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MONETARY ACCOMMODATION, EXCHANGE RATE REGIMES AND INFLATION PERSISTENCE*

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Price stability has almost always featured as one of the important objectives of macroeconomic policy in the industrialised countries. Yet, not unlike other objectives, there have been many periods when actual performance has been much worse than what one would have expected on the basis of the pronouncements of the authorities. Furthermore, there have been periods when inflation (and in one particular period deflation) has shown significant persistence.

There is little disagreement among economists that inflation is in many ways a monetary phenomenon, although there are important differences concerning its deeper causes and the short-run nature of the inflationary process. This paper examines the relation between the dynamics of inflation in the industrial economies, and the nature of international monetary and exchange rate regimes.

The analysis is in two parts: The first deals with global monetary policy. The suggestion is that higher monetary accommodation of inflationary shocks at the world level will be taken into account by forward-looking wage and price setters, and, through the wage-price spiral, will cause an increase in the persistence of such shocks. To the extent that international monetary regimes based on commodity standards, and/or 'conservative' world central bankers are characterised by a lower average degree of aggregate monetary accommodation, they will result in lower persistence of world inflation than regimes of monetary discretion based on fiduciary standards. The second, and related, aspect has to do with exchange rate regimes. The opportunity to manage the exchange rate (or conduct an independent monetary policy) afforded by floating, allows different degrees of monetary accommodation across countries. This is reflected in exchange rate accommodation of relative price shocks, in order to partly counteract the effects of such shocks on the real exchange rate and, therefore, output and employment. Exchange rate accommodation is again taken into account by forward-looking wage and price setters, and, through the wage-price spiral, we get higher persistence of inflation differentials.

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The analysis is in terms of an overlapping-contracts model of the inflationary process, and the predictions of the model are investigated both for the monetary and exchange rate policy of the United Kingdom and the United States since 1880, and for the majority of OECD countries in the post-World War II period.

The evidence is not inconsistent with the analysis. It suggests that regimes such as the classical gold-standard and the gold-exchange standard of Bretton Woods, are characterised by much lower persistence of aggregate and relative inflation rates than managed exchange rate regimes based on fiduciary standards. In addition, they are characterised by much lower monetary and exchange rate accommodation of aggregate and relative price shocks. The results of this paper also provide importance evidence for the empirical significance of the Lucas (1976) critique, as they highlight how monetary and exchange rate regimes affect expectations and the nature of wage and price adjustment. The evidence has important implications for the design of international monetary and exchange rate regimes, which are discussed in the concluding section.[1]

The rest of the paper is in three sections. Section I presents a model of the inflationary process based on staggered contracts. This suggests that if monetary and exchange rate policy accommodates price shocks to maintain the level of real aggregate demand and the level of international competitiveness, then it will affect the expectations of wage and price setters, and will result in a higher persistence of inflation. Section II presents evidence that in periods of fiduciary standards and managed exchange rates there has indeed much higher persistence of global inflation and inflation differentials than in the period of the classical gold-standard and Bretton Woods. Monetary accommodation of average price shocks at the global level has also been much higher outside the latter two regimes, and exchange rate accommodation of relative price shocks has been very high in regimes of managed exchange rates. The final section summarises the conclusions and briefly discusses the implications of the findings for international monetary and exchange rate regimes.

I. INTERNATIONAL MONETARY REGIMES AND INFLATION PERSISTENCE

In this Section, I present a simple international macro-model to investigate the relation between the degree of inflation persistence and the nature of international monetary and exchange rate regimes. The model is a simple demand–supply aggregate model, with price-setting firms and staggered wage setting, in the spirit of Taylor (1979, 1980). International monetary and exchange rate regimes are only distinguished by the extent to which they accommodate aggregate and relative price shocks.

[1] Proposals for international monetary reform usually fall somewhere in between the McKinnon (1984) blueprint for a return to fixed exchange rates, and the Williamson (1983), Williamson and Miller (1987) blueprint for a system of target zones. For discussions and analytical comparisons of alternative proposals see Miller and Williamson (1988) and Alogoskoufis (1989).

I.A. *The Demand Side*

I assume that the world economy consists of J open economies of similar structure. Subscript j is a country index. The demand side in economy j is described by the following equations:[2]

$$y_{jt} = -\alpha(i_{jt} - \mathrm{E}_t p_{jt+1} + p_{jt}) + \beta(e_{jt} + p_t - p_{jt}) + v_{jt}, \tag{1}$$

$$m_{jt} - p_{jt} = y_{jt} - \gamma i_{jt} + k_{jt}, \tag{2}$$

$$i_{jt} = i_t + \mathrm{E}_t e_{jt+1} - e_{jt}. \tag{3}$$

Equation (1) is the savings-investment balance condition (IS curve). y is the log of aggregate domestic output (GDP), i is the nominal interest rate, p is the log of domestic prices, e is the log of the exchange rate (units of domestic currency per unit of the numeraire currency), and v is an aggregate demand disturbance. This may reflect shifts in tastes, fiscal policy or other exogenous factors. α and β are positive parameters. Variables not indexed by j refer to world averages.[3]

Equation (2) is the money market equilibrium condition (LM curve). m is the log of the money stock, γ is the interest rate semi-elasticity of money demand, and k is a shock to the demand for money.

Equation (3) is an uncovered interest parity condition, reflecting an assumption of perfect substitutability between bonds of different economies. A differential between a country's nominal interest rate and the average world interest rate reflects expectations of changes in its (average) exchange rate. Note that this condition makes the model of this paper a variant of monetary models of the exchange rate (see Frenkel and Mussa, 1985).

I.B. *International Monetary Regimes*

I next turn to the characterisation of monetary regimes. An international monetary regime has two main elements. The reserve regime, which is a set of rules that affect the creation of international money, and the exchange rate regime, which is a set of rules about exchange rate adjustments. In what follows I shall confine attention to the following class of rules.

$$m_t = \psi p_t + \mu_t, \tag{4}$$

$$e_{jt} = \bar{e}_{jt} + \phi(p_{jt} - p_t). \tag{5}$$

Equation (4) is a parametrisation of the international reserve regime, i.e. the rule for the evolution of the world money supply m. It consists of a component μ following an exogenous stochastic process, and an accommodation coefficient describing the extent to which the world money supply accommodates changes in the world price level. For example, under commodity based systems, such

[2] In what follows I refer to the 'world' economy to denote the average of these J economies. Strictly speaking this is not a world model, but a model of the 'North', i.e. the industrial economies with their similar structure and developed financial markets.

