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Insulating Policies for Large and Small Countries

by W. Michael Cox and Douglas McTaggart*

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ABSTRACT

In this paper we investigate policies for the large and small country that provide complete insulation from foreign real and monetary disturbances. We find that when there exists two channels of transmission, the integrated commodity and capital markets, using only exchange rate policies does not provide complete insulation. However, floating the exchange rate and pursuing a specific interest rate target does. In terms of output variability however, insulating policies may be undesirable.

INSULATING POLICIES FOR LARGE AND SMALL COUNTRIES

by

W. Michael Cox
Douglas McTaggart

1. Introduction

During the era of fixed exchange rates it was generally felt that a movement to flexible exchange rates would reduce the international transmission of disturbances and allow countries to pursue more independent monetary policies. Experience with flexible rates since 1973, however, has indicated little perceptible change in the degree of cross-country correlation in real economic activity[1] and has led to a more eclectic approach to the question of optimal exchange management. The apparent failure of flexible rates to provide adequate insulation may have strengthened the case for activist exchange market intervention policies.[2] This paper investigates policies that do provide complete insulation for large open economies. We focus on a combination of interest rate rules and exchange rate rules that insulates a country from both the systematic and anticipated components of foreign monetary policy and from unanticipated foreign real and monetary shocks.

The paper examines a two-country world where each country is modelled in the rational expectations aggregate supply-aggregate demand framework (essentially an extended Mundell (1968)-Fleming (1962) model) that has become popular for exchange rate analyses in the small open economy.[3] The model analyzes the transmission of disturbances from the home country to the foreign country as well as the standard transmission effect from the foreign to the home economy. The central bank policies considered include exchange rate rules--fixed, freely floating and managed exchange rates--and interest rate rules. Two types of interest rate rules are analyzed--pegging to a foreign interest rate target or to a fixed domestic interest rate target.

The major conclusions reached are as follows. Exchange rate management alone is capable of eliminating the transmission of either real or monetary disurbances but incapable of simultaneously eliminating both. A policy which floats the exchange rate and manages the interest rate is capable of eliminating the transmission of both types of disturbances. The foreign central bank may at the same time pursue such a policy and eliminate the transmission of home monetary and real disturbances and home inflation to the foreign country. In other words, flexible exchange rates combined with an interest rate rule in each country is a feasible joint policy combination which provides monetary autonomy and eliminates the transmission of systematic and unanticipated disturbances worldwide.

In general, however, it will not be optimal for the central bank to pursue a policy of insulating the home economy from foreign and real disturbances. Under most circumstances such a policy increases the variability of prices and output in excess of that generated under a floating exchange and interest rate policy. Only when there are no monetary shocks and solely real disturbances does the policy that eliminates the transmission of foreign disturbance provide a lower variance of output than the other policies considered.

The intuition behind these results follows from the fact that in an integrated trading world the commodity market is just as important as the capital market as a conduit for foreign disturbances. Recent analyses that emphasize the assets approach to exchange rates, hence the role of capital markets, have tended to obscure this observation. It follows, therefore, that the movement to floating rates in 1973 may have been a rational response by central banks to perceived increases in the variance of worldwide real, not monetary, disturbances; or perhaps due to increasing degrees of commodity market integration as the monetary authorities attempted to minimize the fluctuations in their own home output.

Section 2 outlines the assumptions and basic setup of the model. Section 3 postulates central bank behavior and introduces the money supply processes of the two economies. In Section 4 we examine the solution of the model for output and the price level in each of the economies. In Section 5 a variety of central bank policies are considered and their implications for output and the price level are examined. Section 6 briefly analyses the optimality of various policies and concluding comments are presented in Section 7.

2. The Model

Consider two countries that produce and consume the same perfectly substitutable good. Production occurs in spatially distinct areas, but in the absence of transportation costs and other impediments to trade we can consider a single world market where prices adjust to ensure market clearing period by period. Commodity arbitrage will guarantee that purchasing power parity always holds.

Worldwide commodity demand is assumed to consist of a systematic component plus a part that depends on the real rate of interest. For simplicity, we ignore any influence of aggregate income of the demand for commodities.

