IMF Working Paper

© 1999 International Monetary Fund

This is a *Working Paper* and the author(s) would welcome any comments on the present text. Citations should refer to a *Working Paper of the International Monetary Fund.* The views expressed are those of the author(s) and do not necessarily represent those of the Fund.

WP/99/67 INTERNATIONAL MONETARY FUND

Research Department

Price and Monetary Dynamics Under Alternative Exchange Rate Regimes

Prepared by Michael Bleaney*

Authorized for distribution by Donald Mathieson

May 1999

Abstract

According to theory, inflation persistence should have less variance across countries under pegged than floating exchange rates, but not necessarily a lower mean. The paper tests this prediction on postwar data for OECD countries. After allowing for the upward bias to persistence estimates created by shifts in mean inflation, the paper finds persistence has a greater spread (but not a higher mean) in the floating-rate period, as predicted by theory. Monetary growth has been much less accommodative of inflation under floating rates, most probably because of the shifts in monetary policy rather than those in exchange rate regime.

JEL Classification Numbers: E31, E50, F31, F41

Keywords: Price, exchange rates, money, inflation

Author's E-Mail Address: michael.bleaney@nottingham.ac.uk

---

*Michael Bleaney, Department of Economics, University of Nottingham, University Park, Nottingham NG7 2RD, U.K. Tel. (+44) 115-951 5464; Fax. (+44) 115-951 4159.

Content Page

I. INTRODUCTION

Does the exchange rate regime affect how the monetary authorities react to inflation shocks and consequently the persistence of those shocks? Intuitively, one would answer 'yes', in view of the powerful constraints on domestic policy actions imposed by a commitment to a fixed exchange rate. Several empirical studies have suggested that inflation has been significantly more persistent (positively serially correlated) and monetary policy more accommodative of inflation under floating exchange rates than under pegged rates (Alogoskoufis and Smith (1991), Alogoskoufis (1992), Obstfeld (1995)). The general issue was first raised by Dornbusch (1982) in the context of a country operating a linear policy rule for exchange-rate adjustment in a pegged-rate regime. Dornbusch showed that, the more that the exchange rate accommodated inflation shocks, the more persistent these shocks were.

None of these papers fully explores the theoretical dimensions of the problem. Dornbusch (1982) treats the policy rule as exogenous, and does not consider floating exchange rate regimes. Adams and Gros (1986) and Montiel and Ostry (1991) examine the implications of targeting the real exchange rate. Alogoskoufis and Smith (1991), Alogoskoufis (1992) and Obstfeld (1995) provide a purely empirical analysis of the impact of exchange-rate regimes. The first aim of the present paper is therefore theoretical. I analyze the dynamics of inflation as chosen by a government maximizing a social welfare function subject to various constraints, including one that reflects the nature of the exchange-rate system.

On the empirical level, the evidence for OECD countries is apparently rather striking. Simple regressions suggest that, under floating rates, inflation is more persistent and monetary policy is much more likely to accommodate an inflation shock. Alogoskoufis and Smith (1991) estimate first-order autoregressive coefficients for the annual change in the GDP deflator for the United States, and their point estimate is 0.27 for the period 1948–67 and 0.70 for the period 1968–87. Their results for the United Kingdom are very similar. Using data back to 1872, they find that weighted average monetary growth in the United States and the United Kingdom accommodated about half of inflation under floating rates, but did not accommodate it at all under fixed rates. Alogoskoufis (1992) extended this work on inflation persistence to 21 OECD countries. For the OECD weighted average, his results are very similar to those of Alogoskoufis and Smith. For the individual countries, he finds that persistence increased in 20 out of 21 cases, comparing 1972–87 with 1953–71. Obstfeld (1995) revisited the issue, using data for twelve OECD countries over the period 1953 to 1994. Dividing the data into 1953–72 for fixed rates and 1973–94 for floating rates, he finds that persistence increased in the later period (although not always by much) for all countries except the United States, which had particularly high persistence in the fixed rate period. Obstfeld attributes his findings to the reserve-currency role played by the United States under the Bretton Woods system.

In the second part of this paper I reanalyze the evidence for the seven major OECD countries (plus an OECD weighted average) for the period 1954–96. I show that estimates of inflation persistence are highly sensitive to shifts in mean inflation during exchange-rate regimes. Only if we ignore these shifts do we obtain results similar to those described above. If instead we regard these mean shifts as exogenous factors unaffected by the exchange-rate regime, then persistence of inflation appears to have been fairly similar under both regimes, with estimates of the first-order correlation coefficient generally in the region of 0.4 to 0.5, but with a wider spread under floating rates.

I also investigate the dynamics of monetary growth. My findings here are also at variance with previous research. I find that monetary growth was strongly accommodative of immediate past inflation in the Bretton Woods period, but has been much less so under floating rates. This finding makes sense in the light of trends in economists' thinking about monetary policy. Until the 1970s, interest rates were considered to be the principal monetary instrument and the money supply was ignored, passively adjusting upwards in response to shifts in money demand. Since then, monetary targets have become an important signal of the authorities' determination not to accommodate inflation and the money stock has been closely monitored.