[3] In what follows constants have been supressed. Since the disturbances will be later assumed to follow stochastic processes with non zero means, this involves no loss of generality.

as the gold standard or the gold-exchange standard, the evolution of the world money supply is to a large extent exogenous, with restricted scope for discretionary accommodation of changes in the price level. Thus, ψ is low, possibly zero. Under pure fiduciary systems, there may be more scope for the monetary authorities to succumb to the temptation of accommodating price changes, say in order to mitigate the effects of such changes on aggregate demand and, therefore, unemployment (see Barro and Gordon, 1983). Thus, in what follows I shall characterise the classical gold-standard, and the gold-exchange standards of the interwar period and of Bretton Woods, as low monetary accommodation regimes. All others will be deemed high accommodation regimes. This characterisation is of course testable, and in Section II I present some evidence that it cannot be rejected by the data.

Equation (5) is a characterisation of the exchange rate regime. I view all floating exchange rate regimes as managed ones, since clean floating has only operated infrequently and for very short periods. In a fixed exchange rates regime the authorities defend the exchange rate, and thus fixed exchange rate regimes such as the international gold standard (1880–1913) and the Bretton Woods system in its heyday, i.e. between the two rounds of devaluations (1950–1967), are characterised by $\phi = 0$ and $\bar{e}_{jt} = \bar{e}_j$. In managed exchange rate regimes, the exchange rate accommodates inflation differentials at least partly, and ϕ is expected to be different from zero. $\bar{e}_{jt}$ need not be a constant in a managed exchange rate regime. Thus, in what follows, I shall characterise fixed exchange rate regimes by $\phi = 0$, and flexible exchange rate regimes by a positive (and possibly high) ϕ. Again this is an empirical question on which I present evidence in section II.[4]

I next turn to the supply side and price and wage setting.

I.C. *The Supply Side*

Each economy is assumed to consist of a large number of monopolistically competitive firms. Output is assumed to be proportional to employment. Thus, technology is described, by[5]

$$y^h_{jt} = l^h_{jt} + q^h_{jt}, \tag{6}$$

where l is the log of employment and q is the log of marginal (and average) labour productivity, assumed exogenous. Superscript h is a firm index.

[4] Since this is a monetary model of the exchange rate, exchange rate policies are just another way of expressing relative monetary policies. Exchange rate accommodation of relative price shocks is equivalent to different degrees of monetary accommodation of aggregate shocks across countries. Note also that one of the aspects of international monetary regimes that are often emphasised in the specialist literature, namely the extent to which they are symmetric or asymmetric (see Eichengreen, 1989 and Giovannini, 1989), has little significance for our purposes. Whether one of the countries controls international liquidity while the others manage their bilateral exchange rate, or whether international liquidity and exchange rates are controlled in a cooperative (symmetric) fashion would matter only insofar as accommodation is different under symmetric and asymmetric regimes. Such an issue is not addressed in this paper, but it is worth noting that most fixed exchange rate regimes have been asymmetric ones.

[5] The assumption of linear technology can be justified in terms of a 'putty–clay' model with fixed coefficients, in which capital is the abundant factor of production in the short run. Since this is a short-run model I abstract from capital accumulation. The linear technology assumption is not crucial in what follows, and could be replaced by decreasing marginal productivity at the cost of higher notational complexity.

Each firm faces a downward sloping demand curve. Demand for its output differs from average national demand to the extent that its price differs from the average price.

$$y^h_{jt} = y_{jt} - \eta(p^h_{jt} - p_{jt}); \quad \eta > 1 \tag{7}$$

η is the elasticity of demand.

Under profit maximisation, the optimal price for each firm can be shown to be a constant markup on unit labour costs (see Dixit and Stiglitz (1977) for example). In logs, and after aggregating, the optimal price is given by,

$$p_{jt} = \nu + w_{jt} - q_{jt}; \quad \nu = \ln\left(\frac{\eta}{\eta - 1}\right), \tag{8}$$

where w is the nominal wage.

Following Taylor (1979, 1980) I assume that all economies are characterised by staggered wage contracts. In fact I use the Calvo (1983) variant of the Taylor model, according to which each contract has a fixed probability $1-\theta$ of being re-opened in each period. Thus, θ is the proportion of wage contracts that are not renewed in any particular period, and is a measure of the degree of nominal wage and price sluggishness. Contract wages reflect expected inflation and unemployment for the expected duration of the contract, as in the Taylor model. Thus, the contract-wage drawn in period t is given by,[6]

$$\begin{aligned} x_{jt} &= (1-\theta)\, \mathrm{E}_{t-1} \sum_{i=0}^{\infty} \theta^i [\delta p_{jt+i} + (1-\delta)\,(e_{jt+i} + p_{t+i}) - \epsilon u_{jt+i} + \omega_{jt+i}] \\ &= \frac{1-\theta}{1-\theta \mathrm{F}} \mathrm{E}_{t-1}\, [\delta p_{jt} + (1-\delta)\,(e_{jt} + p_t) - \epsilon u_{jt} + \omega_{jt}] \end{aligned} \tag{9}$$

where x_{jt} refers to the wage contract drawn in period t, E is the mathematical expectations operator and F is the forward-shift operator. δ is the share of domestic goods in the consumption bundle (hence $1-\delta$ is the degree of openess) and ϵ is the responsiveness of contract wages to unemployment. ω is a shock to wage setting, and u is the unemployment rate. The latter will be approximated by,

$$u_{jt} \simeq n_{jt} - l_{jt} \tag{10}$$

where n is the log of the labour force, assumed exogenous, and l is the log of aggregate employment.

By aggregating (6) and solving for l we get the following employment equation.

$$l_{jt} = y_{jt} - q_{jt}. \tag{11}$$

[6] Following Calvo (1983), I treat θ as a fixed parameter of the wage setting 'technology'. This may not be too unsatisfactory for the purposes of this paper, where I investigate moderate inflations. In a hyperinflation one would, of course, expect a parameter like θ to be affected. It is also worth noting that the results to be derived are similar, although less transparent, if one used the Taylor two-period contracts. In fact, in the first version of this paper (Alogoskoufis, 1990) I used the Taylor model.

Substituting the definition of unemployment (10) and the labour demand curve (11) in the contract wage equation (9), we get,

$$x_{jt} = \frac{1-\theta}{1-\theta F} E_{t-1}[\delta p_{jt} + (1-\delta)(e_{jt}+p_t) + \epsilon y_{jt} - \epsilon(n_{jt}+q_{jt}) + \omega_{jt}]. \quad (12)$$

The average wage w in the economy is given by aggregating across the wage contracts still in force. It is given by,

$$w_{jt} = (1-\theta) \sum_{s=0}^{\infty} \theta^s x_{jt-s} = \frac{1-\theta}{1-\theta L} x_{jt}, \quad (13)$$

where L is the backward shift (lag) operator.

