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THE ROLE OF INTERVENTION POLICY IN OPEN ECONOMY FINANCIAL POLICY: A MACROECONOMIC PERSPECTIVE

by

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I. INTRODUCTION

This paper is an analysis of the extent to which alternative financial stabilization policies can be expected to dampen the effects of shocks to macroeconomic equilibrium in open economies. According to the view emphasized here intervention policy is an integral part of open economy financial policy.[1/] Intervention operations have effects on macroeconomic variables which can be distinguished from those of monetary operations. Thus the specification of a financial policy regime is not complete until both the intervention and monetary policies of the financial authorities have been described. An alternative view according to which intervention operations have no effects so that the specification of a financial policy regime requires only a description of monetary policy is also discussed briefly.

Intervention operations and monetary operations are defined in Section II. Whether one open economy financial policy regime is better than another usually depends on the source of disturbances to the economy. In Section III this observation is illustrated by a comparison of the effects of different kinds of transitory disturbances to macroeconomic equilibrium in a single open economy under two alternative pure financial policy regimes. Under an "aggregates constant policy" the money supply is kept unchanged

and there is no intervention, so the interest rate and the exchange rate vary when disturbances are experienced. Under a "rates constant policy" monetary operations and intervention operations are employed to keep the interest rate and the exchange rate fixed. The tool of analysis is a discrete time stochastic model in which agents have rational expectations. It is shown that for disturbances to the market for the home good an aggregates constant policy results in less variation in output and that for disturbances to financial markets a rates constant policy results in less variation in output. Section IV is a demonstration that similar results can be obtained when the economy is subject to one kind of permanent disturbance as well as transitory disturbances.

To establish that the nature of the truly optimal financial policy regime depends on the kind of information available to the authorities about the structure of the economy and about the disturbances to which it is subjected is the purpose of Section V. There it is argued that under general conditions it is not optimal for the authorities in a single open economy facing transitory disturbances either to rigidly fix the exchange rate or to allow it to fluctuate freely.

In Section VI attention is turned to the interactions in a two-country world economy that must be considered when choosing financial policies. It is emphasized that the overall stance of intervention policy is the result of the intervention policies of both countries. Then it is shown that for two kinds of transitory disturbances the two countries would agree on what the overall stance of intervention policy should be while for another kind of transitory disturbance a policy conflict would arise. The tool of analysis

is an extended version of the model of Section III. Since intervention policy conflicts can arise, the financial authorities in different countries have an interest in keeping track of the overall stance of intervention policy. Some of the practical difficulties encountered by financial authorities (and private agents) in trying to accomplish this task are discussed in Section VII. Section VIII contains some concluding remarks about the usefulness of the analysis and some suggestions for extending it.

II. DEFINITIONS OF MONETARY OPERATIONS AND INTERVENTION OPERATIONS

The stylized balance sheet of the financial authorities in a hypothetical country which is called the home country has the home money supply as a liability and both home and foreign currency securities as assets. The home authorities' holdings of foreign currency securities are their only foreign exchange reserves. At a given exchange rate, changes in the three balance sheet items must sum to zero, so values for only two of the three items can be chosen independently. The authorities conduct financial policy using two kinds of financial market operations: (1) monetary operations, exchanges of home money for home securities with private agents and (2) intervention operations, exchanges of home currency securities for foreign currency securities with private agents.[2/] Monetary operations alter the mix of money and securities denominated in the same currency available to the public. Intervention operations alter the supplies of securities denominated in different currencies available to the public. The intervention operation just described is often referred to as "sterilized intervention" because it leaves both the home money supply and the foreign money supply unchanged. Although the home money supply may change during the course of the operation,

it is returned again to its original value before the operation is complete. Suppose the authorities sell a foreign currency security to private agents. They obtain foreign money but sell it back to private agents for home money, temporarily reducing the home money supply. However, they then purchase a home currency security from private agents, thus restoring the home money supply to its original value, in order to complete the intervention operation.

There is a widely held view that if the authorities sell a foreign currency security, say, in order to prevent the home currency from depreciating, they reduce the home money supply either unintentionally or intentionally. From the description of an intervention operation above it is easy to see that the home money supply could be lower if the authorities did not complete the intervention operation by purchasing a home currency security. Failure to complete the intervention operation would never be unintentional That is, if the authorities allow the home money supply to remain lower, it is because, given the other choices available to them, they want it to be lower. The view is taken in this paper that if the authorities sell a foreign currency security and do not purchase a home currency security with the home money they acquire, their action can most clearly be understood as being a combination of the intervention operations and monetary operations defined above. If this view is adopted, only monetary operations change the home money supply.

It is interesting to define intervention operations in the way suggested above and to study the effects of such operations only if home currency and foreign currency securities are imperfect substitutes in the portfolios of private agents. If these two types of securities were perfect substitutes, an

intervention operation as defined above would have no effect on the economy. Financial policy would consist only of monetary operations, and whether the money supply were changed through exchanges for home currency securities or for foreign currency securities would be of no consequence. There is no general agreement among economists that home currency securities and foreign currency securities are imperfect enough substitutes that intervention operations of a reasonable size have any important or lasting effect on the economy. Empirical evidence is accumulating on this issue, but it remains unresolved.[3/] The analysis of this paper proceeds under the assumption that home and foreign currency securities are imperfect enough substitutes for one another to warrant inclusion of intervention policy in the study of open economy financial policy.

III. TRANSITORY DISTURBANCES AND FINANCIAL POLICY RESPONSES IN A SINGLE OPEN ECONOMY

In this section a discrete time stochastic model of a single open economy in which agents have rational expectations is employed to analyze the effects of some transitory disturbances to macroeconomic equilibrium under two pure financial policy regimes, an aggregates constant policy and a rates constant policy.[4/] In the first subsection the model is described, and the results are presented and explained.[5/] In the second subsection the results are derived more formally.

The Model and the Results

In the real sector of the economy attention is focused on aggregate demand for and aggregate supply of the single home good which is different

from the single foreign good. Home output (Y) must be equal to aggregate demand for the home good:

$$Y = y_0 + y_1(Y + \overset{*}{Y}) - y_2 r - y_3 \overset{*}{r} + y_4(e + \overset{*}{p} - p) + y_5 e - y_6 p + \alpha + \beta . \quad (1)$$

Here, and in what follows, all coefficients except intercept terms are positive. Aggregate demand depends negatively on the expected real interest rates on home currency securities (r) and on foreign currency securities ($\overset{*}{r}$) and on the (logarithm of the) home currency price of the home good (p). Increases in expected real interest rates raise home and foreign saving. Increases in the price of the home good reduce home and foreign real wealth measured in terms of the home good, and therefore, raise home and foreign saving.[6/] Aggregate demand depends positively on home output, on foreign output ($\overset{*}{Y}$), on the (logarithm of the) exchange rate (e) defined as the home currency price of foreign currency, and on the (logarithm of the) relative price of the foreign good ($e + \overset{*}{p} - p$), where $\overset{*}{p}$ is the (logarithm of the) foreign currency price of the foreign good. Increases in home and foreign output raise income at home and abroad and, therefore, spending on the home good.[7/] It is assumed that the marginal propensities to consume the home good (y_1), to consume the foreign good ($\overset{*}{y}_1$), and to save ($s = 1 - y_1 - \overset{*}{y}_1$) are the same in both countries and are all positive.[8/] A depreciation of the home currency (rise in e) increases the home currency value of foreign currency assets thereby raising home and foreign wealth and reducing home and foreign saving. An increase in the relative price of the foreign good shifts home and foreign spending toward the home good and raises foreign income measured in terms of the home good thereby stimulating foreign spending on the home good. Aggregate demand depends positively on two disturbance terms, α and β.

Positive values of α (β) represent increases in the demand for the home good at the expense of saving (demand for the foreign good). These stochastic variables and those introduced below to represent other disturbances are assumed to have zero means and to be mutually and serially uncorrelated.

The expected real interest rate on home currency securities is equal to the nominal interest rate on these securities (i) minus the expected rate of increase in the average home currency price of the consumption bundle of both home country and foreign country residents:

$$r = i - \bar{h}(\bar{p} - p) - (1 - \bar{h})(\bar{e} - e + \bar{\overset{*}{p}} - \overset{*}{p}). \tag{2}$$

$\bar{h}$ is the proportion of spending that would be allocated to the home good by residents of both countries if all of the disturbance terms were zero. $\bar{p}$, $\bar{e}$, and $\bar{\overset{*}{p}}$ are the constant values of p, e, and $\overset{*}{p}$ expected in any period to prevail in the next period. The expected real interest rate on foreign currency securities is equal to the nominal interest rate on these securities ($\overset{*}{i}$) plus the expected rate of depreciation of the home currency minus the expected rate of increase in the average home currency price of the world consumption bundle:

$$\overset{*}{r} = \overset{*}{i} + \bar{e} - e - \bar{h}(\bar{p} - p) - (1 - \bar{h})(\bar{e} - e + \bar{\overset{*}{p}} - \overset{*}{p}). \tag{3}$$

Home output must also be equal to aggregate supply which depends negatively on the (logarithm of the) real wage measured in terms of the domestic good:

$$Y = x_0 - x_1(w - p). \tag{4}$$

The (logarithm of the) real wage is equal to the (logarithm of the) nominal wage in the home country (w) minus the (logarithm of the) price of the home good. It is assumed that private agents want to supply each period a given amount of labor which does not change when the real wage changes. If this amount of labor is fully utilized in production, the full employment level of output (Y_f) results. However, since the process of wage negotiation is costly, private agents enter into a labor contract each period before other markets meet. They agree to supply whatever amount of labor firms want at the prevailing real wage. Thus, output can exceed its full employment level if the real wage is low enough. They also agree to set the nominal wage at the constant value ($\bar{w}$) which would insure that employment would equal its full employment level if all disturbances were zero:

$$w = \bar{w}. \tag{5}$$

In order to calculate $\bar{w}$, private agents must know the parameters of the economic model and the announced values of the financial authorities' policy instruments.

In the financial sector of the model, attention is focused on the markets for two assets, home money and home currency securities. Home (foreign) residents hold home (foreign) money but no foreign (home) money. The supply of home money (M) must equal the demand for home money by home residents:

$$M = m_0 + m_1 p + m_2(e + \overset{*}{p}) + m_3 Y - m_4 i - m_5(\overset{*}{i} + \bar{e} - e) + \gamma + \delta. \tag{6}$$

Home money demand depends positively on the price of the home good, the exchange rate, the price of the foreign good, and home output. Increases in all of these variables raise the transactions demand for money balances. Money demand depends negatively on the nominal interest rate on home currency securities and on the expected nominal return on foreign currency securities measured in home currency which is equal to the nominal interest rate on foreign currency securities plus the expected rate of depreciation of the home currency. Money demand depends positively on two disturbance terms, γ and δ. Positive values γ (δ) represent shifts of home residents' asset preferences toward home money and away from home currency securities (foreign currency securities).