Commodity supply in each of the two countries follows the Lucas (1973) specification where only unexpected price disturbances produce output movements. Flood (1979) notes that such a supply curve is incompatible with the "islands model" but can be generated by a wage contract model. Specifically, in each country the supply of commodities is assumed to be produced in separate competitive labor markets where money wages are paid in units of the home currency. The labor supply decision in each home market is made at the beginning of the period on the basis of a competitively determined contractual money wage offered in that market and an expected (end-of-period) commodity price level. Expected increases in the home price level are assumed to involve proportional increases in the home contracted average money wage so that the home economy-wide average real wage is not directly affected by an anticipated increase in the home price level. Unanticipated price level changes involve a change in the real wage not accounted for in the original contract. Employers are then free to adjust the level of employment according to the change in the value of the marginal product of labor (a movement along the demand for labor curve) in a way agreed upon by workers who entered the contract at the beginning of the period. The slope of the supply curve is thus intimately connected to the specification of the country's underlying technology and contracting formula.

There is one type of bond perfectly mobile worldwide so that interest parity is an equilibrium condition of the model.

The demand for money in each country is assumed to be proportionately related to the commodity price level, positively related to the level of real income, and inversely related to the nominal rate of interest.[4]

These assumptions are summarized in the following model:

$$(1) \qquad Y_t^s = Y_{nt} + \theta(P_t - P_t^{e(t-1)}) + \varepsilon_t$$

$$(2) \qquad M_t^d = k + P_t + aY_t - bi_t$$

$$(3) \qquad i_t = r_t + P_{t+1}^{e(t)} - P_t$$

$$(4) \qquad Y_t^{*s} = Y_{nt}^* + \theta^*(P_t^* - P_t^{*e(t-1)}) + \varepsilon_t^*$$

$$(5) \qquad M_t^{*d} = k^* + P_t^* + a^*Y_t^* - b^*i_t^*$$

$$(6) \qquad i_t^* = r_t^* + P_{t+1}^{*e(t)} - P_t^*$$

$$(7) \qquad Y_t + Y_t^* = A_{nt} - cr_t - c^*r_t^*$$

(8) $P_t = P_t^* + E_t$

(9) $i_t = i_t^* + E_{t+1}^{e(t)} - E_t$

With the exception of i_t, r_t, and Y_t all variables are expressed in logarithms. An asterisk denotes the foreign economy, t denotes the time period and the superscripts d and s denote demand and supply respectively. The definitions of the variables are:

M = the nominal stock of money

P = the price level

Y = real income

i = the nominal interest rate

r = the real interest rate, and

E = the exchange rate = the number of units of the home country per unit of the foreign currency.

Equations (1) and (4) are the commodity supply relations. Equations (2) and (5) are the money demand functions while (3) and (6) specify the Fisher equations. Worldwide commodity market clearing occurs according to equation (7). The two international abritrage conditions are the PPP relation (8) and the interest parity relation (9). The variable $X^{e(t)}$ represents the expectation of the variable X conditioned on all information available at time period t which includes all variables up to and including period t. The terms ε_t and ε_t^* are assumed to be independently indentically distributed zero mean random supply disturbances with variances σ_ε^2 and $\sigma_{\varepsilon*}^2$ respectively.

For simplicity, the money demand parameters a and a^* are set equal to unity. Without loss of generality, we also assume that $k = k^* = 0$, $c + c^* = 1$, and that $Y_{nt} = Y_n$, $A_{nt} = A_n$, and $Y^*_{nt} = Y^*_n$ so that the systematic parts of home and foreign commodity demand and supply are constant over time.

3. The Money Supply Processes

It remains to specify the money supply processes of the home and foreign central banks. For simplicity, we abstract from the banking sector and assume that the money stock in each country is equal to its monetary base made up of central bank holdings of international reserves and domestic credit. The central bank in each country may want to manage the exchange rate. This is accomplished by purchasing or selling international reserves in response to deviations of the exchange rate from its target value. In addition, each central bank may pursue an interest rate target. This is done by open market purchases or sales of bonds. Together these policies imply the following money supply processes:[5]

$$(10) \qquad M_t = \rho t + m_E(\hat{E}_t - E_t) + m_i(i_t - \hat{i}_t) + \mu_t$$

$$(11) \qquad M^*_t = \rho^* t - m^*_E(\hat{E}^*_t - E_t) + m^*_i(i^*_t - \hat{i}^*_t) + \mu^*_t.$$

$\hat{E}_t$ is the exchange rate target and $\hat{i}_t$ is the interest rate target of the home central bank, ρ is the systematic growth rate of the home money supply and μ_t is an independently identically distributed zero mean random disturbance (an unanticipated home monetary shock) with variance σ_μ^2. The foreign variables are similarly defined.