II. THEORY

Alogoskoufis and Smith (1991), Alogoskoufis (1992) and Obstfeld (1995) all work with variants of the same model, which assumes overlapping contracts, with each contract having a fixed probability of being renegotiated, along the lines of Taylor (1980).[2] If each contract has a probability $1-\psi$ of renegotiation in each period, then

$$p_1 = \psi p_{t-1} + (1-\psi)x_t \qquad 0 \leq \psi \leq 1 \tag{1}$$

where x represents the level of newly contracted prices and p is the price level (all in logs). Taking first differences of (1) shows that, unless new-contract inflation (Δx) is negatively auto-correlated, aggregate inflation will be positively auto-correlated, since

$$\Delta p_t = (1-\psi)\Delta x_t + \psi(1-\psi)\Delta x_{t-1} + \psi^2(1-\psi)\Delta x_{t-2} + \ldots \tag{2}$$

Negative auto-correlation of Δx could of course easily arise if monetary policy refused to accommodate new-contract inflation. The next step is that the money supply (m) in each country (in logs) is assumed to be related to the current price level as follows:

---

[2]Dornbusch (1982) uses a slightly different version of the model in which each contract lasts for precisely two periods.

$$\Delta m = \alpha + b\Delta p \tag{3}$$

In this equation, a is interpreted as a trend which reflects output growth and is independent of current inflation, and b represents the degree to which the authorities are willing to accommodate the current level of prices. In this model, the degree of persistence of inflation (and obviously therefore of monetary growth) increases with the accommodation parameter, b (see the Appendix to Obstfeld (1995) for details). Alogoskoufis and Smith (1991), Alogoskoufis (1992) and Obstfeld (1995) all speculate that b is likely to be higher under floating rates than under fixed rates.[3] In the empirical implementation, because of lack of data on x, the procedure adopted is to estimate a first-order auto-regression for inflation, allowing the coefficients to change across exchange-rate regimes, and to estimate (3), again allowing for coefficients to change across regimes. As mentioned earlier, empirical results suggest markedly higher values of b under floating exchange rates than under fixed rates.

In order to address the theoretical issue of inflation persistence under different exchange-rate regimes, I employ a model developed from the stochastic version of the Barro-Gordon (1983) macroeconomic policy game introduced by Rogoff (1985). In the closed-economy version of the model, the government maximizes a utility function defined over inflation (π) and output (y), where Y represents equilibrium output:

$$Z = -0.5\pi^2 - 0.5b(y - Y - k)^2 \qquad b,k>0 \tag{4}$$

In this equation, b represents the relative weight attached to the output objective, whilst k is a device for introducing inflationary bias into the model. To this we add an expectations-augmented Phillips curve that is subject to stochastic shocks:

$$y = Y + \alpha(\pi - \pi^e) + \varepsilon \qquad a>0 \tag{5}$$

where ϵ is a supply-side shock which is assumed to follow the process:

$$\varepsilon_t = c\varepsilon_{t-1} + \eta_t \qquad \eta \sim N(0,(1-c^2)\sigma^2 I) \tag{6}$$

[3]The use of the word "speculate" is deliberate. These authors do not derive this prediction from their theoretical model; indeed Dornbusch makes this very point in his comments on Obstfeld's paper (Obstfeld, 1995, p. 200).

The parameter c (assumed >0) determines the degree of auto-correlation in supply-side shocks. The variance of η is chosen so that the variance of ϵ is σ^2. In the context of the model described by (4) and (5), equation (6) is a simpler way of introducing inflation persistence than through the overlapping contracts model of equation (1).

The government chooses the inflation rate in order to maximize (4), after observing the current-period shock. The private sector, however, is assumed to form its expectations before observing the current-period shock. Substituting for y from (5), differentiating (4) and setting the differential equal to zero yields the following:

$$(1 + a^2 b)\pi = a^2 b\pi^e + ab(k - \varepsilon) \tag{7}$$

Assuming rational expectations, the private sector's inflationary expectations are determined by taking the mathematical expectation of (7). Using the fact that, from (6), $E(\epsilon_t)=c\epsilon_{t-1}$, this yields

$$\pi^e_t = ab(k - c\varepsilon_{t-1}) \tag{8}$$

In other words, inflationary expectations embody information about the expected shock in time t conveyed by the observed shock in time $t-1$. Substituting from (8) back into (7) yields

