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RESERVE REQUIREMENTS ON EUROCURRENCY DEPOSITS: IMPLICATIONS FOR EURODEPOSIT MULTIPLIERS, CONTROL OF A MONETARY AGGREGATE, AND AVOIDANCE OF REDENOMINATION INCENTIVES

by

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I. Introduction

In this paper a two-country model of international financial markets is employed to analyze some implications of placing reserve requirements on Eurocurrency deposits. The features of this model are described in Section II. Many earlier analyses of the Eurocurrency markets focused on the Eurodeposit multiplier, the response of equilibrium holdings of Eurodeposits to an autonomous shift from domestic deposits into Eurodeposits.[1] The analysis in Section III is a continuation of this tradition; there the model is used to trace out the implications of a shift from domestic demand deposits to Eurodollar deposits for the equilibrium holdings of Eurodollar deposits and total Eurocurrency deposits. The approach of recent contributions to the analysis of monetary policy making has been to evaluate alternative operating procedures and suggested changes in financial regulations under various assumptions about the relative magnitudes of different kinds of shocks to the economy.[2] This is the approach adopted in Section IV where the effects of changes in Eurocurrency reserve requirements on the deviations of a monetary aggregate from a chosen target value are investigated.[3] There it is assumed that the authorities set the supply of high-powered money in an attempt to achieve a desired value for a monetary aggregate, which is their intermediate target. Deviations between the actual and desired values arise because the authorities have incomplete current information about the shocks which buffet the financial system. In Sections II, III, and IV one possible system of Eurocurrency reserve requirements is analyzed. In Section V it is demonstrated that under some alternative systems the imposition of Eurocurrency reserve requirements may give rise to an incentive for Eurocurrency deposits denominated in one or the other currency to be redenominated so that all Eurocurrency deposits are denominated in a single currency. This section also includes a discussion of how to structure Eurocurrency reserve requirements so as to avoid giving rise to redenomination incentives. Section VI contains some conclusions.

II. The Model

The model is a description of financial dealings among agents in two countries, the United States (U.S.) and Germany, denominated in two currencies, the dollar and the Deustche Mark (DM). The exchange rate (E) is defined as the dollar price of the DM. The seven groups of agents whose behavior is portrayed are U.S. nonbanks, German nonbanks, U.S. banks' home country offices (U.S. banks), German banks' home country offices (German banks), U.S. and German banks' foreign affiliates (Eurobanks), the U.S. central bank (Federal Reserve), and the German central bank (Bundesbank). In addition it is assumed that the U.S. (German) Treasury issues a stock of dollar (DM) denominated securities designated by $\overline{B}$ ($\overline{F}$). Eighteen financial instruments are mentioned below, but simplifying assumptions spelled out there and the balance sheet constraints of the agents imply that attention can be focused on the markets for only two instruments, U.S. high-powered money and German high-powered money.

The balance sheets of the agents and the market clearing conditions for the financial instruments are described below and are summarized in Table 1 which also contains a list of all the financial instruments included in the model. Since balance sheets must be expressed in a single currency, all DM denominated magnitudes are converted to dollars. Summing the entries in the row for a given group of agents in Table 1 yields the balance sheet constraint for that group of agents; therefore, the sum of the entries in each row must be identically equal to zero. The sum of the entries in the last column of Table 1 must also be identically equal to zero since the sum of the net worths of banks and nonbanks must always be equal to the sum of the net worths of the German central bank and the two Treasuries. For the model to be in equilibrium each remaining column must sum to zero. How the variables in the model change to insure that these conditions are fulfilled is explained below.

U.S. banks (Row 1), whose holdings are designated with the superscript B, have as liabilities dollar demand deposits, dollar time deposits, and a net worth item measured in dollars and as assets dollar high-powered money, dollar loans, U.S. Treasury securities, German Treasury securities, and dollar claims on the Eurobanks.

German banks (Row 2), whose holdings are designated with asterisks, as are all German holdings, and with the superscript B, have as liabilities DM demand deposits, DM time deposits, and a net worth item measured in dollars and as assets DM high-powered money, DM loans, German Treasury securities, U.S. Treasury securities, and DM claims on the Eurobanks.

The Eurobanks (Row 3), whose holdings are designated with the superscript A, have as liabilities short-term Eurodollar deposits, short-term

Table 1

Balance Sheets of the Agents and

Market Clearing Conditions for the Financial Instruments

Agents \ Instruments	H	EA	B	EF	D	T	EG	EU	L	EP	V	EX	Y	EZ	Q	ES	I	EJ	W
U.S. Banks	H^B		B^B	EF^B	$-D^B$	$-T^B$			L^B								I^B		$-W^B$
German Banks		$\overset{*}{EA}{}^{B}$	$\overset{*}{B}{}^{B}$	$\overset{*}{EF}{}^{B}$			$-\overset{*}{EG}{}^{B}$	$-\overset{*}{EU}{}^{B}$		$\overset{*}{EP}{}^{B}$								$\overset{*}{EJ}{}^{B}$	$-\overset{*}{W}{}^{B}$
Euro-Banks	H^A										$-V^A$	$-EX^A$	$-Y^A$	$-EZ^A$	Q^A	ES^A	$-I^A$	$-EJ^A$	$-W^A$
U.S. Nonbanks	H^N		B^N	EF^N	D^N	T^N		EU^N	$-L^N$	$-EP^N$	V^N	EX^N	Y^N	EZ^N	$-Q^N$	$-ES^N$			$-W^N$
German Nonbanks		$\overset{*}{EA}{}^{N}$	$\overset{*}{B}{}^{N}$	$\overset{*}{EF}{}^{N}$		$\overset{*}{T}{}^{N}$	$\overset{*}{EG}{}^{N}$	$\overset{*}{EU}{}^{N}$	$-\overset{*}{L}{}^{N}$	$-\overset{*}{EP}{}^{N}$	$\overset{*}{V}{}^{N}$	$\overset{*}{EX}{}^{N}$	$\overset{*}{Y}{}^{N}$	$\overset{*}{EZ}{}^{N}$	$-\overset{*}{Q}{}^{N}$	$-\overset{*}{ES}{}^{N}$			$-\overset{*}{W}{}^{N}$
Federal Reserve	$-H^C$		B^C																
Bundesbank		$-\overset{*}{EA}{}^{C}$	$\overset{*}{B}{}^{C}$	$\overset{*}{EF}{}^{C}$															$\overset{*}{W}{}^{C}$
U.S. Treasury			$-\bar{B}$																W^T
German Treasury				$-\overline{EF}$															$\overset{*}{W}{}^{T}$

(Table 1 continued on next page)

(Table 1 continued)

H - U.S. high-powered money	G - German banks' DM demand deposits	Y - Long-term Eurodollar deposits
A - German high-powered money	U - German banks' DM time deposits	Z - Long-term Euro-DM deposits
B - U.S. Treasury securities	L - U.S. banks' dollar loans	Q - Eurodollar loans
F - German Treasury securities	P - German banks' DM loans	S - Euro-DM loans
D - U.S. banks' dollar demand deposits	V - Short-term Eurodollar deposits	I - U.S. banks' dollar loans to Eurobank
T - U.S. banks' dollar time deposits	X - Short-term Euro-DM deposits	J - German banks' DM loans to Eurobanks
		W - Net worth in dollars

Euro-DM deposits, long-term Eurodollar deposits, long-term Euro-DM deposits, dollar borrowings from U.S. banks, DM borrowings from German banks, and a net worth item measured in dollars and as assets U.S. high-powered money, Eurodollar loans, and Euro-DM loans.

Throughout, it is assumed that all banking institutions are risk neutral price takers which have zero intermediation costs and that the interest rates on demand deposits at banks in both countries are fixed at zero. Initially it is assumed that each central bank pays interest on required bank reserves at a rate equal to the rate on Treasury securities denominated in its country's currency and that even when the exchange rate is flexible all private agents expect the exchange rate to remain unchanged.[4/] Under these assumptions the interest rates associated with all the variable-rate financial instruments must be equal to a single representative interest rate (r). Only when this condition is met will individual U.S. banks, German banks, and Eurobanks expect neither profits nor losses from accepting all the kinds of interest-bearing deposits, engaging in all types of interbank borrowing, and holding all the forms of assets assumed to be specific to their category of banking institution.[5/]

U.S. nonbanks (Row 4), whose holdings are designated by the superscript N, allocate their net worth among all the financial instruments except DM currency, DM demand deposits at German banks, and interbank loans denominated in dollars and DM.[6/] German nonbanks (Row 5), whose holdings are designated with an asterisk and the superscript N, allocate their net worth measured in dollars among all the financial instruments except dollar currency, dollar demand deposits at U.S. banks, and interbank loans denominated in dollars and DM. The symbol θ ($\overset{*}{\theta}$) is employed to represent the ratio of U.S. (German) residents' net dollar assets to their net worth measured in dollars. It is assumed that θ ($\overset{*}{\theta}$) lies between zero and one so that U.S. (German) residents' net holdings of both dollar and DM assets are positive.

The Federal Reserve (Row 6), whose holdings are designated by the superscript C, has U.S. Treasury securities as an asset and high-powered money as a liability. The Bundesbank (Row 7), whose holdings are designated with an asterisk and the superscript C, has German Treasury securities and U.S. Treasury securities as assets and the DM high-powered money as a liability. The net worth item measured in dollars ($\overset{*}{W}{}^{C}$) moves to offset the effects of changes in the exchange rate on the value of the Bundesbank's assets so that the DM value of German high-powered money remains unchanged.

Now consider the demands by U.S. and German nonbanks for the various financial instruments. Since the assumptions made above regarding banking institutions imply that all interest rates move together in lock step, these demands can be taken to depend on the single representative interest rate. The demands for the various financial instruments by nonbanks in each country also depend on the net worth of nonbanks in that country and that country's exogenous real-output. As examples, consider the desired holding of dollar currency by U.S. nonbanks,

$$H^N = H^N(r, W^N, y), \tag{1a}$$

and the desired holding of DM currency by German nonbanks expressed in dollars,

$$EA^N = EA^N(r, \frac{\overset{*}{W}{}^{N}}{E}, \overset{*}{y}), \tag{1b}$$

where y ($\overset{*}{y}$) represents U.S. (German) real output. All desired holdings of financial instruments by nonbanks are given by analogous expressions.

U.S. nonbanks and German nonbanks regard all the instruments in their portfolios as strict gross substitutes.[7/] Whenever the interest rate on a given asset (liability) rises the desired holding of that asset (liability) rises (falls) and the desired holdings of all other assets (liabilities) fall (rise) while the desired holdings of all liabilities (assets) rise (fall). It is also assumed that for each financial instrument the own rate effect exceeds the sum of cross rate effects. This assumption implies that if all variable interest rates rise by the same amount, as they must because of the assumptions made above, then the desired holdings of each interest bearing asset must rise, the desired holding of each interest bearing liability must fall, and the desired holdings of currency and demand deposits must fall.

The functions describing U.S. and German nonbanks' desired holdings of financial instruments are assumed to be linear homogeneous in net worth so that the fraction of their net worth allocated by nonbanks in either country to each of the financial instruments they hold is independent of the level of their net worth. It has been assumed that both U.S. and German nonbanks have positive net asset positions in both dollars and DM. This assumption implies that when the dollar depreciates, that is when E rises, W^N rises ($\overset{*}{W}^N/E$ falls), so U.S. residents' (German residents') desired holdings of each financial instrument rise (fall) when measured in dollars (DM).[8/]

U.S. nonbanks' demands for dollar currency, dollar demand deposits, and short-term Eurodollar deposits are assumed to be positively related to exogenous U.S. output. Exogenous U.S. output is assumed to be equal to a constant ($\overline{y}$) plus a stochastic disturbance term (λ) which will be referred to in the analysis below:

$$y = \bar{y} + \lambda. \tag{2}$$

Exogenous German output is assumed to be equal to a constant $(\bar{\overset{*}{y}})$.