The parameter m_E determines the degree to which the home central bank supports the exchange rate. For $m_E > 0$ exchange rate policy in the home country can be described as leaning against the wind. As m_E becomes larger the exchange rate becomes progressively more fixed i.e., $\lim_{m_E \to \infty} E_t = \hat{E}_t$. For $m_E = 0$ exchange rate policy is freely floating. In general for $m_E \neq 0$ the exchange rate is managed (a dirty float).

Similarly, the parameter m_i measures the degree to which the home central bank targets the home interest rate. For $m_i > 0$ home interest rate policy is leaning against the wind and $\lim_{m_i \to \infty} i_t = \hat{i}_t$. By increasing m_i the home central bank permits less deviation in the home interest rate from its target value $\hat{i}_t$. For $m_E \neq 0$ and $m_i \neq 0$ the home central bank is following a "mixed" policy directed in part toward managing the exchange rate and in part toward managing the interest rate. Similar central bank behavior is presumed for the foreign economy.

The target exchange rate of the home economy is assumed to be

$$(12) \qquad \hat{E}_t = E_o + \eta t$$

where η is the selected rate of growth of the target exchange rate in the home country and E_o is the base value of the target. Similarly for the foreign country

$$(13) \qquad \hat{E}_t^* = E_o^* + \eta^* t.$$

Two targets for the interest rate should be considered. These are: (i) a fixed interest rate target ($\hat{i}_t = \bar{i}$, $\hat{i}_t^* = \bar{i}^*$), and (ii) a foreign interest rate target ($\hat{i}_t = i_t^*$, $\hat{i}_t^* = i_t$). It is easy to show that targeting the home interest rate to the foreign interest rate is policy equivalent to managing the exchange rate. This is because the interest parity condition directly relates deviations of i_t from i_t^* to deviations of $E_{t+1}^{e(t)}$ from E_t which are directly related to $\hat{E}_t$. In view of this, the case of a foreign interest rate target is not taken up further here.

In choosing a fixed target for the nominal interest rate we require that the target be achievable by the appropriate selection of the parameter m_i. Since $i^{e(t-1)} = \pi + r_n$, where π is the expected or systematic rate of inflation ($P_{t+1}^{e(t-1)} - P_t^{e(t-1)}$) and r_n is the natural rate of interest in the home country (that rate which ex ante clears the world commodity market), for $m_i = \infty$ it must be true that $\bar{i} = \pi + r_n$, i.e. a nominal interest rate target cannot be chosen independently of the expected equilibrium rate of inflation. In general (specifically, except under fixed exchange rates) there is freedom of choice regarding the value for π and therefore $\bar{i}$. Similarly, $\bar{i}^*$ must be chosen compatible with π^* given r_n^*.

4. Solution of the Model

In obtaining solutions for home and foreign output, the price level, and other variables of interest it is helpful to make use of the definition $X_t = X_t^{e(t-1)} + \tilde{X}_t$ where $\tilde{X}_t$ is the unanticipated component at X_t and is orthogonal to $X_t^{e(t-1)}$. This and the linear structure of the model allows the solution for each variable to be obtained in two separate parts—a systematic part and an unanticipated part—thereby simplifying the solution technique.[6] This yields solutions for the domestic and foreign price level,

$$(14) \qquad \underset{\sim}{P_t} = K_0 + K_1 t + K_2 \underset{\sim}{T} + K_3 \underset{\sim}{\eta_t}$$

where $\underset{\sim}{P_t'} = [P_t \; P_t^*]$, $\underset{\sim}{T'} = [E_0 \; \bar{i} \; E_0^* \; \bar{i}^*]$, $\underset{\sim}{\eta_t'} = [\varepsilon_t \; \mu_t \; \varepsilon_t^* \; \mu_t^*]$