$$\pi_t = ab(k - c\varepsilon_{t-1}) - [(ab)/(1 + a^2 b)]\eta. \tag{9}$$

Within the context of this model, we may define monetary accommodation as the degree to which a supply-side shock is absorbed in price rather than output fluctuations. From (9), it is evident that the anticipated component of the shock ($c\epsilon_{t-1}$) is more strongly accommodated than the unanticipated component (η_t). Since c determines the proportion of the shock which is anticipated, it follows that more persistent shocks are more strongly accommodated. Equation (9) shows that the unconditional mean of inflation is abk and, since we may write, using the fact that from (6) $c\epsilon_{t-2} = \epsilon_{t-1} - \eta_{t-1}$,

$$\pi_{t-1} = ab(k - \varepsilon_{t-1}) + ab\eta_{t-1} - [(ab)/(1 + a^2 b)]\eta_{t-1} \tag{10}$$

it follows that the covariance of π_t and π_{t-1} is given by

$$\mathrm{cov}\,(\pi_t, \pi_{t-1}) = c(ab)^2\sigma^2 \tag{11}$$

The variance of π_t is:

$$\mathrm{var}(\pi_t) = (ab)^2\sigma^2[c^2 + (1+a^2b)^{-2}\,(1-c^2)] \tag{12}$$

from which it follows that the correlation between π_t and π_{t-1} (i.e. inflation persistence) is:

$$\mathrm{corr}(\pi_t, \pi_{t-1}) = c/[c^2 + (1+a^2b)^{-2}(1-c^2)]. \tag{13}$$

This is zero when c=0, and increases with c to reach a maximum at c^2=1/[(1+a^2b)^2-1], which could be greater or less than one. Inflation persistence either increases monotonically with c, or increases with c up to this maximum, and then declines.

So far this is a model of a closed economy. The only difference from Rogoff (1985) lies in the assumption of persistence in the supply-side shock. To derive an open-economy version capable of allowing for different exchange-rate regimes, I introduce an additional term in the government's utility function that reflects the costs of deviating from the inflation rate of the foreign country which issues the reserve currency of the fixed-rate system. These costs will reflect the exchange-rate regime in operation. Thus equation (4) becomes

$$Z = -0.5\pi^2 - 0.5b(y-Y-k)^2 - 0.5h(\pi-\pi^*)^2 \qquad h \geq 0 \tag{14}$$

where π^* is the inflation rate of the reserve currency. The idea is that, under a system of pegged exchange rates, h will be large and the last term will dominate the other terms in (14), inducing the government to choose an inflation rate close to π^*. The costs of deviating from π^* will be reflected in balance of payments disequilibria and the policy adjustments required to correct them. Because of nontraded goods, transport costs etc., it is realistic to permit some deviation of π from π^* (i.e. h is not infinite). Under floating rates, there is no cost to deviating from π=π^*, since the exchange rate is free to adjust, so that h=0.

Pegged exchange rates are assumed to impose no constraints on the reserve country, which consequently chooses its inflation rate as if it were a closed economy. The parameters a, b and k are assumed common to all countries, but the crucial parameter c, which measures the persistence of shocks, differs across countries. This is a convenient way of capturing the idea that differences in institutional arrangements (e.g. the length and timing of wage contracts, or the degree of wage indexation) will affect the persistence of any inflationary shock.

Shocks are assumed to have the same variance in all countries. The reserve country is unconstrained by the pegged-rate regime and chooses its inflation rate using (9), with $c{=}c^*$ (* denotes a reserve country variable):

$$\pi^*_t = ab(k - c^*\varepsilon^*_{t-1}) - [(ab)/(1 + a^2b)]\eta^*_t \qquad (15)$$

The government of a nonreserve country chooses its inflation rate by maximizing (14), subject to (5), (6) and (15), after observing the realizations of the shock in each country. It chooses the inflation rate

$$\begin{aligned} \pi^*_t &= ab\left\{k - (1+h)^{-1}\,(c\varepsilon_{t-1} + hc^*\varepsilon^*_{t-1}) - g[(1+a^2b)\eta_t + h\eta^*_t]\right\} \\ g &= (1+a^2b)^{-1}(1+a^2b+h)^{-1} \end{aligned} \qquad (16)$$

As h tends to zero, equation (16) tends to equation (9), whilst as h tends to infinity, it tends to equation (15), and π approaches π^*. For intermediate values of h, we get a weighted average of these two solutions.

Following the same procedure as before, we find that inflation persistence is given by

$$\begin{aligned} \mathrm{corr}(\pi_t, \pi_{t-1}) &= (c + h^2c^*) \div \\ &\left\{c^2 + h^2c^{*2} + g^2(1+h)^2[(1+a^2b)^2(1-c^2) + h^2(1-c^{*2})]\right\} \end{aligned} \qquad (17)$$

This expression is effectively a weighted average of inflation persistence under floating rates and inflation persistence in the reserve country, with the weight attached to the latter increasing with the degree of exchange-rate constraint (h). It implies that a more constraining exchange-rate regime tends to reduce the variance of inflation persistence across countries, because all countries take on the inflation persistence of the reserve currency in proportion to the degree of exchange-rate constraint. It does not suggest, as previous authors have speculated, that inflation persistence is lower in more constraining regimes. The model would only predict this if the exchange-rate regime constrains the reserve currency to have low inflation persistence, or if it happened to have low inflation persistence by chance.