Three conditions must be fulfilled in equilibrium. First, the demand for U.S. high-powered money must equal the supply:

$$H^C = H^N + H^B + H^A. \tag{3a}$$

Second, the demand for German high-powered money measured in dollars must equal the supply measured in dollars:

$$E\overset{*}{A}^C = E(\overset{*}{A}^N + \overset{*}{A}^B). \tag{3b}$$

Third, the sum of private demands for U.S. and German Treasury securities measured in dollars must equal the amount of these assets measured in dollars available to private agents:

$$\bar{B} - B^C - \overset{*}{B}^C + E(\bar{F} - \overset{*}{F}^C) = B^N + \overset{*}{B}^N + B^B + \overset{*}{B}^B + E(F^N + \overset{*}{F}^N + F^B + \overset{*}{F}^B). \tag{4}$$

These three conditions are sufficient for equilibrium in all financial markets, and only two of them are independent. First, equilibrium is guaranteed in all markets except those for government securities and high-powered moneys because as long as interest rates are locked together, banking institutions will accept all the deposits and make all the loans that nonbanks want, and U.S. and German banks will accommodate the desired borrowings of the Eurobanks. Thus, when all interest rates are the same, the sum of each of the columns in Table 1 except the first four is identically equal to zero. Second, if (4) holds, both security markets are in equilibrium since banks regard German and U.S. Treasury securities as being the same asset.[9/] Third, when account is taken of the balance sheet constraints, the sum of the excess demands for both high-powered moneys and both securities is identically equal to the sum of the sum of all columns in Table 1 except the first four which is identically equal to zero. Hence only two of the equilibrium conditions are independent.

The two independent equilibrium conditions that are used in what follows are the equilibrium conditions for the U.S. and German high-powered money markets. To complete the description of the model it is necessary to specify the demands for U.S. and German high-powered money by banking institutions. It is assumed that the demands for U.S. and German high-powered money by U.S. banks, German banks, and Eurobanks are equal to required reserves.[10/] U.S. banks hold the U.S. high-powered money implied by required reserve ratios on their demand deposits (k_D) and on the time deposits they accept from U.S. residents (k_T).[11/] German banks hold the German high-powered money implied by required reserve ratios on their demand deposits ($\overset{*}{k}_G$) and on the time deposits they accept from German residents ($\overset{*}{k}_U$). Eurobanks hold the U.S. high-powered money implied by required reserve ratios on their short-term Eurodollar deposits accepted from U.S. residents (k_V) and on their long-term Eurodollar deposits accepted from U.S. residents (k_Y). It is assumed that the reserve ratio for dollar demand deposits is greater than or equal to the reserve ratios for dollar time deposits and short-term and long-term Eurodollar deposits of U.S. residents and that the reserve ratio for DM demand deposits is greater than or equal to the reserve ratio for DM time deposits of German residents ($k_D \geq k_T$, k_V, k_Y; $\overset{*}{k}_G \geq \overset{*}{k}_U$).

The final version of the two high-powered money market equilibrium conditions is obtained by substituting the bank demands for U.S. and German high-powered money just described, the nonbank behavioral relations, and expressions for H^C and $\overset{*}{EA}{}^C$ from the central bank balance sheets into equations (3) to obtain equations (5):[12/]

$$B^C = H^N + k_D D^N + k_T T^N + k_V V^N + k_Y Y^N - (k_D - k_V)\alpha - k_D\gamma - k_V\beta - \eta, \qquad (5a)$$

$$\overset{*}{F}{}^{C} + \frac{1}{E}(\overset{*}{B}{}^{C} + \overset{*}{W}{}^{C}) = \overset{*}{A}{}^{N} + \overset{*}{k}_{G}\overset{*}{G}{}^{N} + \overset{*}{k}_{U}\overset{*}{U}{}^{N}, \tag{5b}$$

where α, γ, β, and η are stochastic disturbance terms which will be referred to in the analysis below.

An initial equilibrium in world financial markets is represented by the intersection of the H_0H_0 and A_0A_0 schedules at a_0 in panel I of Figure 1. The HH schedule shows the pairs of the interest rate and the exchange rate for which the demand for U.S. high-powered money is equal to a fixed supply. The HH schedule must have a positive slope under the assumptions of this paper. A depreciation of the dollar (rise in E) increases the demand for U.S. high-powered money. The depreciation raises U.S. residents' demands for all types of reservable dollar deposits measured in dollars because it increases their net worth measured in dollars. In order to reduce the demand for U.S. high-powered money to its previous level, the interest rate must rise.

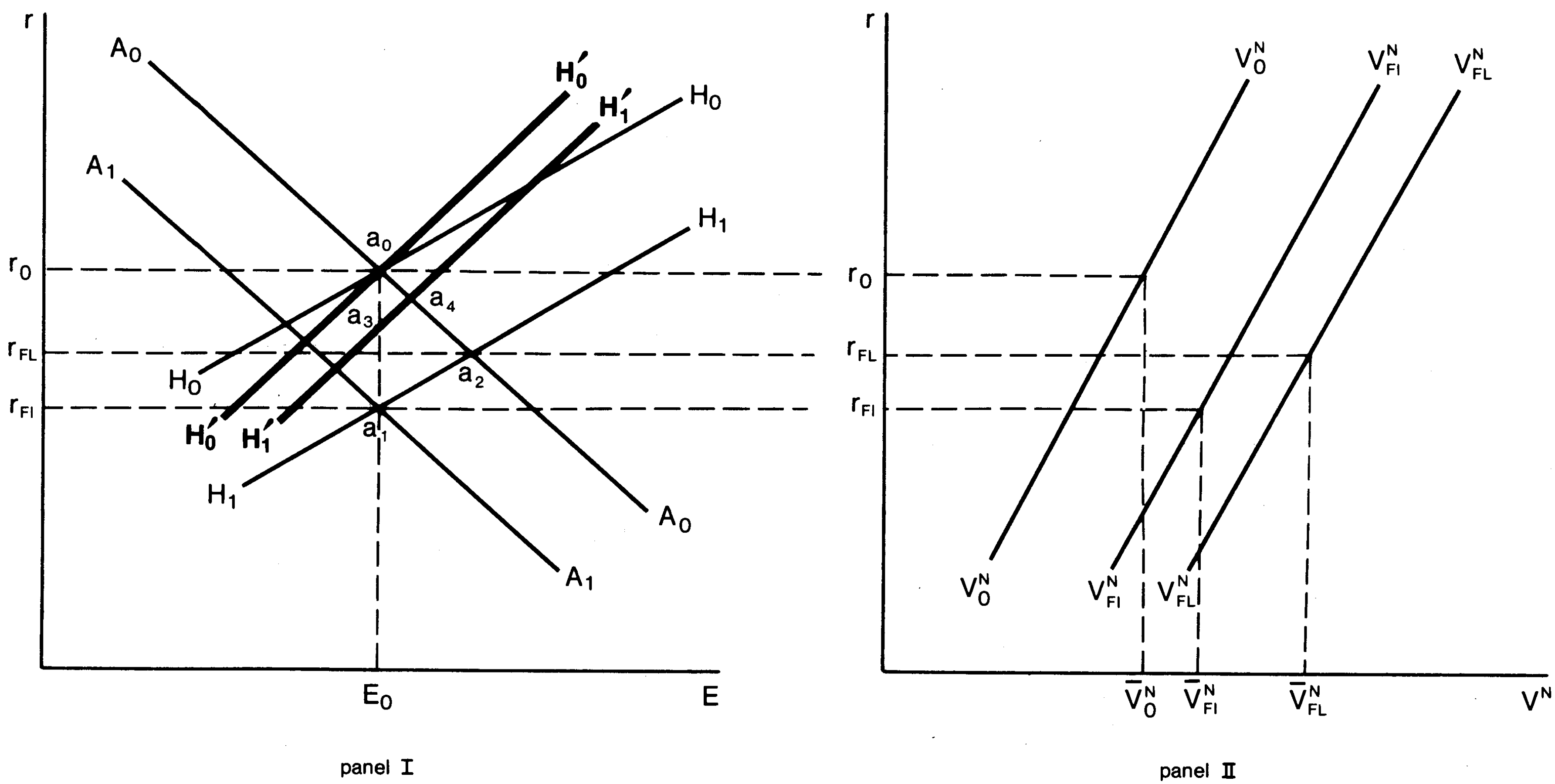
It must be established that an increase in the interest rate reduces the demand for U.S. high-powered money. The interest rate responsiveness of the demand for U.S. high-powered money (H_r) is given by

$$H_r = H_1^N + k_D D_1^N + k_T T_1^N + k_V V_1^N + k_Y Y_1^N. \tag{6}$$

which can be rewritten as

$$H_r = k_D\left(\frac{1}{k_D} H_1^N + D_1^N + \frac{k_T}{k_D} T_1^N + \frac{k_V}{k_D} V_1^N + \frac{k_Y}{k_D} Y_1^N\right). \tag{7}$$

Given the assumptions made above about U.S. residents' demands for financial instruments it is an implication of the balance sheet constraint for U.S. residents that



r
A0
A1
H0'
H1'
H0
H1
a0
a4
a3
a2
a1
r0
rFL
rFI
E0
E
panel I
V0N
VFIN
VFLN
V̄0N
V̄FIN
V̄FLN
VN
panel II

FIGURE 1

$$\overset{(-)}{H_1^N} + \overset{(-)}{D_1^N} + \overset{(+)}{T_1^N} + \overset{(+)}{V_1^N} + \overset{(+)}{Y_1^N}$$
$$\equiv - \overset{(+)}{B_1^N} + \overset{(-)}{L_1^N} + \overset{(-)}{Q_1^N} - E(\overset{(+)}{F_1^N} + \overset{(+)}{U_1^N} - \overset{(-)}{P_1^N} + \overset{(+)}{X_1^N} + \overset{(+)}{Z_1^N} - \overset{(-)}{S_1^N}) < 0. \tag{8}$$

H_r must be negative since the weighted sum of interest rate responsivenesses in parentheses on the right hand side of (7) is more negative than the unweighted sum of the same interest rate responsivenesses on the left hand side of (8) since the weight on the negative H_1^N is greater than one while the weights on the positive T_1^N, V_1^N, and Y_1^N are less than or equal to one.

The AA schedule shows the pairs of the interest rate and the exchange rate for which the demand for German high-powered money is equal to a fixed supply. The AA schedule must have a negative slope. A depreciation of the dollar reduces the demand for German high-powered money. The depreciation lowers German residents' demands for all types of reservable DM deposits measured in DM because it reduces their net worth measured in DM. In order to increase the demand for German high-powered money to its previous level, the interest rate must fall. That a decline in the interest rate increases the demand for German high-powered money can be established by an argument analogous to the one used to establish the sign of the interest rate responsiveness of the demand for U.S. high-powered money.

As preparation for the analysis below it is useful to consider the effects of a reduction in the U.S. demand for high-powered money. The HH schedule shifts down from H_0H_0 to H_1H_1 since at each exchange rate the interest rate must be lower in order to reestablish equilibrium in the market for U.S. high-powered money. Under fixed exchange rates the new equilibrium is at point a_1. The shift down in the demand for U.S. high-powered money causes the interest rate to decline. The drop in the interest rate gives rise to excess demand for German high-powered money. As a result of this excess demand there is pressure on the dollar to depreciate. In order to prevent a depreciation of the dollar the Bundesbank undertakes an intervention operation which satisfies the excess demand for German high-powered money. This operation involves a purchase of U.S. Treasury securities from private agents in return for German high-powered money.[13/] The AA schedule corresponding to the new higher supply of German high-powered money is A_1A_1. In the case of fixed exchange rates the interest rate falls by the full amount necessary to restore equilibrium in the market for U.S. high-powered money.

