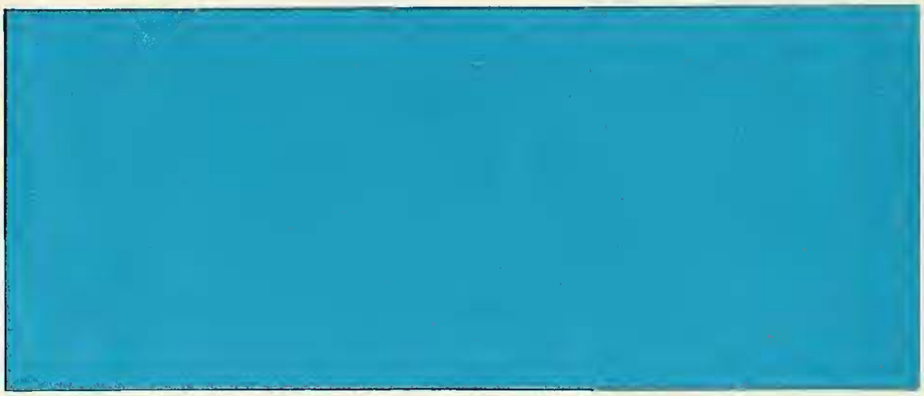
working paper
department
of economics

STABILITY AND EXCHANGE RATE SYSTEMS
IN A MONETARIST MODEL
OF THE BALANCE OF PAYMENTS

Stanley Fischer

Number 138 August 1974

massachusetts
institute of
technology
50 memorial drive
cambridge, mass. 02139



STABILITY AND EXCHANGE RATE SYSTEMS IN A MONETARIST MODEL OF THE BALANCE OF PAYMENTS

Stanley Fischer

Number 138 August 1974

Research for this paper was supported by a grant from the National Science Foundation.

August 1974

STABILITY AND EXCHANGE RATE SYSTEMS IN A MONETARIST MODEL OF THE BALANCE OF PAYMENTS

Stanley Fischer*

M.I.T.

Introduction:

The fixed versus flexible exchange rates debate appears destined for as long a life as any of the standing controversies in economics. The standard arguments need no repetition; they are well outlined by Johnson (1969) and Kindleberger (1969). This paper focusses on points which are less often discussed, (related points are mentioned in Laffer (1973)) but which may be as significant.

The concern of this paper is with the stability of consumption and the price level in a single country and in a two country world under regimes of fixed and flexible exchange rates. The formal examination of the effects of exchange rate systems on stability is not new: Mundell (1960), Stein (1963) and Tower and Courtney (1974) are among the contributors to the literature.[1] The impetus for the present paper, however, comes more directly from papers delivered at the first Wingspread conference by Argy and Kouri (1974) and McKinnon (1974). In particular, one of the aims of the analysis is to study McKinnon's suggestion that adoption of a set of rules of the game in a fixed exchange rate system could lead to better performance for each country individ-

---

* I am grateful to Rudiger Dornbusch for extremely helpful discussions.

[1] References to other literature are provided by Tower and Courtney.

ually than would result from each country pursuing apparently stabilizing policies on its own.

The structure of the paper is simple: the stability of the price level and consumption in a single small country under floating and fixed rates in the face of monetary and real disturbances are examined in Sections I.A and I.B. Active monetary policy for the small country under fixed rates is examined in Section I.C. The analysis of Sections I.A-C is paralleled in Sections II.A-C for a two country world. Conclusions and comments are presented in Section III.

I. A SINGLE SMALL COUNTRY

The simplest monetarist model, due to Dornbusch (1973) is:

$$L_t = kP_tY_t \tag{1}$$

$$P_t = P^*_te_t \tag{2}$$

$$B_t = M_t - M_{t-1} \tag{3}$$

$$M_t - M_{t-1} = \alpha(L_t - M_{t-1}) \qquad 0 < \alpha < 1 \tag{4}$$

$$C_t = P_tY_t - B_t \tag{5}$$

where L is the demand for money, P the domestic price level, Y domestic real income and output, P* the foreign price level, e the exchange rate, B the balance of payments, α an adjustment coefficient, and C consumption.