The model could be developed in various ways, for example by allowing more of the parameters to vary across countries. A more realistic version would replace the inflation differential in equation (14) by a term reflecting the accumulated disequilibrium in the real exchange rate. This would reduce to (14) only in the special case where the real exchange rate was at its equilibrium value in period *t-1*. It seems unlikely, however, that these more complex versions of the model would greatly modify the conclusions reached above. In the next section we turn to the empirical evidence from major OECD countries over the post-war period.

III. Empirical Findings

The analysis is based on annual observations of prices and the broad money stock for the seven major OECD countries, plus a weighted average of all industrial countries. The data source is *International Financial Statistics*. I work mostly with consumer price indices, although I also present results for the weighted-average GDP deflator, to show that the results are very similar. The first year used in the analysis is 1954, in order to ensure that results are not affected by transitional phenomena in the immediate post-war period.[4]

In the categorization of exchange-rate regimes, the European Monetary System (EMS) is a significant complication, since it is neither a pure float nor a purely fixed regime (since EMS currencies are still floating against currencies outside the system). At the world level, the EMS represents a group of linked currencies within a floating-rate system, and for this reason (like the earlier writers cited) I do not treat these currencies as having returned to a pegged-rate regime. The empirical results do not suggest that the inflationary experience of these currencies was markedly different from others'.

A. Simple Estimates of Inflation Persistence

A first-order autoregression of inflation for each exchange-rate regime generates simple estimates of persistence of the type estimated by previous authors. The top half of Table 1 presents such estimates for the seven major OECD countries for 1954–72 and 1973–96 (for France, dummies are included for the years 1958 and 1959, since without them the inflation spike associated with the devaluation of 1958 severely depresses estimated inflation persistence).[5] The mean point estimate of persistence for the seven countries is 0.63 for 1954–72 and 0.82 for 1973–96, with standard deviations of 0.12 and 0.07 respectively. These results apparently confirm the findings of previous authors and refute the theory of the

---

[4]More frequent observations (monthly or quarterly) are available for most of the period, but it is not clear that it would be advantageous to use them. With higher-frequency observations, measurement error problems would be magnified, since the one-period changes would be smaller. Using annual data also preserves consistency with previous research.

[5]Inflation rose to 15 percent in 1958 and then fell back to 6 percent in 1959. Without the dummy variables inflation persistence is estimated to be close to zero for France in the Bretton Woods period.

previous section about the international dispersion of inflation persistence. I argue below, however, that these estimates are distorted by shifts in mean inflation within exchange rate regimes and that, once these shifts are allowed for, these results are turned on their head.

The bottom half of Table 1 examines the implications of the view that the Bretton Woods system was never quite the same after the sterling devaluation of November 1967, which marked the beginning of an era of large U.S. current account deficits, increasing wage militancy in Europe and rising speculative flows across the exchanges were creating pressures to adjust exchange rates more frequently. Reallocating the years 1968–72 to the floating-rate period makes very little difference to persistence estimates under floating rates, but dramatically reduces them for fixed rates, from an average of 0.63 to 0.44 for the individual countries, but from 0.81 to 0.52 for weighted-average consumer price inflation, and by an even larger amount for the weighted-average GDP deflator. The sensitivity of the estimates to the reallocation of just five years is an indication that the persistence estimates in the top half of Table 1 may not be robust.

B. Allowing for Shifts in Mean

Why should shifting five years out of 43 from one exchange-rate regime to the other make so much difference to estimated rates of persistence under the Bretton Woods system? I shall demonstrate that this is the result of ignoring shifts in mean inflation rates *during* exchange-rate regimes. The argument is easily demonstrated graphically. A crude graphical indicator of persistence is the number of occasions on which the inflation rate crosses the estimated regime mean. The fewer the number of mean-crossings, the greater will be the estimate of persistence. Figure 1 shows weighted average consumer price inflation for the industrial countries. In Figure 1a, the estimated mean inflation rates for the regimes 1954–72 and 1973–96 are shown, on the assumption of a constant mean for each exchange-rate regime. There are only six mean-crossings in the 43 years, and five of these occur in the fixed-rate period. In Figure 1b, by contrast, I allow for one shift of mean in the Bretton Woods period (splitting it into 1954–67 and 1968–72) and two in the floating-rate period (1973–83, 1984–92 and 1993–96). Allowing for these shifts in mean raises the number of mean-crossings from six to 18, which suggests much lower persistence.