$$K_0 = \begin{bmatrix} \Pi_1[(b+m_i)(r_n+\pi) - Y_n] + (1-\Pi_1)[(b^*+m_i^*)(r_n+\pi^*) - Y_n^*] \\ (1-\Pi_1^*)[(b+m_i)(r_n+\pi) - Y_n] + \pi_1^*[(b^*+m_i^*)(r_n+\pi^*) - Y_n^*] \end{bmatrix}$$

$$K_1 = \begin{bmatrix} \Pi_1(\rho + m_E\eta) + (1-\Pi_1)(\rho^* - m_E^*\eta^*) \\ (1-\Pi_1^*)(\rho + m_E\eta) + \Pi_1^*(\rho^* - m_E^*\eta^*) \end{bmatrix}$$

$$K_2 = \begin{bmatrix} \Pi_1 m_E & -\Pi_1 m_i & -(1-\Pi_1)m_E^* & -(1-\Pi_1)m_i^* \\ (1-\Pi_1^*)m_E & -(1-\Pi_1^*)m_i & -\Pi_1^* m_E^* & -\Pi_1^* m_i \end{bmatrix}$$

$$K_3 = \pi_4 \begin{bmatrix} -\Pi_2^*(1+b+m_i)-\Pi_3(b^*+m_i^*) & \Pi_2^* & -\Pi_2^*(b+m_i)-\Pi_3(1+b^*+m_i^*) & \Pi_3 \\ -\Pi_3^*(1+b+m_i)-\Pi_2(b^*+m_i^*) & \Pi_3^* & -\Pi_3^*(b+m_i)-\Pi_2(1+b^*+m_i^*) & \Pi_2 \end{bmatrix}$$

$$\Pi_1 = \frac{1 + m_E^*}{1 + m_E + m_E^*} \qquad \Pi_1^* = \frac{1 + m_E}{1 + m_E + m_E^*}$$

$$\Pi_2 = (1+\theta)(1+b+m_i) + m_E \qquad \Pi_2^* = (1+\theta^*)(1+b^*+m_i^*) + m_E^*$$

$$\Pi_3 = m_E - \theta^*(b+m_i) \qquad \Pi_3 = m_E^* - \theta(b^*+m_i^*)$$

$$\Pi_4 = (\Pi_2\Pi_2^* - \Pi_3\Pi_3^*)^{-1},$$

and where $\underset{\sim}{T}$ is the vector of target values and $\underset{\sim}{\eta_t}$ in the vector of disturbances.

It is evident that the systematic and the unanticipated components of the price level in each country depend on the systematic and unanticipated components of policy in both countries. This interdependence makes the choice of policy a very complicated and possibly strategic game for the central banks.

From equations (14) we have that

(15) $\pi = \Pi_1(\rho+m_E\eta) + (1-\Pi_1^*)(\rho^*-m_E^*\eta^*)$, and

(16) $\pi^* = \Pi_1^*(\rho^*-m_E^*\eta^*) + (1-\Pi_1^*)(\rho+m_E\eta)$,

for all t.

Using $\lim_{m_E\to\infty} \Pi_1 = 0$, $\lim_{m_E\to\infty} \Pi_1^* = 1$, $\lim_{m_E^*\to\infty} \Pi_1 = 1$, and $\lim_{m_E^*\to\infty} \Pi_1^* = 0$

verifies that, except under a home central bank policy of fixed exchange rates, the home central bank is free to select the home interest rate target $(\bar{i})$ by choice of the home money growth rate (ρ) and target rate of exchange rate growth (η). Under a foreign central bank policy of fixed exchange rates ($m_E^* \to \infty$) π equals $\rho + m_E\eta$ hence the home central bank is free to target the home interest rate; however π^* equals π and the foreign central bank looses its ability to target the foreign interest rate.