This is, needless to say, an extremely simple model; the major shortcoming from the viewpoint of this paper is that capital flows are ignored. We assume that domestic output is simply manna; later we discuss adding a Phillips curve. For analytical convenience in examining stability, we assume that average rates of inflation at home and abroad have been agreed on and are identically zero. Thus, we abstract from one of the major causes leading to the adoption of flexible rates. However, there would be little difficulty in extending the analysis of the flexible exchange rate system to situations in which rates of inflation between the two countries differ.

The object of enquiry is the steady-state behavior, in particular the variances, of prices and consumption when the economy is subjected to repeated shocks. We consider in turn disturbances in the demand for money, the foreign price level, and real income and the resultant steady state variances of prices and particularly consumption.[2/] We shall assume purely passive monetary policy initially.

2/ Baumol (1961) has emphasized the distinction between the transient response of a system to a single disturbance and its behavior under repeated shocks.

I.A Money Demand and Foreign Price Level Disturbances.

Let the demand for money be represented by

$$L_t = kP_tY_t + \varepsilon_t \tag{6}$$

where ε_t is a random variable with mean zero, variance σ_ε^2, and serially uncorrelated. Let $P_t^* = P^*$ and $Y_t = Y$ for all t.

(i) Floating Rate

Under floating rates with passive monetary policy,

$$M_t = M \qquad \text{for all } t. \tag{7}$$

Then the balance of payments is always zero, consumption has zero variance, and since

$$M = kP_tY + \varepsilon_t,$$

$$P_t = \frac{M - \varepsilon_t}{kY} \tag{8}$$

Thus

$$\sigma_P^2 = \frac{\sigma_\varepsilon^2}{k^2Y^2} \tag{9}$$

is the variance of prices. The corresponding variance of the exchange rate is easily calculated from (2).

(ii) Fixed Rate

Under floating rates, in this simplest model, all adjustment is in prices and none in quantities. Under a fixed rate, the adjustment is entirely in quantities and none in prices. Specifically, from (4), in steady state, the variance of the nominal money stock is

$$\sigma_M^2 = \frac{\alpha^2 \sigma_\varepsilon^2}{1-(1-\alpha)^2} \tag{10}$$

Then, using (3) and (5), the variance of real consumption is:

$$\sigma_{\frac{c}{p}}^2 = \frac{2\alpha^3 \sigma_\varepsilon^2}{p^2(1-(1-\alpha)^2)} \tag{11}$$

It is clear that similar qualitative results emerge when we consider foreign price level disturbances: under floating rates, changes in foreign prices affect only the exchange rate while domestic prices and consumption do not vary; under fixed rates, foreign price disturbances produce disturbances in both domestic prices and domestic consumption.

I.B Real Disturbances.

The most interesting comparison between the responses of the two types of system to disturbances occurs when the disturbance is in domestic income and output. Let

$$Y_t = Y + u_t \tag{12}$$

where u_t has zero mean, variance σ_u^2 and is serially uncorrelated. Once again, $P_t^* = P^*$ for all t.

(i) Floating Rate

Under floating rates, with passive monetary policy, we have

$$\sigma_{c/p}^2 = \sigma_u^2 \tag{13}$$

and

$$P_t = \frac{M}{k(Y+u_t)} \quad (14)$$

Without specifying the distribution of u_t, it is not in general possible to write down the mean and variance of the price level. It is, however, clear that the price level has non-zero variance.