The problem of the negative correlation between the assumed number of mean shifts and the estimate of persistence is analogous to that of structural breaks and unit root tests discussed by Perron (1989). Previous researchers have allowed for a mean shift only at the date of transition to floating rates. This is a by-product of their estimation procedure rather than the outcome of any consideration of the probable number of mean shifts in the data. Formal tests support the idea of at least two regime shifts in the post-war inflationary process, if not more (Bleaney, 1997; Evans and Wachtel, 1993; Ricketts and Rose, 1995). I have chosen to assume that mean shifts which appear to be "in the data" are genuine. Of these, I believe the shifts at the beginning and end of the oil-shock period (1973–82) to be uncontentious. The shifts at the end of 1967 and 1992 are more open to debate. In defense of

Figure 1a. Inflation 1954-96

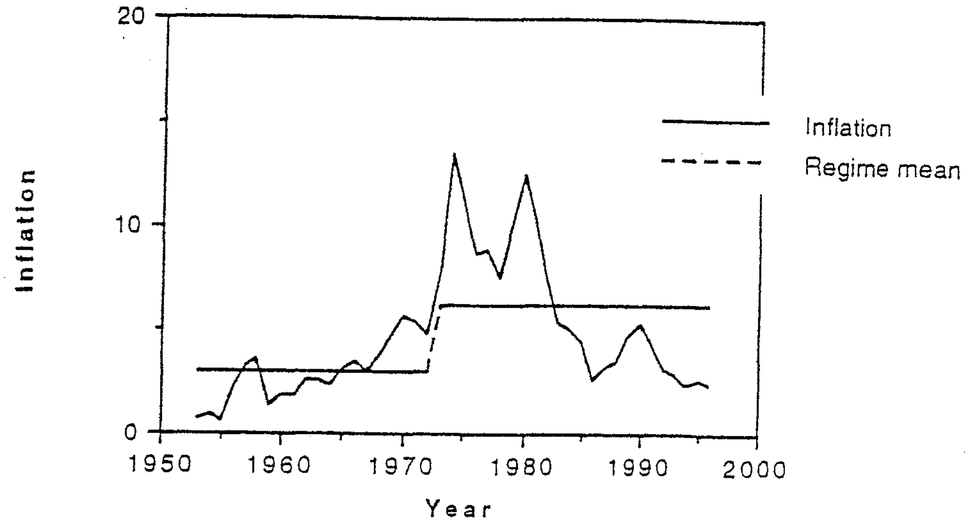
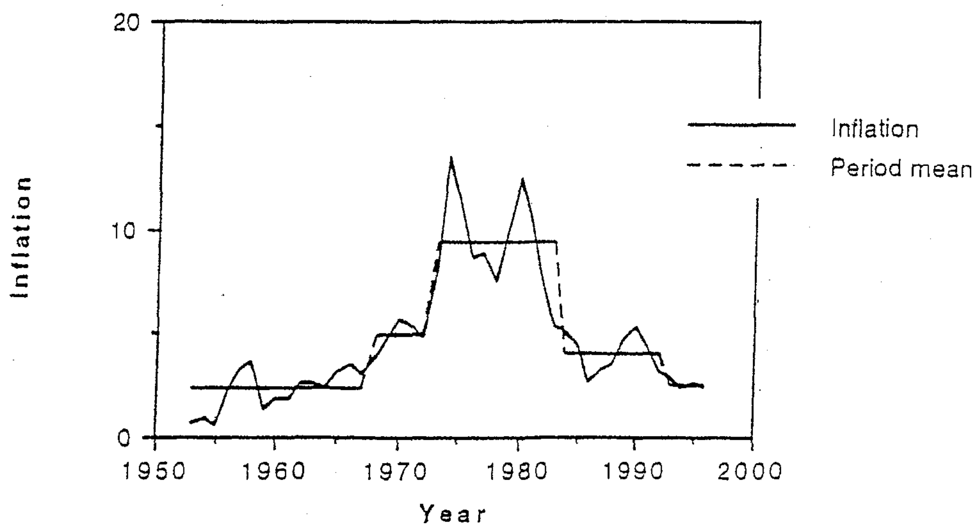


Fig. 1b. Inflation with mean shifts



the former, I would argue (a) that inflation in every year of 1968–72 exceeded the maximum rate observed in 1954–67, and (b) that long-term interest rates shifted upwards by a similar amount, indicating that the financial markets perceived a shift in mean. My argument in defense of a mean shift at the end of 1992 is very similar. Inflation has been under 3 percent p.a. since 1993, and there is a widespread perception of a regime change associated with greater emphasis on inflation targets and central bank independence and more labor market flexibility in many countries. Long bond yields have also shifted markedly downwards since 1993, although latterly a fall in real interest rates may have contributed to this. These points are indicative rather than decisive; I now proceed to demonstrate, however, that the resulting estimates of persistence are more robust than those in Table 1.