Solving for the home nominal interest rate yields

$$(17) \qquad i_t = r_n + \pi + \alpha_1\varepsilon_t + \alpha_2\mu_t + \alpha_3\varepsilon_t^* + \alpha_4\mu_t^*$$

where

$$\alpha_1 = -[(1+\theta)k_{11} + \theta^* k_{21} + 1]$$

$$\alpha_2 = -[(1+\theta)k_{12} + \theta^* k_{22}]$$

$$\alpha_3 = -[(1+\theta)k_{13} + \theta^* k_{22} + 1]$$

$$\alpha_4 = -[(1+\theta)k_{14} + \theta^* k_{24}]$$

and where k_{ij} is an element of the matrix K_3. Taking the limit as $m_i \to \infty$ gives $\lim_{m_i \to \infty} i_t = r_n + \pi$ so that a central bank policy of fixing the nominal interest rate with target $\bar{i} = r_n + \pi$ in in fact achievable. We can similarly solve for the equilibrium exchange rate .

5. Exchange Rate and Interest Rate Policy

In this section we focus on exchange rate and interest rate policies and the international transmission of disturbances. Of interest are the implications of independent exchange rate and interest rate policies on the part of each central bank and the implications of coordinated policy. In the spirit of policy discussions pre-1973 (i.e., before the complete breakdown of the Bretton-Woods system), the goal of the central bank in each country is presumed to be to reduce the international transmission of disturbances--both monetary and real--to that country and to pursue a more independent monetary policy. For the home central bank pursuit of this goal involves the selection of the interest rate management parameter (m_i), the exchange rate management parameter (m_E), the target rate of exchange rate growth (η), and the rate of home money growth (ρ). The foreign country chooses m_i^*, m_E^*, η^*, and ρ^* in a similar spirit.

5.1 Exchange Rate Policies

Consider pure exchange rate policies where the central bank floats the interest rate ($m_i = 0$) but manages the exchange rate. For fixed exchange rates the unexpected price shock in each country is equal ($\tilde{P}_t = \tilde{P}_t^*$) and equal to $-(\Pi_2^*-\Pi_3^*)^{-1}[(b^*+m_i^*)\varepsilon_t + (1+b^* + m_i^*)\varepsilon_t^* - \mu_t^*]$. Similarly, the anticipated rate of inflation in each country is equal ($\pi=\pi^*$) and equal to $(\rho^*-m_E^*\eta^*)$. Under fixed exchange rates, therefore, home output is open to foreign real and monetary shocks and the home inflation rate is open to systematic foreign inflation. Notice that neither the home country monetary shocks, μ_t, nor the home country parameters b or θ enter the solution for the unexpected price suprises. This is because home country monetary shocks are totally overwhelmed by the exchange rate management practices of its central bank. In other words, the home country has lost control of its money supply. The opposite result would arise if it were the foreign country fixing the exchange rate. The systematic rate of inflation depends only on the actions of the country not given responsibility for setting the exchange rate. Under these circumstances it is unlikely that either country will be indifferent as to who maintains the fixed exchange rate.

For the case of freely floating exchange rates ($m_E = m_E^* = 0$) π equals ρ so that the home inflation rate depends only on home money growth. As is evident from (14) $\tilde{P}_t$ remains dependent upon μ_t^* and ε_t^*. A freely floating exchange rate, therefore, does not eliminate the transmission of either monetary or real shocks to the home country.[7] Similar results hold for the foreign country.

As noted above pure exchange rate policies are not capable of simultaneously eliminating the transmission of both real and monetary foreign disturbances. However, the elimination of one of the shocks may be achieved by an appropriate dirty float. For example, by setting $m_i = 0$ and $m_E = \theta^* b$ transmission of foreign money shocks is eliminated, but the influence of foreign real shocks on home output remains. This is an exchange rate policy of leaning against the wind. On the other hand, an exchange rate policy that eliminates the effect of foreign real shocks requires an exchange rate policy of leaning with the wind. Specifically, setting $m_E = -b[1-m_E^*(1+b^*+m_i^*)^{-1}]$ insulates the home economy from foreign real shocks but permits the influence of foreign monetary shocks.

Each of the above policies eliminates one source of transmission of shocks from the foreign country to the home country but neither is capable of eliminating the transmission of both types of shocks.

Moreover, no coordination of pure exchange rate policies between the home and the foreign country (no combination of m_E and m_E^* for $m_i = m_i^* = 0$) is capable of eliminating the transmission of both real and monetary shocks worldwide.