Under flexible exchange rates the new equilibrium following a shift down in the demand for U.S. high-powered money is at point a_2. The Bundesbank undertakes no intervention operation, so the dollar depreciates. This depreciation of the dollar increases the demand for U.S. high-powered money, so the interest rate does not fall by the full amount necessary to restore equilibrium in the U.S. high-powered money market at the initial exchange rate (E_0). The depreciation of the dollar reduces the demand for German high-powered money, so the demand for German high-powered money does not exceed the fixed supply even though the interest rate is lower.

III. Eurodeposit Multipliers Under Fixed and Flexible Exchange Rates

The effects of a shift in U.S. nonbanks' portfolio preferences away from dollar demand deposits at U.S. banks and toward short-term Eurodollar deposits are traced out in the two panels of Figure 1. The effects of the shift on the interest rate and the exchange rate are shown in panel I. The shift in portfolio preferences reduces the demand for U.S. high-powered money since the reserve ratio for short-term Eurodollar deposits is less than the reserve ratio for dollar demand deposits. It is assumed that the size of the shift is such that it causes the HH schedule to move down from H_0H_0 to H_1H_1. The interest rate falls under both fixed and flexible exchange rates, and the dollar depreciates under flexible exchange rates.

The effects on U.S. residents' equilibrium holdings of short-term Eurodollar deposits are shown in panel II. The case of fixed exchange rates is examined first. This case is particularly interesting because the assumption of fixed exchange rates facilitates a comparison with the closed-economy case of a shift out of demand deposits into time deposits.

Under fixed exchange rates U.S. residents' demand for short-term Eurodollar deposits shifts from V_0^N to V_{FI}^N in panel II. Their holdings at the new equilibrium must be higher ($\bar{V}_{FI}^N > \bar{V}_0^N$), but the increase is less than the original shift in demand because the interest rate decline discourages the holding of short-term Eurodollar deposits. A shift out of dollar demand deposits can be represented by an increase in α in equation (5a). The increase in U.S. residents holdings of short-term Eurodollar deposits under fixed exchange rates (FI) is given by

$$\left.\frac{dV^N}{d\alpha}\right|_{FI} = V_1^N \left.\frac{dr}{d\alpha}\right|_{FI} + 1, \tag{9}$$

where

$$\left.\frac{dr}{d\alpha}\right|_{FI} = \frac{k_D - k_V}{H_r} < 0. \tag{10}$$

Making use of (10) and (6), (9) can be rewritten as

$$0 < \left.\frac{dV^N}{d\alpha}\right|_{FI} = \frac{1}{H_r}(H_1^N + k_D D_1^N + k_T T_1^N + k_D V_1^N + k_Y Y_1^N) < 1. \tag{11}$$

An argument analagous to the one used to establish that H_r is negative can be used to establish that the weighted sum in parentheses in (11) is negative. This weighted sum is less than H_r in absolute value because the positive V_1^N is weighted by k_D which is greater than k_V. This result for the multiplier for U.S. nonbanks' holdings of short-term Eurodollars illustrates the familiar contention that the largest possible multiplier for U.S. nonbanks' holdings of Eurodollars given a shift in U.S. nonbanks' preferences from dollar demand deposits to Eurodollar deposits under fixed exchange rates is positive but less than one. As a result of the interest rate decline the changes in total U.S. nonbank holdings of all Eurodollar deposits, and for that matter of all Eurocurrency deposits measured in dollars is positive but less than the increase in their holdings of short-term Eurodollar deposits. This result can be proved by making use once again of the balance sheet constraint for U.S. residents. The qualitative effects of a shift out of dollar demand deposits and into short-term Eurodollar deposits on the equilibrium holdings of Eurodollar and Eurocurrency deposits by U.S. residents are the same as the effects of a shift out of demand deposits and into time deposits on the equilibrium holdings of time deposits in a closed economy.

However, when the behavior of German nonbanks is taken into account it becomes clear that there is a difference between the qualitative results for a shift into short-term Eurodollar deposits in an open economy and those for a shift into time deposits in a closed economy. The decline in the interest rate causes German nonbanks to reduce their holdings of short-term Eurodollar deposits, so the total of all nonbanks holdings of short-term

Eurodollar deposits may actually fall as a result of the interest rate decline caused by the shift in U.S. residents' portfolio preferences:

$$0 \lessgtr \frac{d(V^N + \overset{*}{V}^N)}{d\alpha}\bigg|_{FI} = \frac{dV^N}{d\alpha}\bigg|_{FI} + \frac{\overset{*}{V}{}_1^N(k_D - k_V)}{H_r} < 1. \qquad (12)$$

A fortiori the total of all nonbanks' holdings of Eurodollar deposits and Eurocurrency deposits measured in dollars may fall. This possibility illustrates another familiar contention that for some measures of the Eurodollar or Eurocurrency market the multiplier may actually be negative.[14/] The possibility that holdings of time deposits may fall does not arise in the case of a shift out of demand deposits into time deposits in a closed economy.

It is interesting to note that, whatever happens to the total of Eurocurrency deposits, the total of Eurocurrency loans must rise because of the decline in the interest rate. Thus, by at least one measure of size, the size of the Eurocurrency markets must increase no matter what happens to the total of Eurocurrency deposits. Of course, if the total of Eurocurrency deposits falls or if Euroloans rise more than Eurodeposits, Eurobanks increase their borrowings from U.S. and German banks to the extent necessary to fund their increased loans to nonbanks.

Under flexible exchange rates the depreciation of the dollar shifts the demand for Eurodollar deposits out from V_0^N farther than V_{FI}^N to a position like V_{FL}^N. The short-term Eurodollar deposit multiplier may now be greater than one as shown in panel II. All multipliers for Eurodollar deposits and for Eurocurrency deposits measured in dollars are raised, and the likelihood of a negative multiplier for total nonbank Eurodollar deposits or total Eurocurrency deposits measured in dollars is reduced. Eurocurrency loans measured in dollars rise but the increase may be less or more than with a fixed exchange rate since the interest rate declines by less but the depreciation of the dollar raises nonbanks' Eurocurrency loan demand measured in dollars. An unavoidable ambiguity which has plagued analysts of the Eurocurrency markets is also evident: for example, even when the total of Eurocurrency deposits measured in dollars rises it may fall when measured in DM. We would be in a better position to know what to make of this possibility if we understood more fully the implications of changes in nominal deposit or loan totals measured in any given currency.

IV. Eurocurrency Reserve Requirements and the Control of a Monetary Aggregate

In order to determine the circumstances under which monetary authorities might find it desirable to place a reserve requirement on Eurocurrency deposits it is necessary to describe the environment in which monetary policy is formulated. Assumptions are made about the operating strategy for monetary policy, about the types of disturbances faced by policy makers, and about the implementation of the operating strategy.

As an operating strategy the monetary authorities in several countries set the instruments under their direct control in order to achieve desired values for one or another monetary aggregate over well-defined periods of as short as a month or as long as a year. Therefore, it seems useful to consider how the expected degree of success of such an intermediate-target strategy is affected by the introduction of Eurocurrency reserve requirements. Specifically, it is assumed that the U.S. authorities attempt to achieve a desired value for $M1'$ defined as U.S. residents' holdings of currency, demand deposits, and short-term Eurodollar deposits.[15/] The effects of changes in the reserve requirement on short-term Eurodollar deposits on the deviations of $M1'$ from its target value are investigated.

As has often been observed, in models such as the one investigated in this paper the U.S. authorities could always hit an intermediate target value for $M1'$ exactly in the absence of uncertainty. So that meaningful and tractable questions can be addressed it is assumed that the U.S. high-powered money demand function is affected by stochastic shifts in U.S. nonbanks' desired holdings of financial instruments. Five kinds of shifts are considered, each of which is represented by a separate disturbance term: (1) shifts between dollar demand deposits and short-term Eurodollar deposits, represented by α; (2) shifts between short-term Eurodollar deposits and nonreservable instruments, represented by β; (3) shifts between dollar demand deposits and nonreservable instruments, represented by γ; (4) shifts between dollar currency and nonreservable instruments, represented by η; and (5) shifts in the demands for all reservable assets resulting from shifts in exogenous U.S. output, represented by λ. It is useful to observe that shifts between dollar currency and nonreservable instruments have the same effects as would shifts in the supply of U.S. high-powered money through open market operations. The stochastic variables representing the five kinds of shifts are assumed to have zero expected values and to be mutually and serially uncorrelated.

A single method for the implementation of the operating strategy of the U.S. monetary authorities is considered. It is assumed that they cannot observe $M1'$ in the current period. They use the supply of U.S. high-powered money as their policy instrument.[16/] The supply of high-powered money is set before the values of the disturbances emerge in any period so that the expected value of $M1'$ is equal to a desired value $\tilde{M1}'$. If the desired value of $M1'$ is changed, a different amount of U.S. high-powered money must be supplied. When the values of the disturbance terms emerge in any period, the implied value for M1´ is, in general, different from $\tilde{M1}'$. The sizes of deviations of M1´ from its desired (and expected) value resulting from the various stochastic shifts depend on the parameters of the high-powered money demand functions, on the parameters of the demand function for M1´, on the exchange rate regime, and on the levels of the reserve requirements.

The purpose of this section is to determine how deviations of M1´ from its desired value are affected when the U.S. authorities raise the reserve ratio for short-term Eurodollar deposits held by U.S. residents (k_V). It is assumed that k_V can be varied within a range which has a lower limit of zero and an upper limit of the exogenous reserve requirement on demand deposits.[17/] Given the assumption that the disturbance terms representing the stochastic shifts are mutually uncorrelated, it is possible to consider the effect of an increase in k_V when each of the stochastic shifts is the only source of uncertainty. These effects can then be combined to obtain the overall effect of an increase in k_V. For simplicity, it is assumed that the reserve ratios for dollar time deposits at U.S. banks and for long-term Eurodollar deposits held by U.S. residents are zero throughout this section.

The same general approach is used in the analysis of each source of deviations of M1´ from its desired value. First, for each type of disturbance an example is chosen which leads to the same sized reduction in the demand for U.S. high-powered money at the initial value of k_V. Thus for all disturbances the shift in the HH schedule given the initial k_V can be represented by the shift from H_0H_0 to H_1H_1 in panel I of Figure 1. Second, the implications of the shift for M1´ are described. Although the impact effects on M1′ vary among disturbances, the induced change in M1′ at the initial k_V is the same for all disturbances since the interest rate decline and, under flexible exchange rates, the depreciation of the dollar are the same. Third, the effects of an increase in k_V on the size of the interest rate decline and, under flexible exchange rates, on the amount of dollar depreciation required to restore equilibrium are determined. These effects arise because an increase in k_V alters the impact effect of disturbances on the demand for U.S. high-powered money and the responsivenesses of this demand to changes in the interest rate and the exchange rate. The change in the impact effect and, therefore, in the size of the shift in the HH schedule is different depending on the source of the disturbance. However, the changes in both the interest rate responsiveness and the exchange rate responsiveness and, therefore, in the slope of the HH schedule are the same for all disturbances. The final step in the analysis of each disturbance is to spell out the implications of the new equilibrating adjustments of the interest rate and the exchange rate for the size of the induced change in M1′.