Substituting the wage equation (13) in the price equation (8), after some rearrangement, we get,

$$p_{jt} = \theta p_{jt-1} + (1-\theta) x_{jt} + \nu(1-\theta) - q_{jt} + \theta q_{jt-1}. \quad (14)$$

The price equation (14) and the contract-wage equation (12) summarise the behaviour of suppliers.[7]

To solve the model we must bring together the demand and supply sides. The solution of the model is conceptually simple, but in practice it can become quite messy since this is a multi-country model. The combination of (12) and (14) means that in each country there is a second-order difference equation in prices. This system can be de-composed into two independent second-order systems, by using the method of Aoki (1981) of averaging the single country models (the average or world model), and taking the difference of each country's model from the average and call it the relative model.

I.D. *The Average or World Model*

By summing the IS, LM, price and contract-wage equations of the J countries, and dividing by J, one gets the following average (world) model:

$$y_t = -\alpha(i_t - E_t p_{t+1} + p_t) + v_t, \quad (15)$$

$$m_t - p_t = y_t - \gamma i_t + k_t, \quad (16)$$

$$m_t = \psi p_t + \mu_t, \quad (17)$$

$$x_t = \frac{1-\theta}{1-\theta F} E_{t-1}[p_t + \epsilon y_t - \epsilon(n_t + q_t) + \omega_t], \quad (18)$$

$$p_t = \theta p_{t-1} + (1-\theta) x_t + \nu(1-\theta) - q_t + \theta q_{t-1}. \quad (19)$$

Note that all terms involving the exchange rate disappear, as the average of the logarithms of exchange rates is equal to zero. Thus the average model is essentially a closed economy model, since the J countries are assumed to comprise the world, and the world is a closed economy.

[7] Note that (15) implies that prices are also sluggish. This is because of the assumption that pricing is based on unit labour costs. There is evidence of price sluggishness for most of the countries we are concerned with in this paper. See for example Gordon (1982) and Rotemberg (1982) for the United States and Alogoskoufis and Pissarides (1983) for the United Kingdom.

The average model can be solved very easily. From (15), (16) and (17),

$$i_t = \frac{1-\psi}{\gamma}p_t + \frac{1}{\gamma}y_t + \frac{1}{\gamma}(k_t - \mu_t). \tag{20}$$

From (20) one can see that the higher the degree of monetary accommodation, the lower world nominal interest rates will be, for given output, prices and excess money demand shocks.

Substituting (20) in (16) and solving for y_t,

$$y_t = \frac{1}{\alpha+\gamma}[\alpha\gamma E_t p_{t+1} - \alpha(1-\psi+\gamma)p_t - \alpha(k_t-\mu_t) + \gamma v_t]. \tag{21}$$

Equation (21) is the 'aggregate demand curve'. A higher degree of accommodation, for given shocks and expectations of future prices, results in higher output, because of the reduction in nominal (and real) interest rates.

Substituting the contract wage equation (18) in the price equation (19), after taking expectations conditional on information at the end of $t-1$ and using the output equation (21), we end up with the following reduced form difference equation for the expected world price level.

$$E_{t-1}p_{t+1} - \left[1 + \frac{\theta(\alpha+\gamma)+\epsilon\alpha(1-\psi)(1-\theta)^2}{\theta(\alpha+\gamma)+\epsilon\alpha\gamma(1-\theta)^2}\right]E_{t-1}p_t + \frac{\theta(\alpha+\gamma)}{\theta(\alpha+\gamma)+\epsilon\alpha\gamma(1-\theta)^2}p_{t-1}$$
$$= -\frac{\alpha+\gamma}{\theta(\alpha+\gamma)+\epsilon\alpha\gamma(1-\theta)^2}E_{t-1}z_t, \tag{22}$$

where

$$z_t = (1-\theta)^2\left[\frac{\epsilon\gamma}{\alpha+\gamma}v_t - \frac{\epsilon\alpha}{\alpha+\gamma}(k_t-\mu_t) - \epsilon(n_t+q_t) + \omega_t + v\right] - (1-\theta F)(1-\theta L)q_t.$$

This only consists of exogenous parameters and shocks.

Equation (22) can be re-written as,

$$[F^2 - (\rho_1+\rho_2)F + \rho_1\rho_2]LE_{t-1}p_t = -\frac{\alpha+\gamma}{\theta(\alpha+\gamma)+\epsilon\alpha\gamma(1-\theta)^2}E_{t-1}z_t, \tag{23}$$

where ρ_1 and ρ_2 are the two roots of the difference equation (22). Under fairly mild conditions on the parameters, the two roots are real, distinct and positive, and lie on either side of unity, and the difference equation for expected world prices is saddlepath stable.

Assuming that ρ_1 is the smaller root and ρ_2 the larger root, (23) can be factorised as,

$$(F-\rho_1)(F-\rho_2)LE_{t-1}p_t = -(1/\theta)\rho_1\rho_2 E_{t-1}z_t. \tag{24}$$

Dividing through by $F-\rho_2$, after some re-arrangement we get,

$$(F-\rho_1)LE_{t-1}p_t = \frac{\rho_1}{\theta(1-F\rho_2^{-1})}E_{t-1}z_t = \frac{\rho_1}{\theta}E_{t-1}\sum_{s+0}^{\infty}\rho_2^{-s}z_{t+s}. \tag{25}$$

Assuming that all the exogenous components that make up z are random walks with drift, we get the following closed form solution for expected inflation,[8]

$$E_{t-1}\,\Delta p_t = \rho_1\,\Delta p_{t-1} + \frac{\rho_1 \rho_2}{\theta(\rho_2 - 1)}(g_z + \xi_{zt-1}), \tag{26}$$

where g_z is the drift of the z process, and ξ_z is the white-noise process driving it.

