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Monetary Policy and the Informational Implications of the Phillips Curve

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In this paper I examine optimal monetary policy and the informational implications of the Phillips curve in a stochastic macroeconomic model. It is assumed that wages are not only indexed to the price level, but respond to the state of the labour market as well. If information about current disturbances is conveyed only through market prices, it turns out that wages have independent informational content, over and above the informational content of other aggregate prices. The optimal policy in this model implies reactions to changes in both wages and the aggregate price level, as, unlike the commonly used model of Gray and Fischer, wages and prices are only partially correlated signals about the unobserved disturbances. The paper also discusses an extension to an open economy and the relation between exchange rate policy and wages.

Introduction

The question of the appropriate reactions of stabilization policy to new information about the state of the economy is probably one of the most important issues facing both academic macroeconomists and policy-makers.

As in all intelligent discussions about economic policy, disagreements focus on the appropriate model and the objectives of policy. An important class of models of aggregate fluctuations assumes that the labour market fails to adjust adequately to the various disturbances, and thus becomes the main source and propagating mechanism of the distortions usually associated with the business cycle. This of course was the main message of Keynes's *General Theory*, and is still the main difference between followers of the Keynesian and classical traditions.

A number of recent papers have focused on stabilization policy in stochastic models, and on its dependence on the extent of wage indexation and the information set currently available to the monetary authorities. The main set of assumptions that these models use to characterize wage adjustment is the framework usually associated with papers by Gray (1976) and Fischer (1977). It is assumed that nominal wages are negotiated in advance of the realization of the current disturbances, with a view to ensuring expected labour market equilibrium, and that *ex post* they are only partially indexed to the price level. It is also usually assumed that indexation is non-optimal, in which case there is scope for a welfare-improving feedback stabilization policy rule. As for commodity and asset markets, it is usually assumed that prices can jump to equilibrate them. Finally, it is assumed in many cases that the information set currently available to the monetary authorities consists of full knowledge about past disturbances, and the vector of current aggregate prices in the economy, which may or may not be a sufficient statistic for current disturbances. Of course, the monetary policy rule is modelled as a function of the information set of the authorities.

This paper differs from the previous ones in this strand of the literature, in that it replaces the Gray-Fischer wage adjustment assumption, with a more conventional 'Phillips curve' wage adjustment assumption. There is overwhelming empirical evidence, for most OECD economies, that nominal wages respond not only to current inflation, but also to current employment.[1]

The paper demonstrates that some of the most widely accepted results in this literature are special to the Gray-Fischer model of wage adjustment. First, it no longer remains true that the vector of prices reveals less information about the current disturbances in an economy with wage contracts than in an economy where wages fully adjust to clear the labour market. This is one of the key results of Aizenman (1986), and is shown to depend crucially on the Gray-Fischer framework. Second, it no longer remains true that the optimal wage indexation coefficient is state-invariant. This is another of the key results of Gray (1976), Fethke and Jackman (1984), Aizenman (1986) and others, which again crucially depends on the Gray-Fischer framework. Third, it no longer remains true that optimal monetary policy reactions to prices are a perfect substitute for monetary policy reactions to wages. Reactions of monetary policy to wages are a complement to reactions to prices.

These results are a direct consequence of the informational properties of the Phillips curve. In most of the simple aggregate models utilized in the literature, the existence of a Phillips curve is a sufficient condition for the vector of prices to convey full information about the current directly unobserved disturbances. This has the even stronger implication that stabilization policy can reproduce the equilibrium allocations that would result with full flexibility of wages. In more complicated models, where there are at least three types of different disturbances, the 'Phillips curve' simply conveys more information than the Gray-Fischer contracts; but it is no longer sufficient for the resolution of all uncertainty about the current disturbances. An open-economy example of this nature is examined in Alogoskoufis (1987).

The rest of the paper is organized as follows. In Section I I present the basic model. To allow comparisons I use a variant of the simple demand and supply model of Gray (1976) and Fischer (1977), a model that has also been used by many other writers. I discuss the differences between the Gray-Fischer type of wage adjustment rule and a Phillips curve type of wage adjustment rule, and demonstrate the informational advantages of the latter. In Section II I discuss optimal wage indexation and monetary policy. In Section III I present an extension to an open economy and discuss the relation between optimal exchange market intervention and wage accommodation. The conclusions are briefly summed up in the final section.