Since the effects of an increase in k_V on the interest rate responsiveness and the exchange rate responsiveness of the demand for U.S. high-powered money are the same no matter what type of disturbance is under consideration, it is useful to describe these effects and their implications for the slope of the HH schedule at the outset. When k_V is increased, the interest rate responsiveness of the demand for U.S. high-powered money is lowered in absolute value. This interest rate responsiveness is a weighted sum of the interest rate responsivenesses of the demands by U.S. resident's for currency, dollar demand deposits, and short term Eurodollar deposits where each of the deposit demand responsivenesses is weighted by the relevant reserve requirement. It has been shown above that the weighted sum is negative even though the interest responsiveness of U.S. residents' demand for short-term Eurodollar deposits is positive. When k_V is increased the weighted sum remains negative but becomes less negative because the weight on the positive component is increased. When k_V is increased, the exchange rate responsiveness of the demand for U.S. high-powered money becomes more positive. This exchange rate responsiveness is a weighted sum of the exchange rate responsivenesses of the demands by U.S. residents for currency, dollar demand deposits, and short-term Eurodollar deposits where each of the deposit demand responsivenesses is weighted by the relevant reserve requirement. The weighted sum is positive because all of the exchange rate responsivenesses are positive. When k_V is increased the weight on a positive component is increased. Since the interest rate responsiveness of the demand for U.S. high-powered money is lowered in absolute value and the exchange rate responsiveness is increased when k_V rises, the slope of the HH schedule becomes more positive as illustrated by the $H_0'H_0'$ schedule in panel I of Figure 1.

The first disturbance to be considered is a shift by U.S. residents out of dollar demand deposits into short-term Eurodollar deposits. As explained above this disturbance causes the HH schedule to shift down from H_0H_0 to H_1H_1 in panel I of Figure 1. The interest rate declines under both fixed and flexible exchange rates, and the dollar depreciates under flexible exchange rates. Although, the disturbance under consideration has no impact effect on M1', the changes in the interest rate and the exchange rate induce M1' to rise under both fixed and flexible exchange rates.[18/]

Now consider how the size of the increase in M1′ is affected by a rise in k_V. As explained above, a rise in k_V increases the slope of the HH schedule by the same amount no matter what the source of the disturbance. This increase is represented by the rotation of HH from H_0H_0 to $H_0'H_0'$. In the case of a shift out of dollar demand deposits into short-term Eurodollar deposits, a rise in k_V also reduces the downward shift in the HH schedule at a given exchange rate as shown by the shift in HH from $H_0'H_0'$ to $H_1'H_1'$ ($a_0a_3 < a_0a_1$). The downward shift tends to be smaller because the reduction in the difference between k_D and k_V decreases the impact effect of the disturbance on the demand for U.S. high-powered money. The downward shift tends to be larger because the interest responsiveness of the demand for high-powered money is reduced in absolute value. The reduction in the impact effect outweighs the reduction of the absolute value of the interest rate responsiveness, so the downward shift in the HH schedule is definitely smaller:

$$\frac{d(dr/d\alpha|E = E_0)}{dk_V} = \frac{d[(k_D - k_V)/H_r]}{dk_V} = -\frac{1}{(H_r)^2}[H_r - (k_D - k_V)V_1^N] > 0. \quad (13)$$

Consequently, the new equilibrium under fixed exchange rates (point a_3) involves a smaller interest rate decline, and the new equilibrium under flexible exchange rates (point a_4) involves a smaller interest rate decline and less dollar depreciation.

Thus, in the case of a shift by U.S. residents from dollar demand deposits to Eurodollar deposits, the rise in M1′ above its desired value is less when k_V is higher. Since such shifts have no impact effect on M1′, the smaller interest rate decline and, under flexible exchange rates, the smaller dollar depreciation imply a smaller total effect on M1´.

The second disturbance to be considered is a shift by U.S. residents from short-term Eurodollar deposits to nonreservable instruments. Figure 2 is employed in the analysis of this disturbance. As before it is assumed that this disturbance leads to a shift down in the HH schedule from H_0H_0 to H_1H_1 at the initial value of k_V. M1´ declines under both fixed and flexible exchange rates because the fall in the interest rate and, under flexible exchange rates, the depreciation of the dollar only partially offset the negative impact effect on the demand for M1´ of the shift in portfolio preferences.[19/] The impact effect of the disturbance on the demand for U.S. high-powered money is k_V times the impact effect on the demand for M1´. The absolute value of the interest rate responsiveness of the demand for U.S. high-powered money is greater than k_V times the absolute value of the interest rate responsiveness of the demand for M1´ because the reserve requirements for currency (one) and demand deposits exceed k_V. Thus, under fixed exchange rates, the interest rate decline that clears the market for U.S. high-powered money is less than the one that would be required to keep M1´ constant. Under flexible exchange rates the dollar must depreciate when the interest rate declines in order to keep the market for German high-powered money in equilibrium. This depreciation increases the demand for U.S. high-powered money and the demand for M1´. The induced exchange rate effect on the demand for U.S. high-powered money is greater than k_V times the induced exchange rate effect on M1´ because the reserve requirements for currency and demand deposits exceed k_V. Thus, under flexible exchange rates, the interest rate decline and dollar depreciation that clear the market for U.S. high-powered money and maintain equilibrium

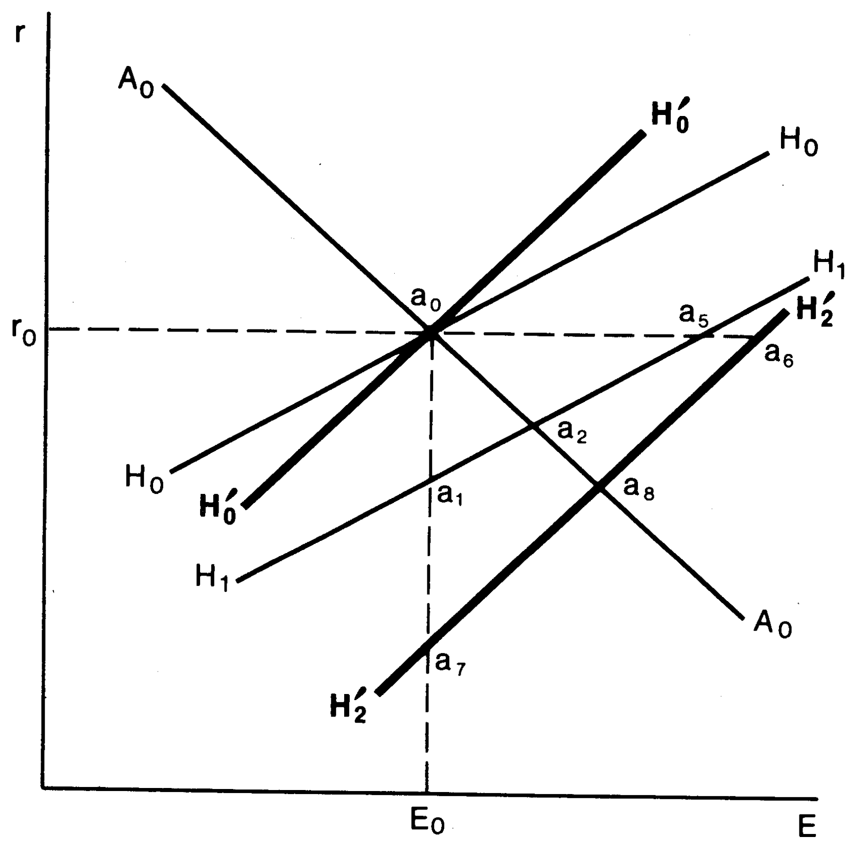


FIGURE 2

in the market for German high-powered money are less than those that would be required to keep M1´ constant.

An increase in k_V raises the slope of the HH schedule by an amount represented by the rotation of HH from H_0H_0 to $H_0'H_0'$ as before. In the case of a shift out of Eurodollar deposits and into nonreservable instruments, an increase in k_V increases the amount by which the HH schedule shifts to the right at a given interest rate as shown by the shift of HH from $H_0'H_0'$ to $H_2'H_2'$ ($a_0a_6 > a_0a_5$). The shift tends to be larger because the impact effect of the disturbance on the demand for U.S. high-powered money is increased with a larger k_V. The shift tends to be smaller because the exchange rate responsiveness of the demand for high-powered money is increased. The increase in the impact effect outweighs the increase in the exchange rate responsiveness, so the HH schedule definitely shifts farther to the right:

$$\frac{d(dE/d\beta|r = r_0)}{dk_V} = \frac{1}{(H_E)^2}[H_E - k_V V_2^N W^N (1 - \theta)] > 0. \tag{14}$$

The new equilibrium under fixed rates (point a_7) involves a larger interest rate decline. The new equilibrium under flexible exchange rates (point a_8) involves a larger interest rate decline and more dollar depreciation.

Thus, in the case of a shift by U.S. residents from Eurodollar deposits to nonreservable instruments, the decline in M1´ below its desired value is less when k_V is higher. The negative impact effect of the disturbance on M1´ is unchanged. However, the overall decline in M1´ is less since the larger induced interest rate decline and, under flexible exchange rates, the larger induced dollar depreciation offset a greater fraction of the negative impact effect.

The third disturbance to be considered is a shift by U.S. residents out of dollar demand deposits into nonreservable instruments. Figure 3 is employed in the analysis of this disturbance. Once again it is assumed that the disturbance leads to a shift down in the HH schedule from H_0H_0 to H_1H_1 at the initial value of k_V. Under fixed exchange rates M1´ definitely declines because the fall in the interest rate only partially offsets the negative impact on the demand for M1´ of the shift in financial instrument preferences, but under flexible exchange rates M1´ may fall or rise.[20/] The impact effect of this disturbance on the demand for U.S. high-powered money is k_D times the impact effect on the demand for M1´. The absolute value of the interest rate responsiveness of the demand for U.S. high-powered money is greater than k_D times the absolute value of the interest rate responsiveness of the demand for M1´ because the reserve requirement for currency exceeds k_D and because the postive interest rate responsiveness of the demand for short-term Eurodollar deposits which tends to reduce the absolute value of the interest rate responsiveness of U.S. high-powered money demand is weighted by k_V which is less than k_D. Thus, under fixed exchange rates, the interest rate decline that clears the market for U.S. high-powered money is too small to keep M1´ from falling. Under flexible exchange rates the induced exchange rate effect on the demand for U.S. high-powered money may be greater than or less than k_D times the induced exchange rate effect on the demand for M1´. The induced exchange rate effect on the demand for U.S. high-powered money tends to be greater because the reserve requirement for currency is greater than k_D but tends to be less because k_V is less than k_D. Thus, under flexible exchange rates, the interest rate decline and dollar depreciation that clear the market for U.S. high-powered money and maintain equilibrium in the market for German high-

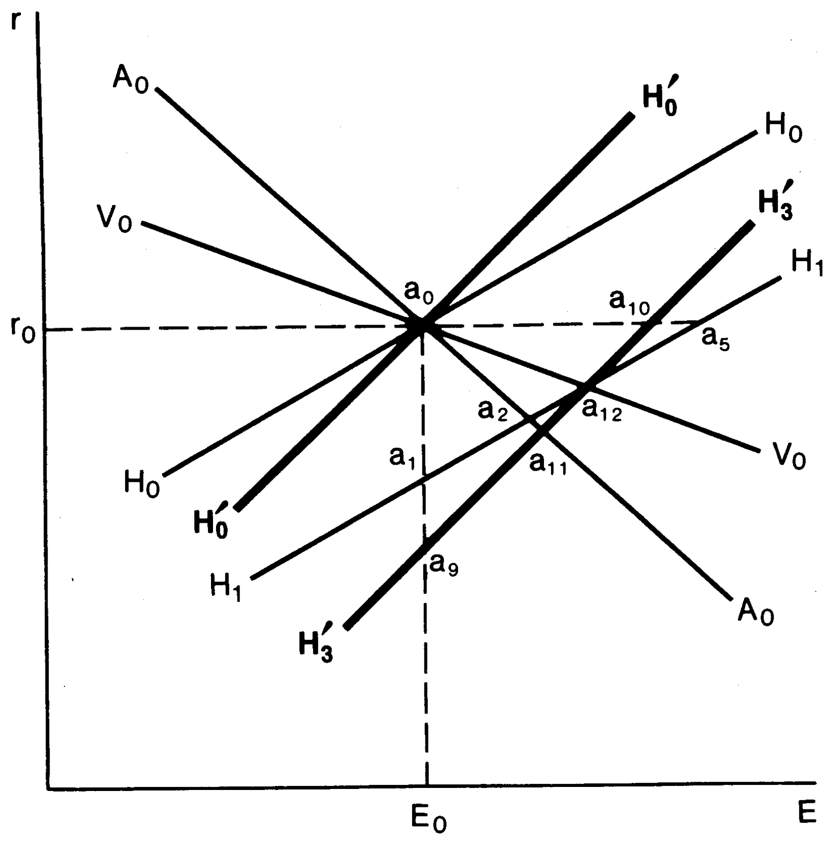


FIGURE 3

powered money may be less or more than those that would keep M1´ constant.