One can see that the persistence of inflation, conditional on information available at the end of period $t-1$, is equal to the smaller root of the difference equation (22). It is straightforward to show that ρ_1 depends positively on the degree of monetary accommodation ψ. To see that, express the characteristic equation as,

$$\chi^2 + b\chi + c,$$

where $b = -(\rho_1 + \rho_2)$ and $c = \rho_1 \rho_2$. The expressions in terms of the structural parameters can be read off from equation (22). The smaller root ρ_1 is given by,

$$\rho_1 = -\tfrac{1}{2}b - \tfrac{1}{2}[b^2 - 4c]^{\frac{1}{2}}.$$

Taking the first derivative of ρ_1 with respect to the degree of monetary accommodation ψ we find that it is given by,

$$\frac{\partial \rho_1}{\partial \psi} = -\tfrac{1}{2}[1 + b(b^2 - 4c)^{-\frac{1}{2}}]\frac{\epsilon\alpha(1-\theta)^2}{\theta(\alpha+\gamma) + \epsilon\alpha\gamma(1-\theta)^2} > 0. \tag{27}$$

Equation (27), one of the two main theoretical results of this paper, suggests that an increase in the degree of monetary accommodation will result in an increase in the degree of persistence of world inflation. Thus, to the extent that a shift from monetary regimes based explicitly or implicitly on a gold-standard results in higher monetary accommodation, one would expect that the persistence of inflation will also rise. This prediction of the model will be tested in section II.

The intuition is straightforward. Wage setters take into account not only current but also expected future developments. With an accommodative monetary policy, a shock that raises prices today will result in lower unemployment and higher wages than in the absence of accommodation, both today and in subsequent periods. Since future prices are expected to be higher and unemployment to be lower than in the absence of accommodation, contracts that are re-opened after the realisation of the shock will reflect these expectations. Thus, the higher future price rises that accommodation implies are partly brought forward through the forward-looking behaviour of price setters, with the net result being higher inflation persistence.

In the case where there is full accommodation of price changes by the world money supply, i.e. $\psi = 1$, it is easy to see from (22) that the sum of the two roots

[8] The hypothesis that most macroeconomic time series and the shocks that drive them have unit roots has gained wide acceptance after the evidence presented in Nelson and Plosser (1982). Also note that I have implicitly used the 'minimal set of state variables' solution concept suggested by McCallum (1983). Obviously the difference equation (22) has an infinity of other solutions.

in that case is $\rho_1 + \rho_2 = 1 + \zeta$, and their product is equal to $\rho_1 \rho_2 = \zeta$. ζ is defined as,

$$\zeta = \frac{\theta(\alpha+\gamma)}{\theta(\alpha+\gamma)+\epsilon\alpha\gamma(1-\theta)^2} \leqslant 1.$$

The two roots are $\rho_1 = \zeta$, and $\rho_2 = 1$. Thus, with full monetary accommodation, world inflation has a unit root, which means that the forward solution in (25) does not converge. World inflation does not converge to a steady state value, even when the exogenous degree of price and wage sluggishness θ is extremely low.

I.E. *The Relative Model*

We can now turn to the relative model. I shall consider deviations of economy *j*'s variables from the average variables determined in the previous sub-section. Subtracting (15) from (1), and using the uncovered interest parity condition (3) and the exchange rate rule (5), we end up with the following equation for differences in output.

$$\hat{y}_{jt} = \alpha(1-\phi)\,\mathrm{E}_t\hat{p}_{jt+1} - (\alpha+\beta)\,(1-\phi)\,\hat{p}_{jt} + \hat{v}_{jt}. \tag{28}$$

For all variables a 'hat' denotes the deviation from the world average, i.e. $\hat{z}_{jt} = z_{jt} - z_t$. The term $\bar{e}_{jt}$ has been normalized to zero for notational simplicity.

Subtracting the average contract wage equation (18) from the country specific contract wage equation (12), and the world price equation (19) from the country specific price equation (14), after utilising the exchange rate rule (5) and some re-arrangement, one obtains the following expressions for relative contract wages and prices.

$$\hat{x}_{jt} = \frac{1-\theta}{1-\theta\mathrm{L}}\mathrm{E}_{t-1}[\{1-(1-\delta)\,(1-\phi)\}\hat{p}_{jt} + \epsilon\hat{y}_{jt} - \epsilon(\hat{n}_{jt}+\hat{q}_{jt}) + \tilde{\omega}_{jt}], \tag{29}$$

$$\hat{p}_{jt} = \theta\hat{p}_{jt-1} + (1-\theta)\,\hat{x}_{jt} - \hat{q}_{jt} + \theta\hat{q}_{jt-1}. \tag{30}$$

The relative model consists of (28) for the demand side, and (29) and (30) for the supply side. The relative monetary policy (exchange rate) rule and the uncovered interest parity condition have already been utilised. Substituting the output equation (28) in the contract-wage equation (29), and then substituting the resulting expression in (30) and taking expectations at $t-1$, after some re-arrangement, we get the following second-order difference equation for the expected relative price level.

$$\mathrm{E}_{t-1}\hat{p}_{jt+1} - \left\{1 + \frac{\theta + [\epsilon\beta + (1-\theta)^2(1-\delta)]\,(1-\phi)}{\theta+\epsilon\alpha(1-\phi)}\right\}\mathrm{E}_{t-1}\hat{p}_{jt} + \frac{\theta}{\theta+\epsilon\alpha(1-\phi)}\hat{p}_{jt-1} = -\frac{1}{\theta+\epsilon\alpha(1-\phi)}\mathrm{E}_{t-1}z_{jt}, \tag{31}$$

where

$$\hat{z}_{jt} = (1-\theta)^2[\epsilon\hat{v}_{jt} - \epsilon(\hat{n}_{jt}+\hat{q}_{jt}) + \tilde{\omega}_{jt}] - (1-\theta\mathrm{F})\,(1-\theta\mathrm{L})\,\hat{q}_{jt}.$$

Factorizing (31) in the same manner as was done for (22), and solving the stable root forward and the unstable root backward, under the assumption that the relative shocks follow random walks with drift, we end up with the following expression for the relative inflation rates.

$$E_{t-1}\Delta\hat{p}_t = \lambda_1 \Delta\hat{p}_{t-1} + \frac{\lambda_1\lambda_2}{\theta(\lambda_2 - 1)}(\hat{g}_z + \hat{\xi}_{zt-1}), \tag{32}$$

where λ_1 and λ_2 are the two roots of the difference equation (31), and $\hat{g}_z$ and $\hat{\xi}_z$ are the drift and innovation respectively of the driving composite process $\hat{z}$. λ_1 is assumed to be the smaller root.

As in the case of the aggregate model, it is straightforward to show that the persistence of differential inflation depends positively on the degree of exchange rate accommodation ϕ. The relevant expression is given by,

$$\frac{\partial\lambda_1}{\partial\phi} = -\tfrac{1}{2}[1 + b(b^2 - 4c)^{-\frac{1}{2}}]\frac{\theta[\epsilon(\beta-\alpha) + (1-\theta)^2(1-\delta)]}{[\theta + \epsilon\alpha(1-\phi)]^2} > 0, \tag{33}$$

where b and c now refer to minus the sum and plus the product respectively of the roots of the difference equation (31).