I. The Model

The model is a simple variant of that of Gray (1976) and Fischer (1977), as used by Aizenman (1986). It describes a monetary economy composed of a large number of producers who sell their output in a competitive market. Capital is assumed fixed, so labour is the only variable factor of production. Because of negotiation costs, wages are governed by labour contracts. The labour market has the following characteristics. First, wages for period t are negotiated at the end of period $t-1$, before any information about period t

disturbances is revealed. The negotiation is between each firm and a fixed number of workers who are attached to it. Second, actual employment in period t is determined by the firm in the light of its private information about a productivity shock and its period t real wage. Thus, the model is a variant of what has been dubbed the 'right-to-manage' model (Nickell and Andrews, 1983). Third, wages are indexed to the aggregate price level and also depend negatively on aggregate excess labour supply (unemployment). The effect of unemployment can be derived from a variety of theoretical models. The simplest interpretation is that of Phillips (1958) and Lipsey (1960), namely that unemployment exerts some market pressure on current nominal wages. Alternatively, one can think of a formal indexation rule which envisages the dependence of nominal wages on the choice of employment by the firm (Phelps, 1977, Calvo and Phelps, 1977). Both interpretations would give rise to a negative aggregate relation between (unanticipated) changes in nominal wages and changes in unemployment, which is the essence of the Phillips curve.[2]

Following Aizenman (1986), I assume that disturbances are independent white noise processes, I drop the time subscripts, and I present the variables as proportional deviations from a stationary long-run equilibrium. The aggregate version of the model is presented in Table 1.

TABLE 1

THE MODEL

(1)	Labour supply	$l^s = \varepsilon(w-p)$
(2)	Labour demand	$l = -\sigma(w-p-\mu)$
(3)	Output supply	$y = -\sigma\beta(w-p)+\sigma\mu$
(4)	Wage adjustment	$w = \theta p - \eta(l^s - l)$
(5)	Money demand	$m-p = y+k$

Notes:
All variables are logarithmic deviations from a stationary equilibrium normalized to zero. All shocks are independent white noise processes. l is employment, w the nominal wage, p the price level, μ a supply shock, y output, m the money shock and k a money demand shock.

Equation (1) is an aggregate labour supply curve. l^s is labour supply, w is the nominal wage and p is the price level. ε is the elasticity of labour supply presumed positive.

(2) is the labour demand function which determines employment. It is derived, as in Gray (1976), from the marginal productivity condition of a Cobb-Douglas production function. σ is the elasticity of labour demand and is equal to the inverse of one minus the share of labour β. μ is a white noise supply (production function) shock.

(3) is the aggregate supply function. It is derived from the Cobb-Douglas production function, when the labour demand function (2) is substituted for employment.

(4) is the wage adjustment equation (the 'Phillips curve'). θ is the indexation coefficient to prices, and η is the response of wages to unemployment. Setting $\eta = 0$ gives us the Gray-Fischer type models, whereas as $\eta \to \infty$, the model becomes equivalent to a competitive equilibrium labour market model,

like in Alogoskoufis (1983), or the benchmark competitive equilibrium model of Aizenman (1986).

Finally, (5) is a simple 'quantity theory' money demand function, where k a white noise shock to money demand.

Because wages do not adjust to equilibrate the labour market, there is a case in a model of this nature for a welfare-improving feedback monetary policy. Aizenman (1986), using a similar model with Gray–Fischer contracts, concluded that the absence of a spot labour market implies two types of costs. One is an informational cost. It arises because the vector of current prices (wages and the price level) is less revealing about the current (unobservable) shocks than in a spot labour market. The second is the perceived welfare cost of unemployment. He showed that monetary or indexation policies can eliminate the second type of shock, but not the first. In the remainder of this section I examine how these conclusions are modified by the existence of the Phillips curve (a non-zero η).

Substituting (1) and (2) in (4), we get

$$w=\phi p+\psi\mu \tag{6}$$

where

$$\phi=\frac{\theta+\eta(\varepsilon+\sigma)}{1+\eta(\varepsilon+\sigma)}<1 \quad \text{and} \quad \psi=\frac{\eta\sigma}{1+\eta(\varepsilon+\sigma)}<1.$$

Note that, in the case where $\eta=0$, (6) reduces to $w=\theta p$; i.e. $\phi=\theta$ and $\psi=0$.