Once again an increase in k_V raises the slope of the HH schedule. In the case of a shift out of demand deposits and into nonreservable instruments an increase in k_V increases the amount by which the HH schedule shifts down at a given exchange rate and reduces the amount by which the HH schedule shifts to the right at a given interest rate as shown by the shift of HH from $H_0'H_0'$ to $H_3'H_3'$ ($a_0a_9 > a_0a_1$ and $a_0a_{10} < a_0a_5$). An increase in k_V has no effect on the impact effect of the disturbance, but it reduces the absolute value of the interest rate responsiveness of the demand for high-powered money and increases the exchange rate responsiveness. The new equilibrium under fixed exchange rates (point a_9) involves a larger interest rate decline.

Under flexible exchange rates an increase in k_V may increase the interest rate decline and dollar depreciation as at point a_{11} or reduce these adjustments. In order to isolate the factors which determine whether the adjustment of the interest rate and the exchange rate are larger or smaller it is useful to consider an additional schedule. The V_0V_0 schedule shows the pairs of the interest rate and the exchange rate which are consistent with unchanged holdings of short-term Eurodollar deposits by U.S. residents; a depreciation of the dollar raises the demand for Eurodollar deposits, so the interest rate must decline in order to reduce demand to its previous level. This schedule is useful in analyzing the disturbance under consideration because the H_1H_1 schedule and the $H_3'H_3'$ schedule shift by the same distance (a_0a_{12}) along the V_0V_0 schedule. Setting the total differential of the demand for U.S. high-powered money equal to zero yields

$$(H_1^N + k_D D_1^N + k_V V_1^N)dr + (H_2^N + k_D D_2^N + k_V V_2^N)W^N(1 - \theta)dE - k_D d\gamma = 0. \qquad (15)$$

If U.S. residents' holdings of Eurodollar deposits are to remain constant, then whenever E changes, r must change so that the resulting pair of E and r lies on the V_0V_0 schedule.

$$V_1^N dr + V_2^N W^N (1 - \theta) dE = 0. \tag{16}$$

Solving equation (16) for dr and substituting the result into (15) yields

$$[(H_1^N + k_D D_1^N)(-V_2^N W^N (1 - \theta)/V_1^N) + (H_2^N + k_D D_2^N) W^N (1 - \theta)] dE - k_D d\gamma = 0. \tag{17}$$

Thus, any changes in r and E that keep the demand for short-term Eurodollars constant and reestablish equilibrium in the market for U.S. high-powered money at some arbitrary value of k_V also reestablish equilibrium at all values of k_V

The slope of the VV schedule may be less negative than the slope of the A_0A_0 schedule as shown in Figure 3 or more negative. If the slope of the VV schedule is less (more) negative than the slope of the AA schedule, then the intersection of H_1H_1 and $H_3'H_3'$ lies above (below) the A_0A_0 schedule, and since the slope of the $H_3'H_3'$ schedule is more positive than the slope of the H_1H_1 schedule, the intersection of $H_3'H_3'$ and A_0A_0 lies below (above) point a_2. Consequently when the slope of the VV schedule is less (more) negative than the slope of the A_0A_0 schedule, a higher k_V leads to an increase (decrease) in the interest rate decline and dollar depreciation under flexible exchange rates.

Thus, in the case of a shift by U.S. residents from demand deposits to nonreservable instruments, an increase in k_V may reduce or increase the resulting deviation of M1' from its desired value. If the exchange rate is fixed, then an increase in k_V reduces the decline in M1' below its desired value. If the exchange rate is flexible, the slope of V_0V_0 is less (more) negative than the slope of A_0A_0, and M1´ declines, then an increase in k_V reduces (increases) the decline in M1´. If the exchange rate is flexible, the slope of V_0V_0 is less (more) negative than the slope of A_0A_0, and M1´ rises, then an increase in k_V increases (reduces) the rise in M1´.

The fourth disturbance to be considered is a shift by U.S. residents out of currency into nonreservable instruments. Recall that this disturbance has the same effect as would an open market operation which increased the supply of U.S. high-powered money. Once again this disturbance leads to a shift down in the HH schedule from H_0H_0 to H_1H_1 at the initial k_V in Figure 3. M1´ may fall or rise under both fixed and flexible exchange rates because the fall in the interest rate and, under flexible exchange rates, the depreciation of the dollar may only partially offset or may more than offset the negative impact effect on M1´ of the shift in portfolio preferences.[21/] The impact effect of this disturbance on the demand for U.S. high-powered money is equal to the impact effect on the demand for M1´. The absolute value of the interest rate responsiveness of the demand for U.S. high-powered money may be greater or less than the absolute value of the interest rate responsiveness of the demand for M1´. It tends to be less because the negative interest rate responsiveness of demand deposits receives a weight of k_D rather than one, but it tends to be greater because the positive interest rate responsiveness of the demand for short-term Eurodollar deposits receives a weight of k_V rather than one. Thus, under fixed exchange rates the interest rate decline that clears the market for U.S. high-powered money may be less or greater than the one that would be required to keep M1´ constant. Under flexible exchange rates the induced exchange rate effect on the demand for U.S. high-powered money is less than the induced exchange rate effect on the demand for M1´ since k_D and k_V are less than one. Nonetheless, under flexible exchange rates, the interest rate decline and dollar depreciation that clear the market for U.S. high-powered money and maintain equilibrium in the market for German high-powered money may be less or more than those that would keep M1´ constant.

The analysis of the effect of an increase in k_V on the interest rate decline and, under flexible exchange rates, the depreciation of the dollar caused by a shift out of currency and into nonreservable instruments is exactly equivalent to the analysis when the shift under consideration is a shift out of demand deposits into nonreservable instruments. In the cases of both shifts an increase in k_V does not change the impact effect of the shift on the demand for U.S. high-powered money. Furthermore, the increase in k_V alters the interest rate responsiveness and the exchange rate responsiveness in the same way. Therefore, the change in the slope of the HH schedule and the shifts of the HH schedule at a constant exchange rate and at a constant interest rate are exactly the same.

Thus, in the case of a shift by U.S. residents from currency to nonreservable instruments, an increase in k_V may reduce or increase the resulting deviation of M1´ from its desired value. If the exchange rate is fixed and M1´ declines below (rises above) its desired value, then an increase in k_V reduces (increases) the decline (rise) in M1´. If the exchange rate is flexible, the slope of V_0V_0 is less (more) negative than the slope of A_0A_0, and M1´ declines, then an increase in k_V reduces (increases) the decline in M1´. If the exchange rate is flexible, the slope of V_0V_0 is less (more) negative than the slope of A_0A_0, and M1´ rises, then an increase in k_V increases (reduces) the rise in M1´.

The fifth and final disturbance to be considered is a shift down in exogenous U.S. output. This shift is a weighted sum of shifts out of dollar currency, dollar demand deposits, and short-term Eurodollar deposits into nonreservable instruments where the weights are the income responsivenesses of currency, demand deposits, and short-term Eurodollar deposits respectively.[22/] Recall that in Section II it is assumed that the demand for each of these assets is positively related to output. The effects of each of the three component shifts on M1´ have been analyzed above. Under fixed exchange rates, if a shift out of currency into nonreservable instruments lowers M1´, than the total effect of a shift down in U.S. output is to lower M1´. Otherwise whether M1´ is lowered or raised depends on the relative sizes of the effects of the three component shifts and their weights. Under flexible exchange rates, if shifts out of currency and demand deposits into a nonreservable instrument lower M1´, then the total effect of a shift down in U.S. output is to lower M1´. If shifts out of either currency or demand deposits or both raise M1´, then whether M1´ is lowered or raised depends on the relative sizes of the effects of the three component shifts and their weights.

If a shift down in U.S. output causes M1´ to decrease (increase) under fixed exchange rates, an increase in k_V lowers (raises) the amount of the decrease (increase) since it increases the interest rate decline induced by each of the three component shifts. If a shift down in U.S. output under flexible exchange rates causes $M1'$ to decrease (increase), an increase in k_V lowers (raises) the amount of the decrease (increase) if it increases (decreases) the interest rate decline and dollar depreciation resulting from the three component shifts. A rise in k_V always increases the interest rate decline and dollar depreciation resulting from a shift out of short-term Eurocurrency deposits under flexible exchange rates. A rise in k_V increases the interest rate decline and dollar depreciation resulting from the other two component shifts if the slope of the V_0V_0 schedule is less negative than the slope of the A_0A_0 schedule. If the slope of the V_0V_0 schedule is more negative than the slope of the A_0A_0 schedule, the interest rate decline and dollar depreciation resulting from a shift down in U.S. output may increase or decrease depending on the relative sizes of the component effects and their weights.

V. Eurocurrency Reserve Requirements and Avoidance of Redenomination Incentives

In this section it is shown that under some Eurocurrency reserve requirement systems there may be an incentive to redenominate Eurocurrency deposits so that all Eurocurrency deposits are denominated in a single currency. Such an incentive is to be avoided since redenomination could defeat the purpose of imposing the reserve requirement or could lessen the information content of movements in a monetary aggregate. Redenomination incentives can be avoided by setting up a reserve requirement system so that no matter what the currency denomination of a deposit, the burden of holding reserves against that deposit is the same.

Suppose a Eurobank accepts dollars from a customer and assumes a future dollar liability to that customer. The bank can book this liability in at least two ways: as a dollar deposit or as a covered DM deposit, that is, as a DM deposit combined with a forward contract which commits the bank to sell the customer dollars for DM. In order to make the decision about how to book its dollar liability the bank will compare the payments and the returns associated with the two alternatives.

If the liability is booked as a dollar deposit, the payment to the customer is the Eurodollar deposit rate (r_V). If the liability is booked as a covered DM deposit, the payment is the Euro-DM deposit rate (r_X) plus the forward discount on the dollar (δ) which is the payment associated with the forward contract.[23/] If depositors are indifferent between dollar and covered DM deposits, then the deposit rates and the forward discount must satisfy the condition for covered interest parity:

$$r_V = r_X + \delta, \tag{18}$$

and the payments under both booking alternatives are the same. Since the reserve requirement system does not directly affect the payments under the two alternatives, an incentive to choose one alternative over the other must arise from a comparison of the returns the bank receives from investing the deposited funds.