<u>(ii) Fixed Rate</u>

From (4) we have:

$$M_t = (1-\alpha)M_{t-1} + \alpha kP(Y+u_t) \quad (15)$$

Accordingly, the steady-state variance of the nominal money stock is

$$\sigma_M^2 = \frac{\alpha^2 k^2 P^3 \sigma_u^2}{1-(1-\alpha)^2} \quad (16)$$

Now rewriting the consumption function (5) and using (4):

$$\frac{C_t}{P} = Y_t(1-\alpha k) + \frac{\alpha M_{t-1}}{P} \quad (17)$$

It is natural to assume $(1-\alpha k) > 0$ so that the propensity to consume out of current income is positive. From (17) we see that there are two sources of disturbance in consumption: there are changes in current income, which are smoothed through the balance of payments (via the $-\alpha k$ term), but also, past disturbances in the money stock affect current consumption as consumers try to restore money balance equilibrium. The variance of real consumption is:

$$\sigma_{\frac{c}{P}}^2 = (1-\alpha k)^2 \sigma_u^2 + \frac{\alpha^4 k^2 \sigma_u^2}{1-(1-\alpha)^2} \quad (18)$$

Now we obviously want to compare the variance of consumption under the two exchange rate regimes from (13) and (18). Consider the inequality:

$$1 > (1-\alpha k)^2 + \frac{\alpha^4 k^2}{1-(1-\alpha)^2}$$

With some manipulation this is equivalent to

$$(1-\alpha k) + (1-\alpha) > 0 \qquad (19)$$

which is ensured by the assumptions on α and αk. Accordingly, the variance of consumption in the fixed rate regime is less than that in the floating rate regime. This result reflects the shock absorber role of the balance of payments under fixed rates. Since there is also no variance of prices under fixed rates, it is clear that fixed rates are preferable if disturbances are real.

I.C Active Monetary Policy.

Thus far the monetary authority in the small country has been purely passive. Would not more active policies change the conclusions reached? Actually the model should be thought of as one in which there is very little for the monetary authority to do. It seems natural in the case of each disturbance to assume that the current disturbance does not affect current monetary policy -- i.e. that there is at least a one-period recognition and decision lag for the monetary authority.[3/] Accordingly there is nothing the monetary authority can do to stabilize even prices under flexible rates where all adjustments to a particular disturbance are completed within the period the disturbance occurs.

Under fixed exchange rates, however, private adjustments to a given

---

3/ See, however, the discussion in Section III.

disturbance are not completed within a single period since the restoration of money balances takes place with a distributed lag. There is thus room for some stabilizing action by the government. Specifically, suppose that money can be freely manufactured (destroyed) and distributed (collected) by the monetary authority. Let ΔMG_t be the government-created money stock in each period. The balance of payments is no longer given by (3) but rather by

$$B_t = M_t - (M_{t-1} + \Delta MG_t) \tag{20}$$

The optimal monetary rule under fixed rates with stabilization of consumption as the target is the certainty equivalence rule[4/]:

$$\Delta MG_t = \alpha(kPY-M_{t-1}) \tag{21}$$

In words, the monetary authority provides that amount of money which would put consumption at its mean level if there were no distrubance in the current period -- i.e. it compensates for past disturbances.

(i) Money Demand Disturbances

Using equations (4), (6), (20) and (21), we obtain

$$\begin{aligned} B_t &= \alpha(L_t - M_{t-1}) - \alpha(kPY-M_{t-1}) \qquad (22) \\ &= \alpha(kPY + \varepsilon_t - kPY) \\ &= \alpha\varepsilon_t \end{aligned}$$

4/ This is for the cases of disturbances in money demand and income; the rule for foreign price disturbances is different.

Substituting into (5), we obtain

$$\sigma^2_{\frac{c}{p}} = \frac{\alpha^2 \sigma^2_\varepsilon}{p^2} \tag{23}$$

which is less than the corresponding variance given in (11) with passive monetary policy.

(ii) Real Disturbance

We remarked, following equation (17), that there were two sources of variation in consumption with real disturbances under fixed rates: the variation arising from the current disturbance and that arising from lagged adjustment of the money stock. The latter source of variation is removed by the use of an active monetary policy.

Combining (4), (12), (20) and (21), we obtain

$$\begin{aligned} B_t &= \alpha(L_t - M_{t-1}) - \alpha(kPY - M_{t-1}) \qquad (24) \\ &= \alpha(kP(Y+u_t) - kPY) \\ &= \alpha kPu_t \end{aligned}$$

The variance of real consumption is then

$$\sigma^2_{\frac{c}{p}} = (1-\alpha k)^2 \sigma^2_u \tag{25}$$

which is less than the corresponding expression in (18) with passive monetary policy and is a fortiori less than the variance of consumption under flexible rates.

