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THE INTERNATIONAL MONETARY SYSTEM

An Analysis of Alternative Regimes

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This is an exercise in the positive economics of alternative monetary regimes. The behavior of output and prices is compared using a stochastic specification which allows asymptotic variances to be obtained without difficulty. Free floating of exchange rates together with national money supply targets is analyzed first, with and without the presence of 'fads' in the exchange rate. Two alternatives for monetary coordination are then considered. First is McKinnon's proposal to fix nominal exchange rates and stabilize aggregate monetary growth (or average inflation); second is Williamson's system of target zones for stable real exchange rates, complemented by nominal income targets for fiscal policy.

1. Introduction

At the beginning of the 1970s the OECD countries were on a de facto Dollar Standard, in which the U.S. selected its monetary policy with a view to domestic stability and other countries pegged to the dollar, with the right to change the peg at their unilateral discretion. By 1973, however, the Dollar Standard had collapsed, giving way to a regime of floating exchange rates coupled with national money supply targets, a regime long advocated by Milton Friedman [see for example, his influential papers on flexible exchange rates (1953) and monetary targets (1968)].

Since the Plaza Agreement of September 1985, however, the U.S.A. has made the external value of the dollar an explicit target of policy. The coordination of international macroeconomic policies has been sought in order to help secure a reduction of its external deficit. These developments prompt two questions – first, is a change in the international monetary

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system really called for rather than simply a change in, for example, U.S. fiscal policy; and, second, if so, what are the alternatives?

It is not the purpose of the present paper to debate the first question with those who maintain 'if it ain't broke, don't fix it', as the case for reform of the system has been developed in some detail elsewhere [see Williamson (1985)]. What we offer instead, on the second question, is a simple exercise in positive economics in which the floating rate regime of 1973–85 is compared with alternatives.

The alternatives considered are indicated in table 1, which classifies monetary systems on two criteria, whether they are hegemonic or not, and how exchange rates are determined. Thus the international system prevailing from 1973 to 1985 appearing in the first column is classified as 'symmetric', in contrast to the hegemony under the Dollar Standard, which appears in the second row of the second column.

The focus of this paper is on regimes *without* hegemony. The alternatives to floating with monetary targets that are considered are, first, McKinnon's proposals for fixed exchange rates, and, second, Williamson's system of target zones for real exchange rates.

McKinnon's proposal of 1984 was designed both to ensure symmetry in the operation of the international monetary system and to put the control of inflation on an explicitly monetarist footing. The plan was to have three key-currency members (U.S.A., Germany and Japan) agree a target for their *combined* monetary growth, which was to be pursued under fixed exchange rates by national DCE targets and symmetrical non-sterilised intervention. McKinnon's confidence that the variations of velocity observed at the national level were due to currency substitution and so would cancel out at the global level (and be adequately neutralised by the intervention policy) was challenged ex ante [Dornbusch (1983)] and has also been eroded by subsequent experience. As a result McKinnon has, in a later version of his proposal (1986), shifted to the 'classical' position that monetary policy at the global level should aim directly at price stability, rather than at the control

Table 1
International monetary systems compared.

	Floating rates with national money supply targets	Fixed exchange rates	Managed exchange rates
Symmetry	OECD 1973–85	McKinnon's proposals	Williamson's target zones
Hegemony	—	Dollar standard 1968–73	EMS 1979–

of a monetary aggregate. McKinnon has thus addressed two issues arising under fixed exchange rates, how to make the determination of monetary policy more symmetric and subsequently how to cope with the observed instability in the demand for money.

Under neither of McKinnon's proposals do the mechanisms which keep inflation at bay at a national level involve control of a *domestic* monetary aggregate. In the absence of portfolio shocks monetary policy will require keeping interest rates in line with those elsewhere (and controlling domestic credit expansion in the first case). The mechanisms are rather the longer run effect on expectations of belonging to such a currency union, together with the immediate impact of union wide interest rates, and more directly the impact on trade and employment of allowing prices to rise relative to those in partner countries. With nominal exchange rates fixed, inflation differentials will change real exchange rates in ways which shift demand from inflationary countries towards non-inflationary countries (while the level of the 'global' interest rate will act so as to stabilise inflation in the union as a whole).

Under the regime of floating-with-money-supply-targets the experience of the U.S. and the U.K. was not that the nominal exchange rate simply adjusted to offset inflationary differentials so as to keep real exchange rates fairly stable (as Friedman had implied would be the case) but that real exchange rates showed prolonged deviations frrom equilibrium ('misalignments'). It is this feature that *Williamson's target zones* are designed to remedy: on the assumption that fiscal policy is not allowed to crowd out the desired (high employment) balance of payments, domestic interest rates (and foreign currency intervention) are to be aimed at keeping the real exchange rate within a band of $\pm 10\%$ of the equilibrium level implied by the balance of payments target.

Williamson's plan resembles McKinnon's proposal in assigning domestic monetary policy to an external objective; in this case, however, the requirement to stabilise the real exchange rate will in the absence of portfolio shocks require *real* interest rates to be kept reasonably in line with those in partner countries. This policy assignment has been severely criticised by Adams and Gros (1986) for leaving domestic inflation out of control. As we show below, however, the combination of assigning monetary policy to this external objective and fiscal policy to a domestic money income target is not open to this criticism – indeed, at a formal level, the mechanism for checking domestic inflation resembles that which operates under the McKinnon plan.

At a global level there is a good deal in common between the Williamson and McKinnon plans. Whereas McKinnon proposed that 'global' interest rates be set so as to stabilise aggregate money or aggregate prices, the proposal in Edison, Miller and Williamson (1987) is that nominal income be the target.

Since 1979 Germany, Italy, France, the Benelux countries and Denmark

have created a regional monetary system (EMS) with agreed nominal parities, which have, however, been adjusted ex post to accommodate most of the inflation differentials emerging between them. It has recently been argued by Giavazzi and Giovannini (1987) that the EMS is in effect a regional currency standard, a hegemony led by Germany, with limited independence permitted by extensive capital controls in France and Italy, so it is entered in the second row of table 1. The EMS, as such, is not analysed in this paper, because it is not symmetric.