The returns on the investment of deposited funds under various reserve requirement systems are presented in Table 2. First consider the system used in the earlier analysis, which is labeled case (a). Under the dollar deposit

Table 2

Return on the Investment of Deposited Funds

Under Various Eurocurrency Reserve Requirement Systems

Case	Interest Payments on Reserves	Currency of Reserves	Reservable Assets	Reserve Requirements	Return on Investment of Deposited Funds	
					Eurodollar Deposit	Covered Euro-DM Deposit
a	$r_\$$	Dollars	U.S. Residents' Short-term Eurodollar Deposits	$k_V \neq 0,\ k_X = 0$	$r_\$(1 - k_V) + k_V r_\$$	$r_\$$
b	None	Currency of Deposit	All Short-term Eurocurrency Deposits	$k_V = k_X = k$	$r_\$(1 - k) + k(0)$	$r_\$(1 - k) + k\delta$
c	None	Currency of Deposit	All Short-term Eurocurrency Deposits	$k_V = k_X r_{DM}/r_\$$	$r_\$(1 - k_V) + k_V(0)$	$r_\$(1 - k_X) + k_X\delta$
d	None	Dollars	All Short-term Eurocurrency Deposits	$k_V = k_X = k$	$r_\$(1 - k) + k(0)$	$r_\$(1 - k) + k(0)$
e	$r_\$$ on dollars r_{DM} on DM	Currency of Deposit	All Short-term Eurocurrency Deposits	$k_V = k_X = k$	$r_\$(1 - k) + kr_\$$	$r_\$(1 - k) + k(r_{DM} + \delta)$

alternative the bank puts a fraction of the deposit (k_V) into reserves and earns a return equal to the return on a representative dollar asset ($r_\$$). This return might be, for example, the rate of interest on a Treasury bill of the same maturity as the deposit. The remaining fraction of the deposit ($1 - k_V$) is invested in the representative asset and earns the same return as the return on reserves. Under the DM alternative the bank invests all of the deposit in the representative asset. Under both alternatives the returns are the same. Hence, under this system there is no incentive to redenominate dollar deposits as DM deposits that are matched by forward contracts. However, if no interest were paid on reserves, banks and U.S. citizens would have an incentive to redenominate all dollar deposits of Eurobanks as unreserved DM deposits that are matched by forward contracts. In this case redenomination would defeat the purpose of the reserve requirement scheme, which is to alter the parameters of the demand for high-powered money so as to reduce fluctuations in a monetary aggregate which includes the dollar liabilities of Eurobanks to U.S. residents.

Next consider a system where the Eurodeposits of residents of both countries denominated in both currencies are reserved, reserves are held in the currency of the deposit, and the required reserve ratios are equal. This is case (b) in Table 2. If the bank books the dollar liability as a dollar deposit, then it earns a fraction ($1 - k$) of the return on the representative asset. If the bank books the dollar liability as a covered DM deposit, then it earns the same return on the fraction of the deposit not held in reserves. However, the bank has accepted dollars, holds reserves in DM, and has a future dollar liability. Thus, the bank must convert dollars to DM spot and DM to dollars forward thereby earning a return on its required reserves equal to the forward discount on the dollar. Under this system a positive (negative) forward discount on the dollar creates an incentive to redenominate dollar deposits (DM deposits) as DM deposits (dollar deposits) that are matched by forward contracts. If the currency denomination of Eurocurrency deposits switches back and forth with changes in the forward discount, then monetary authorities who take account of Eurocurrency deposits denominated in their country's currency when formulating policy might receive confusing signals.[24/]

The kind of redenomination incentive that arises in case (b) can be avoided in several ways. One way to avoid the redenomination incentive is to vary one of the reserve requirements so as to offset the return arising from the forward discount, case (c). Specifically, the reserve requirement on, for example, dollar deposits (k_V) should be varied so that the product of the dollar reserve requirement and interest rate on the representative dollar asset is equal to the product of the DM reserve requirement and the interest rate on the representative DM asset (r_{DM}):

$$k_V r_\$ = k_X r_{DM}. \tag{19}$$

Varying k_V in this way equalizes the net burdens of holding reserves against the two types of deposits. The burden of holding reserves against a dollar deposit is equal to the interest foregone because reserves must be held, $k_V r_\$$. The net burden of holding reserves against a DM deposit is equal to the interest foregone because reserves must be held, $k_X r_\$$, minus the return to holding reserves arising from the forward discount, $k_X \delta$. Net burdens are equalized if

$$k_V r_\$ = k_X (r_\$ - \delta). \tag{20}$$

Covered interest arbitrage between representative assets insures that the difference between the interest rates on representative assets exactly reflects the forward discount:

$$r_{\$} = r_{DM} + \delta. \tag{21}$$

Solving (21) for δ and substituting the result into (20) yields (19). For instance, a larger discount on the dollar implies a higher representative rate on dollar assets and a lower reserve requirement on dollar deposits. Although variable reserve requirements are a way of avoiding the redenomination incentive, they might be difficult to implement.

A second way to avoid the redenomination incentive which arises in case (b) is to hold all reserves in the same currency, case (d), or a market basket of currencies. If, for instance, reserves are held in dollars there will be no conversion from dollars to DM associated with holding reserves against covered DM deposits, no differential return resulting from currency conversion, and, therefore, no redenomination incentive. Note that the single currency or market basket approach would make it difficult if not impossible for monetary authorities in individual countries to use the monetary base as an instrument to influence monetary aggregates which include Eurodeposits denominated in the home currency and held by residents.

A third way to avoid the redenomination incentive which arises in case (b) is to pay interest on reserves at a rate equal to the representative rate for assets denominated in the same currency as the reserves, case (e). Under the DM deposit alternative, the bank would still have to convert dollars to DM on the spot market and DM to dollars on the forward market since reserves must be held in DM. Thus, the bank's reserves would earn the forward discount on the dollar plus the rate on the representative DM asset

(r_{DM}) under the DM deposit alternative. Under the dollar deposit alternative the bank's reserves would earn the return on the representative dollar asset. Since covered interest arbitrage in the market for representative assets insures that the difference between the interest rates on representative assets exactly reflects the forward discount, the rates of return on reserves are the same, and there is no redenomination incentive.

VI. Some Conclusions

The development of closer links between domestic and Eurocurrency markets has provided an incentive for further investigation of the implications of placing reserve requirements on Eurocurrency deposits. In this paper a two-country model of international financial markets has been employed to make a contribution to that investigation. Most of the paper (Sections II, III, and IV) was devoted to the analysis of a particular system of Eurocurrency reserve requirements. Under that system the only Eurocurrency reserve requirement was one on the short-term Eurodollar deposits of U.S. residents, and interest was paid on all required reserves. First, several Eurodeposit multipliers were derived. Then the implications of raising the reserve requirement on short-term Eurodollar deposits for control of a particular monetary aggregate were traced out. This aggregate, designated M1´, was the sum of U.S. residents' holdings of currency, demand deposits, and short-term Eurodollar deposits. The remainder of the paper was devoted to a discussion of the redenomination incentives that may arise under some alternative Eurocurrency reserve requirement systems and how to avoid these incentives.

Some conclusions can be drawn about the effects of an increase in the reserve requirement on U.S. residents' short-term Eurodollar deposits (k_V) on the Eurodeposit multipliers associated with a shift from dollar demand deposits to short-term Eurodollar deposits by U.S. residents. These conclusions are obtained by combining some of the results obtained above. In Section III it was shown that under fixed exchange rates Eurodeposit multipliers are smaller the larger the interest rate decline resulting from this shift and that under flexible exchange rates the multipliers for various Eurodeposit totals measured in dollars are smaller the larger the interest rate decline and are larger the greater the amount of dollar depreciation. In Section IV it was shown that an increase in k_V reduces the interest rate decline under both fixed and flexible exchange rates and reduces the amount of dollar depreciation under flexible exchange rates. Thus, under fixed exchange rates, an increase in k_V raises all the Eurodeposit multipliers, while under flexible exchange rates it may raise or lower these multipliers.

For some values of the parameters of the model an increase in k_V definitely improves control of M1´; that is, this increase unambiguously reduces the deviations of M1´ from its desired value no matter what the source of the disturbance. First consider the case of fixed exchange rates. When U.S. residents shift out of demand deposits into Eurodollar deposits, M1´ rises. An increase in k_V reduces the interest rate decline resulting from this shift, and therefore damps the rise in M1´. Four other types of disturbances remain. Shifts out of Eurodollar deposits or demand deposits into nonreservable instruments lower M1´; shifts out of currency into non-reservable instruments and, therefore, shifts down in output <u>may</u> lower M1´. A rise in k_V increases the interest rate decline resulting from all four shifts. Thus, if M1´ declines as result of all four types of shifts, then an increase in k_V damps the decline in M1´.

Now consider the case of flexible exchange rates. When U.S. residents shift out of demand deposits into Eurodollar deposits, M1´ rises. An increase in k_V reduces the interest rate decline and dollar depreciation resulting from this shift and, therefore, damps the rise in M1´. Four other types of disturbances remain. A shift out of Eurodollar deposits into nonreservable instruments lowers M1´; shifts out of demand deposits or currency into nonreservable instruments and, therefore, shifts down in output may lower M1´. A rise in k_V increases the interest rate decline and dollar depreciation resulting from a shift out of Eurodollar deposits. A rise in k_V may increase both the interest rate decline and dollar depreciation resulting from shifts out of demand deposits and currency and, therefore, from shifts down in output. Thus, if M1´ declines as a result of all four types of shifts and if an increase in k_V increases the interest rate decline and dollar depreciation resulting from all four kinds of shifts, then an increase in k_V damps the decline in M1´.

If the conditions just described are met, an increase in k_V damps the deviations of M1´ from its desired value for all values of the parameters of the model that satisfy the conditions no matter what the relative magnitudes of the variances of the disturbance terms representing the five kinds of shifts. If these conditions are not met, an increase in k_V may still reduce the variance of M1´. However, whether or not the variance of M1´ is reduced depends on both the parameters of the model and the relative magnitudes of the variances of the disturbance terms representing the five kinds of shifts. Although an analysis of the circumstances under which the variance of M1´ would be reduced if the conditions stated above are not met has not been presented, the ingredients for such an analysis have been provided.

For some alternative Eurocurrency reserve requirements systems under which no interest is paid on required reserves, banks and nonbanks may have an incentive to redenominate Eurocurrency deposits denominated in one currency so that all Eurocurrency deposits are denominated in a single currency. Such redenomination incentives occur when the burdens of holding reserves against deposits denominated in different currencies are not the same. Reserve-holding burdens can be equalized and redenomination incentives avoided by adopting a system of variable reserve requirements, by specifying that reserves must be held in a single currency or basket of currencies, or by paying interest on required reserves at a rate equal to the rate on the representative asset denominated in the currency in which reserves must be held.

It would be useful to extend the analysis of this paper in several ways. In this paper it has been assumed that the authorities employ the intermediate target strategy of controlling M1´ in attempting to achieve their ultimate objective which might be the stabilization of output. Well known objections have been raised to the use of such an intermediate target strategy. Perhaps the most useful extension of the analysis of this paper would be to explore the implications of Eurocurrency reserve requirements for the direct stabilization of an ultimate target variable such as output. For direct stabilization the supply of high-powered money is set so that the expected value of output is equal to its desired value and no attempt is made to achieve a particular value for an intermediate target variable such as a monetary aggregate. Other useful extensions would include more detailed investigations of some of the alternative Eurocurrency reserve requirement systems presented in Section V and considerations of all the Eurocurrency reserve requirement systems in more general models of international financial markets.