Equation (33) is the second main theoretical result in this paper. The persistence of relative inflation rates increases with the accommodation of relative inflation rates by exchange rate policy. Managed exchanged rate regimes will result in more persistent inflation differentials than fixed exchange rate regimes. The rationale is similar to that for monetary accommodation above, and it rests on the interaction between sluggish but forward-looking wage setting, with price setting that depends on unit labour costs. Higher exchange rate accommodation of relative inflation rates results in higher competitiveness following an inflationary shock, and therefore lower relative unemployment. This, through wage setting, re-inforces the impact of the relative inflationary shock in both the current and future periods.

In the case where there is full accommodation of relative price shocks by the exchange rate, one can easily check from (31) that $\lambda_1 + \lambda_2 = 2$, and $\lambda_1\lambda_2 = 1$. Thus, the two roots of the inflation process are equal to unity. As Dornbusch (1982) has demonstrated in a related model, PPP exchange rate rules result in relative inflation rates becoming non-stationary. Even when world inflation is stationary, if a country follows a PPP exchange rate rule, its own inflation will become non-stationary. This is because a PPP exchange rate rule is equivalent to a fully accommodative relative monetary policy.

II. EVIDENCE FROM INTERNATIONAL MONETARY REGIMES

In this Section I present some evidence which shows that, as the model predicts, the persistence of both average and relative inflation rates has been lower under gold based fixed exchange rate regimes than under managed exchange rates. I also present evidence that managed exchange rate regimes are indeed characterised by higher monetary accommodation of aggregate price shocks, and by high exchange rate accommodation of relative price shocks.

Table 1

The Persistence of Average and Relative Inflation Rates in the United Kingdom and the United States 1880–1987

	Δp_t		$\Delta \hat{p}_t$
Const	0·011	Const	0·006
	(0·005)		(0·004)
	[0·005]		[0·004]
Δp^G_{t-1}	0·243	$\Delta \hat{p}^F_{t-1}$	0·158
	(0·095)		(0·223)
	[0·175]		[0·115]
Δp^{NG}_{t-1}	0·824	$\Delta \hat{p}^{NF}_{t-1}$	0·440
	(0·164)		(0·102)
	[0·089]		[0·108]
Δp^W_{t-1}	0·114	$\Delta \hat{p}^W_{t-1}$	−0·066
	(0·220)		(0·313)
	[0·210]		[0·201]
R^2	0·345	R^2	0·164
s	0·044	s	0·039
DW	1·913	DW	1·891
Wald test	3·015	Wald test	1·808
Unit Root Test *G*	4·325	Unit Root Test *F*	7·321
NG	1·978	*NF*	5·185

Notes: p is the log of the average of GDP/GNP deflators for the United Kingdom and the United States, while a hat denotes the difference between the United Kingdom and United States deflators. For sources and other details see the data appendix. Asymptotic standard errors are in parentheses below estimated coefficients, and heteroskedasticity consistent White (1980) standard errors are in brackets. Three zero-one dummy variables have been utilised. The first (*G*) took the value 1 for gold-based international reserve regimes (1880–1913, 1919–39, 1950–67), and zero elsewhere, the second (*W*) took the value 1 in the years of the two world wars (1914–18, 1940–5) and zero elsewhere and the third, *F*, took the value 1 for fixed exchange rate regimes (1880–1913, 1926–30, 1950–67) and zero elsewhere. In the Table variables with superscript *G* (*F*) have been multiplied by dummy variable *G* (*F*), variables with superscript *NG* (*NF*) have been multiplied by $1-G$ ($1-F$), and variables with superscript *W* have been multiplied by *W*. The Wald test reported, is an asymptotically normal variate. For the averages it tests the statistical significance of the difference in persistence coefficients between gold based and non-gold based international reserve regimes. For the differences it tests the statistical significance of the difference in persistence coefficients between fixed and managed exchange rate regimes. The unit root tests reported are also asymptotically normal variates under the alternative of lack of a unit root. Under the null of a unit root its distribution is non-standard, as in the case of the Dickey–Fuller test. Both test statistics are based on White (1980) standard errors.

II.A. *The Persistence of Average and Relative Inflation Rates*

One of the important predictions of the model discussed in Section I is that average world inflation will persist more under regimes in which the world money supply accommodates price shocks, but also that inflation differentials will persist more in managed exchange rate regimes, if exchange rate policy accommodates relative price shocks. In this section I present estimates of first-order autoregressive processes for average inflation and inflation differentials under alternative international monetary and exchange rate regimes.[9]

Table 1 presents estimates of the United Kingdom and the United States

[9] Following the suggestions of a referee, I do not take the theoretical inflation persistence equations (26) and (32) at face value in this Section. I thus only present OLS estimates from simple first-order autoregressions. A more sophisticated treatment is in an extended version of this paper (Alogoskoufis, 1991). See also Alogoskoufis and Smith (1991) who investigate implications for the Phillips Curve.

from 1880 to 1987, while Table 2 presents estimates for 21 OECD countries in the post-World War II period.

The estimates reported in Table 1 suggest that the average UK–US inflation rate has shown greater persistence in the international monetary system of 1968–87, which was not subject to the discipline of a gold or a gold-exchange standard. In addition, the inflation differential between the United Kingdom and the United States has shown much higher persistence in periods of managed exchange rates. Wald tests, based on standard errors adjusted for heteroskedasticity, cannot reject at 5% the hypothesis of lower persistence of average inflation in gold or gold-exchange standards, or the hypothesis of lower persistence of the inflation differential between the United Kingdom and the United States in fixed exchange rate regimes (note that these are one-tailed tests). In addition, tests for unit-roots in inflation cannot reject the hypothesis that the average inflation rate has had a unit root in 1968–87, during a fiduciary international monetary regime, although they reject the hypothesis that the inflation differential between the United Kingdom and the United States has displayed a unit root in either fixed or managed exchange rate regimes.

Table 2 presents estimates for average OECD inflation and for relative inflation rates for 21 OECD countries. The results again suggest quite strongly that the average OECD inflation rate displays much higher persistence after 1967. The relevant Wald test for a parameter shift, which is based on standard errors adjusted for heteroskedasticity, is a massive 8·4. Note that the credibility of the Bretton Woods system of fixed exchange rates was seriously impaired in 1967–8, following the devaluation of sterling in November 1967 and the effective demonetisation of gold, with the establishment of the two-tier gold market, in March 1968. The unit root hypothesis for average OECD inflation is rejected for either regime, but the rejection is far more significant for the 1953–67 period, than after 1968. In any case, the point estimate of the persistence of average OECD inflation in 1968–87 is equal to about 70%, as opposed to the 25% of the 1953–67 period.