2. The framework of analysis

The formal framework used to assess alternative proposals is a simple two bloc model with goods prices which adjust more slowly than the exchange rate which is determined by rational expectations in the foreign exchange market [cf. Dornbusch (1976)]. Inflation expectations are captured simply by augmenting the Phillips curve by terms measuring long-run inflation under the regime in question [cf. Buiter and Miller (1981)]. The formal analysis of the two country, floating rate case is essentially that developed in Miller (1982) to which 'fads', as Poterba and Summers (1987) describe them, have been added, while treatment of the fixed rate case is derived from Buiter (1986). The stochastic specification closely follows recent contributions by Fukuda and Hamada (1986) and Aoki (1987), and we are grateful to have had access to the PRISM package developed by David Currie and his colleagues for the stochastic analysis.

In this paper we make use of asymptotic or steady-state variances (obtained under the assumption of rational expectations) to study the performance of monetary and fiscal policy rules without falling foul of the Lucas critique, as advocated by John Taylor (1985) in an earlier issue of this *Review*. For a comprehensive stochastic treatment of various monetary policy rules – chosen optimally but subject to a 'time consistency' constraint – the reader is referred to McKibbin and Sachs (1986).

The equations which constitute the model are listed in detail in table 2, and the notation is given in table 3. The structure is doubtless familiar so it can be quickly summarised. First comes the condition for money market equilibrium (the LM curves) which are subject to stochastic serially uncorrelated disturbances $\varepsilon_m, \varepsilon_m^*$ (asterisks are used to denote variables involving the foreign country). Output in each country depends on the ex ante real interest rate, the real exchange rate, fiscal stance, output overseas and a stochastic shock $(\varepsilon_g, \varepsilon_g^*)$. As shown in the third line, inflation reflects domestic demand pressure and also long run inflation expectations under the regime in question (represented by the term π). The inflation process is also subject to white noise $\varepsilon_p, \varepsilon_p^*$.

The specification of the foreign currency arbitrage condition contains a novelty as the usual assumption of 'uncovered interest parity' is modified so

Table 2
Model equations.[a]

Home country	*Foreign country*
Money $m-p=ky-\lambda i+\varepsilon_m$	$m^*-p^*=ky^*-\lambda i^*+\varepsilon_m^*$
Goods $y=-\gamma E[r]+\delta c+s+\eta y^*+\varepsilon_g$	$y^*=-\gamma E[r^*]-\delta c+s^*+\eta y+\varepsilon_g^*$
Prices $Dp=\phi y+\pi+\varepsilon_p$	$Dp^*=\phi y^*+\pi^*+\varepsilon_p^*$
Currency arbitrage $E[De]=i-i^*+E[Df]$	
Poterba/Summers fad $Df=-\psi f+\omega$, where	
$r=i-Dp$	$r^*=i^*-Dp^*$
$E[r]=i-\phi y-\pi$	$E[r^*]=i^*-\phi y^*-\pi^*$
$c=e+p^*-p$	

[a]Strictly speaking solutions of stochastic differential equations have no derivatives so the use of the differential operators is inadmissable. Nevertheless for linear systems with constant coefficients, asymptotic moments can be obtained by treating the system as if it were continuously differentiable [see, for example, Jazwinsky (1970, Chapter 4)].

that expected changes in the nominal exchange rate are set equal to the interest differential plus the change in an exogenous, autoregressive 'fad'. The idea comes fromn Poterba and Summers (1987) who show that the existence of such 'fads' is consistent with the behaviour of U.S. stock prices. Adding such a 'coloured noise' process to the arbitrage equation violates the usual assumption of market efficiency – but, as Poterba and Summers also show, the tests used (successfully) to establish market efficiency have very low power against such fads.

Since the parameters in each country are identical, the dynamic (and stochastic) analysis can be conducted separately in terms of 'averages' and 'differences' [cf. Aoki (1981)]. The global economy (averages) looks like a closed economy, see table 3(a), and does not involve the exchange rate. The latter is determined only by the system of differences given in table 3(b). While it may seem rather contrived to work in terms of these artificial variables, the gain in analytical simplification makes it worthwhile. We look first at the global economy (in the next section) before going on to examine the determination of exchange rates, inflation, etc. under the three alternative regimes.

3. The global economy

Thanks to the assumption of symmetry, the analysis of global aggregates is very straightforward. The focus here is on the different nominal targets

Table 3

(*a*) *Global economy*

Money	$m_a - p_a = ky_a - \lambda i_a + \bar{\varepsilon}_m$
	$\Rightarrow i_a = \lambda^{-1}(p_a + k_{ya} + \bar{\varepsilon}_m - m_a)$
Goods	$y_a = -\gamma(i_a - \phi y_a - \pi_a) + s_a + \eta y_a + \bar{\varepsilon}_g$
Prices	$Dp_a = \phi y_a + \pi_a + \bar{\varepsilon}_p$
with notation	$y_a \equiv \frac{y + y^*}{2}$ for variables and $\bar{\varepsilon}_m \equiv \frac{\varepsilon_m + \varepsilon_m^*}{2}$ for stochastic shocks

(*b*) *International differences*

Money	$m_d - p_d = ky_d - \lambda i_d + \hat{\varepsilon}_m$
Goods	$y_d = -\gamma E[r_d] + 2\delta c + sd - \eta y_d + \hat{\varepsilon}_g$
Prices	$Dp_d = \phi y_d + \pi_d + \hat{\varepsilon}_p$
Arbitrage	$E[De] = i_d - \psi f$
Fad	$Df = -\psi f + \omega$
where	$E[r_d] = i_d - E[Dp_d] = i_d - \phi y_d - \pi_d$
	$c = e - p_d$
with notation	$y_d \equiv y - y^*$ for variables and $\hat{\varepsilon}_m = \varepsilon_m - \varepsilon_m^*$ for stochastic shocks.

Notation

y	real output, measured relative to capacity (in logs)
i	short term nominal interest rate
$E[r]$	ex ante short term real interest rate, $i - E[Dp]$
r	ex post real interest rate, $i - Dp$
c	real exchange rate in logs, $(e + p^* - p)$: increase indicates higher competitiveness for home country
s	index of fiscal stance, scaled to have unit effect on log output
p	domestic price index, in logs
m	money supply, in logs
n	nominal income target, in logs
π	'augmentation' term systematically affecting price changes
f	'fad' [see Poterba and Summers (1987)]
ε, ω	white Gaussian noise process; $N(O, \sigma_\varepsilon^2)$, $N(O, \sigma_\omega^2)$ respectively
Dp	inflation
D	differential operator

proposed as guidelines for world monetary policy, starting with the world *money supply target* m_a, growing at the rate μ_a (McKinnon).