5.2 Interest Rate Policies

We now consider pure interest rate policies. A pure interest rate policy is a policy which ignores the exchange rate and keys solely on the interest rate. The exchange rate is then freely floating ($m_E = 0$).

From (14) it is clear that setting $m_E = 0$ gives $\Pi_3 = \theta^*(m_i + b)$ and so by selecting $m_i = -b$ the solution for the unanticipated part of the home price level is

$$(18) \qquad \tilde{P}_t = (\mu_t - \varepsilon_t)(1+\theta)^{-1}.$$

In this way the influence of both monetary and real foreign shocks on the home price level and home output is eliminated. From (15) (and the discussion of flexible exchange rates), setting m_E equal to zero yields $\pi = \rho$ so that a policy of $m_i = -b$ and $m_E = 0$ eliminates the transmission of systematic and unanticipated foreign real and monetary disturbances to the home country. Moreover home output and the home price level are independent of the behavior of the foreign central bank so that regardless of foreign policy (fixed exchange rates, flexible exchange rates, dirty float, an interest rate rule) the home economy is completely insulated from foreign events.

It follows that the foreign central bank may choose $m_E^* = 0$ and $m_i^* = -b^*$ and eliminate any impact of home monetary and real disturbances and home central bank behavior on the foreign economy. Therefore, without the need for coordination, flexible exchange rates combined with an interest rate rule in each country is a feasible policy combination which provides monetary autonomy and eliminates the transmission of systematic and unanticipated disturbances worldwide.

Consider more closely the interest rate rule described above. For $m_i = -b$ and $m_E = 0$ the home money supply process is

$$(19) \qquad M_t = \rho t - b(i_t - \bar{i}) + \mu_t.$$

When the home interest rate falls below its target value the home central bank <u>increases</u> the home money supply by an amount exactly equal to the increase in home money demand. This is a policy of leaning with the wind and may be appropriately termed accommodative since the home central bank accommodates interest-rate-induced changes in the demand for money. By following this policy the home central bank restores monetary equilibrium in the home country without an unanticipated change in the home price level.

5.3 <u>Transmission Channels</u>

It is evident that a policy of fixing the exchange rate and floating the interest rate cannot insulate the home economy from foreign shocks whereas a policy of floating the exchange rate while managing the interest rate can. The reason for this result lies in the nature of the linkages through which disturbances are transmitted from one economy to the others. These linkages are the integrated goods market and the integrated capital market. Real disturbances are transmitted directly through the goods market via their effect on output supplies because of commodity arbitrage and then indirectly through the capital market via induced price and interest rate changes as output changes. Monetary disturbances have direct interest rate effects transmitted through capital markets because of the assumption of interest rate parity and indirect output effects via induced unanticipated price suprises. To insulate an economy thus requires closing the above two channels. A flexible exchange rate breaks the link between foreign and domestic prices and so closes the goods market channel. A managed interest rate breaks the link between foreign and domestic interest rates as long as the exchange rate is floating.

In other words, because real disturbances are transmitted primarily through the goods market while monetary disturbances are transmitted primarily through the capital market, exchange rate policy should be directed to real disturbances with interest rate policy directed to monetary disturbances.

6. Optimal Policies

To this point we have only been concerned with central bank policies that can be used to reduce the transmission of disturbances. A policy capable of eliminating the influence of both real and monetary foreign disturbances is one of floating the exchange rate and pursuing a "leaning with the wind" interest rate policy. It remains to be verified that the central bank would want to pursue such a policy according to an optimality criterion other than simply achieving international independence. At question here is whether or not the pursuit of independent policies, such as attempted following the Bretton-Woods breakdown, entailed hidden or unanticipated costs.

A reasonable criterion by which to judge the effects of different policies is in terms of the variance of output. A policy will be judged more desirable if it lowers the variance of output, given the policy decision of the foreign central bank. Because of the interdependence of the two economies, optimal central bank policy is game strategic in nature and a discussion of fully optimal policies would require a complete description of the game being played and an appropriate definition of equilibrium. For the purposes of this paper we ask a simpler question--given fixed foreign central bank behavior which of the following policies produces the smallest domestic output variance? Choices are limited to a purely floating exchange rate, a floating exchange rate with a fixed interest rate, a floating exchange rate with a managed interest rate (the insulating policy) and a fixed exchange rate with a floating interest rate policy.