Substituting (3) and (6) in (5), and solving for p,

$$p=-\frac{1-\beta\psi}{1-\beta\phi}\mu+\frac{1-\beta}{1-\beta\phi}(m-k). \tag{7}$$

Equation (7) is the reduced-form equation for prices in terms of the real shock μ and the monetary shock $(m-k)$. Substituting (7) in (6), we obtain a reduced-form equation for wages:

$$w=-\frac{\phi-\psi}{1-\beta\phi}\mu+\frac{\phi(1-\beta)}{1-\beta\phi}(m-k). \tag{8}$$

The first question we can ask is whether an observation of (p, w) is a sufficient statistic for μ and $(m-k)$. Clearly, in the case of $\psi>0$, prices are fully revealing, as the system of (7) and (8) can be solved for the two unobserved shocks. Therefore

$$E(\mu\,|\,p, w)=\mu, \qquad E(m-k\,|\,p, w)=m-k \tag{9}$$

where E is the mathematical expectations operator.

However, this is not the case in the absence of a 'Phillips curve', i.e. in the case where $\eta=0$. In that case, $\psi=0$, and $\phi=\theta$. Expressions (7) and (8) reduce to

$$p=-\frac{1}{1-\beta\theta}\mu+\frac{1-\beta}{1-\beta\theta}(m-k) \tag{7'}$$

$$w=-\frac{\theta}{1-\beta\theta}\mu+\frac{\theta(1-\beta)}{1-\beta\theta}(m-k)=\theta p. \tag{8'}$$

Since (7′) and (8′) are linearly dependent, they can no longer be solved for the two unobserved shocks. In the absence of a 'Phillips curve', the vector of prices is no longer fully revealing, but a noisy signal. It turns out that

$$(9') \qquad E(\mu \mid p, w) = E(\mu \mid p) = \rho p, \qquad E(m-k \mid p, w) = E(m-k \mid p) = (1-\rho)p$$

where

$$\rho = \frac{\operatorname{cov}(\mu, p)}{\operatorname{var}(p)} = -(1-\beta\theta)\frac{\sigma^2\tau_m^2}{\sigma^2\tau_\mu^2 + \tau_m^2 + \tau_k^2}.$$

Clearly, $|\rho| < 1$. τ_i^2 denotes the variance of shock i. Expression (9′) gives the 'rational expectation' of the shocks, given the information set assumed.

To conclude, whereas with a 'Phillips curve' the vector of prices is fully revealing about the underlying disturbances, with a Gray–Fischer wage adjustment equation it is a noisy signal. I next turn to the implications for optimal wage indexation and the design of monetary policy.

II. Optimal Wage Indexation and Monetary Policy

In discussing optimal policies, I shall follow previous writers and compare the actual allocations to the spot labour market case. This assumes risk neutrality for both firms and workers.

If wages were fully flexible and adjusted to equilibrate the labour market, the equilibrium real wage would be given by

$$(10) \qquad \tilde{\omega} = (w \tilde{-} p) = \frac{\sigma}{\varepsilon+\sigma}\mu.$$

The reduced-form equation for the price level is given by

$$(11) \qquad \tilde{p} = -\frac{\sigma(1+\varepsilon)}{\varepsilon+\sigma}\mu + (m-k).$$

Under labour market clearing, the vector of prices (p, w) is fully revealing. $w-p$ allows the calculation of the value of the production function shock; and substitution of the calculated value in the reduced-form price equation (11) allows calculation of the excess money supply shock $(m-k)$.

The perceived current welfare cost of unemployment in the absence of a spot labour market is given by (see Aizenman and Frenkel, 1985)

$$(12) \qquad E(H \mid p, w) = cE\{(w-p-\tilde{\omega})^2 \mid p, w\}$$
$$= cE\left[\left\{-(1-\phi)p + \left(\psi - \frac{\sigma}{\varepsilon+\sigma}\right)\mu\right\}^2 \middle| \, p, w\right]$$

where H denotes the welfare loss, and

$$c = \frac{\sigma^2}{2}\left(\frac{1}{\varepsilon} + \frac{1}{\sigma}\right).$$

Optimal wage indexation

Taking the first derivative of (12) with respect to θ, and using the definition of ϕ, we get the following expression for the optimal degree of wage indexation:

$$(13) \qquad \theta^* = \{1+\eta(\varepsilon+\sigma)\}\left\{1 - \left(\psi - \frac{\sigma}{\varepsilon+\sigma}\right)\frac{E(\mu \mid p, w)}{p}\right\}.$$