Appendix A

In this Appendix a version of the equilibrium condition which states that the sum of private demands for U.S. and German Treasury securities measured in dollars must equal the sum of supplies of these assets measured in dollars comparable to equations (5) in the text is derived. The first step is to specify the demands for U.S. and German Treasury securities by U.S. and German banks. U.S. banks' demand for the sum of the two types of treasury securities, which they regard as perfect substitutes, is equal to their net worth plus the deposits they accept minus their required reserves and the loans they make to both nonbanks and the Eurobanks:

$$B^B + EF^B = W^B + (1 - k_D)D^N + (1 - k_T)T^N + \overset{*}{T}^N - L^N - \overset{*}{L}^N - I^A. \qquad (A1)$$

German banks' demand for the sum of the two types of treasury securities, which they regard as perfect substitutes, is equal to their net worth plus the deposits they accept minus their required reserves and the loans they make to both nonbanks and the Eurobanks:

$$\overset{*}{B}^B + \overset{*}{E}F^B = \overset{*}{W}^B + E[(1 - \overset{*}{k}_G)\overset{*}{G}^N + (1 - k_U)\overset{*}{U}^N + U^N - \overset{*}{P}^N - P^N - J^A]. \qquad (A2)$$

It is also useful to note that Eurobanks' demand for the sum of loans denominated in dollars from U.S. banks and the dollar equivalent of loans denominated in DM from German banks, which they regard as perfect substitutes, is equal to the loans they make to nonbanks plus their required reserves minus their net worth and the deposits they accept from nonbanks:

$$I^A + EJ^A = Q^N + \overset{*}{Q}^N - W^A - (1 - k_V)V^N - \overset{*}{V}^N - (1 - k_Y)Y^N - \overset{*}{Y}^N$$

$$+ E(S^N + \overset{*}{S}^N - X^N - \overset{*}{X}^N - Z^N - \overset{*}{Z}^N). \qquad (A3)$$

The desired version of the treasury securities market equilibrium condition is obtained by substituting three items into equation (4) of the text: banks' demand for combinations of U.S. and German Treasury securities given by equations (A1) and (A2), the Eurobanks desired holdings of combinations of dollar and DM interbank loans given by equation (A3), and nonbank behavioral relations. These substitutions yield equation (A4):

$$\begin{aligned}\bar{B} - (B^C + \overset{*}{B}{}^C) + E(\bar{F} - \overset{*}{F}{}^C) &= W^B + \overset{*}{W}{}^B + W^A + B^N + \overset{*}{B}{}^N - L^N - \overset{*}{L}{}^N - Q^N - \overset{*}{Q}{}^N \\ &+ \overset{*}{T}{}^N + \overset{*}{V}{}^N + \overset{*}{Y}{}^N + E(F^N + \overset{*}{F}{}^N - P^N - \overset{*}{P}{}^N + U^N - S^N - \overset{*}{S}{}^N + X^N + \overset{*}{X}{}^N + Z^N + \overset{*}{Z}{}^N) \\ &+ (1 - k_D)D^N + (1 - k_T)T^N + (1 - k_V)V^N + (1 - k_Y)Y^N + (1 - k_G)E\overset{*}{G}{}^N + (1 - k_U)E\overset{*}{U}{}^N . \quad (A4)\end{aligned}$$

Appendix B

In this Appendix algebraic expressions for the effects of four of the five disturbances on M1′ under fixed and flexible exchange rates are derived.

A shift out of short-term Eurodollar deposits into nonreservable instruments. Under fixed exchange rates (FI) the effect of this disturbance is given by

$$\left.\frac{dM1'}{d\beta}\right|_{FI} = M1'_r \left.\frac{dr}{d\beta}\right|_{FI} - 1, \tag{B1}$$

where

$$M1'_r = H_1^N + D_1^N + V_1^N < 0. \tag{B2}$$

(B1) can be rewritten as

$$\left.\frac{dM1'}{d\beta}\right|_{FI} = \frac{1}{k_V}\left(H_r \left.\frac{dr}{d\beta}\right|_{FI} - k_V\right) + \frac{1}{k_V}\left[(k_V - 1)H_1^N + (k_V - k_D)D_1^N\right]\left.\frac{dr}{d\beta}\right|_{FI} < 0, \tag{B3}$$

where

$$H_r = H_1^N + k_D D_1^N + k_V V_1^N. \tag{B4}$$

In order for equilibrium to be reestablished in the market for U.S. high-powered money, the first term on the right hand side of (B3) must be zero, and $\left.\frac{dr}{d\beta}\right|_{FI}$ must be negative, so the second term on the right hand side of (B3) is negative.

Under flexible exchange rates (FL) the effect of this disturbance is given by

$$\left.\frac{dM1'}{d\beta}\right|_{FL} = M1'_r \left.\frac{dr}{d\beta}\right|_{FL} + M1'_E \left.\frac{dE}{d\beta}\right|_{FL} - 1, \tag{B5}$$

where

$$M1'_E = (H_2^N + D_2^N + V_2^N)W^N(1 - \theta) > 0. \tag{B6}$$

If the market for German high-powered money is to remain in equilibrium $\left.\frac{dr}{d\beta}\right|_{FL}$ and $\left.\frac{dE}{d\beta}\right|_{FL}$ must satisfy

$$\left.\frac{dE}{d\beta}\right|_{FL} = -\frac{\overset{*}{A}_r}{\overset{*}{A}_E} \left.\frac{dr}{d\beta}\right|_{FL}, \tag{B7}$$

where $\overset{*}{A}_r$ and $\overset{*}{A}_E$ are respectively the interest rate responsiveness and the exchange rate responsiveness of the demand for German high-powered money. Given (B7), (B5) can be rewritten as

$$\left.\frac{dM1'}{d\beta}\right|_{FL} = (M1'_r - M1'_E \frac{\overset{*}{A}_r}{\overset{*}{A}_E}) \left.\frac{dr}{d\beta}\right|_{FL} - 1, \tag{B8}$$

or as

$$\left.\frac{dM1'}{d\beta}\right|_{FL} = \frac{1}{k_V}[(H_r - H_E \frac{\overset{*}{A}_r}{\overset{*}{A}_E}) \left.\frac{dr}{d\beta}\right|_{FL} - k_V] + \frac{1}{k_V}\{[(k_V - 1)H_1^N + (k_V - k_D)D_1^N]$$

$$-[(k_V - 1)H_2^N + (k_V - k_D)D_2^N] \frac{\overset{*}{A}_r}{\overset{*}{A}_E} W^N(1 - \theta)\} \left.\frac{dr}{d\beta}\right|_{FL} < 0, \tag{B9}$$

where

$$H_E = (H_2^N + k_D D_2^N + k_V V_2^N) W^N (1 - \theta) > 0. \qquad \text{(B10)}$$

In order for equilibrium to be reestablished in the market for U.S. high-powered money, given that the market for German high-powered money remains in equilibrium the first term on the right hand side of (B9) must be equal to zero, and $\left.\frac{dr}{d\beta}\right|_{FL}$ must be negative, so the second term on the right hand side of (B9) is also negative.

<u>A shift out of dollar demand deposits into nonreservable instruments.</u> Under fixed exchange rates the effect of this disturbance is given by

$$\left.\frac{dM1'}{d\gamma}\right|_{FI} = M1'_r \left.\frac{dr}{d\gamma}\right|_{FI} - 1, \qquad \text{(B11)}$$

which can be rewritten as

$$\left.\frac{dM1'}{d\gamma}\right|_{FI} = \frac{1}{k_D}\left(H_r \left.\frac{dr}{d\gamma}\right|_{FI} - k_D\right) + \frac{1}{k_D}\left[(k_D - 1)H_1^N + (k_D - k_V)V_1^N\right]\left.\frac{dr}{d\gamma}\right|_{FI} < 0. \qquad \text{(B12)}$$

The first term on the right hand side of (B12) must be equal to zero, and $\left.\frac{dr}{d\gamma}\right|_{FI}$ must be negative, so the second term on the right hand side of (B12) must be negative.

Under flexible exchange rates the effect of this disturbance is given by

$$\left.\frac{dM1'}{d\gamma}\right|_{FL} = M1'_r \left.\frac{dr}{d\gamma}\right|_{FL} + M1'_E \left.\frac{dE}{d\gamma}\right|_{FL} - 1. \tag{B13}$$

which can be rewritten as

$$\left.\frac{dM1'}{d\gamma}\right|_{FL} = \frac{1}{k_D}[(H_r - H_E \frac{\overset{*}{A}_r}{\overset{*}{A}_E}) \left.\frac{dr}{d\gamma}\right|_{FL} - k_D] + \frac{1}{k_D}\{[k_D - 1)H_1^N + (k_D - k_V)V_1^N]$$
$$- [(k_D - 1)H_2^N + (k_D - k_V)V_2^N]\frac{\overset{*}{A}_r}{\overset{*}{A}_E} W^N(1 - \theta)\}\left.\frac{dr}{d\gamma}\right|_{FL} \gtrless 0. \tag{B14}$$

The first term on the right hand side of (B14) must equal zero, and $\left.\frac{dr}{d\gamma}\right|_{FL}$ must be negative, but with $\left.\frac{dr}{d\gamma}\right|_{FL} < 0$ the second term on the right hand side of (B14) may be positive if the negative term

$$- \frac{1}{k_D}[(k_D - k_V)V_2^N]\frac{\overset{*}{A}_r}{\overset{*}{A}_E} W^N(1 - \theta) \tag{B15}$$

is large enough relative to the other three positive terms that are multiplied times $\left.\frac{dr}{d\gamma}\right|_{FL}$. Note that if $k_V = k_D$, $\left.\frac{dM1'}{d\gamma}\right|_{FL}$ is negative.

<u>A shift out of dollar currency into nonreservable instruments</u>. Under fixed exchange rates the effect of this disturbance is given by

$$\left.\frac{dM1'}{d\eta}\right|_{FI} = M1'_r \left.\frac{dr}{d\eta}\right|_{FI} - 1, \tag{B16}$$

which can be rewritten as

$$\left.\frac{dM1'}{d\eta}\right|_{FI} = (H_r \left.\frac{dr}{d\eta}\right|_{FI} - 1) + [(1 - k_D)D_1^N + (1 - k_V)V_1^N]\left.\frac{dr}{d\eta}\right|_{FI} \gtrless 0. \tag{B17}$$

The first term on the right hand side of (B17) must be equal to zero, and $\left.\frac{dr}{d\eta}\right|_{FI}$ must be negative, but with $\left.\frac{dr}{d\eta}\right|_{FI} < 0$ the second term on the right hand side of (B17) is positive unless $(1 - k_V)V_1^N > \left|(1 - k_D)D_1^N\right|$.

The effect of a rise in η on M1′ under flexible rates is given by

$$\left.\frac{dM1'}{d\eta}\right|_{FL} = M1'_r \left.\frac{dr}{d\eta}\right|_{FL} + M1'_E \left.\frac{dE}{d\eta}\right|_{FL} - 1, \tag{B18}$$

which can be rewritten as

$$\left.\frac{dM1'}{d\eta}\right|_{FL} = [(H_r - H_E \frac{\overset{*}{A}_r}{\overset{*}{A}_E}) \left.\frac{dr}{d\eta}\right|_{FL} - 1] + \{[(1 - k_D)D_1^N + (1 - k_V)V_1^N]$$
$$- [(1 - k_D)D_2^N + (1 - k_V)V_2^N] \frac{\overset{*}{A}_r}{\overset{*}{A}_E} W^N(1 - \theta)\}\left.\frac{dr}{d\eta}\right|_{FL} \lesseqgtr 0. \tag{B19}$$

The first term on the right hand side of (B19) must be equal to zero, and $\left.\frac{dr}{d\eta}\right|_{FL}$ must be negative, but with $\left.\frac{dr}{d\eta}\right|_{FL} < 0$ the second term on the right hand side of (B19) will be positive unless $(1 - k_V)V_1^N$ which is positive outweighs the other three terms which are multiplied times $\left.\frac{dr}{d\eta}\right|_{FL}$ which are all negative.