For relative inflation rates the results are more mixed but again largely conform with the thesis presented in this paper. Relative inflation rates are uniformly more persistent after 1972, but the difference between 1953–71 and 1972–87 is statistically significant at 5% (see the Wald test) for only 12 of the 21 economies. Even if one excludes Canada, who had a floating rate for most of the 1950s, these are only slightly more than half of the economies considered. However, for 14 out of 21 countries one could not reject the hypothesis that the persistence of relative inflation rates was zero in 1953–71. The corresponding number for the 1972–87 period is 5. In addition, if one were to opt for 3 as the critical value for unit root tests at conventional significance levels, which is the approximate value of the Dickey–Fuller tests, these diagnostics reject the unit root hypothesis for all but three of the countries in the 1953–71 period, whereas for the 1972–87 period they only reject it for four of the countries. Thus, the evidence that inflation differentials are more persistent, even non-stationary, in managed exchange rate regimes is quite strong, if not overwhelming.

Table 2

The Persistence of Average and Relative Inflation Rates in the OECD countries: 1953–87

	1953–71	1972–87	Unit–root test 1953–71	Unit–root test 1972–87	Wald test	R^2	DW
OECD*	0·242	0·718	15·160	4·548	8·449	0·819	1·364
	[0·050]	[0·062]					
Australia	−0·251	0·747	3·897	1·497	2·944	0·294	1·304
	[0·321]	[0·169]					
Austria	0·376	0·814	1·743	1·248	1·147	0·405	2·426
	[0·358]	[0·149]					
Belgium	0·460	0·672	3·140	1·608	0·806	0·362	1·715
	[0·172]	[0·204]					
Canada	0·017	0·288	4·726	3·728	0·986	0·042	1·935
	[0·208]	[0·191]					
Denmark	0·520	0·394	4·324	3·223	0·668	0·291	1·886
	[0·111]	[0·188]					
Finland	−0·109	0·448	6·161	2·165	1·943	0·146	1·368
	[0·180]	[0·255]					
France	0·402	0·529	2·821	2·309	0·451	0·170	1·788
	[0·212]	[0·204]					
W. Germany	0·443	0·872	2·757	1·391	2·094	0·684	1·701
	[0·202]	[0·092]					
Greece	0·454	0·816	4·136	1·720	2·576	0·561	2·050
	[0·132]	[0·107]					
Ireland	−0·188	0·320	3·845	2·720	1·643	0·116	1·807
	[0·309]	[0·250]					
Italy	0·400	0·881	3·846	1·155	2·513	0·727	1·820
	[0·156]	[0·103]					
Japan	−0·012	0·785	5·850	0·575	1·540	0·390	2·024
	[0·173]	[0·374]					
Netherlands	0·246	0·980	3·053	0·118	2·174	0·464	1·792
	[0·247]	[0·170]					
Norway	0·036	0·088	8·169	3·390	0·178	0·005	2·019
	[0·118]	[0·269]					
New Zealand	−0·307	0·634	5·446	1·926	2·993	0·258	1·839
	[0·240]	[0·190]					
Portugal*	0·060	0·945	3·369	0·809	2·759	0·787	1·784
	[0·279]	[0·068]					
Spain*	0·463	0·686	3·891	2·415	1·390	0·449	1·498
	[0·138]	[0·130]					
Sweden	0·098	0·327	6·054	2·828	1·013	0·064	1·990
	[0·149]	[0·238]					
Switzerland	0·091	0·767	6·733	1·331	3·158	0·442	1·749
	[0·135]	[0·175]					
U.K.	−0·306	0·497	4·488	3·645	2·470	0·280	1·858
	[0·291]	[0·138]					
U.S.	0·487	0·648	3·000	2·411	0·913	0·404	2·091
	[0·171]	[0·146]					

Notes: Numbers in brackets are White standard errors. For details on the tests see Table 1 and the appendix.

* OECD 1953–67, 1968–87, Portugal 1956–71, 1972–87, Spain 1957–71, 1972–87.

Table 3

Monetary Accommodation in the United Kingdom and the United States: 1880–1987

Dependent Variable: Δm_t

	I	II	III	IV
Constant	0·031	0·031	0·031	0·032
	(0·007)	(0·006)	(0·007)	(0·006)
W	—	—	0·063	0·058
			(0·017)	(0·016)
Δp_t^G	0·011	0·077	0·014	0·032
	(0·372)	(0·330)	(0·337)	(0·310)
Δp_t^{NG}	0·596	0·600	0·579	0·579
	(0·205)	(0·182)	(0·184)	(0·169)
Δp_t^W	0·797	0·747	—	—
	(0·263)	(0·233)		
MA(1)	—	0·502	—	0·434
		(0·099)		(0·099)
R^2	0·243	0·412	0·379	0·480
s	0·048	0·043	0·043	0·040
DW	1·192	1·995	1·292	1·995
Wald Test	1·667	1·681	1·776	1·880

Notes: m is the log of the average stock of high-powered money in the United Kingdom and the United States, and p the log of their average GDP/GNP deflators. For sources and other details see the data appendix. The estimates have been obtained by instrumental variables. The instruments used were the second lag of inflation in the United States and the United Kingdom, the second lag of the rate of change of average high powered money in the United States and the United Kingdom, the second lag of the rate of change of the exchange rate, and two zero-one dummy variables. The first (G) took the value 1 for gold-based international reserve regimes (1880–1913, 1919–39, 1950–67), and zero elsewhere, whereas the second (W) took the value 1 in the years of the two world wars (1914–18, 1940–5) and zero elsewhere. In the Table variables with superscript G have been multiplied by dummy variable G, variables with superscript NG have been multiplied by $1-G$, and variables with superscript W have been multiplied by W. MA(1) denotes a first order moving average error. Asymptotic standard errors are below estimated parameters, while the Wald test reported is a asymptotic normal test, and tests the statistical significance of the difference in the estimated monetary accommodation coefficient between gold based and non-gold based international reserve regimes.

We can now turn to the evidence on monetary and exchange rate accommodation.