Substituting world interest rates i_a from the first line of table 3(a) into the world IS curve of line two we obtain

$$y_a=\frac{1}{\Delta_a}(-\gamma\lambda^{-1}p_a+\gamma\lambda^{-1}m_a+\gamma\mu_a+s_a-\gamma\lambda^{-1}\bar{\varepsilon}_m+\bar{\varepsilon}_g), \tag{1}$$

where $\Delta_a=1+\gamma\lambda^{-1}k-\phi\lambda-\eta$, and π_a has been set equal to μ_a as in Buiter and Miller (1981), i.e., the inflation process is

$$Dp_a=\phi y_a+\mu_a+\bar{\varepsilon}_p. \tag{2}$$

To simplify matters a little we set $m_a=\mu_a=s_a=0$, i.e., the world money stock is fixed and fiscal policy 'neutral', so output is determined only by prices and aggregate shocks to velocity and demand, as shown in the top row of table 4. On combining this with the inflation process (2), the asymptotic or unconditional variance of price is determined (see annex 1) as,

$$\sigma^2_{p_a}=\frac{1}{2|\rho_s|}\left\{\rho_s^2\sigma^2_{\bar{\varepsilon}_m}+\left(\frac{\phi}{\Delta_a}\right)^2\sigma^2_{\bar{\varepsilon}_g}+\sigma^2_{\bar{\varepsilon}_p}\right\}, \tag{3}$$

given that the shocks are independent. The speed of adjustment, ρ_s, appearing here is found from table 4, column 2. Note that the variance of price includes the variance of velocity multiplied by half this speed of adjustment.

The results so obtained for a money supply target are easily modified to reflect a change of target variable. For convenience we assume that the McKinnon price level target is for *stable* prices and Williamson's is for *stable* nominal income – and take the growth of potential GNP to be zero. Now the rules for interest rate setting involved in pursuing these targets can be written as simplified versions of the inverted LM curve used above; specifically McKinnon II: $i_a=\beta_M p_a$, i.e., $k=0$, $\lambda^{-1}=\beta_M$ and $\sigma^2_{\bar{\varepsilon}_m}$ is omitted, and Williamson: $i_a=\beta_w(p_a+y_a)$, i.e., $k=1$, $\lambda^{-1}=\beta_w$ and $\sigma^2_{\bar{\varepsilon}_m}$ is omitted.

These parameter substitutions will alter the speed of adjustment and the term Δ_a appearing in eq. (3), but one can see that both these rules, like McKinnon's monetarist rule, involve a feedback of interest rates on the price level (the integral of past inflation). But they omit the 'noise' caused by using money supply targets to achieve this feedback (as $\sigma^2_{\bar{\varepsilon}_m}$ is omitted).

Table 4
Determinants of output (y) and the speed of adjustment (ρ_s).[a]

	Output	Speed of adjusment
Averages		
Global economy	$y_a=\frac{1}{\Delta_a}(-\gamma\lambda^{-1}p_a-\gamma\lambda^{-1}\bar{\varepsilon}_m+\bar{\varepsilon}_g)$	$\rho_s=-\phi\gamma\lambda^{-1}/\Delta_a$ $\Delta_a=1+\gamma\lambda^{-1}k-\phi\gamma-\eta$
Differences		
1. Floating with money targets	$y_d=\frac{1}{\Delta_1}(-(\gamma\lambda^{-1}+2\delta\theta)p_d-\gamma\lambda^{-1}\hat{\varepsilon}_m+\hat{\varepsilon}_g)$	$\rho_s=\phi(\gamma\lambda^{-1}+2\delta\theta)/\Delta_1$ $\Delta_1=1+\gamma\lambda^{-1}k-\phi\gamma+\eta$
2. McKinnon	$y_d=\frac{1}{\Delta_2}(-2\delta p_d+\hat{\varepsilon}_g)$	$\rho_s=-\phi 2\delta/\Delta$ $\Delta_2=1-\phi\gamma+\eta$
2a. McKinnon with fiscal activism	$y_d=\frac{1}{\Delta_{2a}}(-(2\delta+\xi\alpha)p_d+\hat{\varepsilon}_g)$	$\rho_s=-\phi(2\delta+\xi\alpha)/\Delta_{2a}$ $\Delta_{2a}=1-\phi\gamma+\eta+\xi\beta$
3. Williamson	$y_d=\frac{1}{\Delta_3}(-\sigma p_d+\hat{\varepsilon}_g)$	$\rho_s=-\phi\sigma/\Delta_3$ $\Delta_3=1+\sigma+\eta$

[a]The denominators (indicated by $\Delta_a, \Delta_1, \ldots$) in the first column are given in detail in the second column. The 'speed of adjustment' refers to ρ_s, the stable root characteristic of the system averages or differences for the regime in question.

4. Floating with national monetary targets

In this section we analyse the behaviour of the real exchange rate when each country adopts a fixed target growth rate for its money supply (not necessarily the same) and allows its currency to float freely. With identical coefficients in the separate national economies, the exchange rate depends only on 'differences', including the differences of shocks (denoted $\hat{\varepsilon}_m, \hat{\varepsilon}_g, \hat{\varepsilon}_p$ where $\hat{\varepsilon}_m=\varepsilon_m-\varepsilon_m^*$), together with the fad process

On the assumption that the 'augmentation' term in the price equation is the domestic rate of monetary growth, i.e.,

$$Dp=\phi y+\mu+\varepsilon_p \quad \text{and} \quad Dp^*=\phi y^*+\mu^*+\varepsilon_p^*, \qquad \text{then}$$

$$Dp_d=\phi y_d+\mu_d+\hat{\varepsilon}_p \quad \text{and} \quad E[Dp_d]=\phi y_d+\mu_d. \tag{4}$$

