitude α/β. The dynamic process following such a shock conserves the ratio $k/p = \alpha/\beta$ as appears upon inspection of the state matrix. Therefore, one of the first two differential equations can be replaced by the equation[5]

$$p = \frac{\beta}{\alpha} k + p_o - \frac{\beta}{\alpha} k_o , \tag{11}$$

where p_o and k_o are the initial values of p and k, respectively.

Elimination of Equation (9b) and substitution of (11) give a reduced dynamic system in the capital stock and real wages.

$$\begin{bmatrix} \dot{k} \\ \dot{w} \end{bmatrix} = \begin{bmatrix} -(\alpha + \beta) & \alpha\lambda \\ -\frac{\gamma}{\lambda} \quad 1 - \lambda + \frac{\beta}{\alpha} & -\theta \end{bmatrix} \begin{bmatrix} k \\ w \end{bmatrix}$$

$$+ \begin{bmatrix} -\alpha & \alpha & 0 & 0 \\ -\frac{\gamma}{\lambda} & \frac{\gamma}{\lambda} & \theta & -\gamma \end{bmatrix} \begin{bmatrix} p_o - (\beta/\alpha)k_o \\ a \\ \omega \\ s \end{bmatrix} . \tag{12}$$

As can be easily checked, the roots of the state matrix on the RHS of (12) are equal to σ_2 and σ_3 given above. As a result the dynamic system presented in (12) is stable. The rest point may be a stable

[5]This procedure of eliminating the zero root can be generalized as zero roots reflect dependency of rows and columns in the state matrix. Now, the system of equations $Ax = b$, where the matrix A is of order $n \times n$ and of rank r, has a solution if the augmented matrix $B = [A{:}b]$ is also of rank r. The solution is obtained from r equations, and the remaining $(n - r)$ equations can be ignored as derivable from them. The latter can be called surplus equations (for example, Allen 1956). The solution expresses r variables in terms of the $(n - r)$ surplus variables. Substitution of the solution in the original system gives a reduced system with a nonsingular matrix. Application to a system of differential equations yields a state matrix with non-zero roots, which can be handled in the usual way.

node or the focus of a spiral if the roots are conjugate complex. This result corresponds in a qualitative sense with the outcome of the dynamic neoclassical model of Bruno and Sachs (1985, chap. 3). The long-run or steady state solution implying $\dot{k} = \dot{w} = 0$ can be found from

$$\begin{bmatrix} k^* \\ w^* \end{bmatrix} = -\begin{bmatrix} -(\alpha+\beta) & \alpha\lambda \\ -\frac{\gamma}{\lambda} \quad 1-\lambda+\frac{\beta}{\alpha} & -\theta \end{bmatrix}^{-1}$$

$$\cdot \begin{bmatrix} -\alpha & \alpha & 0 & 0 \\ -\frac{\gamma}{\lambda} & \frac{\gamma}{\lambda} & \theta & -\gamma \end{bmatrix} \begin{bmatrix} p_o - (\beta/\alpha)k_o \\ a \\ \omega \\ s \end{bmatrix}. \tag{13}$$

Solving Equation (13) yields

$$k^* = \frac{\alpha}{\Lambda}\left[-(\gamma+\theta)\left(p_o - \frac{\beta}{\alpha}k_o\right) + (\gamma+\theta)a + \lambda(\theta\omega - \gamma s)\right], \tag{14a}$$

$$w^* = \frac{1}{\Lambda}\left[-\alpha\gamma\left(p_o - \frac{\beta}{\alpha}k_o\right) + \alpha\gamma a + (\alpha+\beta)(\theta\omega - \gamma s)\right], \tag{14b}$$

where the determinant of the state matrix $\Lambda = (\alpha + \beta)\theta + \gamma[\alpha(1 - \lambda) + \beta]$ is positive. From Equations (11) and (14a) the long-run solution of p can be determined as

$$p^* = \frac{\beta}{\Lambda}\left\{\frac{\alpha}{\beta}[(1-\lambda)\gamma + \theta]\left(p_o - \frac{\beta}{\alpha}k_o\right) + (\gamma+\theta)a + \lambda(\theta\omega - \gamma s)\right\}. \tag{14c}$$

The solutions for the other endogenous variables can now be found by substituting (14a), (14b), and (14c), in (9d), (9e), (9f), and (9g). The results are

$$y^* = x^* = \frac{1}{\Lambda}\left\{-\alpha[(1-\lambda)\gamma + \theta]\left(p_o - \frac{\beta}{\alpha}k_o\right) + \alpha[(1-\lambda)\gamma + \theta]a - \beta\lambda(\theta\omega - \gamma s)\right\}, \tag{14d}$$

$$l^* = n^* = \frac{1}{\Lambda}\left\{-\alpha\theta\left(p_o - \frac{\beta}{\alpha}k_o\right)\right.$$
$$\left. + \alpha\theta a - [(1-\lambda)\alpha + \beta](\theta\omega - \gamma s)\right\}. \tag{14e}$$

The long-run solutions give rise to a number of interesting observations:

(a) The results show what hysteresis in this model means: the long-run outcomes of all the endogenous variables depend on the initial conditions of the state variables p and k and on the approach path, so that the parameters which determine the dynamics of adjustment have a permanent effect on the economy (compare Giavazzi and Wyplosz 1985). It should be noted that we only consider constant values of the exogenous variables. If these variables are time-dependent, the solutions are more complex and depend on the entire sequence of exogenous shocks (compare Buiter 1986).