Table 2 presents point estimates of persistence allowing for the shifts in mean shown in Figure 1b. Three features stand out. First, estimated inflation persistence rates are much lower than in the top half of Table 1 (very few of the estimates exceed 0.6). The second point is that there is now no systematic difference between the fixed-rate and floating-rate periods. In both cases estimates of inflation persistence center around the range 0.4–0.5. Thirdly, the exact choice of date for the transition from fixed to floating rates no longer has much effect on the results, which indicates that the conclusions are much more robust. Finally, the dispersion of persistence estimates for the individual countries is now rather lower for the fixed-rate than for the floating-rate period, which is consistent with the predictions of the model developed in the previous section.

It might be argued that estimates of persistence in the floating-rate period have been depressed by "spikes" in the inflation process created by the sudden rises in oil prices in 1973 and 1979. To allow for this effect, Table 3 shows estimates of persistence with the oil-shock period (1973–83) separated from the rest of the floating-rate period. The table shows that there is no clear tendency for persistence to be lower in the oil-shock period. Comparing Table 3 with Table 2, persistence estimates for the floating-rate period are raised for four countries (Japan, France, Germany and Italy) and reduced for three (the United States, Canada and the United Kingdom). Using the weighted average, persistence estimates rise for consumer prices but fall for the GDP deflator. It seems that the "spike" effect of oil price shocks is not distorting the estimates of persistence shown in Table 2.

C. Monetary Accommodation and Persistence

I turn now to monetary growth. Alogoskoufis and Smith (1991) and Alogoskoufis (1992) estimate monetary accommodation of inflation by regressing monetary growth on current inflation, using instrumental variables to account for endogeneity. Using over a century of data and estimating world money supply as a weighted average of the United States and the United Kingdom, they find that monetary accommodation was significant under floating rates, but zero under fixed rates. In replicating this exercise for post-war data, I develop the model slightly by specifying monetary growth as a function of both inflation and monetary growth in the previous year—in other words, I allow for both accommodation of inflation and persistence in monetary growth simultaneously. The reason for this is that financial innovation has shifted the demand function over time, and the gradual spread of financial innovations, as they occur, creates some serial correlation in monetary growth. This is particularly the case when the industrial countries' average is used, since these financial innovations may have been implemented at different dates in different countries. I use the industrial countries' average because the effects of changes in definition, which have affected the series for quite a few of the individual countries, are smoothed by averaging over many countries. I also present results for the United States to show that the findings are replicated for individual countries. I find that entering lagged rather than current inflation in the regression yields a better fit (without altering the conclusions in any substantive way), and this permits the use of OLS.

The results are shown in Table 4. Regressions (1) and (2) refer to the weighted average growth rate of money plus quasi-money for the industrial countries, and regression (3) refers to the United States only. In regression (1), the dummies for changes in mean are included, but they are all insignificant, and regression (2) omits them. The other parameters are little affected by the inclusion of the dummies. The results are striking. Monetary persistence is high in both exchange-rate regimes. Accommodation of inflation, however, is estimated to be very high (approximately 90 percent) under the Bretton Woods system, but negligible since 1968. Regression (3) shows that a very similar picture emerges using United States data, the single difference being that in this case the estimated accommodation of inflation is still approximately 0.5 after 1973.

These results dramatically contradict those of Alogoskoufis and Smith (1991). They are, however, quite logical if one considers the history of monetary theory. There was a decisive shift during the 1970s from an emphasis on interest rates to an emphasis on the money supply as the appropriate indicator of monetary stance. The shift reflected a belated recognition of the impact of inflationary expectations on the demand for money at any given nominal interest rate, and also of the need for the authorities to signal their determination not to accommodate inflation. The issues were well put by the international panel of experts appointed by the OECD in 1975. They wrote (OECD, 1977, p.120):

"It seems likely that some of the problems of monetary policy reflect increasing inadequacies in the use of interest rates as indicators . . . [U]p to the early 1970s, monetary authorities themselves placed considerable—and increasingly unjustified—reliance on interest rates as an indicator of monetary policy. In this respect the roles both of price expectations and of income- and wealth-related demand for money as determinants of interest rates were insufficiently recognized. Subsequently of course, central banks have begun to pay greater attention to monetary aggregates."

This suggests that the results of Table 4 should be interpreted in terms of shifts in monetary policy rather than in exchange-rate regime.

IV. CONCLUSIONS

The constraints imposed by pegging the exchange rate have the effect of making inflation in all countries reflect the dynamics of inflation in the reserve currency. This only reduces inflation persistence if persistence is particularly low in the reserve country, or if the exchange-rate regime constrains the reserve country to have low persistence. It is not clear that either of these last two conditions held under the Bretton Woods system. In the general case, theory predicts that persistence will have a greater cross-country spread under floating than under pegged exchange rates. Empirical tests of this hypothesis are complicated by significant shifts in mean inflation which were not controlled for in previous research. Once mean-shifts are allowed for, inflation persistence appears to be in the region of 0.4 to 0.5, irrespective of exchange-rate regime, and to have greater cross-country dispersion under floating rates, as predicted by theory. By contrast, monetary growth has become much less accommodating of inflation over time. This is consistent with developments in the theory of monetary policy, with a shift in emphasis from interest rates to monetary targets, and almost certainly has nothing to do with the exchange-rate regime.