The supply of home currency securities (B) must equal the demand for these securities by both home and foreign residents:

$$B = b_0 - b_1 p - b_2 \overset{*}{p} - b_3 Y + b_4 i - b_5(\overset{*}{i} + \bar{e} - e) + b_6(i - \bar{e} + e) - b_7 \overset{*}{i} + b_8 e - b_9 \overset{*}{Y} - \gamma + \varepsilon. \tag{7}$$

It is assumed that both home and foreign residents determine the home currency amount that they will hold in securities by subtracting their money demands measured in home currency from the home currency value of their wealth and allocate the same fraction of this amount to home currency securities. The resulting demand for home currency securities depends negatively on the prices of the home and foreign goods, on home and foreign output, on the expected nominal return on foreign currency securities measured in home currency, and on the nominal interest rate on foreign currency securities. Increases in prices and outputs raise the transactions demands for money of both home and

foreign residents partly at the expense of their demands for home currency securities. It is assumed that both home and foreign residents regard the three assets they hold as strict gross substitutes. Therefore, the negative effect of an increase in the expected rate of return on foreign securities (the nominal interest rate on foreign securities) on the demand for home securities resulting from the increased relative attractiveness of foreign currency securities dominates the positive effect on this demand resulting from reduced home (foreign) money demand. The demand for home currency securities depends positively on the nominal interest rate on home currency securities, on the expected nominal rate of return on home currency securities measured in foreign currency which is equal to the nominal interest rate on home currency securities minus the expected rate of depreciation of the home currency, and on the exchange rate. Increases in the nominal interest rate on home currency securities (the expected rate of return on home securities) make these securities more attractive relative to foreign securities and reduce home (foreign) money demand. Therefore, $b_4 > m_4$. It is assumed that the postive effect of an increase in the exchange rate on the demand for home currency securities resulting from the increased home currency value of world wealth dominates the negative effect on this demand resulting from increased home currency denominated demand for both home and foreign money for transactions purposes. The demand for home securities depends negatively (positively) on the disturbance term γ (ε). Positive values of γ (ε) represent decreases (increases) in the demand for home currency securities matched by increases (decreases) in the demand for home money (foreign currency securities).

Now the behavior of the home and foreign financial authorities is described. It is assumed that the home authorities do not observe home output

and the price of the home good in the current period. They can choose as policy instruments, and set values for, any two of the four financial variables M, B, i, and e. The values of the other two variables are determined by the model. The discussion of the home authorities' balance sheet in section II implies that if the home authorities seek to change B without changing M, they must also change the supply of foreign currency securities available to the public through intervention operations. It is assumed that the home authorities follow either an aggregates constant policy or a rates constant policy. Under an aggregates constant policy M and B are kept unchanged, while under a rates constant policy M and B are allowed to vary to keep i and e constant. Under each policy regime, the home authorities set and announce the same values for two financial policy instruments before markets meet each period; that is, they either do not observe or elect not to respond to movements in the financial variables for which they do not set values. The announced values of the two financial policy instruments can be chosen arbitrarily because private agents set the nominal wage so that the expected value of Y is equal to Y_f given these announced values. In this and the next two sections it is assumed that the foreign authorities can observe the level of foreign output ($\overset{*}{Y}$) and the price of the foreign good ($\overset{*}{p}$) in the current period and that they act to keep these variables as well as the interest rate on foreign currency securities ($\overset{*}{i}$) fixed at constant values denoted by $\overline{\overset{*}{Y}}$, $\overline{\overset{*}{p}}$, and $\overline{\overset{*}{i}}$.[9/] Given the nature of the disturbances and the behavior of the authorities, it is rational for agents to expect in any period that the values of the price of the home good and the exchange rate in the next period will be equal to the constants $\overline{p}$ and $\overline{e}$, respectively, and

for home residents to set the nominal wage at the constant $\bar{w}$ each period before other markets meet.[10/] [11/]

Equilibrium schedules for the markets for the home good, home money, and home currency securities are shown in Figure 1. In order to construct these schedules it is necessary to eliminate p from these markets with the use of the relationship between p and Y implied by the aggregate supply function when w is set equal to $\bar{w}$. X_0X_0 is an equilibrium schedule for the home good. An increase in i, which lowers demand, must be accompanied by a decline in Y, which raises excess demand. M_0M_0 is an equilibrium schedule for home money. An increase in i, which reduces money demand, must be offset by a rise in Y, which raises money demand. B_0B_0 is an equilibrium schedule for home currency securities. An increase in i, which raises demand, must be matched by an increase in Y which lowers demand. It is assumed that the effect of an increase in Y on the demand for home money is greater than the absolute value of the effect of an increase in Y on the demand for home currency securities.[12/] In the next subsection it is demonstrated that this assumption is sufficient to insure that M_0M_0 is steeper than B_0B_0 as shown in Figure 1, and the implications of relaxing it are discussed. X_0X_0, M_0M_0, and B_0B_0 are the equilibrium schedules which would result if all disturbances were zero, so they intersect at Y_f. Changes in the exchange rate or the home authorities' holdings of home and foreign securities cause the schedules to shift in a manner described below.

Consider the effects of stochastic shifts in the XX schedule in the range between X_1X_1 and X_2X_2 shown in Figure 1. These shifts might result from disturbances affecting home or foreign saving behavior or from disturbances

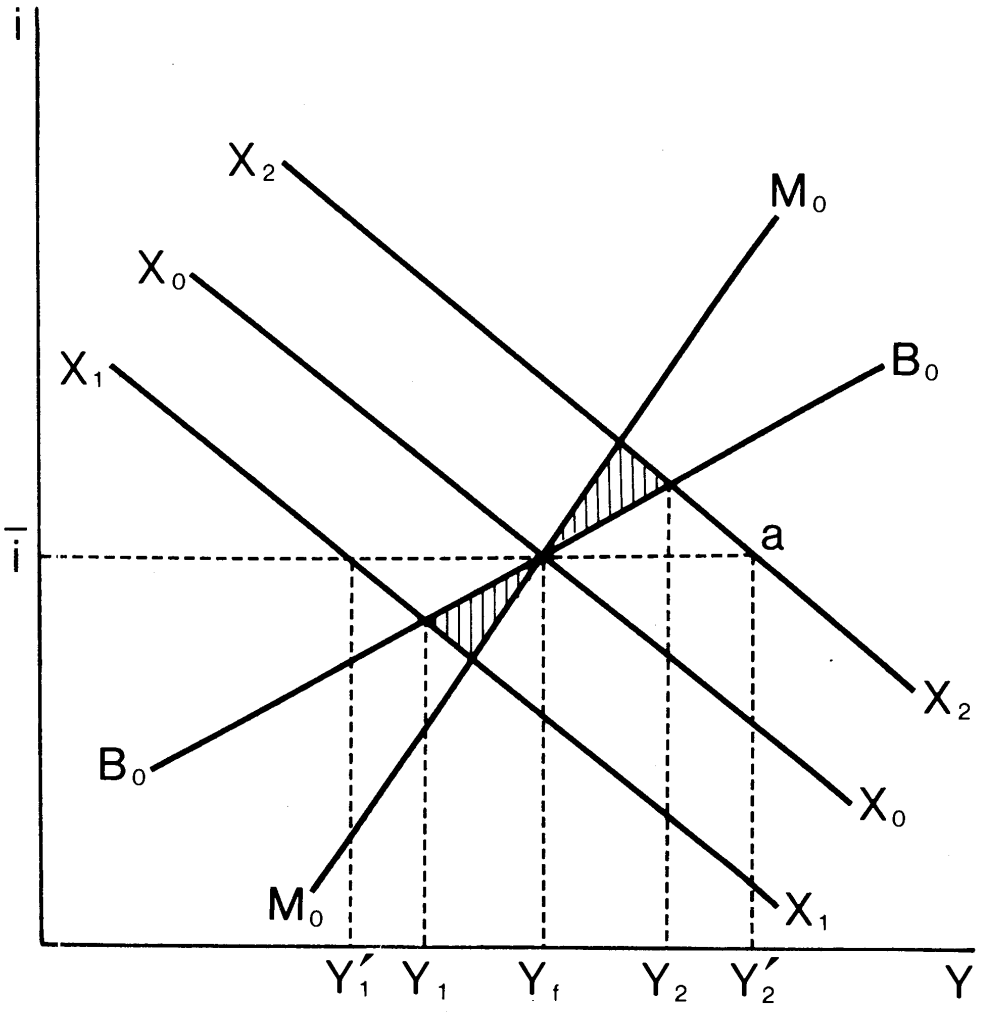

Figure 1

affecting the allocation of spending between home and foreign goods either at home or abroad. If the authorities pursue an aggregates constant policy, levels of output between Y_1 and Y_2 result. For example suppose an increase in the demand for the home good shifts the XX schedule to X_2X_2 and gives rise to excess demand for the home good. Output tends to increase, creating an excess demand for home money and an excess supply of home securities. These disequilibria can be removed only by a rise in i and an appreciation of the home currency (fall in e). An appreciation of the home currency raises excess supply in the markets for the home good, home money, and home currency securities. As the home currency appreciates, the X_2X_2, M_0M_0, and B_0B_0 schedules shifts toward one another until they intersect at a point in the shaded triangle above X_0X_0.

If instead the authorities pursue a rates constant policy, levels of output between Y_1' and Y_2' result. If the XX schedule shifts to X_2X_2, then the new equilibrium point is at point a. Since there is no change in the exchange rate the XX schedule does not shift back from X_2X_2. The MM and BB schedules are shifted to the right by monetary and intervention operations until they pass through point a. An expansionary monetary operation, a purchase of home securities with home money, shifts both MM and BB to the right. However, BB is shifted farther since increases in income raise the demand for money by more than they reduce the demand for home currency securities. Thus, in order to keep both the exchange rate and interest rate constant, the authorities must undertake an intervention operation, a sale of home securities in exchange for foreign securities, so that the BB schedule does not shift farther to the right than point a. When the only source of shocks to equilibrium is

stochastic shifts in the XX schedule, an aggregates constant policy leads to less variation in output than a rates constant policy. Under an aggregates constant policy disturbances to the home good market induce changes in the interest rate and the exchange rate that dampen the movement in output.