(b) An adverse demand shock ($\Delta a < 0$) leads to a reduction in the stock of capital and a reduction in prices depending on the relative size of the relevant speed of adjustment. This is most clearly seen in the special case that $\gamma = 0$ (no Phillips curve effect). We then have $\Delta w^* = 0$, $\Delta k^* = [\alpha/(\alpha + \beta)]\Delta a$, and $\Delta p^* = [\beta/(\alpha + \beta)]\Delta a$. A relatively high value of the "accelerator," α, compared with the measure of price flexibility, β, leads to a relatively large capital decumulation while prices are much less affected. This looks plausible. If prices do not adjust fast, profitability will not be restored quickly and a larger number of firms will face bankruptcy. In the case of price rigidity $\beta = 0$, there is a one-to-one correspondence between the demand shock and the decline in the capital stock. If prices are fully flexible, $\beta \rightarrow \infty$, the capital stock, does not change at all, and there is an exact correspondence between a demand shock and the resulting price level. As can be seen, a negative demand shock gives rise to unemployment unless the labor market clears in the long run ($\theta = 0$, $\gamma > 0$).

(c) A negative supply shock ($\Delta\omega > 0$ or $\Delta s < 0$) induces a rise in real wages. The long-run demand curve for labor therefore has a negative slope. Rising real wages go along with an increase in the capital stock and a fall in employment. The fall in employment is the outcome of opposing forces. The positive capacity effect (via k) of a rise in ω or a decline in s is smaller than the negative substitution effect (via l), with the result that y decreases. From a policy point of view it is interesting to note that a decline in employment in case of a negative supply shock can be prevented by a positive demand shock of sufficient strength. However, there may be a caveat here. From the mathematical point of view the model can be applied symmetrically. Positive and negative shocks exhibit the same quantitative effects in absolute terms. In reality there may be some *asymmetry* as speeds of adjustment differ in both situations. In severe recessions, α may be relatively large, whereas in booms, β may be relatively large. During downturns, bankruptcies lead to selling out assets and an immediate loss of firm- or industry-specific physical capital. In contrast, during upturns investment in new capacity may take more time. For instance, the problem many European countries have faced in recent years is how the supply side of the economy can cope with an expansion in demand when its capacity has been reduced by previous demand shocks resulting in capital scrapping.

(d) Anti-cyclical economic policy may not only take the form of stabilizing demand but may also be aimed at a reduction of the parameter, α, in recessions. Retaining supply-side capacity is the main theme of Hudson (1988) in his thought-provoking contribution to the theory of the trade cycle. Whether this is a feasible policy remains to be seen, as it requires empirical evidence which is not readily available. Moreover, there is the question of whether the political system can handle it.

4. Conclusion

As indicated in the first section, empirical evidence gives support to a capital shortage interpretation of European unemployment, which during the recessions of 1974–1975 and 1980–1982 increased by two substantial jumps. This paper has sought to explore how capital decumulation might arise as a consequence of adverse demand shocks. The neoclassical model does not predict such a relationship, not even when monopolistic competition is taken into account. To cope with the problem, we therefore have to resort to the assumption that the market for commodities exhibits price inertia. In such a Keynesian model quantity adjustments (of output and capacity) are of central importance. The labor market is modeled by assuming that unions and firms negotiate over real wages.

The implications of the model are sketched by discussing the effects of a negative demand shock. The model exhibits hysteresis: a demand shock leads to a reduction in the stock of capital, which is not restored by the reduction in prices unless in the limiting (and unrealistic) case that prices are assumed to be fully flexible. As a result, an adverse demand shock gives rise to unemployment, unless unions are absent and the labor market clears. If so, full employment may be possible, but capital and output will not return to their initial positions.

The present analysis can be extended in different directions. Insider effects and outsider effects (compare Layard and Bean 1988) may provide forms of hysteresis, which can be combined with state dependency of the capital stock. Moreover, the idea of fragile equilibria (compare Summers 1988) may be fruitful in analyzing firm behavior along the lines set in this paper.

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Appendix

List of notation

The logarithm of a variable is denoted by a small letter.

A, a = parameter demand.
K, k = stock of capital.
L, l = notional labor demand.
N, n = actual employment.
P, p = price level.
Q = rate of capacity utilization.
R = real user cost of capital.
S, s = supply of labor.
W, w = real wage rate.
X, x = actual output.
Y, y = potential output.
α = speed of adjustment investment.
β = speed of adjustment prices.
γ = speed of adjustment real wages.
ϵ = parameter production function.
λ = production elasticity.
θ = parameter labor supply
Ω, ω = target real wage rate.