It should be noted that although the stabilization instrument above has been the money stock, there is no reason why fiscal policy could not have been used to the same effect. In fact, one way one can think of monetary policy as operating here is through lump sum taxes and transfers, so that monetary and fiscal policy become indistinguishable. Alternatively, one could think of a commodity stabilization scheme being operated to smooth consumption. This need not necessarily be government run.

I.D Price versus Quantity Changes.

If disturbances are real, then a fixed exchange rate system provides less variance of both consumption and prices than a flexible rate system. With money demand disturbances, however, fixed rates provide a stable price level and variable consumption while flexible rates yield variable prices and stable consumption. The question arises of how the variability of prices is to be compared with the variability of consumption in assessing the alternative exchange rate systems.

Concavity of utility functions expressed as a function of consumption justifies concern with the stability of consumption but it is not obvious that price variability is, of itself, undesirable. Indeed, for a while it was popular to argue that price variability is desirable.[5/] In the context of this model, two possible costs of price instability suggest themselves: first, price changes could lead to output changes through Phillips-curve type phenomena referred to by Lucas (1973) in which entrepreneurs mistake absolute price changes for relative price changes, or alternatively, because nominal wages adjust at a different rate than prices; second, it is sometimes argued that price variability reduces the quality of money. The second argument has attractive poetic qualities though the first is more plausible.

Consider now adding to the basic model represented by equations (1)-(5)

5/ For references to this literature, and for the resolution of the debate, see Hanoch (1974).

the Phillips curve equation:

$$Y_t - \mu_y = \beta(P_t - E_{t-1}(P_t)) + u_t \qquad \beta > 0 \qquad (26)$$

where μ_y is the mean level of output and $E_{t-1}(P_t)$ is the expectation of P_t conditional on information available up to and including period t-1. The addition of (26) complicates the model considerably and requires more precise specification of the distributions of the stochastic terms (as in Section II.B below) for the calculation of the relevant means and variances. Since qualitative conclusions on stability of consumption with the Phillips curve (26) in the model depend on the values of the parameters β, α and k it does not appear useful to develop the analysis at length here. The obvious is, however, worth stating: the greater is β -- the more sensitive is output to absolute price level changes -- the more likely is it that consumption is more stable under fixed than flexible rates, even in response to monetary disturbances.

II. A TWO-COUNTRY WORLD

The extension of the results for a single country to a two-country world is obvious and straightforward for a flexible exchange rate regime in the simplest model in which there is no Phillips curve. We use the simplest model throughout this section.

Most equations of the two country model are the same as those of the one-country model, (1)-(5). Corresponding to (1), (3), (4) and (5) are identical equations for the foreign country, but with all variables asterisked. In addition, with inactive monetary policies, under floating rates we have

$$M_t = M \tag{27}$$

$$M_t^* = M^* \tag{28}$$

$$M_t + eM_t^* = \bar{M} \tag{29}$$

where $\bar{M}$ is the world money supply. We shall, for convenience, assume that the countries are identical -- in size and behavioral parameters -- except for stochastic components of the functions, and under fixed exchange rates we set the exchange rate at unity.

II.A Money Demand Disturbances.

In the two countries, let

$$L_t = kP_tY_t + \varepsilon_t \tag{30}$$

and

$$L_t^* = kP_t^*Y_t^* + \varepsilon_t^* \tag{31}$$

respectively. Assume that ε_t and ε_t^* have means zero, variances σ_ε^2 and $\sigma_{\varepsilon^*}^2$ and each serially uncorrelated; the correlation between ε_t and ε_t^* will be specified below.

(i) Floating Rates

Under floating rates the money demand disturbances work themselves out entirely in price-changes. If the disturbances are perfectly positively correlated and have the same variance then the exchange rate remains constant, otherwise it too varies. The rate of consumption is constant through time in each country. That is, the single country conclusions carry over directly though the actual variance of prices will be the same for the two cases only if the disturbances are perfectly correlated.