II.B. *Monetary Accommodation*

Table 3 presents monetary accommodation coefficients for the longer time series available for the United Kingdom and the United States. These are estimated for two different international reserve regimes, gold based and non-gold based (the latter is effectively the period after 1968). The two World Wars are treated in two alternative ways. In the first (Columns I and II), I allow for a different monetary accommodation coefficient, while in the second (Columns III and IV) I allow for a different exogenous rate of change of high powered money, by including an additive zero-one dummy variable. The results for the latter treatment have a lower standard error of estimate, but there is not much between the two methods. In Columns II and IV I have allowed for moving average errors, as the Durbin–Watson statistics in I and III suggest some time dependence in the residuals.

For all specifications the results suggest much higher monetary accommodation after the demonetisation of gold in 1968. Wald tests for the hypothesis of lower monetary accommodation in gold based international reserve regimes do not suggest rejection at 5% for a single tailed test. Thus, the hypothesis of higher monetary accommodation after the demonetisation of gold cannot be rejected by this evidence.

I next consider aggregate monetary accommodation in the OECD countries since the early 1950s. Estimates of the monetary accommodation coefficient before and after 1968, the year of the establishment of the two tier gold market and the effective demonetisation of gold, are reported below. The results, which have been obtained by instrumental variables using lagged monetary growth, lagged inflation and the dummy variable G as instruments, are as follows:

$$\underset{(0{\cdot}013)}{\Delta m_t = 0{\cdot}052} - \underset{(0{\cdot}448)}{0{\cdot}357}\Delta p_t^G + \underset{(0{\cdot}184)}{0{\cdot}418}\Delta p_t^{NG} \quad [\underset{(0{\cdot}184)}{\mathrm{MA}(1) = 0{\cdot}693}].$$

Sample 1952–87, $R^2 = 0{\cdot}653$, $s = 0{\cdot}017$, DW $= 1{\cdot}960$, Wald-Test $= 2{\cdot}682$

These estimates confirm the UK–US results regarding monetary accommodation. Accommodation in the 1952–67 period has not been statistically significant (indeed the point estimate is negative), while after the demonetisation of gold in 1968 it has been high (of the order of 50%) and statistically significant. The Wald test for the significance of the structural shift after 1968 suggests that this has been statistically significant.

II.C. *Exchange Rate Accommodation*

I next turn to exchange rate accommodation. I consider a generalisation of the exchange rate accommodation rule used in the theoretical section, to allow for the authorities to react to a distributed lag of deviations of relative prices from their equilibrium value:

$$e_{jt} = \phi \sum_{i=0}^{\infty} (1-\phi)^i (p_j - p + \bar{e}_j)_{t-i}, \tag{34}$$

ϕ is the short-run accommodation coefficient, as it denotes the extent to which current relative prices are reflected in the current nominal exchange rate. (34) has the desirable property that if the perceived equilibrium real exchange rate was constant, there would be full accommodation in the long run. It encompasses a number of exchange rate rules as special cases. For example, as ϕ tends to unity we tend to a PPP exchange rate rule, and as ϕ tends to zero we tend to a fixed nominal exchange rate regime.

Using the lag operator L, (34) can be re-written as,

$$e_{jt} = \phi(p_j - p + \bar{e}_j)_t \sum_{i=0}^{\infty} (1-\phi)^i \mathrm{L}^i = \phi(p_j - p + \bar{e}_j)_t / [1-(1-\phi)\mathrm{L}]. \tag{35}$$

Equation (35) can be re-arranged as,

$$e_{jt} = (1-\phi)\, e_{jt-1} + \phi(p_j - p + \bar{e}_j)_t. \tag{36}$$

Assuming that the equilibrium real exchange rate $\bar{e}_j$ follows a random walk (possibly with drift), as would be the case with permanent shocks in relative productivities, after some re-arrangement we get,

$$\Delta e_{jt} = \phi g_{ej} + (1-\phi)\,\Delta e_{jt-1} + \phi(\Delta p_j - \Delta p)_t + \phi \xi_{jt}, \tag{37}$$

where g_{ej} is the drift, and ξ the innovation driving the random walk for $\bar{e}$.[10]

For the longer time series for the United Kingdom and the United States ϕ was not statistically different from unity. TSLS estimates of (37), ommiting the lagged change in the nominal exchange rate ($\phi = 1$), are given below:

$$\Delta e_t = \underset{(0\cdot024)}{0\cdot014} + \underset{(0\cdot577)}{1\cdot178}\quad \Delta(p_t^{UK} - p_t^{US}),$$

Sample: 1919–25, 1931–39, 1973–87, $R^2 = 0\cdot163$, $s = 0\cdot107$ DW $= 1\cdot817$.

The estimates strongly suggest that the United Kingdom has on average been fully accommodating inflation differentials with the United States in the managed exchange rate regimes of the inter-war and the post-war period. The accommodation coefficient is statistically different from zero at conventional significance levels, but not significantly different from one. Thus, the monetary sovereignty afforded by flexible exchange rates seems to have been one of the reasons for the high persistence of inflation in the United Kingdom. In fact the results suggest that the persistence of deflation in the 1920s may also be explained by exchange rate policy, which accommodated the relative fall in Britain's price level in the run-up to sterling's return to the pre-war parity in 1925. This latter episode is examined in detail in an appendix to the longer version of this paper (Alogoskoufis, 1991).

TSLS estimates of (37) for the 21 OECD countries appear in Table 4. Only lagged variables have been used as instruments, in order to avoid as much as possible the problem of contemporaneous endogeneity between the nominal exchange rate and prices.

The results suggest that short-run exchange rate accommodation of inflation differentials is prevalent in the post-1972 regime of managed floating. With only a couple of exceptions, the point estimates of short-run accommodation coefficients are all higher than 50% and statistically different from zero at conventional significance levels. In fact, for the majority of these countries, the estimated accommodation coefficients are not statistically different from unity either, in the same vein that the estimated persistence of inflation was not statistically different from unity in the results reported in Table 2. A Wald test for the restriction implicit in equation (37), namely that the sum of the coefficients of lagged chances in the exchange rate and current inflation differentials is equal to unity, does not suggest rejection of this restriction at conventional significance levels for nineteen of the twenty one countries. It is this restriction that embodies the assumption that, in managed exchange rate regimes, the authorities allow the exchange rate to accommodate inflation differentials fully in the long run.

[10] Note that the exchange rule implicit in (35) and the assumption that the real exchange rate target of the authorities is a random walk, is equivalent to partial adjustment towards a relative PPP target.