Since inflation (and the inflation differential) may persist, it is convenient to deflate each nominal money stock by the domestic price level, so $l=m-p$, $l^*=m^*-p^*$ and $l_d=l-l^*$. As the evolution of real balances depends on the rate of inflation relative to the rate of monetary growth, so, using eq. (4), we note that

$$Dl_d=-\phi y_d-\hat{\varepsilon}_p. \tag{5}$$

The behaviour of the *real* exchange rate reflects both the inflation differential and the determinants of the *nominal* exchange rate. So, using eq. (4) again, we find (on taking expectations of both sides) that as

$$Dc = De + Dp^* - Dp \text{ so } E[Dc] = E[i_d] - \psi f - \phi E[y_d] - \mu_d. \tag{6}$$

Eqs. (5) and (6) show the evolution of real balances (l_d) and the real exchange rate (c) depend on both income and interest differentials. Solving for the latter (using the goods and money market relationships from table 3(b)) and adding the autoregressive fad process

$$Df = -\psi f + \omega \tag{7}$$

yields the stochastic differential equations for this regime, as follows:

$$\begin{bmatrix} Dl_d \\ E[Dc] \\ Df \end{bmatrix} = \frac{1}{\Delta} \begin{bmatrix} \phi\gamma & 2\phi\lambda\delta & 0 \\ 1+\eta & 2\delta(\phi\lambda - k) & -\Delta\psi \\ 0 & 0 & -\Delta\psi \end{bmatrix} \begin{bmatrix} l_d \\ c \\ f \end{bmatrix}$$

$$+ \frac{1}{\Delta} \begin{bmatrix} -\phi\gamma & \phi\lambda & \phi\gamma\lambda & -\Delta & 0 \\ 0 & 0 & \lambda(1+\eta) & 0 & 0 \\ 0 & 0 & 0 & 0 & \Delta \end{bmatrix} \begin{bmatrix} \hat{\varepsilon}_m \\ \hat{\varepsilon}_g \\ \mu_d \\ \hat{\varepsilon}_p \\ \omega \end{bmatrix}$$

where $\Delta = -k\gamma - \lambda(1 - \phi\gamma + \eta)$ and is assumed to be negative, and $s_d = 0$.

Since the nominal exchange rate is a forward looking variable, stable behaviour is observed only on the stable manifold (i.e., the subspace of this system associated wth the stable roots which we denote as ρ_s and $-\psi$). The stable dynamics of this system and the role played by the serially correlated fads in changing the more orthodox account is most easily seen from fig. 1. In the absence of fads, the dynamics of adjustment in this Dornbusch-style model would lie on the line marked SS in this figure. Where there is 'overshooting', the slope of this line will be greater than one – since a shock to the money stock will have a greater than unit effect on the exchange rate [cf. Dornbusch (1976, Appendix)].

However, the serial correlation of the fad process adds another stable root, and (in the diagrammatically convenient case where $-\psi = \rho_s$) the stable trajectories leading to equilibrium have the shape shown in the line TT.

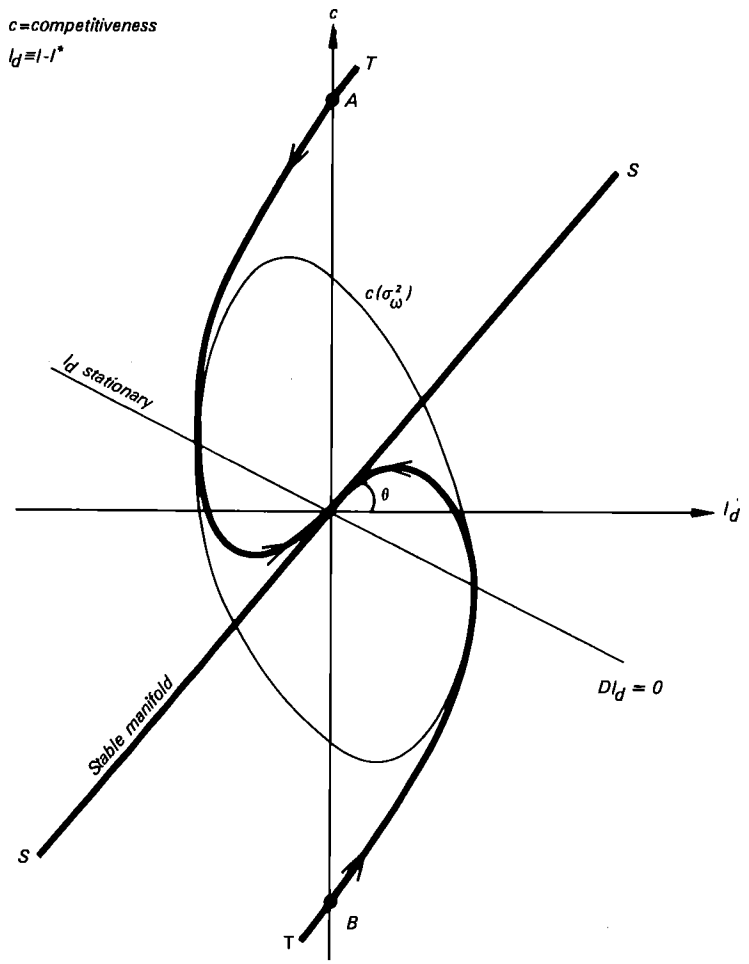

Fig. 1. 'Fads', dynamics and asymptotic probability contours.

These trajectories are symmetric around the origin but not around SS. The reason is that a fad which by raising the value of the domestic currency cuts competitiveness (so that c lies beneath SS) *slows down* the adjustment of real balances towards the origin, while a fad which increases competitiveness (putting c above SS) gives rise to forces which *speed up* the adjustment of l_d towards equilibrium.

Also shown in the figure is an (asymptotic) probability contour, showing points of equal probability in the long run. As the orientation of the ellipse demonstrates, the pattern of correlation between l_d and c arising from such fads is negative. The reason is made clear by observing that from a point such as A a large part of the subsequent expected trajectory is in the North West quadrant, and conversely for movements from point B; which orients

the ellipse in the fashion shown. (This negative correlation appears to be independent of the respective sizes of $|\rho_s|$ and $|\psi|$.)