(ii) Fixed Rates

Under fixed rates the qualitative conclusions of Section I apply. There will in general be variability in both prices and consumption in the two countries. In particular

(a) If the disturbances are perfectly negatively correlated with $\varepsilon_t = -\varepsilon_t^*$ then the price level in each country is constant and the variance of consumption in each country is given by the same formula (11) as it is for the single country of Section I. To see this, use (29), (4), (30) and (31): then

$$\bar{M} = (1-\alpha)M_{t-1} + \alpha(kP_tY+\varepsilon_t) + (1-\alpha)M^*_{t-1} + \alpha(kP_tY^*+\varepsilon_t^*)$$

So, using (29) and (2):

$$P_t = \frac{\bar{M} - (\varepsilon_t+\varepsilon_t^*)}{k(Y+Y^*)} \qquad (32)$$

With $\varepsilon_t = -\varepsilon_t^*$ then $P_t = \frac{\bar{M}}{k(Y+Y^*)}$ for all t.

The remainder of the analysis proceeds as in Section I.

(b) If the disturbances in the two countries are perfectly positively correlated with $\varepsilon_t = \varepsilon_t^*$, then, from (32)

$$P_t = \frac{\bar{M} - 2\varepsilon_t}{k(Y+Y^*)}$$

Then using (4) to compute the asymptotic variance of the money supply in the home country:

$$\sigma_M^2 = (1-\alpha)^2\sigma_M^2 + \alpha^2(k^2Y^2\sigma_p^2 + 2kY \text{ cov } (P_t\varepsilon_t) + \sigma_\varepsilon^2) \qquad (33)$$

$$= (1-\alpha)^2\sigma_M^2 + \alpha^2\sigma_\varepsilon^2\left(\frac{4Y^2}{(Y+Y^*)^2} - \frac{4Y}{(Y+Y^*)} + 1\right)$$

Since $Y=Y^*$ by assumption

$$\sigma_M^2 = 0. \qquad (34)$$

Thus with perfect positive correlation of the disturbances the money supply in each country remains fixed, consumption is equal to output in each country, and behavior is the same as it is under flexible rates.[6/]

(c) In other cases -- i.e. when the correlation coefficient is less than unity in absolute value -- the variance of prices is greater than it is for the single country under fixed rates and the variance of consumption is less than it is for the single country under fixed rates.

II.B Real Disturbances.

This case will be analyzed in more detail than was done for money demand disturbances. Accordingly, it is necessary to make strong assumptions about

---

6/ It will be recalled that with perfect positive correlation of the disturbances under flexible rates, the exchange rate remained constant.

the distributions of the levels of income in each country. We assume that income has the gamma distribution,[7/] with parameters $n > 2$ and $\lambda > 0$ in each country. For $n > 1$, the distribution is hump-shaped and skewed to the right. The mean and variance of Y_t and Y_t^* are given by

$$E(Y_t) = \frac{n}{\lambda} = \mu_Y \qquad E\left(\left(Y_t - \frac{n}{\lambda}\right)^2\right) = \frac{n}{\lambda^2} = \sigma_Y^2 \tag{35}$$

and similarly for Y^*. Given the assumptions on the distributions, we now proceed to examine the behaviour of the system under the two exchange rate regimes.

(i) Floating Rates

Under floating rates both prices and consumption are variable. The variance of real consumption is given by

$$\sigma_{c/p}^2 = \sigma_Y^2 = \frac{n}{\lambda^2} \tag{36}$$

The price level is determined by

$$P_t = \frac{M}{kY_t} \tag{37}$$

with resultant variance of prices

$$\sigma_P^2 = \frac{\lambda^2 M^2}{k^2(n-1)^2(n-2)} \tag{38}$$

(ii) Fixed Rates

(a) With perfectly negatively correlated disturbances, the analysis of section II.A (ii) (a) applies almost exactly. The price level in