<u>A shift down in exogenous U.S. output</u>. Under fixed exchange rates the effect of this disturbance is given by

$$\left.\frac{dM1'}{d\lambda}\right|_{FI} = M1'_r \left.\frac{dr}{d\lambda}\right|_{FI} - M1'_y, \tag{B20}$$

where

$$M1'_y = H_3^N + D_3^N + V_3^N. \tag{B21}$$

It can be shown that it is possible to rewrite $\left.\frac{dr}{d\lambda}\right|_{FI}$ as

$$\left.\frac{dr}{d\lambda}\right|_{FI} = H_3^N \left.\frac{dr}{d\eta}\right|_{FI} + D_3^N \left.\frac{dr}{d\gamma}\right|_{FI} + V_3^N \left.\frac{dr}{d\beta}\right|_{FI}, \tag{B22}$$

so that (B20) can be rewritten as

$$\left.\frac{dM1'}{d\lambda}\right|_{FI} = H_3^N(M1'_r \left.\frac{dr}{d\eta}\right|_{FI} - 1) + D_3^N(M1'_r \left.\frac{dr}{d\gamma}\right|_{FI} - 1)$$

$$+ V_3^N(M1'_r \left.\frac{dr}{d\beta}\right|_{FI} - 1) \gtrless 0. \tag{B23}$$

Thus, the effect of a shift down in exogenous U.S. output on M1′ can be expressed as a weighted sum of the effects of shifts out of currency, demand deposits, and short-term Eurodollar deposits into nonreservable instruments where the weights are the positive income responsivenesses of currency, demand, and short-term Eurodollar deposits respectively. The effect of each of the three component shifts on M1′ under fixed exchange rates has been analyzed above and by referring to that analysis it can be determined that the sign of the weighted average of those effects is ambiguous and under what conditions this weighted average is negative.

Under flexible exchange rates the effect on M1′ of this shift is once again a weighted sum of the effects of the same three kinds of shifts where the weights are income responsivenesses:

$$\left.\frac{dM1'}{d\lambda}\right|_{FL} = H_3^N[(M1'_r - M1'_E \frac{\overset{*}{A}_r}{\overset{*}{A}_E}) \left.\frac{dr}{d\eta}\right|_{FL} - 1] + D_3^N[(M1'_r - M1'_E \frac{\overset{*}{A}_r}{\overset{*}{A}_E}) \left.\frac{dr}{d\gamma}\right|_{FL} - 1]$$

$$+ V_3^N[(M1'_r - M1'_E \frac{\overset{*}{A}_r}{\overset{*}{A}_E}) \left.\frac{dr}{d\beta}\right|_{FL} - 1] \gtrless 0. \tag{B24}$$

From the analysis above it can be determined that the sign of this weighted average is ambiguous and under what conditions it is negative.

Footnotes

* Economists, Board of Governors of the Federal Reserve System. This paper will appear in Dreyer, Haberler, and Willet (forthcoming). The model employed in this paper is a substantially modified version of one developed by Henderson and Lance Girton which is discussed briefly in Henderson (1977). The authors have benefited greatly from discussions of many of the issues considered in this paper with Stephen Axilrod, Michael Dooley, Richard Froyen, Lance Girton, Don Roper, Jeffrey Shafer, and Roger Waud. Helpful suggestions were received from Peter Clark, Walter Enders, Pentti Kouri, Harvey Lapan, Thomas Pugel, and Clas Wihlborg. This paper represents the views of the authors and should not be interpreted as reflecting the views of the Board of Governors of the Federal Reserve System or other members of its staff.

1/ Among the studies which consider the Eurodeposit multiplier as well as many other important topics suggested by the existence and rapid growth of the Eurocurrency markets are Freedman (1977), Hewson and Sakakibara (1975), Masera (1972), and Niehans and Hewson (1976).

2/ This approach to the evaluation of alternative operating procedures was pioneered by Poole (1970) and has been developed and applied by many analysts including Benavie and Froyen (1979), Bryant (1980), Canzoneri (1977), Friedman (1975), Kareken, Muench, and Wallace (1973), Kopecky (1978), Lindsey (1977), Pierce and Thompson (1972), Roper and Turnovsky (1980), Santomero and Siegel (1978), Sherman, Sprenkle, and Stanhouse (1979), Siegel (1979), and Sprenkle and Stanhouse (undated).

3/ It is not an objective of this paper to consider the advisability of this kind of operating strategy under which a monetary aggregate is viewed as an intermediate target. Cogent critiques of this strategy are provided by Bryant (1980), Canzoneri (1977), Friedman (1975), and Kareken, Muench, and Wallace (1973). Henderson and Waldo (forthcoming) investigate the implications of Eurocurrency reserve requirements for the stabilization of real output.

4/ The assumption that all private agents expect the exchange rate to remain unchanged could be replaced by the assumption that the expected rate of change in the exchange rate is nonzero but exogenous without altering any of the conclusions in Sections II, III, and IV. The analysis in Section V is consistent with a nonzero expected rate of change in the exchange rate. See also footnote 8.

5/ The profits and losses of banks do not affect the wealth of nonbanks participating in the market for traded financial assets because it is assumed that the risk neutral owners of banks do not sell shares to risk averse holders of traded financial assets and do not hold traded financial assets.

6/ It could be assumed that U.S. (and German) nonbanks hold all financial instruments, but, unless additional assumptions about the relative magnitudes of parameters were made, some of the results derived below could not be obtained. For example, it could not be proved that the interest rate responsivenesses of the demands for the two kinds of high-powered money are definitely negative.

7/ The assumption that, for example, dollar deposits at U.S. banks and Eurodollar deposits are imperfect substitutes is crucial for the analysis below. This assumption is plausible and empirically supportable. The two types of deposits have somewhat different payment provisions and are subject to different political risk factors. Furthermore, legal restrictions have some effect on depositors' decisions about where to place their funds. Factors such as these may explain why nonbanks actually hold dollar certificates of deposit issued by U.S. banks and Eurodollar deposits despite a rate of return differential which usually exactly reflects U.S. reserve requirements. Furthermore, there is substitution in favor of Eurodollar deposits when the return differential rises as nominal interest rates rise.

The assumption that, for example, dollar loans from U.S. banks and Eurodollar loans are imperfect substitutes is less important. It does make the location of booking of dollar loans determinate. The conclusion regarding the quantity of Eurocurrency loans in Section III depends on this assumption. However, the other conclusions of the paper are independent of this assumption. It is not immediately apparent why a borrower would care where his loan was booked. Further investigation which focuses on tax laws and other determinants of bank and borrower behavior may be required in order to arrive at a more adequate explanation of why loans are booked where they are.

8/ Short-run financial models of the type explored here yield appealing predictions about the effects of various shocks on the exchange rate when assumptions are made that insure that when the dollar depreciates the demand for U.S. (German) high-powered money measured in dollars (DM) rises (falls). One very simple set of assumptions that guarantees that a dollar depreciation has these effects is the pair of assumptions just discussed in the text. Alternatively it could be assumed that the demand for U.S. (German) high-powered money depends negatively (positively) on the expected rate of depreciation of the dollar. Then it could be assumed that exchange rate expectations are regressive so that the expected rate of depreciation of the dollar depends positively on the gap between a constant "normal" value of the exchange rate and its current value. Under these assumptions actual dollar depreciation would increase (decrease) U.S. (German) high-powered money demand if this demand were independent of net worth or if expectations effects dominate any perverse valuation effects arising from negative net foreign asset positions or any negative response of U.S. (German) high-powered money demand to increases in net worth.

9/ The last condition is based on the assumption that total government security holdings are treated as the residual item on the balance sheets of U.S. and German banks. If another item, say lending to the Eurobanks, were chosen as the residual item, the third equilibrium condition would be different, but it would still be linearly dependent with equations (3).

10/ Excess reserves for both U.S. and German banks are ruled out for simplicity. They could be included with relatively little difficulty. If it were assumed that no interest was paid on excess reserves, the qualitative effects of interest rate changes on desired holdings of excess reserves would be the same as those on desired holdings of currency. Under this assumption none of the results of the paper would be affected by the inclusion of excess reserves.

11/ It could be assumed that all time deposits at U.S. banks were resevable, but, unless additional assumptions were made about the relative magnitudes of parameter values, some of the results derived below could not be obtained. For example, it could not be proved that the interest rate responsiveness of the demand for U.S. high-powered money is definitely negative.

12/ For a version of equation (4) which is in a form comparable to equations (5), see Appendix A.

13/ That is, it is assumed that a change in the Bundesbank's holdings of U.S. Treasury securities results in an equal absolute change in German high-powered money and no change in U.S. high-powered money. This assumption that the Bundesbank does not sterilize at all and that its actions amount to complete sterilization of U.S. high-powered money is probably the most appealing simple assumption that can be made. Alternatively, it could be assumed that the supplies of both kinds of high-powered money are sterilized partially but not completely, and this assumption would lead to some changes in the results reported below. Models in which the supplies of both kinds of high-powered money can be sterilized completely such as the ones employed by Freedman (1977) and Hewson and Sakakibara (1975) are somewhat more complex than the one considered here.

14/ This possibility would still exist if German residents' holdings of short-term Eurodollar deposits were reserved.

15/ Attention is focused on a single monetary aggregate for simplicity. It could be assumed that another monetary aggregate, for example M1 defined as the U.S. residents' holdings of currency plus demand deposits, was the intermediate target but the results of the analysis would not be as unambiguous or intuitively appealing. See footnote 18.

16/ It could be assumed instead that the U.S. authorities use the interest rate as their policy instrument. If this assumption were made, then the deviations of $M1'$ from its desired value would be independent of the levels of all reserve ratios, including k_V. Since the purpose of this section is to investigate the effects of changes in k_V on such deviations, the case in which the interest rate is the policy instrument is not considered here. It would be interesting to extend the analysis of this paper to compare the variance of $M1'$ when U.S. high-powered money is the policy instrument and k_V is set at its <u>optimal</u> value with the variance of $M1'$ when the interest rate is the policy instrument in order to determine circumstances under which one policy instrument would be preferred to the other. Also, reserve requirements are used as the policy instrument by some countries, notably Germany. A different approach would be required to analyze the effects of varying the reserve requirement on Eurodollars in response to changes in the desired value of a monetary aggregate.

17/ This limitation is consistent with proposals that have been considered recently.

18/ M1´ tends to rise less (more) under flexible exchange rates because the decline in the interest rate is less (the dollar depreciates).

It can be proved that when the exchange rate is fixed and $k_T = k_Y = 0$, M1 defined as U.S. residents' holdings of currency plus demand deposits falls but by less than the shift down in demand. When the exchange rate is flexible and $k_T = k_Y = 0$, M1 tends to fall less because of the depreciation of the dollar but tends to fall more because the interest rate decline is smaller.

19/ See Appendix B for an algebraic derivation of this result.

20/ See Appendix B for an algebraic derivation of this result.

21/ See Appendix B for an algebraic derivation of this result.

22/ See Appendix B for an algebraic derivation of this result.

23/ The forward discount on the dollar is the forward dollar price of a DM less the spot dollar price of a DM divided by the spot dollar price of a DM. Assumptions made earlier imply that risk neutral banks would bid the forward discount equal to the expected rate of depreciation of the dollar, so for there to be a forward discount on the dollar private agents must expect the dollar to depreciate. This last statement would have to be modified slightly if difficulties raised by Jensen's inequality were taken into account. If banks were not risk neutral, the forward discount would not have to equal the expected rate of depreciation. However, the results of this Section depend on covered interest arbitrage and, therefore, are valid whether or not the forward discount equals the expected rate of depreciation.

24/ It might be argued that if the nonbank public regards home currency deposits and covered foreign currency deposits as perfect substitutes, then both should be included in the definition of a monetary aggregate. However, forward contracts and foreign currency deposits can be held for reasons other than the evasion of reserve requirements, and the reason these instruments are being held cannot be inferred simply from an inspection of a bank's balance sheet.

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