A different kind of conclusion is reached when shocks to financial markets are considered. For purposes of illustration, attention is focused on a type of shock for which intervention operations are the appropriate remedy. Consider stochastic shifts in the BB schedule between B_1B_1 and B_2B_2 shown in Figure 2. These shifts result from changes in preferences between home and foreign securities either at home or abroad. If the authorities pursue an aggregates constant policy, levels of output between Y_1 and Y_2 result. Suppose a shift in asset preferences toward home securities and away from foreign securities causes the BB schedule to move to B_2B_2. The increase in the demand for home securities leads to a decrease in i, which in turn creates excess demand for home money. In order for equilibrium in financial markets to be reestablished, the home currency must appreciate. Appreciation causes the three schedules to shift together as before, so the new equilibrium must lie in the shaded triangle below B_0B_0. Output may fall, rise, or remain the same since the changes in financial variables have opposite effects on demand for the home good.

If instead, the authorities pursue a rates constant policy, output definitely remains unchanged. The BB schedule is shifted back to B_0B_0 by an intervention opration consisting of a sale of home securities and purchase of foreign securities. When the only source of shocks to equilibrium is stochastic shifts in the BB schedule, a rates constant policy leads to less variation in output than an aggregates constant policy.

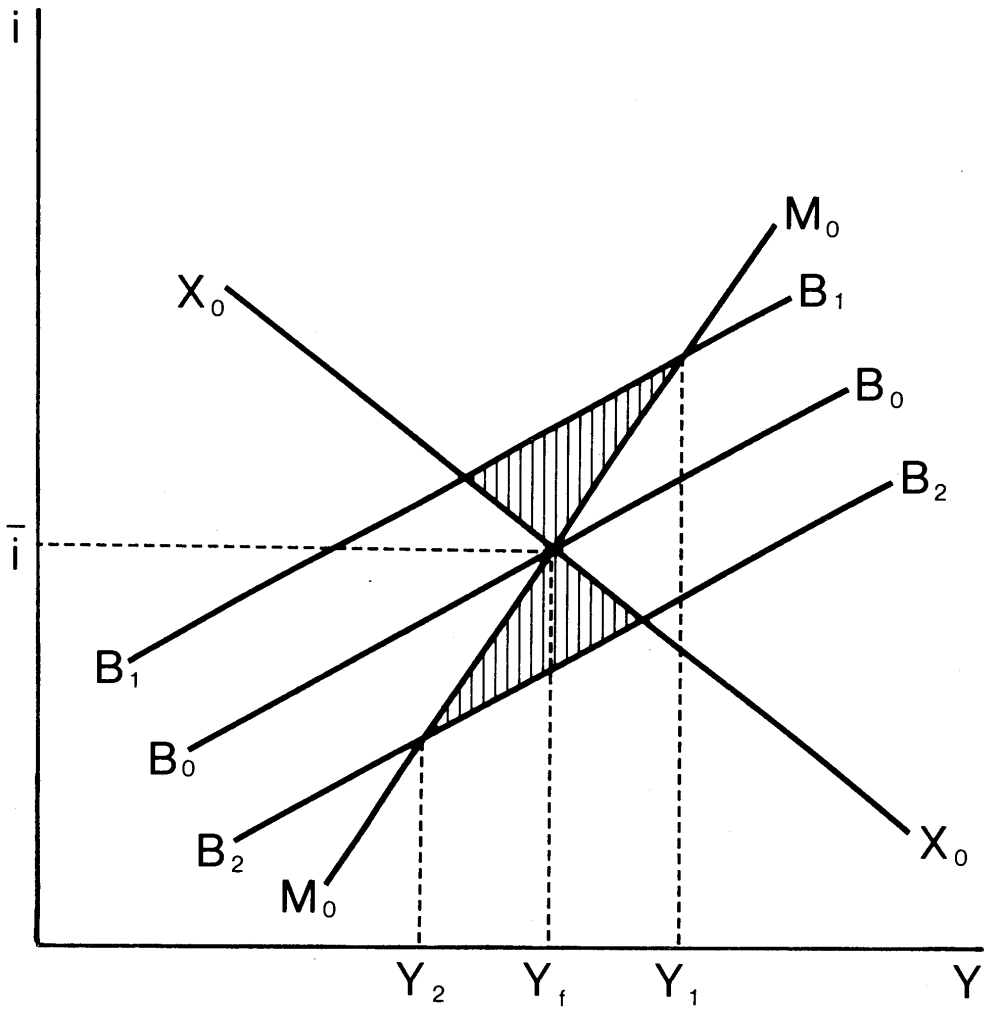

Figure 2

Two other possible sources of stochastic shocks to equilibrium are (1) shifts in home residents' preferences between home money and foreign securities which cause movements in the MM schedule and (2) shifts in home residents' preferences between home money and home securities which cause movements in both the MM and BB schedules. In both these cases, a rates constant policy leads to less variation in output than an aggregates constant policy. Under a rates constant policy the transmission of financial market disturbances to the market for the home good through interest rate and exchange rate changes is prevented.

The Derivation of the Results

This subsection contains a formal derivation of the results of the previous subsection. It is convenient to work with the model in a somewhat more compact form. (2) and (3) are substituted into (1), and (5) is substituted into (4). The modified version of (4) is solved for p, and the result is substituted for p wherever it appears in the other equations. Each of these other equations with the disturbances set equal to zero is subtracted from the same equation with the disturbances free to take on any value to obtain

$$0 = -y_Y\hat{Y} - y_2\hat{i} + y_e\hat{e} + \alpha + \beta, \tag{8}$$

$$\hat{M} = m_Y\hat{Y} - m_4\hat{i} + m_e\hat{e} + \gamma + \delta, \tag{9}$$

$$\hat{B} = -b_Y\hat{Y} + b_i\hat{i} + b_e\hat{e} - \gamma + \varepsilon, \tag{10}$$

where

$$y_Y = s + \overset{*}{y}_1 + [y_4 + (y_2 + y_3)\bar{h} + y_5]x_1, \qquad b_Y = b_1/x_1 + b_3,$$

$$y_e = y_4 - y_2(1 - \bar{h}) + y_3\bar{h} + y_5, \qquad b_i = b_4 + b_6,$$

$$m_Y = m_1/x_1 + m_3, \qquad b_e = b_5 + b_6 + b_8.$$

$$m_e = m_2 + m_5,$$

A hat over a variable indicates the deviation of that variable from its constant expected value. It is assumed that relative price and wealth effects outweigh possibly "perverse" expected real interest rate effects so that y_e is positive. Foreign variables do not appear in (8), (9), and (10) because they are fixed by the foreign authorities.

The difference between the slopes of the MM and BB schedules of Figure 1 is

$$(\hat{i}/\hat{Y})_{MM} - (\hat{i}/\hat{Y})_{BB} = (m_Y b_i - b_Y m_4)/(b_i m_4). \tag{11}$$

It has been assumed that $m_Y > b_Y$. This assumption is sufficient to insure that the MM schedule is steeper than the BB schedule since $b_4 > m_4$ and therefore $b_i > m_4$. The intuitively appealing result that an increase in the demand for the home good ($\alpha > 0$) causes the home currency to appreciate under an aggregates constant policy is obtained if and only if the MM schedule is steeper than the BB schedule.

The variances of home output (σ_Y^2) under a rates constant (RC) and an aggregates constant (AC) financial policy regime are given by

$$\sigma_Y^2|_{RC} = (1/y_Y)^2(\sigma_\alpha^2 + \sigma_\beta^2), \tag{12}$$

$$\sigma_Y^2|_{AC} = (C_1/\Delta_1)^2(\sigma_\alpha^2 + \sigma_\beta^2) + [(C_2 + C_3)/\Delta_1]^2\sigma_\gamma^2 + (C_2/\Delta_1)^2\sigma_\delta^2 + (C_3/\Delta_1)^2\sigma_\varepsilon^2, \tag{13}$$

$$C_1 = m_4 b_e + b_i m_e, \qquad C_3 = y_2 m_e - m_4 y_e,$$

$$C_2 = y_2 b_e + b_i y_e, \qquad \Delta_1 = y_Y C_1 + m_Y C_2 + b_Y C_3.$$

Since $b_i > m_4$ and it has been assumed that $m_Y > b_Y$, $C_2 + C_3$ and the sum of the second and third terms in Δ_1 are positive. Thus, if $\sigma_\gamma^2 = \sigma_\delta^2 = \sigma_\varepsilon^2 = 0$ and either σ_α^2 or $\sigma_\beta^2 > 0$, $\sigma_Y^2|_{AC} < \sigma_Y^2|_{RC}$. This result can still be obtained if $m_Y < b_Y$ but (11) is positive or if (11) is negative but $y_2(m_Y b_e + b_Y m_e) > |y_e(m_Y b_i - b_Y m_4)|$. If $\sigma_\alpha^2 = \sigma_\beta^2 = 0$ and σ_γ^2, σ_δ^2, or $\sigma_\varepsilon^2 > 0$ then $0 = \sigma_Y^2|_{RC} < \sigma_Y^2|_{AC}$.

IV. PERMANENT DISTURBANCES AND FINANCIAL POLICY RESPONSES IN A SINGLE OPEN ECONOMY

This section contains a brief description of some implications of alternative financial policy responses when a single open economy experiences permanent as well as transitory disturbances. The analysis of the effects of transitory disturbances above proceeds under the assumption that private agents know exactly the structure of the economy which is embodied in the coefficients of an economic model, including the intercept terms of that model. However, they are ignorant of the current values of the transitory disturbance terms when they set the nominal wage given the announced constant values of the financial policy instruments. While the average level of output is its full employment level, there are variations in output about this level. It is into this environment that permanent disturbances are introduced.

As an example of a permanent disturbance consider a once and for all shift up in the demand for the home good. Of course, if private agents know that this disturbance has occured and take it into account when setting the nominal wage, it has no effect on the average levels of output and employment.

Now suppose that private agents do not realize that this permanent disturbance has occurred. It seems reasonable to assume that the nominal wage would not be changed, at least for a while. During this time the average real wage would be lower and the average level of output would be higher than their full employment values under either an aggregates constant or a rates constant financial policy regime. The results regarding the effects of transitory disturbances under alternative financial policy regimes carry over with minor modifications to cases in which a permanent disturbance is also present. For an unrecognized permanent disturbance in the market for the home good (markets for home money and home currency securities) the deviation of average output from its full employment level is smaller (greater) under an aggregates constant policy than under a rates constant policy. After a while private agents would recognize that levels of output above the full employment value were being observed more frequently than would be suggested by what was known about the joint probability distribution of the transitory disturbances, would conclude that the economic structure had changed, and would change the nominal wage. Important research on how private agents would go about trying to separate permanent from transitory disturbances under various sets of conditions is well under way, but it is not reported on here.[13/]

Up to this point only the case of a single permanent disturbance has been considered. Such a disturbance would not call into question the feasibility of a rates constant policy unless it were large enough to require, for example, the sale of most of the authorities' foreign currency securities in intervention operations. However, if there were a series of even moderate-sized permanent disturbances that required the sale of foreign currency securities by the authorities, such as a succession of permanent shifts in asset preferences away from home currency securities and toward foreign currency securities, a rates constant financial policy regime, even though desirable, might not be feasible because the financial authorities might exhaust their holdings of foreign currency securities.