Table 1. Simple Estimates of Inflation Persistence According to Exchange-rate Regime

Annual consumer price inflation 1954–96—estimates of first-order auto-correlation

Country	**Fixed rates 1954–72**	**Floating rates 1973–96**
United States	0.79	0.76
Canada	0.74	0.86
Japan	0.48	0.72
United Kingdom	0.73	0.77
France	0.51	0.92
Germany	0.67	0.82
Italy	0.55	0.86
Mean of the above	*0.63*	*0.82*
Standard deviation of the above	*0.12*	*0.07*
Weighted average of industrial countries		
Consumer price inflation	0.81	0.85
GDP deflator inflation	0.91	0.92
Money + quasi-money growth*	0.82	0.79

With Alternative Dating of Regime Change

Country	**Fixed rates 1954–67**	**Floating rates 1968–96**
United States	0.52	0.76
Canada	0.64	0.85
Japan	0.43	0.72
United Kingdom	0.25	0.75
France	0.30	0.90
Germany	0.43	0.81
Italy	0.48	0.86
Mean of the above	*0.44*	*0.81*
Standard deviation of the above	*0.13*	*0.07*
Weighted average of industrial countries		
Consumer price inflation	0.52	0.84
GDP deflator inflation	0.40	0.90
Money + quasi-money growth*	0.73	0.76

Notes: Point estimates from the OLS regression $\pi_t = b_0 + b_1 D + b_2 \pi_{t-1} + b_3 D \pi_{t-1}$, where D=1 for floating exchange rates and D=0 for fixed rates. Estimates for France include dummies for the years 1958 and 1959. *Estimation up to 1992 only.

Table 2. Estimates of Inflation Persistence Allowing for Mean Shifts in Inflation

Annual consumer price inflation 1954–96—estimates of first-order auto-correlation

Country	**Fixed rates 1954–72**	**Floating rates 1973–96**
United States	0.44	0.43
Canada	0.56	0.12
Japan	0.41	0.51
United Kingdom	0.35	0.41
France	0.51	0.44
Germany	0.59	0.73
Italy	0.55	0.35
Mean of the above	*0.50*	*0.43*
Standard deviation of the above	*0.09*	*0.18*
Weighted average of industrial countries		
Consumer price inflation	0.50	0.31
GDP deflator inflation	0.47	0.47
Money + quasi-money growth*	0.65	0.55

With Alternative Dating of Regime Changes

Country	**Fixed rates 1954–67**	**Floating rates 1968–96**
United States	0.52	0.42
Canada	0.64	0.10
Japan	0.43	0.50
United Kingdom	0.25	0.41
France	0.30	0.43
Germany	0.43	0.79
Italy	0.48	0.37
Mean of the above	*0.44*	*0.43*
Standard deviation of the above	*0.13*	*0.20*
Weighted average of industrial countries		
Consumer price inflation	0.52	0.32
GDP deflator inflation	0.40	0.48
Money + quasi-money growth*	0.73	0.52

Notes: Point estimates from the OLS regression $\pi_t = b_0 + b_1 D + b_2 \pi_{t-1} + b_3 D \pi_{t-1}$ + I-intercept dummies for 1968–72, 1973–83 and 1993–96, where D=1 for floating exchange rates and D=0 for fixed rates. Estimates for France include dummies for the years 1958 and 1959.
*Estimation up to 1992 only.

Table 3. Estimates of Inflation Persistence Allowing for Oil Shock Effects

Annual consumer price inflation 1954–96—estimates of first-order auto-correlation

Country	**Fixed 1954-72**	**Floating 1984-96**	**Oil shock 1973-83**
United States	0.44	0.27	0.45
Canada	0.56	-0.63	0.21
Japan	0.41	0.59	0.51
United Kingdom	0.35	0.31	0.42
France	0.51	0.61	0.31
Germany	0.59	0.81	0.64
Italy	0.55	0.55	0.27
Weighted average of industrial countries			
Consumer price inflation	0.50	0.44	0.29
GDP deflator inflation	0.47	0.18	0.46
Money + quasi-money growth*	0.65	0.55	0.54

With Alternative Dating of Regime Change

Country	**Fixed 1954-67**	**Floating 1968-96**	**Oil shock 1973-83**
United States	0.52	0.26	0.45
Canada	0.64	-0.57	0.21
Japan	0.43	0.38	0.51
United Kingdom	0.25	0.36	0.42
France	0.30	0.57	0.31
Germany	0.43	0.88	0.64
Italy	0.48	0.59	0.26
Weighted average of industrial countries			
Consumer price inflation	0.52	0.45	0.29
GDP deflator inflation	0.40	0.38	0.46
Money + quasi-money growth*	0.73	0.51	0.54

Notes: Point estimates from the OLS regression $\pi_t = b_0 + b_1 D + b_2 \pi_{t-1} + b_3 D \pi_{t-1} + b_4 OIL + b_5 OIL \pi_{t-1}$ + intercept dummies for 1968–72 and 1993–96, where D=1 for floating exchange rates and D=0 for fixed rates, and OIL=1 in 1973-83 and zero otherwise. Estimates for France include dummies for the years 1958 and 1959. *Estimation up to 1992 only.