With a 'Phillips curve', the conditional expectation of μ is equal to the realization of μ. Thus, the optimal degree of wage indexation depends on the realization of the shocks, in particular the ratio of the size of the real shock μ to the price deviation p. The optimal degree of wage indexation is thus state-contingent, and not a fixed parameter. Furthermore, because of the full revelation of information, this optimal degree of wage indexation will result in a full elimination of the welfare cost of unemployment. Of course, one could think of this feedback degree of wage indexation as a form of optimal incomes policy.

On the other hand, with the Gray–Fischer type of contracts, (13) reduces to

$$(13') \qquad \theta^* = 1 + \frac{\sigma}{\varepsilon+\sigma}\frac{E(\mu \mid p, w)}{p} = 1 + \frac{\sigma}{\varepsilon+\sigma}\rho.$$

The expression in (13′) is state-independent, and the value of θ^* is less than 1 as $0 \geq \rho \geq -1$. The state independence of the optimal indexation parameter in this context arises from the fact that there is not enough information to deduce the exact value of the real shock. As the rational expectation of the real shock is proportional to price deviations, the ratio of the real shock to price deviations is equal to the factor of proportionality ρ. In a stationary environment this will be a constant. Of course, because of imperfect information, (13′) is a second-best policy. It does not result in the complete elimination of the welfare cost.

To conclude, the informational implications of the Phillips curve in this context result in the optimal degree of wage indexation being state-contingent, whereas with Gray–Fischer-type contracts it is not. In addition, for this particular example, the optimal degree of wage indexation results in the first-best allocation, while with Gray–Fischer contracts it does not.

Optimal monetary policy

Let me now turn to monetary policy. Substituting the reduced-form price equation (7) in the perceived welfare loss function (12), one gets

$$(14) \qquad E(H \mid p, w) = cE\left\langle \left[\left\{ \frac{(1-\phi)(1-\beta\psi)}{1-\beta\phi} + \psi - \frac{\sigma}{\varepsilon+\sigma} \right\} \mu - \frac{(1-\phi)(1-\beta)}{1-\beta\phi}(m-k) \right]^2 \middle| p, w \right\rangle.$$

From the first-order condition for a minimum of (14) with respect to the money stock m, the optimal money supply rule is given by

$$(15) \qquad m^* = E(k \mid p, w) + \left(\sigma + \frac{\psi}{1-\phi} - \frac{1-\beta\phi}{1-\phi}\frac{\sigma^2}{\varepsilon+\sigma} \right) E(\mu \mid p, w).$$

With a Phillips curve, the expectations of the money demand shock k and the supply shock μ will be functions of both p and w. As discussed in Section I, the vector of prices will in fact be a sufficient statistic for k and μ. Thus, the optimal money supply rule will require reactions to both wages and prices.

With Gray–Fischer contracts ($\psi = 0$, $\phi = \theta$), the two expectations will only be functions of p. As discussed in Section I, $E(\mu \mid p, w) = \rho p$, and $E(k \mid p, w) = (1-\rho)p$. Thus, the optimal money supply rule will only be a function of p. It will be given by

$$(15') \qquad m^* = \left\{1 - \rho + \rho\sigma\left(1 - \frac{1-\beta\phi}{1-\phi}\frac{\sigma}{\varepsilon+\sigma}\right)\right\}p.$$

In conclusion, with contemporaneous reaction of nominal wages to unemployment, optimal monetary policy must be conditioned on both wages and prices, whereas without such reaction it need be conditioned only on one of them. This is the informational implication of the Phillips curve for the design of monetary policy. Furthermore, in the simple aggregate models utilized in much of the literature, the Phillips curve implies full revelation of information, and the resulting optimal monetary policy is first-best.

In the next section I consider an extension to an open economy.

III. Open Economy Aspects

Extending the analysis to an open economy would allow us to examine the relation between optimal exchange market intervention and wage accommodation.

A minimal open economy macro model could be obtained from the model in Section I by allowing for an interest-elastic money demand function, and appending the 'law of one price' and 'uncovered interest parity'. One would then obtain a version of the model of Aizenman and Frenkel (1985), with the crucial difference again being the assumption about wage adjustment.[3]

Let us first replace the money demand function (5) by one that is interest-elastic.

$$(5') \qquad m - p = y - \alpha i + k$$

where i is the domestic nominal interest rate, and α is the semi-elasticity of domestic money demand.