In the absence of fads, the probability distribution of outcomes for c and l_d lies along the stable manifold (and the isoprobability 'contours' become two points on SS). Under the convenient assumption that the rates of monetary growth are the *same* (so we can write $\mu_d = m_d = 0$) then $l_d = -p_d$ and on the stable manifold, $c = \theta l_d = -\theta p_d$, i.e., competitiveness is simply relative prices multiplied by the coefficient θ (which measures the degree of overshooting). Under these assumptions the determination of output is shown in line 2 of table 4 and the formulae of annex 1 may be used to calculate asymptotic moments.

As was observed earlier the regime of floating with money supply targets led to much greater fluctuations in real exchange rates than many economists had expected. The above account is inevitably something of a caricature, but it suffices to show how the combination of sluggish prices, shocks to the economy and inefficiency in the foreign exchange market is in principle capable of generating substantial fluctuations in the real exchange rates.

5. Fixed exchange rates

The combination of a fixed exchange rate regime wth perfect capital mobility is usually taken to ensure that nominal interest rates are equalised across countries, which would mean *eliminating* the fad process included earlier to characterise the behaviour of the floating exchange rate. Of course, if the fad were to be treated as a phenomenon which has nothing to do with the exchange rate regime per se – but is for example a 'safe-haven' portfolio shift – then it would be perfectly possible to incorporate the effects of such fads on interest differentials under fixed exchange rates. For present purposes, however, we assume that the fad *is* eliminated by the change of regime.

Under a fixed rate regime, 'competitiveness' is measured by the ratio of nominal prices, $c \equiv p^* - p = -p_d$, and its evolution reflects differential inflation. Under the assumption, which seems reasonable in this context, that the augmentation term π_d will also go to zero the inflation differential is as in eq. (4) above, except that $\pi_d = 0$ [cf. Buiter (1986)].

The determination of output differences (after substitutions reflecting the assumption of zero interest differentials, constant nominal exchange rate and the inflation process) is given in the line labelled for McKinnon in table 4. Using the values for Δ_2 and ρ_s shown there, the asymptotic variance of the real exchange rate may be calculated as

$$\sigma_c^2 = \sigma_{p_d}^2 = \frac{1}{2|\rho_s|}((\phi^2/\Delta_2)\sigma_{\hat{\varepsilon}_g}^2 + \sigma_{\hat{\varepsilon}_p}^2).$$

assuming for convenience that $\hat{\varepsilon}_g$ and $\hat{\varepsilon}_p$ are independent and $s_d = 0$.

Thus the real exchange rate depends on shocks to the goods market and on differential inflation shocks, but not on the money market disturbances represented by $\hat{\varepsilon}_m$, which are accommodated so as to keep interest rates equalised. What keeps relative prices in line in the long run – and so keeps the asymptotic variance of the real rate from diverging – is the negative *feedback* effect of past inflation differentials on the current output and inflation differentials; the country which has had more inflation is less competitive and loses demand for that reason.

It is of course possible to include in addition a fiscal policy response to external developments. Thus if

$$s_d = -\xi B = -\xi(-\alpha p_d - \beta y_d),$$

where B is the balance of trade, the parameters are modified as shown on the next line of table 4, labelled 'McKinnon with fiscal activism'.

6. Stable real exchange rates with domestic nominal income targets

Finally we turn to the case where real exchange rates are stabilised, and fiscal policy used to support the anti-inflationary stance of policy. For reasons discussed earlier, we treat the fad as a characteristic of free floating which disappears with the change of regime. (Once again, however, behaviour of this sort which reflects portfolio shifts can if necessary be included). We consider in detail a regime where the real exchange rate is kept constant; this is, of course, a limiting case since Williamson's target zones are 20% wide. Nevertheless it is of interest in view of the argument that limiting movements in the real rate will necesarily destabilise inflation [see Adams and Gros (1986)].

Assume first that nominal interest differentials are set equal to the anticipated inflation differential (reducing to zero the ex ante real interest differential), i.e.,

$$i_d = \phi y_d + \pi d. \tag{10}$$

Let fiscal policy be used to pursue a nominal income target (n, n^*) with fiscal stance being adjusted in *proportion* to the deviation from target, i.e, $s = -\sigma(p + y - n)$, $s^* = -\sigma(p^* + y^* - n^*)$, so

$$s_d = -\sigma(p_d + y_d - n_d). \tag{11}$$

The nominal income targets are designed to accommodate non-inflationary potential income growth; as we are, for simplicity, ignoring the growth of potential output in this paper, the two targets n and n^* will be constant (and their difference n_d can be set to zero by choice of units). For the same reason,

the term π_d appearing in (10) can be set to zero, just as in McKinnon's monetary union – except here it is the commitment to nominal income targets that is to achieve this result. Relative output demand is usually affected by the (ex ante) real interest differential and the real exchange rate. But the former is zero (by assumption); and the latter will also be constant (as a corollary). The argument is simply that the real rate differs from equilibrium by the integral of expected future real interest differentials, which are set to zero by policy.

So relative output depends only on relative prices and demand shocks as shown in the last row of table 4, which is formally very similar to the preceding calculations for the fixed *nominal* exchange rate, the main difference being that here only relative fiscal stance and not the real exchange responds to past inflation differentials (represented in integral form by p_d). Since the inflation process is unchanged, the formula for the unconditional variance of inflation will be as for (9) above, except that now $\rho_s = -\phi\sigma/\Delta_3$ and $\Delta_3 = 1+\sigma+\eta$.

How can one square the striking correspondence between the output and inflation behaviour and that derived for McKinnon's monetary union (where surely inflation was under control) with the basic conclusion of Adams and Gros (that assigning monetary policy to real things destabilises inflation)? The answer lies in the fact that, in the extended target zone system being analysed here, a fiscal policy rule is used in conjunction with the monetary policy assignment. If this is deleted, so σ goes to zero, then indeed the asymptotic variance will go to infinity – the Adams and Gros point.

7. Summary and conclusions

When the Dollar Standard came to an end, macroeconomic policy became ipso facto more decentralised, and by and large policy-makers adopted national monetary targets to fight inflation and floated exchange rates to offset inflation differentials. But the velocity of money has proved highly variable; and deviations from purchasing power parity have been both pronounced and prolonged. The alternative systems examined here attempt to cope with these developments.