Table 4. Monetary Accommodation and Persistence 1956–95

Dependent variable: annual percentage growth in money plus quasi-money (Δm_t)

Regression:	Weighted average of industrial countries¤ **(1)**	**(2)**	United States **(3)**
Independent variables:			
Constant	1.55	1.04	0.574
	(0.85)	(0.97)	(0.61)
Δm_{t-1}	0.552	0.597*	0.564*
	(2.56)	(3.44)	(3.08)
(Dummy 1973-96) * Δm_{t-1}	0.008	0.070	−0.059
	(0.03)	(0.41)	(_0.30)
π_{t-1}	0.886	0.938	0.945
	(1.82)	(2.57)	(2.72)
(Dummy 1973-96) * π_{t-1}	−0.837	−0.695	−0.439
	(−1.55)	(−1.81)	(−1.21)
Dummy 1968-72	0.841		
	(0.29)		
Dummy 1973-96	0.168		
	(0.12)		
Dummy 1973-83	1.90		
	(1.07)		
No. of observations	37	37	40
R-squared	0.681	0.666	0.616
Standard error	1.78	1.73	2.37
Serial correlation (SC)	0.09	1.56	0.06
Functional form (FF)	0.00	0.05	0.18
Normality of residuals (N)	0.53	0.48	0.83
Heteroscedasticity (H)	0.35	0.17	0.31

Notes: Figures in parentheses are *t*-statistics. ¤denotes estimation up to 1992 only. *denotes significant at the 1 percent level. Diagnostic statistics are defined as follows: *SC* – Lagrange multiplier test for first-order serial correlation (χ^2_1); *FF* – test for functional form based on correlation of residuals with the squared dependent variable (χ^2_1); *N* – Jarque-Bera statistic for normality of residuals (χ^2_2); *H* – test for heteroscedasticity based on correlation between fitted values and squared residuals (χ^2_1).

REFERENCES

Adams, C., and D. Gros, 1986, "Consequences of Real Exchange Rate Rules for Inflation," *Staff Papers*, International Monetary Fund, Vol. 33, pp. 439–76.

Alogoskoufis, G.S., 1992, "Monetary Accommodation, Exchange Rate Regimes and Inflation Persistence," *Economic Journal*, Vol. 102, pp. 461–80.

Alogoskoufis, G.S., and R.P. Smith, 1991, "The Phillips Curve, the Persistence of Inflation, and the Lucas Critique," *American Economic Review*, Vol. 81, pp. 1254–75.

Barro, R.J., and D.B. Gordon, 1983, "A Positive Theory of Monetary Policy in a Natural-rate Model," *Journal of Political Economy*, Vol. 91, pp. 589–610.

Bleaney, M.F., 1997, "Can Switching Between Inflationary Regimes Explain Fluctuations in Real Interest Rates?" IMF Working Paper 97/131 (Washington: International Monetary Fund).

Dornbusch, R., 1982, "PPP Exchange Rate Rules and Macroeconomic Stability," *Journal of Political Economy*, Vol. 90, pp. 158–65.

Evans, M.D.D., and P. Wachtel, 1993, "Inflation Regimes and the Sources of Inflation Uncertainty," *Journal of Money, Credit and Banking*, Vol. 25, pp. 475–520.

Montiel, P.J., and J. Ostry, 1991, "Macro Implications of Real Exchange Rate Targeting in Developing Countries," *Staff Papers*, International Monetary Fund, Vol. 38, pp. 872–900.

Obstfeld, M., 1995, "International Currency Experience: New Lessons and Lessons Relearned," *Brookings Papers on Economic Activity*, Vol. 1, pp. 119–220.

OECD, 1977, *Towards Full Employment and Price Stability*, Paris: OECD.

Perron, P., 1989, "The Great Crash, the Oil Shock, and the Unit Root Hypothesis," *Econometrica*, Vol. 57, pp. 1361–401.

Ricketts, N. and D. Rose, 1995, "Inflation, Learning and Monetary Policy Tegimes in the G-7 Economies," *Working Paper* no. 95/6 (Ottawa: Bank of Canada).

Rogoff, K., 1985, "The Optimal Degree of Commitment to a Monetary Target," *Quarterly Journal of Economics*, Vol. 100, pp. 1169–90.

Taylor, J.B., 1980, "Aggregate Dynamics and Staggered Contracts," *Journal of Political Economy*, Vol. 88, pp. 1–23.