---

7/ See Mood, Graybill and Boes (1974, p. 112) for details on the gamma distribution. The chi-square distribution belongs to the gamma family.

each country stays constant but there is variability of consumption for each country, equal to

$$\sigma^2_{c/n} = \sigma^2_Y\left((1-\alpha k)^2 + \frac{\alpha^4 k^2}{1-(1-\alpha)^2}\right) = \frac{n}{\lambda^2}\left((1-\alpha k)^2 + \frac{\alpha^4 k^2}{1-(1-\alpha)^2}\right) \tag{39}$$

This variance of consumption is less than that under floating rates. Surprisingly though, although world output is constant, consumption in each country is not constant. Thus smoothing through the balance of payments is not complete. There would be more -- though probably not complete -- smoothing of consumption in the presence of capital movements

(b) If the disturbances are perfectly positively correlated, then $Y_t \equiv Y^*_t$ and the system behaves exactly like the flexible exchange rate system, with the same variances of prices and consumption in each country as under flexible rates.

(c) With zero correlation of the disturbances, we have

$$P_t = \frac{\bar{M}}{k(Y_t+Y^*_t)} \tag{40}$$

with

$$\sigma^2_P = \frac{\bar{M}^2\lambda^2}{k^2(2n-1)^2(2n-2)} \tag{41}$$

Comparing (38) with (41), assuming $2M = \bar{M}$, the price level for the individual country will be more stable under fixed than floating rates on the assumption $n > 2$ which is required for the variance to exist for the single country.

To calculate the variance of consumption, it is first necessary to obtain the variance of the money stock, using (4), (29) and (40).

$$M_t = (1-\alpha)M_{t-1} + \alpha\bar{M}\frac{Y_t}{Y_t+Y_t^*} \tag{42}$$

yielding[8/]

$$E(M_t) = \frac{\bar{M}}{2} \text{ and } \sigma_M^2 = \frac{\bar{M}^2}{4(2-\alpha)(2n+1)} \tag{43}$$

Then, from (3), (4) and (5),

$$\frac{C_t}{P_t} = Y_t(1-\alpha k) + \frac{\alpha M_{t-1}}{P_t} = Y_t(1-\alpha k) + \frac{\alpha k M_{t-1}}{\bar{M}}(Y_t+Y_t^*)$$

It follows that

$$E\left(\frac{C_t}{P_t}\right) = \frac{n}{\lambda} \tag{44}$$

and[9/]

$$\sigma_{c/p}^2 = \frac{n}{\lambda^2}\left((1-\alpha k) + \frac{\alpha^3 k^2}{1-(1-\alpha)^2}\right)$$

This variance is smaller than the variance of consumption under floating rates but larger than the corresponding variance when incomes in the two countries are perfectly negatively correlated.

Thus, as one would expect, with real disturbances, consumption is more stable under fixed than floating rates, and is more stable under fixed rates, the smaller (algebraically) the correlation between the disturbances in the two countries.

8/ The reason for using the gamma distribution should now be clear. The sum of independent gamma-distributed variables with the same λ is gamma-distributed; the ratio of gamma distributed variables with the same λ has the beta distribution. Thus $(Y_t+Y_t^*)$ is gamma distributed with parameters 2n and λ; the ratio in (42) is beta distributed with parameters n and n. See Mood, Graphill and Boes (1974, p. 115) for the beta distribution.

9/ The derivation of (45) is fairly lengthy and will be supplied on request.

II.C Active Monetary Policy.

Under fixed exchange rates there is room for stabilizing monetary policy by one or both countries: the effects of one country's stabilizing actions on the other depend critically on the correlation of disturbances in the two countries.

At one extreme, where total world income and output are constant (perfect negative correlation of disturbances), stabilization of consumption by one country is automatically stabilizing for the other country. At the other extreme of perfect correlation, stabilization by one country is automatically destabilizing for the other.[10/]

With zero correlation of disturbances, there is room for the adoption of the same monetary rule in each country such that the rule is mutually stabilizing and more stabilizing than the adoption of the rule by one country alone.