In seeking to stabilise exchange rates, they seek to coordinate monetary policy across countries, but without returning to a Dollar Standard. In the belief that variations in velocity were due to 'currency substitution' McKinnon initially proposed that the world interest rate be set so as to attain an aggregate money supply target. Even in aggregate, however, velocity has proved too fickle. Both McKinnon's revised plan to use the *price level* as a target and Williamson's choice of *nominal income* are ways of avoiding shocks to velocity while retaining the crucial monetarist principle that monetary stringency be progressively increased in response to inflation.

At the national level McKinnon proposes to fix nominal exchange rates while Williamson seeks to stabilise real exchange rates within a relatively wide band: in neither case are monetary targets recommended. The adoption of such policy rules may avoid the 'fads' which appear to characterise floating exchange rates, although this is still an open question. Even aside from this important issue, there are crucial differences between the regimes, as illustrated for example in table 5, where the long-run variances of prices and output – in the face of supply and demand disturbances – are shown for various regimes. For brevity, we consider only the variances arising from supply-side shocks, shown in columns (4) and (5) of the table. It is apparent that, for the illustrative parameters used here, the product of price and output variances is a constant in the face of supply-side shocks: the regimes are 'trading off' variations in prices and output.

In row 1, one can see that for both a world money supply target as originally proposed by McKinnon and for a global nominal income target (pursued with an equally active use of interest rates), the variance of prices exceeds that of output. (If one were to include shocks to the velocity of money as well, they would increase the variances associated with the money supply rule, leaving those for the nominal income target unchanged). However, targeting the price level directly, as McKinnon has more recently recommended, does, even without fiscal activism, reduce price variance (see row 2) – at the cost of higher output variance.

Turning now to the country-specific inflation shocks, one sees, in rows and 3 and 4, that the fluctuations in relative prices and of relative output levels are much closer together. The reason is that, in an open economy, the movement of the real exchange rate adds an extra channel to monetary policy. In addition to the direct effect of real interest rates on aggregate demand, the real interest rate will influence the trade balance via its effect on the real exchange rate. Interestingly, however, the 'gold standard' results appearing in row 4 – where the country with high inflation sticks to a fixed exchange rate and suffers a loss in competitiveness – are much the same as those for free floating with money supply targets (in row 3). The intuitive reason for this is that if, as here, the exchange rate does not significantly 'overshoot' under floating, and if the money target is constant, then the floating nominal exchange rate will be pretty stable too – absent the 'fads'. (In practice the variance of exchange rates seems to have exceeded what can be explained in terms of variation in economic fundamentals: this is why we have included 'fads' in the foreign exchange market, which affect the behaviour of the floating exchange rate but disappear when the rate is fixed or managed.)

Under both these two regimes international competitiveness will fluctuate as relative prices move but the nominal exchange rate remains stable. As can be seen from the last row, moving nominal rates so as to keep competitive-

Table 5

Asymptotic variances of price and output under various regimes: Supply and demand shocks only.[a]

	Key parameters values			Asymptotic variances: Supply side shocks		Asymptotic variances: Demand shocks	
	a	Δ	ρ_s	σ_p^2	σ_y^2	σ_p^2	σ_y^2
	See table 4	See table 4	$\frac{-\phi a}{\Delta}$	$\frac{1}{2\lvert\rho_s\rvert}$	$\frac{a}{2\phi\Delta}$	$\frac{\phi}{2a\Delta}$	$\frac{1}{\Delta^2}\left(\frac{a\phi}{2\Delta}+1\right)$
Averages	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) Money or nominal income target	0.25	0.9	−0.139	3.60	0.28	1.11	1.32
(2) Price level target (with $\beta=\lambda^{-1}$)	0.25	0.65	−0.192	2.60	0.38	1.54	2.59
Differences							
(3) Floating with money target	1.18	1.1	−0.536	0.93	1.07	0.19	1.05
(4) McKinnon's proposal	1.0	0.85	−0.588	0.85	1.18	0.29	1.79
(5) Williamson's target zones	0.5	1.6	−0.156	3.2	0.31	0.31	0.42

[1]Supply side shocks are disturbances to the inflation equation. Demand side shocks are disturbances to the demand equation. a is the parameter appearing in eq. (1) of Annex 1. Asymptotic variances are given as a multiple of the variances of the shock indicated. Parameter values: $\eta=0.1$, $\gamma=\phi=\delta=\sigma=0.5$, $\theta=0.93$, $k=1$, $\lambda=2$.

ness constant does stabilize output, but it means that prices become more volatile. Indeed, the outcomes begin to look more like those for the closed economy – which makes sense as the monetary authorities are acting so as to prevent real exchange rates from moving as they have in the previous two cases.

In the remainder of the table the variances arising from demand shocks are also shown for the several regimes. A more complete treatment would of course include other shocks and a consideration of their joint distribution. But this illustration gives some idea of the way in which the different exchange rate regimes seek to spread the burden of checking supply side inflation. [See also Frankel, 1983)].

The options with regard to exchange rate policy are no longer simply of whether to use monetary policy so as to fix the exchange rate or to let it float freely. This paper has shown that schemes to manage the exchange rate, involving both monetary and fiscal policy, give distinct and equally coherent answers to the issues involved in the choosing of an exchange regime.

Annex 1

Deriving the asymptotic moments for price and output

Given (1) $y=\frac{1}{\Delta}(-ap-b\varepsilon_m+\varepsilon_g)$,

(2) $Dp=\phi y+\varepsilon_p=-\frac{\phi}{\Delta}ap-\frac{\phi}{\Delta}b\varepsilon_m+\frac{\phi}{\Delta}\varepsilon_g+\varepsilon_p$,

so $\rho_s=-\phi a/\Delta$, then the asymptotic variance of price is

$$(3)\quad \sigma_p^2=\frac{1}{2|\rho_s|}\left\{\frac{\phi^2}{\Delta^2}(b^2\sigma_{\varepsilon_m}^2+\sigma_{\varepsilon_g}^2)+\sigma_{\varepsilon_p}^2\right\}$$

$$=\frac{\phi}{2a\Delta}(b^2\sigma_{\varepsilon_m}^2+\sigma_{\varepsilon_g}^2)+\frac{\Delta}{2\phi a}\sigma_{\varepsilon_p}^2,$$

assuming that the disturbances are independently distributed. From (1) and (3), the asymptotic variance of output is

$$(4)\quad \sigma_y^2=\frac{1}{\Delta^2}(a^2\sigma_{\varepsilon_p}^2+b^2\sigma_{\varepsilon_m}^2+\sigma_{\varepsilon_g}^2)$$

$$=\frac{1}{\Delta^2}\left\{\frac{a\phi}{2\Delta}b^2\sigma_{\varepsilon_m}^2+\left(\frac{a\phi}{2\Delta}+1\right)\sigma_{\varepsilon_g}^2+\frac{a\Delta}{2\phi}\sigma_{\varepsilon_p}^2\right\}.$$