The foreign central bank is assumed to do nothing, i.e., it sets ($m_E^* = m_i^* = 0$). Using (1) and (15) we can derive

$$(20) \quad Y_t = Y_n + \gamma_1 \varepsilon_t + \gamma_2 \mu_t + \gamma_3 \varepsilon_t^* + \gamma_4 \mu_t^*,$$

where the γ_j are complicated expressions involving θ, θ^*, b, b^* and the policy parameters. However, setting $m_E^* = m_i^* = 0$ and selecting the appropriate values for m_E and m_i we have in Table 1 the values of γ_i corresponding to the different policies. Using (20) we have

$$(21)\quad Var(Y_t) = \gamma_1^2\sigma_\varepsilon^2 + \gamma_2^2\sigma_\mu^2 + \gamma_3^2\sigma_\varepsilon^{2*} + \gamma_4\sigma_{\mu*}^2.$$

Because of the complexity of parameters γ_i as functions of the underlying structural parameters it is difficult to compare variances for unspecified values of θ, θ^*, b and b^*. In order to get useful results we numerically calculated the value of $Var(Y_t)$ for a range of reasonable values of the structural parameters and for different size variances σ_x^2, $x = \varepsilon, \mu, \varepsilon^*$ and μ^*. A broad range of "reasonable values" for θ, θ^*, b and b^* was considered.[8] Although we failed to find unambiguous results, the following consistent patterns emerged from the calculations.

i) Under most circumstances a purely floating exchange rate and interest rate (a non-interventionist policy) yielded the lowest output variance.

ii) Also under most circumstances the completely insulating policy, yielded the highest output variance. In many cases a fixed exchange rate policy competed with the insulating policy for the highest output variance with neither completely dominating the other.

iii) When there were only real shocks ($\sigma_\varepsilon^2 = \sigma_{\varepsilon*}^2 > 0$, $\sigma_\varepsilon^2 = \sigma_{\varepsilon*}^2 = 0$) the insulating policy yielded the lowest output variance.

iv) When there were only monetary shocks ($\sigma_\mu^2 = \sigma_{\mu*}^2 > 0$, $\sigma_\varepsilon^2 = \sigma_{\varepsilon*}^2 = 0$) a fixed exchange rate yielded the lowest output variance.

TABLE 1

Parameters	Floating E ($m_i = 0$): Floating i ($m_i=0$)	Floating E ($m_i = 0$): Targeted i ($m_i = \infty$)	Floating E ($m_i = 0$): Fixed i ($m_i = -b$)	Fixed E ($m_E = \infty$, m_i = (
γ_1	$k_1(1+\theta^*)(1+b^*)$	$k_2(1+\theta^*)(1+b^*)$	$k_3(1+\theta^*)(1+b^*)$	$k_4[(1+b)(1+b^*)(1+\theta^*)$
γ_2	0	0	$k_3\theta(1+\theta^*)(1+b^*)$	$k_4\theta(1+\theta^*)(1+b^*)$
γ_3	$-k_1\theta(1+b^*)$	$-k_2\theta(1+b^*)$	0	$-k_4\theta b(1+b^*)$
γ_4	$k_1\theta$	$-k_2\theta\theta^*$	0	$-k_4\theta\theta^* b$

where:

$$k_1 = (1+\theta^*)(1+b^*) + \theta b^*$$

$$k_2 = (1+\theta)(1+\theta^*)(1+b^*) - \theta\theta^* b^*$$

$$k_3 = (1+\theta)(1+\theta^*)(1+b^*)$$

$$k_4 = (1+\theta)(1+\theta^*)(1+b)(1+b^*) - \theta\theta^* b b^*.$$

v) In all cases, the variance of output varied systematically with the size of θ, θ^*, b and b^*, usually tending to grow with size of the parameters although not uniformly.