Assume that domestic bonds are perfect substitutes for foreign bonds. Then the domestic interest rate will be determined by 'uncovered interest parity':

$$(16) \qquad i = r + s^e = r - s$$

where r is the foreign interest rate, and s^e is the expected rate of future depreciation of the exchange rate. The foreign interest rate, as with all exogenous disturbances in this analysis, is assumed to be a white noise process. Assuming rational expectations, and using the 'minimal state variable' solution concept (McCallum, 1983), the expected future rate of future depreciation is going to be equal to minus the current deviation of the nominal exchange rate from its long-run equilibrium value. This is denoted by s. Hence the expected future depreciation of the exchange rate is replaced by $-s$ in the right-hand side of (16).

Finally, with regard to commodity markets, let us assume the 'law of one price':

$$(17) \qquad p = s + \chi$$

where χ denotes foreign prices, and s is the exchange rate (units of domestic currency per unit of foreign currency). χ is assumed to be white noise.

The rest of the model is as in Table 1. Solving the model, the reduced-form equation for the exchange rate is given by

$$(18)\qquad s=\frac{1}{\lambda+\alpha}\{m-k+\alpha r-\lambda\chi-\sigma(1-\beta\psi)\mu\}$$

where $\lambda=\sigma(1-\beta\phi)$ denotes the elasticity of nominal income with respect to the price level.

Substituting the law of one price condition in (6), nominal wages as a function of the exchange rate and exogenous variables are given by

$$(6')\qquad w=\phi(s+\chi)+\psi\mu.$$

As in the closed-economy case, nominal wages have informational content over and above that of the exchange rate and foreign prices. They can be used to calculate the supply shock μ.

We can now briefly discuss optimal monetary policy. I shall again assume that the information set of the authorities contains the vector of current prices (p, w, s, i, r, χ). Because of the law of one price and uncovered interest parity, two of them are redundant. Thus, the vector of current prices has the same informational content as the vector (w, s, r, χ). The perceived welfare cost of unemployment is given by substituting the law of one price condition in (12).

$$(12')\qquad E(H\mid w, s, r, \chi)=cE\left[\left\{-(1-\phi)(s+\chi)+\left(\psi-\frac{\sigma}{\varepsilon+\sigma}\right)\mu\right\}^2\,\middle|\, w, s, r, \chi\right].$$

From (12′), the optimal degree of exchange-rate depreciation is given by

$$(19)\qquad s^*=-\chi+\frac{1}{1-\phi}\left(\psi-\frac{\sigma}{\varepsilon+\sigma}\right)E(\mu\mid w, s, r, \chi)$$

$$=-\chi-\frac{\sigma}{(1-\theta)(\varepsilon+\sigma)}E(\mu\mid w, s, r, \chi).$$

The last expression of the right-hand side has been obtained by substituting out the definitions of ϕ and ψ from equation (6).

As in the closed-economy case, the expectation of the supply shock μ will be different depending on whether we have a 'Phillips curve' or not. If there is one, we can use (6′) to obtain

$$(20)\qquad E(\mu\mid w, s, r, \chi)=\psi^{-1}w-\phi\psi^{-1}(s+\chi).$$

Substituting (20) in (19), and solving for s, one gets, after some rearrangement,

$$(21)\qquad s^*=-\chi+\frac{1}{\theta}w.$$

A number of points are worth making about the optimal exchange rate rule (21). First, note that it fully eliminates the welfare cost of unemployment. This is because the existence of the Phillips curve means that policy is decided under full information and is therefore first-best. The optimal policy rule (21) can be rewritten as $w=\theta(s+\chi)$, which is the same as the wage adjustment rule (4) with zero unemployment. The second point to note is that the exchange rate counteracts foreign inflation one for one, and that it more than accommodates wage inflation, as $\theta < 1$. This means that domestic inflation may show large fluctuations, and is a reflection of the absence of inflation considerations in the welfare loss function. I shall return to this point below.