Let ΔMG_t and ΔMG_t^* be the policy induced changes in period t in the money supply domestically and in the foreign country respectively. Let $\bar{M}_t$ be the world money supply in period t. Then it can be shown that

$$P_t = \frac{\alpha\bar{M}_{t-1} + \Delta MG_t + \Delta MG_t^*}{\alpha k(Y_t+Y_t^*)} \tag{46}$$

and

10/ Accordingly, as Jacob Frenkel has pointed out to me, the potential for conflict with regard to policy depends crucially on the correlations of disturbances.

$$\frac{C_t}{P_t} = Y_t(1-\alpha k) + \frac{\alpha M_{t-1} + \Delta MG_t}{P_t}$$

$$= Y_t(1-\alpha k) + \frac{\alpha M_{t-1} + \Delta MG_t}{\alpha \bar{M}_{t-1} + \Delta MG_t + \Delta MG_t^*} \alpha k(Y_t+Y_t^*)$$

$$= Y_t(1-\alpha k) + \phi(\quad)\alpha k(Y_t+Y_t^*)$$

We want now to consider the potential for agreement on rules of the game. It can be shown that, from the viewpoint of each country, and conditional on the assumption that ΔMG_t and ΔMG_t^* are functions only of lagged variables, that the optimal policy is to keep the function $\phi(\quad)$ in (47) and the corresponding $\phi^*(\quad)$ function each constant. If one country -- say the foreign country -- uses a purely passive policy, it appears at first glance that the domestic country can manipulate ΔMG_t to keep $\phi(\quad)$ constant, even though ϕ^* will then be stochastic. However, that implies that the asymptotic variance of the price level is infinite[11/] -- i.e. that adoption of a stabilizing rule for domestic consumption by the domestic monetary authority creates price level instability for the world.

On the other hand, both countries acting together can stabilize consumption in each country and maintain world price stability.[12/] In particular, subject to each country's using the same rule, an optimal rule for stabilizing consumption is the policy rule (21) where kPY is now $kE(P_tY_t)$. Then, for the

---

11/ At issue is the root of the difference equation for M_t^*, since for $\phi(\quad) \equiv \theta$, $P_t = \frac{M_{t-1}^*}{(1-\theta)k(Y_t+Y_t^*)}$. The relevant difference equation is $M_t^* = \left(1-\alpha + \frac{\alpha Y_t^*}{(1-\theta)(Y_t+Y_t^*)}\right)M_{t-1}^*$. Now, in order for the expected price level not to have a trend, it is necessary to set $\theta = 1/2$. But then the asymptotic variance of the price level is infinite.

12/ In the sense that price level variance is finite.

home country,

$$\frac{C_t}{P_t} = Y_t(1-\alpha k) + \frac{\alpha k}{2}(Y_t + Y_t^*) \tag{48}$$

yielding

$$\sigma^2_{c/p} = \frac{n}{\lambda^2}\left(1-\alpha k + \frac{\alpha^2 k^2}{2}\right),$$

a variance which is less than that obtained under passive policy as given in (45). In addition, the variance of the price level is finite.[13] If the domestic country alone followed the rule, the variance of its consumption would exceed that in (49).

13/ The rule (21) is not the only rule which yields the variance (49) -- hence the reference to it as "an" optimal rule. However, it is probably the only one of those rules which also keeps the price level stable.

III. CONCLUSIONS

The paper had two basic aims: first, to study the responses of an economy to various repeated disturbances under systems of flexible and fixed exchange rates; and second, to consider potential rules of the game for monetary policy under fixed rates.

The conclusions with regard to the first point are simple: if disturbances are monetary, then under floating rates, price level changes absorb the shocks completely while the shocks are transmitted to consumption under fixed rates. If disturbances are real, then floating rates prevent the transmission of shocks abroad and result in greater instability of consumption -- even for both countries in a two country world -- than obtains under fixed rates. Incidentally, it is seen that results in the small country case are equivalent to those obtaining in the two-country world with perfect negative correlation of disturbances. The conclusions on the superiority of flexible rates in the face of monetary shocks depends heavily on the assumption that price level instability, *per se*, has no real effects. If price level instability produces real instability through a Phillips curve or some other mechanism, then the superiority of floating rates in the face of monetary shocks becomes less certain. Despite their simplicity, the conclusions differ from those of Mundell (1960) who argues that, with capital immobility, stability is always greater under floating than under fixed rates.