V. TRANSITORY DISTURBANCES, INFORMATION, AND FINANCIAL POLICIES IN A SINGLE OPEN ECONOMY

The analysis of this section proceeds under the assumption of section III that the economy experiences only transitory disturbances. In section III conclusions were drawn about which of two alternative financial policy regimes the authorities should choose if all disturbances were in the home good market or if all disturbances were in financial markets. Here it is asked how the financial authorities should proceed when the economy is buffeted by all of the types of transitory disturbances considered above. It is assumed that both the authorities and private agents wish to minimize the expected squared deviations of output from Y_f. What financial policy is optimal depends on what information the authorities have about the structure of the economy, about the disturbances to which it is subjected, and about the current values

of the two financial variables they do not set when implementing their monetary and intervention policies.

Suppose the authorities operate in an environment in which they know, or have unchanging beliefs about, the nonstochastic coefficients of the three linear market equilibrium relations and the joint distribution of the additive disturbance terms. Suppose also that they cannot observe output and the price of the home good, and cannot observe or, at least, do not respond to current movements in the two financial variables they do not set when implementing their monetary and intervention policies. In this environment it makes sense to compare alternative pure financial policies under which values for the two financial variables chosen as policy instruments are set before markets meet each period and are not changed once markets meet. The aggregates constant and rates constant policies considered above are examples of such pure financial policies. Once a policy is found to be superior it is followed period after period unless there are changes in the parameters of the system or the joint distribution of the stochastic disturbances.[14/]

The analysis of section III suggests one kind of conclusion; for example, given the coefficients of the system and all of the other parameters of the joint distribution of the disturbances, there exists a variance of the disturbance term in the market for the home good large enough to insure that an aggregates constant policy leads to lower expected loss than a rates constant policy. Additional conclusions must be based on explicit calculations of expected losses. Suppose that the three equilibrium relations are normalized on income and that the variances of the normalized disturbances are equal.[15/] An aggregates constant policy may or may not be better than a rates constant

policy whereas under similar assumptions in a closed economy a money supply constant policy dominates an interest rate constant policy.[16] An aggregates constant policy is superior (inferior) to a rates constant policy for large values of the degree of substitutability between home and foreign securities (the responsiveness of home good demand to changes in the exchange rate).

The authorities should proceed differently in a second environment in which the only difference is that they can observe and respond to current movements in the two financial variables not chosen as policy instruments.[17] In this environment one policy instrument can be kept fixed. However, the authorities should choose and announce a linear rule which tells them how to vary the other policy instrument in response to deviations of the remaining two financial variables from their expected values.[18] These remaining two financial variables can be regarded as information variables since deviations in these variables from their expected values provide a basis for making estimates of the current values of the disturbance terms. In general, the coefficients of the decision rule will be functions of both the coefficients of the model and the parameters of the joint distribution of the additive disturbance terms. While the decision rule is the same period after period, the value of the variable policy instrument is changed from period to period since the authorities can learn something about the shocks in the current period from observations on the two information variables. It has been assumed that the authorities change a financial policy instrument in response to current information while the nominal wage remains fixed at a value set before other market meet. That the authorities rather than private agents should adjust to current information even if it is available to both sets of agents seems reasonable since the costs associated with

changing a financial policy instrument are much smaller than the costs associated with renegotiating the nominal wage.[19/]

The implication that one financial instrument, for example the exchange rate, can be kept fixed depends crucially on the assumption that the authorities and private agents are concerned only about expected squared deviations of Y from Y_f.[20/] If the authorities and private agents were also concerned, for example, about expected squared deviations in interest-sensitive consumption from some desired level, optimal financial policy would involve variations in both financial policy instruments, so the exchange rate would have to vary no matter whether it was chosen as a policy instrument or was used as an information variable. Thus, in general circumstances it will always be optimal for an individual country to opt for a managed floating exchange rate rather than a fixed or freely floating exchange rate.

VI. TRANSITORY DISTURBANCES AND THE SCOPE FOR AGREEMENT ON FINANCIAL POLICIES IN A TWO-COUNTRY WORLD ECONOMY

Up to this point it has been assumed that the authorities in the foreign country have enough information and a sufficient number of policy instruments to set foreign output and the price of the foreign good in addition to the interest rate on foreign securities. It seems more natural to suppose that the foreign authorities are no better informed than the home authorities and, therefore, cannot fix foreign output and the price of the foreign good so that transitory disturbances such as those considered above affect outputs in both countries of the two-country world economy. Here the model of section III is extended to incorporate this assumption.[21/] For simplicity it is also assumed that the authorities in each country use

monetary operations to fix the interest rate on securities denominated in the currency of their country. The overall stance of intervention policy is the net result of the intervention operations of the two sets of authorities. Taken together they can choose as a policy instrument and set a value for either the total supply of home currency securities (and, by implication, the total supply of foreign currency securities) or the exchange rate. In this environment it is interesting to consider whether the authorities in the two countries could agree on a fixed or a freely fluctuating exchange rate. In the first subsection the necessary modifications to the model are described, and the results are presented and explained. In the second subsection the results are derived more formally.

The Modifications to the Model and the Results

The only additional market which must be considered explicitly is the market for the foreign good. Foreign output ($\overset{*}{Y}$) must be equal to aggregate demand for the foreign good:

$$\overset{*}{Y} = \overset{*}{y}_0 + \overset{*}{y}_1(Y + \overset{*}{Y}) - \overset{*}{y}_2 r - \overset{*}{y}_3 \overset{*}{r} - y_4(e + \overset{*}{p} - p) - \overset{*}{y}_5 e - \overset{*}{y}_6 \overset{*}{p} - \beta . \quad (14)$$

Aggregate demand depends negatively on expected real interest rates, on the relative price of the foreign good, on the exchange rate, and on the price of the foreign good. Increases in the exchange rate and the price of the foreign good reduce home and foreign real wealth measured in terms of the foreign good and, therefore, raise home and foreign saving. Aggregate demand depends positively on home and foreign output. It is assumed that trade is initially balanced so that the effect of an increase in the relative price of the foreign good on the demand for the foreign good is equal in absolute value to the effect on the demand for the home good.[22/] Positive

values of β represent decreases in the demand for the foreign good matched by increases in demand for the home good.

Foreign output must also be equal to aggregate supply which depends negatively on the (logarithm of the) real wage measured in terms of the foreign good:

$$\overset{*}{Y} = \overset{*}{x}_0 - \overset{*}{x}_1(\overset{*}{w} - \overset{*}{p}). \tag{15}$$

The (logarithm of the) real wage is equal to the (logarithm of the) foreign nominal wage ($\overset{*}{w}$) minus the (logarithm of the) price of the foreign good. It is assumed that the nominal wage is set each period before other markets meet at the constant value ($\overline{\overset{*}{w}}$) which would insure that employment would equal its desired level and output would equal its corresponding full employment level ($\overset{*}{Y}_f$) if all disturbances were zero:

$$\overset{*}{w} = \overline{\overset{*}{w}}. \tag{16}$$

Equilibrium schedules for the home good, the foreign good, and home currency assets are shown in Figure 3. In order to construct these schedules it is necessary to eliminate p and $\overset{*}{p}$ from these markets with the use of the relationships between p and Y and between $\overset{*}{p}$ and $\overset{*}{Y}$ implied by the aggregate supply functions when w and $\overset{*}{w}$ are set equal to $\overline{w}$ and $\overline{\overset{*}{w}}$. X_0X_0 is an equilibrium schedule for the home good. An increase in Y which reduces excess demand must be matched by a rise in $\overset{*}{Y}$ which increases demand. $\overset{*}{X}_0\overset{*}{X}_0$ is an equilibrium schedule for the foreign good. An increase in Y which raises demand must be matched by a rise in $\overset{*}{Y}$ which reduces excess demand. The XX schedule is steeper than the $\overset{**}{XX}$ schedule. The absolute value of the reduction in excess demand for the home good caused by a rise in Y which increases home saving as well as home imports exceeds the increase in excess demand for the foreign good caused by a rise in Y which increases not only foreign exports (home imports)

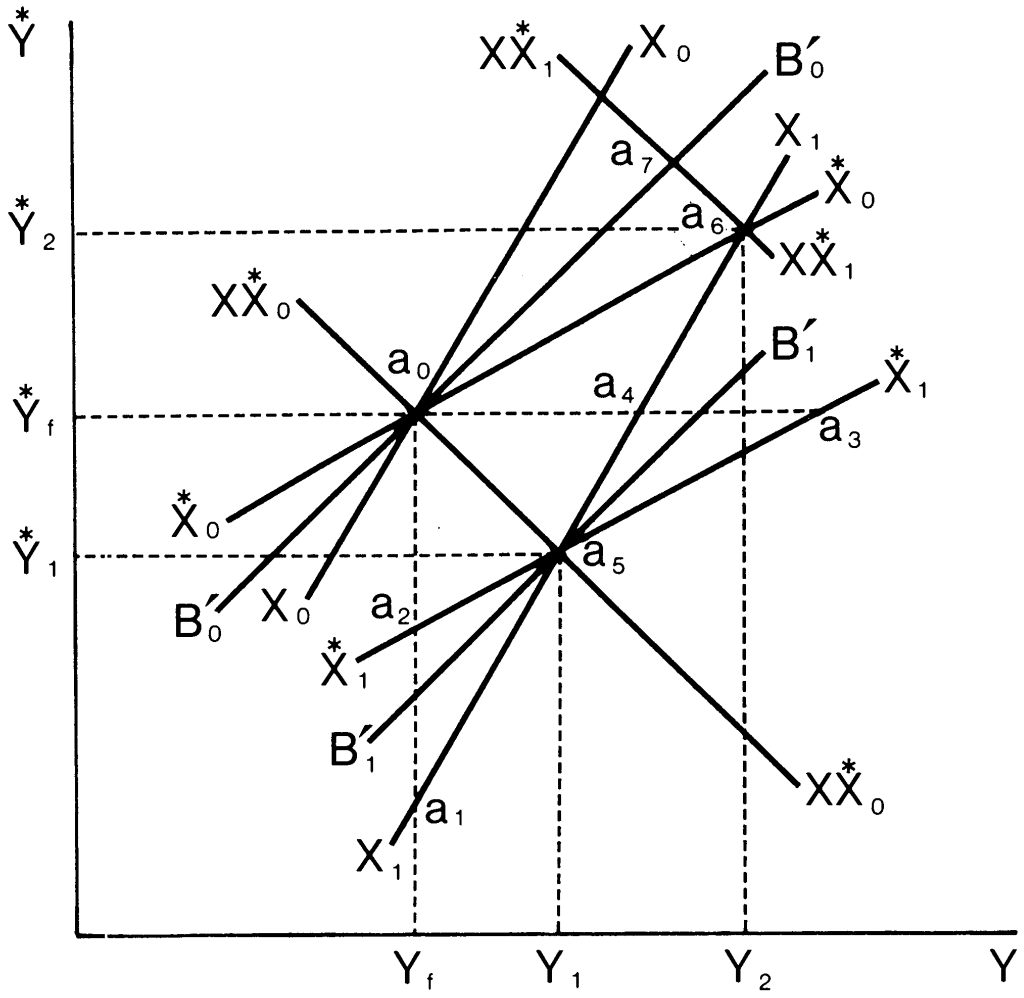
Y*
Y*2
Y*f
Y*1
XX*1
X0
B'0
X1
a7
X*0
a6
XX*1
XX*0
a0
B'1
a4
X*1
a3
X*0
a5
B'0
X0
a2
X*1
B'1
a1
X1
XX*0
Yf
Y1
Y2
Y