Table 4
Estimates of Exchange Rate Accommodation Coefficients in the OECD Countries: 1972–87

	ϕ	R^2	s	DW	Wald-test
Australia	0·695 (0·250)	0·486	0·094	1·917	0·217
Austria	0·680 (0·298)	0·407	0·063	1·867	1·779
Belgium	0·254 (0·248)	0·052	0·062	1·627	2·450
Canada	0·777 (0·304)	0·451	0·084	1·932	2·550
Denmark	0·377 (0·245)	0·102	0·054	1·739	0·774
Finland	0·648 (0·267)	0·363	0·050	1·803	0·811
France	0·906 (0·288)	0·573	0·071	1·975	1·675
W. Germany	0·611 (0·286)	0·279	0·067	1·841	1·773
Greece	0·975 (0·423)	0·187	0·061	2·206	0·566
Ireland	0·830 (0·195)	0·832	0·050	2·077	0·806
Italy	1·125 (0·272)	0·852	0·060	1·953	1·265
Japan	1·077 (0·270)	0·999	0·085	2·094	0·815
Netherlands	0·599 (0·279)	0·332	0·066	1·936	1·268
Norway	0·473 (0·218)	0·208	0·037	2·275	0·471
N. Zealand	1·206 (0·560)	0·281	0·070	1·185	0·737
Portugal	0·568 (0·274)	0·254	0·065	1·235	0·171
Spain	0·774 (0·296)	0·408	0·082	1·788	0·032
Sweden	0·551 (0·244)	0·237	0·053	1·640	0·893
Switzerland	0·930 (0·337)	0·524	0·084	1·922	0·966
U.K.	0·534 (0·228)	0·098	0·064	1·708	0·214
U.S.	0·476 (0·261)	0·201	0·066	1·766	1·839

Note: Estimation is by 2SLS. Only lagged instruments were used in estimation. For details see the appendix.

To recapitulate, the results reported in Table 4 suggest a very significant degree of short-run accommodation of inflation differentials by exchange rate policy. Obviously there have been short periods for which particular countries did not accommodate inflation differentials (e.g. the Thatcher government in 1980–1), but these exceptions only reinforce the general tendency for accommodation identified in Table 4.

III. CONCLUSIONS

This paper has suggested that accommodation of international price shocks by the world money supply and relative price shocks by the exchange rate may have been one of the most important reasons for the persistence of inflation after the demonetisation of gold and the move to managed exchange rates. The experience of Britain in the aftermath of World War I also suggests that exchange rate accommodation can cause both inflation and deflation to persist, even if the world money supply is non-accommodative.

However, these results should be interpreted with caution. Apart from the general health warnings that apply to all econometric exercises, one should be careful not to jump to the conclusion that a restoration of the gold-standard, or some other rigid commodity standard, would necessarily be desirable on anti-inflationary grounds. The gold-standard and the gold-dollar standard of Bretton Woods may have been characterised by lack of accommodation for special reasons. This was not necessarily because the relationship between money and gold was a fixed mechanical one (see Eichengreen, 1985). It may have been because the issuer of the main international reserve that was an alternative to gold, was chiefly concerned with her gold reserves, and used monetary policy to stabilise them. For example, Eichengreen (1987) examined the behaviour of the Bank of England during the pre-1914 gold standard. His analysis suggests that since sterling was the main international reserve currency other than gold, the Bank of England stabilised international reserves when it stabilised its gold reserve. The end result was lack of monetary accommodation internationally. Similar considerations may have applied to the heyday of the Bretton Woods system, when the Federal Reserve played a similar role.[11]

In addition, a link between the world money supply and gold is not necessary for a non-accommodative international monetary system. In fact, given some of the disadvantages of the gold standard emphasised in Cooper (1982), going back to such a sytem may not be desirable. What is required for low inflation persistence is a credible commitment that price shocks will not be accommodated. This can be achieved in a number of ways. It can be achieved if each country had an independent central bank with a constitution which would in effect forbid it to accommodate price shocks. For example they could be following the celebrated Friedman (1960) $x\%$ rule, or targeting the price level. Alternatively, it could be achieved through international cooperation in a fixed exchange rates regime in which monetary policy in the main industrial economies (say the G-3) is constrained not to accommodate their average inflation rate. This could be like the symmetric system proposed by McKinnon (1984), or, alternatively, an asymmetric world system like the EMS (see

[11] A referee, an associate editor and various seminar participants have pointed out that the late 1960s and early 1970s were characterised by exogenous price and wage shocks of such ferocity and persistence that a non-accommodative Bretton Woods could not survive them. This suggests an alternative interpretation to the one offered in this paper. My own reading of the history of the period suggests that the escalation of the Vietnam War and the inflationary finance it imposed on the Federal Reserve System may have more to do with the collapse of Bretton Woods, which was in the cards since the demonetisation of gold in March 1968, in the same vein that the gold-standard effectively collapsed because of World War I.

Giavazzi and Giovannini, 1989) in which world monetary policy was determined by an anti-inflationary central bank. In either case, lack of accommodation would ensure low inflation persistence.

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APPENDIX: DATA AND ESTIMATION DETAILS

1. *Data*

The GNP historical data for the United States are from Department of Commerce, *Historical Statistics of the United States: From Colonial Times to 1970* (Government Printing Office) for the period 1870–1945, and from *Economic Report of the President* (Government Printing Office), for the period 1946–88. For the United Kingdom the sources are Feinstein C. H. (1972), *National Income, Expenditure and Output in the United Kingdom, 1855–1965* (Cambridge University Press), for the period before 1946, and from *Economic Trends, Annual Supplement* (Her Majesty's Stationery Office) for 1946–88. US data for high-powered money (which refer to end of year) are from M. Friedman and A. J. Schwartz (1970), *Monetary Statistics of the United States*, New York; Columbia University Press and NBER, and *Economic Report of the President*. UK data (Wide Monetary Base) are from F. Capie and A. Weber (1985), *A Monetary History of the United Kingdom: 1870–1982*, Volume 1, London: Allen and Unwin, and *Bank of England Quarterly Bulletin*, various issues. The historical data on the sterling/dollar exchange rate are from M. Friedman and A. J. Schwartz (1983), *Monetary Trends in the United States and the United Kingdom*, Chicago, University of Chicago Press and NBER, and HMSO, *Economic Trends, Annual Supplement.*

The post-war data for GDP deflators of the OECD Countries are from *National Accounts of OECD Countries* (OECD, Paris). The data for exchange rates (annual averages of spot rates) are from *International Financial Statistics* (IMF, Washington).

2. *Estimation*

Table 1, Table 2: The estimates of have been obtained by Ordinary Least Squares (with White's heroskedasticity consistent matrix estimator).

Table 3, Table 4: Accommodation coefficients were obtained by instrumental variables. Only lagged instruments were used.

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