Note that with Gray-Fischer contracts, i.e. with $\eta = \psi = 0$ in (6′), wages have no informational content over and above that of foreign prices and the exchange rate. The price vector no longer suffices for the supply shock μ to be inferred accurately, and

$$(22) \qquad E(\mu \mid s, w, r, \chi) = \rho s$$

where $\rho = \text{cov}(s, \mu)/\text{var}(s) < 1$. These variances and covariances can be calculated from the reduced-form exchange rate equation (18). Substituting (22) in (19) and solving for s, the optimal degree of exchange rate depreciation is given by

$$(23) \qquad s^* = -\frac{(1-\theta)(\varepsilon+\sigma)}{(1-\theta)(\varepsilon+\sigma)+\sigma\rho}\chi.$$

The optimal degree of exchange rate depreciation no longer depends on what happens to domestic wages, and is only a function of foreign inflation. The exchange rate still counteracts foreign inflation, but now the reaction is less than one for one.

The optimal exchange rate rules (21) and (23) can be transformed into monetary policy rules. This can be done by using the reduced-form exchange rate equation (18) to get a rule for the money supply (as was done in Section II above). Alternatively, one can use the uncovered interest parity condition (16) to get a rule for domestic interest rates. For example, the optimal interest rate rule in the case of a Phillips curve is given by

$$(24) \qquad i^* = r + \chi - \frac{1}{\theta} w.$$

To conclude, as for the closed economy, the implications of the Phillips curve are that the optimal monetary policy rule should take account of wages, as these contain independent information about the unobserved supply shocks.

The final point I want to consider in this section is the question of possible modifications if the welfare loss is affected not only by unemployment, but also by inflation. Consider the following more general welfare loss function:

$$(25) \qquad E(W \mid w, s, r, \chi) = \zeta c E\left[\left\{-(1-\phi)(s+\chi)+\left(\psi-\frac{\sigma}{\varepsilon+\sigma}\right)\mu\right\}^2 \middle| w, s, r, \chi\right] + (1-\zeta)(s+\chi)^2.$$

Expression (25) is a generalization of the welfare loss function (12), to take account of the possible aversion of policy-makers to inflation. ζ is the weight given to the welfare cost of unemployment, and $(1-\zeta)$ the weight given to squared deviations of the domestic price level from long-run equilibrium. In this model these deviations are equivalent to inflation.

From the first-order conditions for a minimum of (25), optimal exchange rate depreciation is given by

$$(26)\qquad s^* = -\chi - \frac{1}{\Delta}\frac{\zeta c\sigma}{(\varepsilon+\sigma)\{1+\eta(\varepsilon+\sigma)\}}E(\mu \mid s, w, r, \chi)$$

where $\Delta = 1 - \zeta\{1 - c(1-\phi)^2\}$.

As before, (26) can be used to calculate the optimal degree of exchange rate depreciation in both the Phillips curve and the Gray–Fischer case. The main difference from the cases considered above is that a first-best is no longer attainable even under full information. The reason is that with one instrument, monetary policy, there is a trade-off between unemployment and inflation. An optimal policy like (26) is only second-best, in the sense that it equates the marginal welfare cost of unemployment to the marginal welfare cost of inflation.

IV. Conclusions

This paper has considered the informational implications of wage adjustment rules that allow a response of nominal wages not only to price inflation, but also to unemployment (a Phillips curve). It has contrasted these rules with rules that allow a response only to price inflation. The results suggest that the existence of the Phillips curve will provide the authorities with more information about currently unobservable disturbances than otherwise, and will result in better outcomes for monetary policy.

In the examples considered, the economy is subject to two directly unobserved disturbances, a supply shock and a monetary shock. In such cases a Phillips curve is sufficient for wages and prices to be perfect signals. This is not the case with Gray–Fischer contracts. In conclusion, sluggish wage adjustment need not necessarily entail the informational welfare costs emphasized by Aizenman (1986).

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NOTES

1. Among the recent examples see Bruno and Sachs (1985), Grubb (1986), Bean, Layard and Nickell (1986), Gordon (1987), Alogoskoufis and Manning (1988).
2. This paper is not an attempt to provide micro foundations for indexation, or the response of wages to unemployment. This would be a worthy exercise, which would also reveal the extent to which wage adjustment parameters are independent of policy, but it is beyond the scope of the current paper. Here I am simply concerned with the fact that, if wages respond to unemployment, they may reveal information about some macroeconomic disturbances that are not directly observable.
3. A more general open-economy model with traded and non-traded goods is examined in Alogoskoufis (1987).

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