In general, it appears that whenever real disturbances occur some form of a floating exchange rate policy is desirable, usually a pure float. At the same time a fixed exchange rate policy is always undesirable in the presence of real disturbances. It is also true that a policy of complete insulation is usually undesirable in the presence of monetary disturbances. The explanation for these results is closely related to the discussion in Section 5.3. Real shocks work directly through the goods market and so a flexible exchange rate policy can at least minimize the destabilizing effects of foreign real shocks. On the other hand, a policy of complete insulation at a time when the foreign central bank is doing nothing, means the home economy is retaining its own monetary shocks when it could be exporting them to the foreign country.

When there are no monetary shocks but only real shocks, an accomodative monetary policy offsets the effects of real disturbances transmitted by foreign prices through the capital market. In this case the complete-insulating policy does best.

Finally, fixing the exchange rate is best in a world of only monetary shocks because the domestic monetary authority is now able to export much of its price variability to the foreign economy via the fixed exchange rate.

These results are contingent on the assumption that the foreign central bank does not respond to the domestic policy regime. If we gave the foreign central bank discretion over its own policy the above results would likely change.

7. Summary and Conclusion

This paper considers interest rate and exchange rate management policies that reduce the international transmission of disturbances and allow countries to pursue more independent monetary policies. Exchange rate management alone is capable at eliminating the transmission of either real or monetary shocks but not both. The elimination of foreign monetary disturbances requires an exchange rate policy of leaning against the wind whereas the elimination of foreign real disturbances requires leaning with the wind. Each policy is a dirty float. An interest rate rule, combined with a floating exchange rate, however, is capable of eliminating the transmission of both real and monetary disturbances. By following an interest rate policy of leaning with the wind, specifically by accommodating interest-rate-induced changes in the demand for money, the home country can eliminate the transmission of foreign real and monetary shocks to home output, as well as the transmission of foreign inflation to the home price level. The foreign central bank may simultaneously pursue such a policy and eliminate the transmission of home monetary and real disturbances and home inflation to the foreign country.

The cost of achieving autonomy, however, will generally be increased price and output variances. Under most circumstances a policy of floating both the interest rate and the exchange rate minimizes the variance of output. Autonomy, therefore, is probably not worth pursuing for its own sake.

Finally we have provided a partial explanation as to why central banks moved to floating rates in the early 1970's. That move coincided with a period a large real shocks (primarily natural resource and agricultural shocks of the period, followed later by the oil shocks), that is a period when the variance of real shocks increased relative to the variance of monetary shocks. As demonstrated above, a flexible exchange rate regime usually does best under these conditions so that, in terms of minimizing domestic output fluctuations, the move was a rational response to a change in the international economic environment.

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FOOTNOTES

[1]See Shafer and Loopesko (1983), Artus and Young (1979) and Frenkel (1980).

[2]See Goldstein (1980), especially p. 48-54.

[3]For example, see Barro (1978), Cox (1980), Flood (1979), Kimbrough (1983), Saidi (1980) and Weber (1981), amongst others.

[4]We use the semi-logarithmic money demand form with a one minor modification in that we also take the semi-log relation of income to money demand. With this modification the model in made tractable while clearly no sacrifice of the central conclusions is made.

[5]Recently, Siegel (1983) analyzed interest rate rules for the closed economy. Dotsey and King (1983) also discuss different monetary policy rules, including interest rate rules, for the closed economy. Goodfriend (1984) discusses a related monetary rule.

[6]We make considerable use of the following two facts: (i) there exists just one natural rate of interest (r_n) worldwide because of the integrated goods market, and (ii) the systematic elements introduced into the money supply rule imply that $P^e_{t+1}(t-1) = P^e_{t+1}(t)$.

[7]Similar results are derived by Flood (1979) and Saidi (1980) for the small open economy.

[8]The range of b and b^* considered was between 1 and 10. A value of b or b^* between 1 and 10 implies an interest elasticity of the demand for money between 0.01 and 0.10. The values for θ and θ^* were calculated from Lucas (1973) where his calculations imply a θ of 10.11 for the United States ranging down to 0.40 for Sweden. The average θ-value for 14 economics (excluding the United States, Argentina, Puerto Rico and Paraguay) is 1.73 but for only Great Britain, France and Germany is around 5.0