Given the structure of the model in which money balances are restored to equilibrium with a distributed lag, there is room for a stabilizing active monetary policy under fixed rates with real disturbances. The extent to which one country's stabilization policy with regard to consumption is stabilizing for the other country depends on the correlation of the disturbances in the two countries. If the disturbances are perfectly positively correlated, then one country can stabilize only be destabilizing the consumption of the other country. If the disturbances are perfectly negatively correlated, then any stabilization by one country is automatically stabilizing for the other country. In the case of zero correlation of disturbances, a simple monetary rule is derived which stabilizes consumption for both countries if used by each.

It is also appropriate to comment on certain features of the analysis and to consider extensions. First, it should be noted that the assumption of a one-period lag by the authorities in adjusting the money supply is very strong: in this model some private sector adjustments are made before the authorities can react. In particular, under flexible rates, price level adjustment in response to monetary disturbances occur within one period and absorbs the entire shock. Under fixed rates, the monetary authorities are not given an opportunity to react to the monetary disturbance until one period later. The more usual assumption may be that the authorities respond faster than the private sector. Evidence on the issue is hard to find. Second, it should be noted that it has been assumed that mean rates of output are independent of the exchange rate system and also, for most of the analysis, that output is exogenous. Third, and most important, the analysis will be extended to include capital movements which would presumably operate to smooth consumption and would permit the modification of the very tight link between consumption and money stock behavior of the present model.

REFERENCES

Argy, Victor and Kouri, Pentti J.K., "Sterilization Policies and the Volatility in International Reserves", forthcoming in Robert Z. Aliber, ed., National Monetary Policies and the International Monetary System, University of Chicago Press, 1974.

Baumol, William J., "Pitfalls in Contracyclical Policies; Some Tools and Results", Review of Economics and Statistics, (February 1961), 21-26.

Dornbusch, Rudiger, "Devaluation, Money, and Nontraded Goods", American Economic Review, (December 1973), 871-80.

Hanoch, Giora, "Desirability of Price Stabilization of Destabilization", Harvard Institute of Economic Research, Discussion Paper Number 351, March 1974.

Johnson, Harry G., "The Case for Flexible Exchange Rates, 1969", Federal Reserve Bank of St. Louis Review, (June 1969), 12-24.

Kindleberger, Charles P., "The Case for Fixed Exchange Rates, 1969", in the Federal Reserve Bank of Boston Conference Series No.2, The International Adjustment Mechanism, (October 1969), 93-108.

Laffer, Arthur B., "Two Arguments for Fixed Rates", in H.G. Johnson and A.K. Swoboda (eds.) The Economics of Common Currencies, (London: Allen and Unwin, 1973), 25-34.

Lucas, Robert E. Jr., "Some International Evidence on Output -- Inflation Tradeoffs", American Economic Review, (June 1973), 326-34.

McKinnon, Ronald I., "Sterilization in Three Dimensions: Major Trading Countries, Euro-currencies, and the United States", forthcoming in Robert Z. Aliber, ed., National Monetary Policies and the International Monetary System, University of Chicago Press, 1974.

Mood, Alexander M., Graybill, Franklin A., and Boes, Duane C., Introduction to the Theory of Statistics, Third Edition. (New York: Macmillan, 1974).

Mundell, Robert A., "The Monetary Dynamics of International Adjustment under Fixed and Flexible Exchange Rates", Quarterly Journal of Economics, (May 1960), 227-57.

Stein, Jerome L., "The Optimum Foreign Exchange Market", American Economic Review, (June 1963), 384-402.

Tower, Edward and Courtney, Mark M., "Exchange Rate Flexibility and Macro-Economic Stability", Review of Economics and Statistics, (May 1974), 215-24.