Figure 3

but also foreign saving. The increase in excess demand for the home good caused by a rise in $\overset{*}{Y}$ which increases not only home exports (foreign imports) but also home saving is less than the absolute value of the reduction in excess demand for the foreign good caused by a rise in $\overset{*}{Y}$ which increases foreign saving as well as foreign imports. $B'_0B'_0$ is an equilibrium schedule for the combined market for home money and home currency securities. Attention is focused on this combined market for home currency assets because the home authorities alter the supplies of home money and home securities with monetary operations to satisfy any change in the composition of home currency assets desired by private agents at a constant interest rate on home currency securities. An increase in Y which raises the demand for home money plus home currency securities must be offset by a rise in $\overset{*}{Y}$ which raises the demand for foreign money partly at the expense of the demand for home currency securities. The slope of the B'B' schedule may be greater than or less than the slopes of both the XX and $\overset{**}{XX}$ schedules or it may be greater than the slope of the $\overset{**}{XX}$ schedule but less than the slope of the XX schedule as shown in Figure 3.[23/]

It is useful to consider first the effects of a shift up in the demand for the home good matched by a shift down in the demand for the foreign good which is equal in absolute value. These shifts can be represented by movements in the XX schedule from X_0X_0 to X_1X_1 and in the $\overset{**}{XX}$ schedule from $\overset{*}{X}_0\overset{*}{X}_0$ to $\overset{*}{X}_1\overset{*}{X}_1$. At a constant value of Y, XX shifts down farther than $\overset{**}{XX}$ ($a_0a_1 > a_0a_2$) since in the market for the home good a fall in $\overset{*}{Y}$ reduces not only home exports (foreign imports) but also home saving, while in the market for the foreign good it raises foreign saving as well as foreign imports, A

similar argument can be employed to demonstrate that the demand shift under consideration causes $\overset{**}{XX}$ to shift farther to the right than XX at a constant $\overset{*}{Y}$ ($a_0a_3 > a_0a_4$). A series of demand shifts of the type under consideration would trace out the $\overset{*}{XX}_0\overset{*}{XX}_0$ schedule in Figure 3.

Now consider the effect of a depreciation of the home currency. This depreciation raises demand for the home good and lowers demand for the foreign good. If these two demand effects were equal in absolute value, depreciations (and, of course, appreciations) would also trace out the $\overset{*}{XX}_0\overset{*}{XX}_0$ schedule in Figure 3. In many two-country models the two demand effects are necessarily equal in absolute value when depreciations in the neighborhood of balanced trade are considered because the only effect of a depreciation on the markets for the home and foreign goods is to raise the relative price of the foreign good. This increase leads to changes which are equal in absolute value in the markets for the two goods. However, in this model a depreciation affects expected real interest rates and real wealth in addition to the relative price of the foreign good, so the two demand effects of the depreciation are not necessarily equal in absolute value. There is a set of quite stringent assumptions which, in combination with assumptions already made, is sufficient to insure that the two demand effects are equal in absolute value.[24/] In order to simplify the analysis and to make the results readily comparable to those of other models that set of assumptions is adopted here.[25/] Given these assumptions depreciations (appreciations) of the home currency move the XX and $\overset{**}{XX}$ schedules down (up) so that they continue to intersect on the $\overset{*}{XX}_0\overset{*}{XX}_0$ schedule.

Now the analysis of the effects of a shift up in the demand for the home good matched by a shift down in the demand for the foreign good which is

equal in absolute value can be completed. The shifted XX and $\overset{**}{XX}$ schedules are X_1X_1 and $\overset{*}{X}_1\overset{*}{X}_1$. Under fixed exchange rates the new equilibrium is at point a_5. The shift in preferences for goods causes home output to rise and foreign output to fall. Both of these movements tend to raise the demand for home currency assets, so the home currency tends to appreciate. However, the authorities undertake intervention operations, sales of home currency securities in exchange for foreign currency securities which shift the B'B' schedule down. The new B'B' schedule labeled $B'_1B'_1$ passes through a_5. Under flexible exchange rates the home currency appreciates dampening the rise in home output and the fall in foreign output. The B'B' schedule shifts down and the XX and $\overset{**}{XX}$ schedules shift up along $\overset{*}{XX}_0\overset{*}{XX}_0$ until an equilibrium is reached somewhere on the line segment a_0a_5 above a_5. Thus, for shifts in demands between home and foreign goods there is less variation in both home and foreign output under floating exchange rates, and there is no policy conflict.

Now consider a shift in asset preferences toward home currency assets and away from foreign currency assets. For convenience, suppose that the initial equilibrium is at a_5. The change in asset preferences shifts the B'B' schedule from $B'_1B'_1$ to $B'_0B'_0$. Under fixed exchange rates the new equilibrium is at a_5, which is also the initial equilibrium. The shift in asset preferences puts pressure on the home currency to appreciate. Under fixed exchange rates this pressure is met by intervention operations, sales of home securities in exchange for foreign securities, which shift the B'B' schedule from $B'_0B'_0$ back to $B'_1B'_1$. Under flexible exchange rates the home currency appreciates lowering home output and raising foreign output. B'B'

shifts down and XX and $\overset{**}{XX}$ shift up along $\overset{*}{X}\overset{*}{X}_0\overset{*}{X}\overset{*}{X}_0$ until a new equilibrium is reached along the line segment a_0a_5 above a_5. Thus, for shifts in asset preferences between home currency and foreign currency assets there is less variation in both home and foreign output under fixed exchange rates, and there is no policy conflict.

Finally consider a shift up in home demand for the home good at the expense of home saving. Suppose the initial equilibrium is at a_0. This disturbance initially affects only the XX schedule which is shifted from X_0X_0 to X_1X_1. Under fixed exchange rates the new equilibrium is at a_6. Home output rises, and as a result of induced home demand for foreign goods, foreign output rises. When the B'B' schedule is steeper than the $\overset{**}{XX}$ schedule, there is pressure on the home currency to appreciate.[26/] Under fixed exchange rates this pressure is countered with intervention operations which cause the B'B' schedule to shift down from $B'_0B'_0$. The new B'B' schedule (not shown) passes through a_6. Under flexible exchange rates the home currency appreciates dampening the rise in home output but exaggerating the rise in foreign output. The B'B' schedule shifts down, and the XX and $\overset{**}{XX}$ schedules shift up along the new $\overset{*}{X}\overset{*}{X}\overset{*}{X}\overset{*}{X}$ schedule $\overset{*}{X}\overset{*}{X}_1\overset{*}{X}\overset{*}{X}_1$ until a new equilibrium is reached on the line segment a_7a_6 above a_6. Thus, for shifts in demand for the home good corresponding to shifts in saving there is more variation in home (foreign) output under fixed (floating) exchange rates than under floating (fixed) exchange rates,[27/] and there is a policy conflict.[28/]

The Derivation of the Results

This subsection contains a formal derivation of the results of the previous subsection. As before it is useful to work with the model in a

somewhat more compact form. (2) and (3) are substituted into (1) and (14); (5) is substituted into (4), and (16) is substituted into (15). The modified versions of (4) and (15) are solved for p and $\overset{*}{p}$ respectively and the results are substituted for p and $\overset{*}{p}$ wherever they appear in (1), (6), (7), and (14). The further modified versions of (1) and (14) and the sum of the modified versions of (6) and (7) with the disturbances set equal to zero are subtracted from the same equations with the disturbances free to take on any values, and $\hat{i}$ is set equal to zero to obtain

$$0 = - y_Y \hat{Y} + y_e \hat{e} + y_{\overset{*}{Y}} \overset{*}{\hat{Y}} + \alpha + \beta, \tag{17}$$

$$0 = \overset{*}{y}_Y \hat{Y} - \overset{*}{y}_e \hat{e} - \overset{*}{y}_{\overset{*}{Y}} \overset{*}{\hat{Y}} - \beta, \tag{18}$$

$$\hat{B}' = b'_Y \hat{Y} + b'_e \hat{e} - b'_{\overset{*}{Y}} \overset{*}{\hat{Y}} + \delta + \varepsilon. \tag{19}$$

$\hat{B}'$ is the deviation of B from its expected value in addition to the deviation that is equal in magnitude and opposite in sign to the deviation of the money supply from its expected value ($\hat{B} = \hat{B}' - \hat{M}$). y_Y and y_e are defined above, and

$$y_{\overset{*}{Y}} = y_1 + [y_4 - (y_2 + y_3)(1 - \bar{h})]/\overset{*}{x}_1, \qquad b'_Y = m_Y - b_Y,$$

$$\overset{*}{y}_{\overset{*}{Y}} = s + y_1 + [y_4 + (\overset{*}{y}_2 + \overset{*}{y}_3)(1 - \bar{h}) + \overset{*}{y}_5]/\overset{*}{x}_1, \qquad b'_e = m_e + b_e,$$

$$\overset{*}{y}_e = y_4 + \overset{*}{y}_2(1 - \bar{h}) - \overset{*}{y}_3\bar{h} + \overset{*}{y}_5, \qquad b'_{\overset{*}{Y}} = b_2/\overset{*}{x}_1 + b_7.$$

$$\overset{*}{y}_Y = \overset{*}{y}_1 + [y_4 - (\overset{*}{y}_2 + \overset{*}{y}_3)\bar{h}]/x_1,$$

It is assumed that income, relative price, and wealth effects outweigh possibly "perverse" expected real interest rate effects so that $y_{\overset{*}{Y}}$, $\overset{*}{y}_e$, and

$\overset{*}{y}_Y$ are all positive. m_Y, b_Y, m_e, and b_e are defined above. It has been assumed above that $m_Y > b_Y$, so b'_Y is positive.