The asymptotic covariance of price and output is simply

$$(5)\quad \sigma_{py} = -\frac{a}{\Delta}\sigma_p^2.$$

Footnote

Where the balance of trade is governed by $B = -\alpha p_d - \beta y_d$, then the unconditional covariance of B is

$$\sigma_B^2 = \alpha^2\sigma_{p_d}^2 + \beta^2\sigma_{y_d}^2 + 2\alpha\beta\sigma_{p_d y_d}.$$

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COMMENTS

'The International Monetary System: An Analysis of Alternative Proposals' by Marcus H. Miller and John Williamson

Stanley FISCHER

This paper presents a formal model designed to analyze the two leading alternative proposals to the current international monetary system, the McKinnon proposal to return to fixed nominal rates, and the more subtle and elusive Williamson proposal for target zones. The conclusions are regrettably not crystal clear.

1. The proposals

McKinnon's proposal is the more conventional. In its original form it proposed fixing the exchange rates among the U.S., Japan and Germany, and fixing the growth rate of their combined money stock. The proposal reflected his view that currency substitution was the main cause of exchange rate changes.

McKinnon has moved away from the currency substitution emphasis in more recent versions of the proposal. He now expects the three largest countries basically to follow gold standard rules, manipulating short term interest rates to defend the exchange rate. Presumably it would be the deficit countries that would come under more pressure to pursue active monetary policies. Money growth would be treated as an intermediate run target, consistency with interest rate manipulation being attained by movements of the average level of the nominal interest rate in the three countries.

Two other features should be noted: first, McKinnon's belief that appropriate exchange rates are provided by purchasing power parity calculations and not by the need to attain current account balance; and second, his view that the current account is essentially unaffected by the exchange rate.

Accordingly, fiscal policy would have to be used to bring about current account balance.

By contrast, Williamson's target zone proposal envisages setting exchange rates to bring about current account balance. Central exchange rates, which may crawl, are set by agreement. These rates adjust one for one with relative inflation rates, and thus may be construed as real exchange rates. Wide, $\pm 10\%$, bands around the central rate retain most of the virtues of the floating rate system. But when the rate approaches the limits of the band, action has to be taken. This may involve either monetary or fiscal policy, though Williamson also leaves open the soft option of adjusting the target zone. The benefits and disadvantages of this scheme have been extensively discussed, in the 1986 *Brookings Papers* and elsewhere.[1]

Because the central rates can be viewed as fixed in real terms, the Williamson proposal is vulnerable to the charge, made by Adams and Gros, that price levels become indeterminate. The paper implies that it is for this reason Williamson has recently appended the assumption that fiscal policy should be directed at a nominal income target. This is logically impeccable, but in practice ensures that the proposal will not be accepted – for reasons that I will discuss below. The problem of price-level indeterminacy should not be regarded with as much solemnity as it evidently is by the authors – it goes away if the target exchange rate is adjusted only by 0.99% for every 1% change in relative price levels.

However, there is a more serious reason to worry about fiscal policy. The prime objection to the original Williamson target zone proposal was that divergent fiscal policies (with the difference between the U.S. and the rest of OECD in the early eighties in mind) could overwhelm the defenses of any target zones. The modification of the proposal to include co-ordinated fiscal policies deals appropriately with that difficulty, even if it does reduce the likelihood of its adoption.

2. The analysis

One way of analyzing the alternative proposals is by simulation of a large-scale econometric model. This was done in the paper by Edison, Miller and Williamson. A difficulty in an exercise of this sort is modelling expectations, particularly of the very non-linear Williamson proposal.

The alternative adopted here is to use as simple a stochastic open economy model as possible. The model consists of the IS–LM apparatus, plus an aggregate supply function and asset market relations determined by the perfect mobility of capital plus an assumption about the existence of a fad.

[1]See 'Symposium on Exchange Rates, Trade, and Capital Flows', Brookings Papers on Economic Activity, 1986:1.

The determinisic component of the IS–LM curves is standard. It is not obvious though that the errors in those equations should be treated as white noise – certainly velocity changes appear in practice to be quite persistent. Such serially correlated shocks should be modelled, since they are certainly relevant to the behavior of the system under money targeting. The aggregate supply relationship omits any exchange rate effects on costs: these could be incorporated with little additional complexity. The aggregate supply function includes a term in p that represents a core inflation rate, but that ends up in some versions of the model as the growth rate of money. Although this assumption has been made by Buiter and Miller in earlier work, it is hardly persuasive; expectations are not well handled in this theoretical model.

The authors are obviously pleased with the inclusion of the fad components in the interest rate equalization equation. It serves to complicate the analysis of the floating rate regime, and is interesting. However, the authors fail to make clear its contribution to the comparison among the different policies.

Although the Williamson proposal focuses on the current account, there is no current account equation in this model. Similarly, there is no accounting for reserves, implying that the treatment of the McKinnon proposal is biased in its favor.

The authors use the sum and difference method of Aoki to carry out the analysis. By making the two countries identical they abstract from divergent productivity trends, divergent inflation preferences, and differences in wage and price flexibility in the countries. All these are an important part of the case for flexible exchange rates. Their inclusion would strengthen the case for the existing system or the Williamson proposal over the McKinnon proposal.

The authors take the view that the fads would not be present in the Williamson and McKinnon worlds. I certainly believe that something like the fads of this paper are partly a result of uncertainty of market participants about the exchange rate intentions of governments, but it is doubtful that such movements would disappear if there was a shift to exchange rate targeting or fixing. Rather the fads would be reflected in attacks on the fixed exchange rate or on the edges of the target zones.

The results of the analysis simply do not emerge clearly. It appears that McKinnon and Williamson emerge more or less tied. Table 5 at the end gives comparisons for one set of parameter values, but regrettably no indication of the robustness of the results.