The difference between the slopes of the XX and $\overset{**}{XX}$ schedules of Figure 3 is

$$(\overset{\wedge}{\overset{*}{Y}}/\hat{Y})_{XX} - (\overset{\wedge}{\overset{*}{Y}}/\hat{Y})_{\overset{**}{XX}} = (y_Y\overset{*}{y}^*_Y - \overset{*}{y}_Y y^*_Y)/(y^*_Y\overset{*}{y}^*_Y). \tag{20}$$

The XX schedule is steeper than the $\overset{**}{XX}$ schedule since $y_Y > \overset{*}{y}_Y$ and $\overset{*}{y}^*_Y > y^*_Y$. B'B' has a positive slope but this slope may be greater or less than the slopes of XX and $\overset{**}{XX}$. The difference between the shifts in XX and $\overset{**}{XX}$ schedules at a constant value of Y given a positive β is

$$(\overset{\wedge}{\overset{*}{Y}}/\beta)_{XX} - (\overset{\wedge}{\overset{*}{Y}}/\beta)_{\overset{**}{XX}} = (y^*_Y - \overset{*}{y}^*_Y)/(y^*_Y\overset{*}{y}^*_Y). \tag{21}$$

The XX schedule shifts down farther since $\overset{*}{y}^*_Y > y^*_Y$. It can be shown that the $\overset{**}{XX}$ schedule shifts farther to the right than the XX schedule at a constant value of $\overset{*}{Y}$ given a positive β since $y_Y > \overset{*}{y}_Y$.

Under the assumption that $y_e = \overset{*}{y}_e$ the variances of home output (σ^2_Y) and foreign output ($\sigma^2_{\overset{*}{Y}}$) under fixed (FI) and flexible (FL) exchange rates are given by

$$\sigma^2_Y|_{FI} = (\overset{*}{y}^*_Y/D_1)^2\sigma^2_\alpha + [(\overset{*}{y}^*_Y - y^*_Y)/D_1]^2\sigma^2_\beta, \tag{22}$$

$$\sigma^2_{\overset{*}{Y}}|_{FI} = (\overset{*}{y}_Y/D_1)^2\sigma^2_\alpha + [(\overset{*}{y}_Y - y_Y)/D_1]^2\sigma^2_\beta, \tag{23}$$

$$\sigma^2_Y|_{FL} = (D_3/\Delta_2)^2\sigma^2_\alpha + [b'_e(\overset{*}{y}^*_Y - y^*_Y)/\Delta_2]^2\sigma^2_\beta + [y_e(y^*_Y - \overset{*}{y}^*_Y)/\Delta_2]^2(\sigma^2_\delta + \sigma^2_\varepsilon), \tag{24}$$

$$\sigma^2_{\overset{*}{Y}}|_{FL} = (D_4/\Delta_2)^2\sigma^2_\alpha + [b'_e(\overset{*}{y}_Y - y_Y)/\Delta_2]^2\sigma^2_\beta + [y_e(y_Y - \overset{*}{y}_Y)/\Delta_2]^2(\sigma^2_\delta + \sigma^2_\varepsilon), \tag{25}$$

$$D_1 = y_Y \overset{*}{y}_{\overset{*}{Y}} - \overset{*}{y}_Y y_{\overset{*}{Y}}, \qquad D_3 = y_e b'_{\overset{*}{Y}} + b'_e \overset{*}{y}_{\overset{*}{Y}},$$

$$D_2 = [b'_Y(\overset{*}{y}_{\overset{*}{Y}} - y_{\overset{*}{Y}}) + b'_{\overset{*}{Y}}(y_Y - \overset{*}{y}_Y)], \qquad D_4 = y_e b'_Y + b'_e \overset{*}{y}_Y,$$

$$\Delta_2 = b'_e D_1 + y_e D_2.$$

D_1, D_2, D_3, D_4, and Δ_2 are all positive. Thus, if $\sigma^2_\alpha = \sigma^2_\delta = \sigma^2_\varepsilon = 0$ and $\sigma^2_\beta > 0$, then $\sigma^2_Y|_{FL} < \sigma^2_Y|_{FI}$ and $\sigma^2_{\overset{*}{Y}}|_{FL} < \sigma^2_{\overset{*}{Y}}|_{FI}$. If $\sigma^2_\alpha = \sigma^2_\beta = 0$ and either σ^2_δ or $\sigma^2_\varepsilon > 0$, then $0 = \sigma^2_Y|_{FI} < \sigma^2_Y|_{FL}$ and $0 = \sigma^2_{\overset{*}{Y}}|_{FI} < \sigma^2_{\overset{*}{Y}}|_{FL}$. By manipulating the coefficients of σ^2_α in (22), (23), (24), and (25) it can be shown that if $\sigma^2_\beta = \sigma^2_\delta = \sigma^2_\varepsilon = 0$ and $\sigma^2_\alpha > 0$, then $\sigma^2_Y|_{FL} \lesseqgtr \sigma^2_Y|_{FI}$ but $\sigma^2_{\overset{*}{Y}}|_{FL} \gtreqless \sigma^2_{\overset{*}{Y}}|_{FI}$ when $b'_Y \overset{*}{y}_{\overset{*}{Y}} \gtreqless b'_{\overset{*}{Y}} \overset{*}{y}_Y$. When $b'_Y \overset{*}{y}_{\overset{*}{Y}}$ is greater (less) than $b'_{\overset{*}{Y}} \overset{*}{y}_Y$ the B'B' schedule is steeper (flatter) than the $\overset{**}{XX}$ schedule in Figure 3 since

$$(\overset{\hat{}}{\overset{*}{Y}}/\hat{Y})_{B'B'} - (\overset{\hat{}}{\overset{*}{Y}}/\hat{Y})_{\overset{**}{XX}} = (b'_Y \overset{*}{y}_{\overset{*}{Y}} - b'_{\overset{*}{Y}} \overset{*}{y}_Y)/(b'_{\overset{*}{Y}} \overset{*}{y}_{\overset{*}{Y}}).$$

VII. KEEPING TRACK OF INTERVENTION POLICY

This section is a description of some of the difficulties encountered by financial authorities and private agents in trying to keep track of the overall stance of intervention policy which is the net result of the intervention policies in many countries.[29/] In the last section examples were provided of two types of disturbances for which the authorities in two countries could agree on the overall stance of intervention policy and one type for which they would have different views about the appropriate overall stance of intervention policy. Such examples make it clear that the authorities in a given country need information about other countries' intervention operations in order to negotiate effectively with the authorities in those countries

about what actions are required in order to achieve a desirable overall stance for intervention policy. Private agents also need information about intervention policy so that they can base their decisions on reliable forecasts of financial variables including exchange rates. Up to this point it has been assumed that the authorities in each country hold their international reserves only in the form of stocks of government securities denominated in the currencies of other countries and that changes in these stocks reflect the intervention policies of the authorities. In this section additional forms of international reserve assets are considered. Changes in the stocks of these assets as well as certain other transactions described below can also reflect the intervention policies of the authorities.

Unfortunately keeping track of the intervention policies of the authorities in all the relevant countries is often not an easy task either for the authorities themselves or for private agents. Of course, one source of difficulty is that data on the balance sheet of a country's financial authorities, the consolidated balance sheet of the treasury, the central bank, and the exchange stabilization fund, often become available only with a lag, but this is not the most important source. Far more important sources of difficulty are that the balance sheet is often not presented in a way which makes it easy to isolate and determine the net result of intervention policy actions of the financial authorities which are reflected in different places on the balance sheet and that not all policy actions properly regarded as intervention policy actions are even recorded on the balance sheet of the financial authorities.

Some of the more obvious pitfalls encountered in attempting to interpret changes in the consolidated balance sheet of the financial authorities are well recognized and can be avoided by an alert observer. A balance sheet must be presented in terms of a single unit of account, for example, home currency units. If the home currency value of the authorities' foreign currency securities or of other reserve assets such as gold, Special Drawing Rights (SDR's), or International Monetary Fund position changes, the home currency value of reserves changes without any intervention policy actions. Such "valuation changes" must be removed to arrive at the relevant changes in reserve totals. New allocations of SDR's lead to changes in reserves when no intervention policy action has occurred, so these must be taken out. Increases or decreases in foreign currency assets matched by increases or decreases in liabilities denominated in the same foreign currency lead to changes in gross reserves but not net reserves. It is changes in net reserves that constitute intervention policy action. The foreign currency denominated Carter bonds issued by the U.S. Treasury are examples of the type of foreign currency borrowing by the financial authorities which must be included in calculations of net reserves. Arriving at a net reserve figure is sometimes tricky because a country's foreign currency borrowing, say, by the Treasury may be reported at a different point on the consolidated balance sheet than its foreign currency assets held, say, by the exchange stabilization fund.

Less obvious pitfalls remain. Outright forward exchange contracts entered into by the financial authorities are "off balance sheet items" and information about them is not usually available, at least to most private

agents. Forward foreign exchange operations are equivalent to intervention policy actions in their impact on financial variables. The net return in terms of home currency to a private agent who sells a home currency security to and purchases a foreign currency security from the financial authorities is

$$\frac{\tilde{E}}{E}(1 + \overset{*}{r}) - (1 + r), \tag{26}$$

where E is the spot price of foreign currency in terms of home currency, and $\tilde{E}$ is the unknown spot price of foreign currency in terms of home currency that will prevail in ninety days. The net return to a private agent who sells (1 + r) units of home currency forward to the authorities in return for forward foreign currency is

$$\frac{\tilde{E}}{F}(1 + r) - (1 + r), \tag{27}$$

where F is today's home currency price of foreign currency for delivery in ninety days. Covered interest arbitrage ensures that

$$(1 + r) = \frac{F}{E}(1 + \overset{*}{r}). \tag{28}$$

Substitution of the right hand side of (28) for the first (1 + r) in (27) reveals that (27) and (26) are equal. Private agents regard the security exchange which is implied by an intervention operation and the purchase of the forward contract from the authorities as equivalent transactions because they have the same net return.[30/] Thus, these two types of transactions have the same effect on financial variables, and in the absence of knowledge of the authorities' forward foreign exchange operations the intervention

policy stance of the authorities can not be accurately determined.

As part of their intervention policy the financial authorities can persuade private banks or government related institutions to undertake transactions that have the same effect as their own intervention operations would have had. These transactions which are examples of what some have called the "orgranization" of capital flows are reflected on the balance sheets of the private banks or the government related institutions and not on the balance sheet of the financial authorities, so it is difficult if not impossible for other financial authorities and private agents to monitor them. One common example of this type of transaction involves the financial authorities and private banks in a country. The financial authorities buy spot foreign currency from private agents. Instead of using this spot foreign currency to buy foreign currency securities for their own reserves they sell it to a private bank and agree to buy it back forward, sometimes at a price more favorable than the market price, in a so-called swap transaction. The private bank sells a domestic currency security in order to obtain the spot home currency needed to buy the spot foreign exchange from the authorities. The private bank uses the spot foreign exchange obtained from the authorities to buy a foreign currency security. Thus the effect on the supplies of government securities denominated in home and foreign currencies available to private agents other than home country banks is the same as if the financial authorities had performed a standard intervention operation. The foreign exchange exposure of the home private bank is unchanged because its foreign currency security is matched by a forward contract to receive home currency, and the balance sheet of the financial authorities is unchanged because the forward contract is an off balance sheet item.

Another common example of intervention policy not reflected in the balance sheet of the financial authorities is directed borrowing by government related enterprises. These enterprises issue foreign currency denominated debt instead of domestic currency denominated debt thereby making the supplies of home currency and foreign currency securities closely related to government securities which are available to private agents different from what it otherwise would have been. Foreign currency borrowing by government related enterprises is usually matched by forward contracts with the financial authorities.

It appears that the organization of capital flows which has occurred from time to time over at least the past decade may now be assuming a more important role in overall intervention policy. Innovations in such hidden intervention that make it more difficult to detect are liable to proliferate. These development will make the assessment of the overall stance of intervention policy more difficult for both financial authorities and private agents.

VIII. SOME CONCLUDING REMARKS

An important advantage of the approach used here is that it yields suggestive qualitative results. For example, it was shown in section VI that when disturbances arise from stochastic shifts in asset preferences, the authorities in different countries have a mutual interest in intervening to reduce exchange rate variability. This result helps to explain interest in coordinated official intervention to minimize the exchange rate effects of changes in desired portfolio composition by the oil-producing countries and central banks of some other countries.

Most of this paper is devoted to analyzing the effects of serially uncorrelated transitory disturbances under alternative financial policy regimes when current output and price variations are unobservable in at least one country and nominal wages do not deviate from preset paths. The lessons of such analysis seem more relevant when equilibrium in the model is assumed to refer to a "period" of a half year or a year rather than a month or a quarter. The longer the equilibrium period, the more sense it makes to regard disturbances as serially uncorrelated and to presume that alternative financial policy regimes can lead to measurably different outcomes. However, the longer the equilibrium time period, the less plausible it is to assume that current output and price variations are unobservable and to suppose that nominal wages are not adjusted. It is comforting to note that similar results can be obtained in models with serially correlated disturbances for which it seems more natural to take the equilibrium period to be a quarter.

It has been emphasized that in order to decide between alternative pure policy regimes and in order to implement more complicated financial policy regimes that involve rules for changing policy instruments, the authorities need a considerable amount of information. In particular they must know the nonstochastic coefficients of the economic structure and the parameters of the joint distribution of additive disturbances. In studies which attempt to give empirical content to analytical frameworks of the same general type as the one used here, estimates of the relevant coefficients and parameters from existing econometric models have been employed. There is evidence to suggest that this approach can yield useful results.[31] Of course, such a procedure is open to the objection that this type of analytical

framework calls for exact knowledge of coefficients and parameters, not estimates. Much progress has been made in modifying the analytical framework to take account of the fact that only estimates of coefficients and parameters will ever be available to the authorities.[32/]

In this paper intervention policy has been viewed as part of macroeconomic financial policy in open economies rather than as a tool for stabilizing so called disorderly foreign exchange markets. While the empirical relevance of intervention policy for financial policy has not been firmly established, the interest of the authorities in intervention policy suggests that it is worthwhile to make clear what role it might play. More empirical work attempting to isolate the effects of intervention policy is badly needed. It has been argued that managed floating would be best from the viewpoint of individual countries. Further theoretical work that determines whether this conclusion holds when more attention is paid to the problem of distinguishing between permanent and transitory disturbances would be helpful. It has also been emphasized that the authorities in various countries might find it in their interests to manage the float differently. How conflicts that arise over the proper overall stance of intervention are resolved and how they could be resolved more satisfactorily is another promising area for further research.

Appendix

The model of the text is a partly linear and partly log linear approximation to the model sketched out briefly in this appendix. The symbols used are defined at the end of the appendix. The approximation is made at the equilibrium which would emerge if all the disturbance terms were zero and trade were balanced. In this equilibrium all of the endogenous variables take on their constant expected values, which are represented by the symbols for these variables with bars over them, and units are defined so that $\bar{E} = \bar{\overset{*}{P}} = \bar{P} = 1$. The coefficients displayed below or beside a given equation are the coefficients of the approximation to that equation.

The aggregate demand equations for the home and foreign goods are given by

$$PY = h\left(\frac{E\overset{*}{P}}{P}\right)\{PY + E\overset{**}{PY} - c[a(r,\overset{*}{r})(PY + E\overset{**}{PY}) - (A + \overset{*}{A})]\}, \tag{A1}$$

$$y_1 = h(1 - ca), \qquad y_4 = h'(Y + \overset{*}{Y}) + h(1 - ca)\overset{*}{Y},$$

$$y_2 = ca_r Y, \qquad y_5 = hc(M + F),$$

$$y_3 = ca^*_r Y, \qquad y_6 = hc(A + \overset{*}{A}),$$

$$E\overset{**}{PY} = [1 - h\left(\frac{E\overset{*}{P}}{P}\right)]\{PY + E\overset{**}{PY} - c[a(r,\overset{*}{r})(PY + E\overset{**}{PY}) - (A + \overset{*}{A})]\}, \tag{A2}$$

$$\overset{*}{y}_1 = (1 - h)(1 - ca), \qquad y_4 = h'(Y + \overset{*}{Y}) + h(1 - ca)\overset{*}{Y},$$

$$\overset{*}{y}_2 = ca_r \overset{*}{Y}, \qquad \overset{*}{y}_5 = (1 - h)c(M + B),$$

$$\overset{*}{y}_3 = ca^*_r \overset{*}{Y}, \qquad \overset{*}{y}_6 = (1 - h)c(A + \overset{*}{A}).$$

It is assumed that $0 < h$, $ca < 1$ and that a_r, a^*_r, and $h' > 0$, so all the approximation coefficients are positive, and $0 < y_1, \overset{*}{y}_1 < 1$. In deriving y_2, y_3, $\overset{*}{y}_2$, $\overset{*}{y}_3$, and y_4 use is made of the facts that in equilibrium $h(Y + \overset{*}{Y}) = Y$, and $(1 - h)(Y + \overset{*}{Y}) = \overset{*}{Y}$ and that with balanced trade $h\overset{*}{Y} = (1 - h)Y$. ca is represented by s in the text.

$r, \overset{*}{r}$, and $A + \overset{*}{A}$ are given by

$$r = i - \bar{h}\frac{\bar{P} - P}{P} - (1 - \bar{h})\left(\frac{\bar{E} - E}{E} + \frac{\bar{\overset{*}{P}} - \overset{*}{P}}{\overset{*}{P}}\right), \tag{A3}$$

$$\overset{*}{r} = \overset{*}{i} + \frac{\bar{E} - E}{E} - \bar{h}\frac{\bar{P} - P}{P} - (1 - \bar{h})\left(\frac{\bar{E} - E}{E} + \frac{\bar{\overset{*}{P}} - \overset{*}{P}}{\overset{*}{P}}\right), \tag{A4}$$

$$A + \overset{*}{A} \equiv M + B + E(N + F). \tag{A5}$$

The aggregate supply equations for the home and foreign goods are given by

$$Y = X\left(\frac{\bar{W}}{P}\right), \qquad x_1 = - X', \tag{A6}$$

$$\overset{*}{Y} = \overset{*}{X}\left(\frac{\bar{\overset{*}{W}}}{\overset{*}{P}}\right), \qquad \overset{*}{x}_1 = - \overset{*}{X}'. \tag{A7}$$

It is assumed that X' and $\overset{*}{X}' < 0$, so both the approximation coefficients are positive.

The asset market equilibrium conditions are given by

$$M = QL\left(\frac{P}{Q}Y, i, \overset{*}{i} + \frac{\bar{E} - E}{E}\right), \tag{A8}$$

$$m_1 = L - m_2, \qquad m_3 = L_1, \qquad m_4 = - L_2,$$

$$m_2 = (L - L_1 Y)(1 - \bar{h}), \qquad m_5 = - L_3,$$

$$EN = Q\overset{*}{L}\left(\frac{E\overset{*}{P}}{Q}\overset{*}{Y}, i - \frac{\bar{E} - E}{E}, \overset{*}{i}\right), \tag{A9}$$

$$n_1 = (\overset{*}{L} - \overset{*}{L}_1\overset{*}{Y})\bar{h}, \qquad n_3 = \overset{*}{L}_1, \qquad n_4 = - \overset{*}{L}_2,$$

$$n_2 = \overset{*}{L} - n_1, \qquad n_5 = - \overset{*}{L}_3,$$

$$B = k(i - \overset{*}{i} - \frac{\bar{E} - E}{E})[A + \overset{*}{A} - QL(\cdot) - Q\overset{*}{L}(\cdot)], \tag{A10}$$

$$b_1 = k(m_1 + n_1),\ b_4 = k'(A - L) + km_4,\ b_7 = k'(\overset{*}{A} - \overset{*}{L}) - kn_5,$$

$$b_2 = k(m_2 + n_2),\ b_5 = k'(A - L) - km_5,\ b_8 = k(N + F - m_2 - n_2),$$

$$b_3 = km_3,\qquad b_6 = k'(\overset{*}{A} - \overset{*}{L}) + kn_4,\ b_9 = kn_3,$$

$$EF = [1 - k(i - \overset{*}{i} - \frac{\bar{E} - E}{E})][A + \overset{*}{A} - QL(\cdot) - Q\overset{*}{L}(\cdot)]. \tag{A11}$$

Q is given by

$$Q = \bar{h}P + (1 - \bar{h})E\overset{*}{P}. \tag{A12}$$

It is assumed that $0 < k < 1$; that L_1, $\overset{*}{L}_1$, k', $(L - L_1Y)$, $(\overset{*}{L} - \overset{*}{L}_1\overset{*}{Y})$, $(A - L)$, and $(\overset{*}{A} - \overset{*}{L}) > 0$; and that L_2, L_3, $\overset{*}{L}_2$, and $\overset{*}{L}_3 < 0$. These assumptions imply that all the asset market approximation coefficients except b_5, b_7, and b_8 are positive. The assumption that wealth holders in both countries regard the three assets they hold as strict gross substitutes implies that b_5 and b_7 are positive, that is, that the positive effect of the increase in the ratio of wealth minus money demand that home (foreign) wealth holders want to hold in home currency securities exceeds the negative effect of the increase in home (foreign) money demand. It is assumed that b_8 is positive, that is, that the positive effect of the increase in wealth on the demand for home currency securities exceeds the negative effect of the increase in money demands. Note that $A = aY$ and $\overset{*}{A} = a\overset{*}{Y}$ in the equilibrium at which the approximation is made. Adding (A8), (A9), (A10), and (A11) yields the identity (A5), so only three of the four asset market equilibrium conditions are independent. In this paper the equilibrium condition for foreign currency securities, (A11), is not used.