3. General comments

All economists have suffered through the joke about the physicist, engineer and economist marooned on a desert island with a can of food but no can opener. The economist's solution to the problem begins 'Assume a can-

opener'. This paper has a can-opener of that type in it, namely the assumption in the Williamson proposal that fiscal policy is operated to target nominal income.

The main cause of exchange rate movements in the last five years has been U.S. fiscal policy. If fiscal policy had been directed to a nominal income target over the last five years, the Williamson proposal would not now be receiving the serious attention it is.

The key question about the McKinnon and Williamson proposals is whether the choice of the exchange rate system will constrain domestic policy choices. The answer for some European countries evident from the EMS is yes. It still seems unlikely though that the U.S. Congress or Administraton will allow itself to be constrained. It was the failure of the U.S. to constrain its policies in the late sixties that led to the failure of the Bretton Woods system. There has been no indication subsequently that the U.S. is prepared to modify its behavior in a way that would make either fixed exchange rates or greater exchange rate fixity more likely. That is so despite the Plaza and Louvre agreements – for there has been no evidence that the Administration as opposed to the Secretary of the Treasury plans to adjust fiscal policy. Perhaps all that will change in 1989, but don't bet on it.

This paper has one other failing. It represents the Williamson proposal as one that uses monetary policy to fix the real exchange rate while fiscal policy targets nominal income. None of the subtlety of the proposal's combination of fixed and flexible rates appears here. That is undoubtedly very difficult. But in justice to Williamson the authors should make the attempt, perhaps through simulation of a theoretical model.

COMMENTS

'The International Monetary System: An Analysis of Alternative Regimes' by Marcus H. Miller and John Williamson

Gilles OUDIZ

Marcus Miller and John Williamson have written an attractive paper which applies up to date macroeconomic analysis to the discussion of International Monetary Coordination. The author's objective is to study within a single formal framework the proposals of R. McKinnon and J. Williamson for monetary reform.

We will briefly discuss here the 'technical' aspects of the paper: the model and the policy coordination framework, before commenting on the conclusions of the authors.

1. The model of a two country world

The basic equations of the world economy model follow closely the 'standard' literature in open economy macroeconomics and do not need much comment.

However the authors introduce a more original specification of exchange rate determination. The introduction of 'fads', modelled as a 'coloured noise' process, within the traditional arbitrage equation aims at taking into account the actual working of exchange markets.

The authors are unfortunately quite short on the motivations of their choice which seems largely ad-hoc. Further in the paper this technicality is assumed away partly because it complicates the formal analysis, partly because the introduction of monetary coordination is supposed to eliminate these fads.

2. The policy framework

Using a technique developed by Aoki (1981) the authors analyze separately the behavior of average and differential economic variables.

Far from being strictly technical this choice has in fact an interesting econonomic interpretation. The model of averages – i.e., the global economy – behaves like a closed economy without any exchange rate problem whereas the model of differences focuses on the problem of exchange rate management.

Let us consider a very simple two country model of the world economy to make this point clearer.

Let the model of the home country be:

$$M(m, y, p, m^*, p^*, e) = 0,$$

with the notations of the authors.

Let us further consider that the authorities of the home country choose their monetary policy so as to minimize the following loss function:

$$L = y^2 + \phi p^2.$$

The foreign country's behavior is assumed to be determined by a symmetrical model and loss function:

$$M^*(m^*, y^*, p^*, m, y, p, -e) = 0,$$

$$L^* = y^{*2} + \phi p^{*2}.$$

A supranational authority would thus be faced wih the following optimization problem:

$$\begin{cases} \underset{m, m^*}{\text{Min}}\, 0.5L + 0.5L^*, \\ M = 0, \\ M^* = 0. \end{cases}$$

Taking into account the fact that

$$0.5L + 0.5L^* = L_a + L_d,$$

where

$$L_a = y_a^2 + \phi p_a^2,$$

$$L_d = y_d^2 + \phi p_d^2,$$

and the symmetry of the models, this problem is separable in two sub-problems:

$$\begin{cases} \underset{m_a}{\text{Min}}\, L_a, \\ M_a(m_a, y_a, p_a) = 0, \end{cases}$$

$$\begin{cases} \underset{m_d}{\text{Min}}\, L_d, \\ M_d(m_d, y_d, p_d, e) = 0. \end{cases}$$

The problem of a supranational authority having to determine an optimal coordinated monetary policy is thus twofold: the determination of the global level of output and prices through the management of the world money supply, m_a, and the management of international differences through exchange rate policy, m_d.

This separability of the world economy model is thus meaningful under two quite restrictive assumptions:

- the world economy is symmetrical,
- economic policy is controlled by a supranational authority (or jointly by the two national authorities through policy coordination) which allows for

the separate management of average and differential levels of policy instruments.

The first assumption is clearly not granted at the world level if one considers the three major groups of industrialized economies: U.S.A., Japan and Europe. As the authors acknowledge, it is not granted among European economies either.

The second assumption is more fundamental for it raises the question of the strategic framework within which the world economic policy is set.

A major weakness of Miller and Williamson's paper is the absence of a properly specified welfare analysis. We have no way of knowing whether the two countries are worse off or better off with either monetary coordination proposals. Nor does the formal analysis explicitly specify how the average and differential levels of policy instruments are set.

To put it in less technical terms, it does not suffice to state that the exchange rate is fixed. The policy framework is essential in this respect. A fully developed welfare analysis will yield different results depending on whether this fixed exchange rate level is set by a single dominant country or jointly through policy coordination.

The collapse of the Bretton Woods system of fixed exchange rates and recent European experience show that this is far from being a merely academic consideration.

3. Concluding remarks

The idea of applying recent developments in international macroeconomics literature to the discussion of exchange rate reform is by all means appealing to specialists in both fields.

Following a previous paper which emphasized empirical simulations, the authors have attempted to derive analytically some meaningful conclusions on the advantages of McKinnon's and Williamson's proposals.

However the discussion which they provide falls short of being really convincing. Their sophisticated dynamic analysis remains ad hoc. It does not provide easily understandable conclusions and the strategic interaction of the two countries – conflict or cooperation? – remains unclear.

In short this paper is welcome as a much needed attempt at sorting out formally the arguments in favour of international monetary reform proposals, but further research will be needed along the lines pioneered by the authors.