In section III it is assumed that

$$m_Y = m_1/x_1 + m_3 > b_Y = k(m_1 + n_1)/x_1 + km_3, \tag{A13}$$

which can be rewritten as

$$[(1 - k)/k](m_1 + m_3x_1) > n_1. \tag{A14}$$

This condition is more likely to be satisfied the smaller k, the proportion of wealth minus money demand allocated by residents of both countries to home currency securities; the larger m_3, the effect of an increase in home output on home money demand; the larger x_1, the increase in home output associated with an increase in the price of the home good; and the larger (smaller) $m_1(n_1)$, the effect of an increase in the price of the home good on home (foreign) money demand.

In section VI it is assumed that $y_e = \overset{*}{y}_e$ where

$$y_e = c[-a_r(1 - \bar{h}) + a^*_r\bar{h}]Y + h'(Y + \overset{*}{Y}) + \bar{h}(1 - ca)\overset{*}{Y} + \bar{h}c(N + F),$$

$$\overset{*}{y}_e = c[a_r(1 - \bar{h}) - a^*_r\bar{h}]\overset{*}{Y} + h'(Y + \overset{*}{Y}) + \bar{h}(1 - ca)\overset{*}{Y} + (1 - \bar{h})c(M + B).$$

If in the equilibrium at which the approximation is made home and foreign output are equal when measured in the same units ($Y = \overset{*}{Y}$ so that $\bar{h} = 1 - \bar{h}$), the responsivenesses of the desired ratio of wealth to income to the two expected real interest rates are equal ($a_r = a^*_r$), and the total of home currency assets is equal to the total of foreign currency assets when both totals are measured in the same currency ($M + B = N + F$), then the effects of a depreciation of the home currency on the demands for home and foreign output are equal in absolute value ($y_e = \overset{*}{y}_e$). Y (M + B) can be compared with $\overset{*}{Y}$ (N + F) in the equilibrium at which the approximation is made because $\bar{E} = \overset{*}{\bar{P}} = \bar{P} = 1$.

The symbols are defined as follows:

P home currency price of home good

$\overset{*}{P}$ foreign currency price of foreign good

E home currency price of foreign currency

Y aggregate demand for and aggregate supply of home good

$\overset{*}{Y}$ aggregate demand for and aggregate supply of foreign good

A home residents' wealth measured in home currency

$\overset{*}{A}$ foreign residents' wealth measured in home currency

$h(\cdot)$ proportion of spending allocated by both home and foreign residents to home good

c constant speed of adjustment of actual to desired wealth by both home and foreign residents

$a(\cdot)$ desired ratio of wealth to income for both home and foreign residents

r expected real interest rate on home currency securities

$\overset{*}{r}$ expected real interest rate on foreign currency securities

i nominal interest rate on home currency securities

$\overset{*}{i}$ nominal interest rate on foreign currency securities

W home currency money wage of home residents

$\overset{*}{W}$ foreign currency money wage of foreign residents

$X(\cdot)$ aggregate supply function for home good

$\overset{*}{X}(\cdot)$ aggregate supply function for foreign good

M supply of home money measured in home currency

B supply of home currency securities measured in home currency

N supply of foreign money measured in foreign currency

F supply of foreign currency securities measured in foreign currency

Q home currency average price of consumption bundle of both home and foreign residents

$L(\cdot)$ demand for real balances of home money measured in terms of consumption bundle of both home and foreign residents

$\overset{*}{L}(\cdot)$ demand for real balances of foreign money measured in terms of consumption bundle of both home and foreign residents

$k(\cdot)$ proportion of wealth minus money demand held in home currency securities by both home and foreign residents

Footnotes

* Economist, Board of Governors of the Federal Reserve System. This paper was presented at the Pennsylvania State University Conference on the Political Economy of Domestic and International Monetary Policy held in June 1980 and will appear in Lombra and Witte (1982). Discussions with Donald Adams, Matthew Canzoneri, Michael Dooley, Jo Anna Gray, Kenneth Rogoff, and Jeffrey Shafer led to improvements in the paper. The analysis and conclusions of this paper should not be interpreted as representing the views of the Board of Governors of the Federal Reserve System or any other member of its staff.

1/ There is no discussion of the use of intervention policy to counter "disorderly markets" or such features of exchange market dynamics as runs or bandwagons. Shafer (1982) addresses these issues among others.

2/ Dooley (1979) provides a thorough discussion of intervention operations. Girton and Henderson (1977) compare the effects of intervention operations and monetary operations in a model of financial markets.

3/ Frankel's (1979) evidence suggests that home and foreign currency securities are perfect substitutes. Obstfeld (1980), Hansen and Hodrick (1980), and Meese and Singleton (1980) present evidence that is consistent with home and foreign currency securities being imperfect substitutes. When Obstfeld simulates an intervention operation, he finds that the effects are quantitatively significant but relatively short lived.

4/ Mundell (1968) and Stein (1963) were pioneers in the analysis of open economy financial policy. Their analysis is extended by Tower and Willett (1976). A recent contribution to this analysis has been made by Kaminow (1979). Bryant's (1980) analysis of the effects of disturbances under alternative financial policy regimes is similar to the one of this paper. The approach used here is also employed in Henderson (1979 and 1980).

5/ This model is a partly linear and partly log linear approximation to a non linear model sketched out in the appendix. Explict expressions for the approximation coefficients are presented in the appendix.

6/ In order to consider a fixed interest rate policy in the model of this section under the assumptions about the behavior of the foreign authorities spelled out below or to consider fixed interest rate policies in the two-country model of section VI, it is sufficient but not necessary to assume that real wealth enters the aggregate demand function of at least one country and that tax liabilities corresponding to government securities are not perfectly discounted. For an explanation of why such assumptions are sufficient in the context of a closed economy model, see Canzoneri (1980). For an explanation of why they are not necessary, see Canzoneri, Henderson, and Rogoff (1981).

7/ Y and $\overset{*}{Y}$ can be added together because units are chosen so that the relative price of the foreign good is one in the equilibrium about which the approximation is made.

8/ Home and foreign residents are assumed to have the same tastes so that shifts of wealth between countries through current account surpluses and deficits will have no effects on the variables of the model. Without this assumption a more complicated, dynamic analysis would be required.

9/ The foreign authorities must use monetary operations and two fiscal policy instruments, for example the level of balanced budget government spending and its allocation between the home and the foreign good, to achieve these constant values. Strictly speaking, it is foreign disposable income and not foreign output that is kept constant. Turnovsky (1976) and Flood (1979) make different assumptions about the behavior of the foreign authorities.

10/ This statement is strictly true only if it is assumed that there are "no speculative bubbles". Sargent (1973) explains the implications of this assumption in the context of a closed economy.

11/ Flood (1979), Parkin (1978), and Wallich and Gray (1981) analyze open economy financial policies under the assumption of rational expectations.

12/ For an explanation of the exact restriction that this assumption places on the parameters of the underlying model see the appendix.

13/ Meltzer (1978) has emphasized the importance of the distinction between permanent and transitory disturbances. In Rogoff (1980) private agents must attempt to sort out transitory and "lasting" disturbances and therefore adjust their expectations slowly to new lasting disturbances.

14/ This kind of analysis was first employed by Poole (1970) and has been extended by Friedman (1975).

15/ That is, suppose equations (8), (9), and (10) are divided through by y_Y, m_Y, and b_Y respectively; that $(\alpha + \beta)/y_Y = \beta'$, $(\gamma + \delta)/m_Y = \delta'$, and $(-\gamma + \varepsilon)/b_Y = \varepsilon'$ are disturbances that may be mutually correlated; and that $\sigma^2_{\beta'} = \sigma^2_{\delta'} = \sigma^2_{\varepsilon'}$.

16/ See Poole (1970).

17/ It would be interesting to consider optimal behavior for the authorities in yet a third environment in which they cannot observe or elect not to respond to current movements in the financial variables not chosen as policy instruments but in which the coefficients of the economic model are stochastic variables which have a joint distribution with the additive stochastic terms that is known to the authorities, as in Brainard (1967), and to private agents.

18/ A rule of this kind was first developed by Poole (1970). Kareken, Muench, and Wallace (1973) and Friedman (1975) significantly generalize and extend Poole's results. Boyer (1978) derives an optimal decision rule in a model in which home and foreign currency securities are perfect substitutes and exchange rate expectations are static. Roper and Turnovsky (1980) show how this rule is affected by the incorporation of a more general hypothesis regarding the formation of

of exchange rate expectations and an additional type of disturbance. Boyer (1980) considers decision rules for the authorities in a model which is the same as the one used here in all essential respects except that exchange rate expectations are static. Fischer's (1977) and Frenkel's (1980) optimal rules are derived in models quite different from the one employed here.

19/ It could be assumed that the nominal wage was "indexed" to the two financial variables not chosen as policy instruments and that neither financial policy instrument was changed. If such an indexing rule were determined optimally, it would result in the same variation in output as would the authorities' decision rule. It appears that labor contracts involving indexing to financial variables are not negociated, and conventional indexing is not a perfect substitute for this type of indexing.

20/ It also depends on the assumption that the coefficients of the system are known with certainty.

21/ Sweeney (1983) analyzes open economy financial policy using a two-country model.

22/ See the appendix for a demonstration that the assumption of balanced trade has this implication.

23/ Whenever a result depends on the relative slope of the B'B' schedule, this fact is mentioned in the footnotes.

24/ These assumptions are spelled out in the appendix.

25/ If they were not, the analysis would be somewhat more complicated. If depreciations cause the XX and $\overset{**}{XX}$ schedules to trace out a line with a negative slope, as seems most reasonable, all the results except for those regarding a shift in demand between home and foreign goods are necessarily the same in qualitative terms, but the results for a demand shift may be affected.

26/ If B'B' were flatter than $\overset{**}{XX}$, there would be pressure on the home currency to depreciate.

27/ If B'B' were flatter than $\overset{**}{XX}$, there would be more variation in home (foreign) output under floating (fixed) exchange rates than under fixed (floating) exchange rates.

28/ A game theoretic approach to this and other policy conflicts in open economies has been employed by Hamada (1974), Jones (1979), and Niehans (1968).

29/ Black (1980) discusses the issues addressed in this section among others.

30/ For a more detailed discussion of this equivalence see Girton and Henderson (1977).

31/ This approach is used by Tinsley, Spindt, and Friar (1980).

32/ Kalchbrenner, Tinsley, Berry, and Garret (1977) describe a number of refinements.

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