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EXCHANGE RATES AND PORTFOLIO BALANCE

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ABSTRACT

An open economy portfolio balance model, describing allocation among money, a domestic bond, and a traded foreign currency bond is developed for a world of many countries. A special role is attributed to the dollar, namely that all internationally traded bonds are denominated in that currency. It is shown that, in the short run with real variables exogenous and expectations static, stability requires that all countries except the U.S. be net creditors in dollar-denominated bonds.

What data are available on inter-country claims suggest that some countries may well be net debtors abroad in foreign currency. In particular, if one excludes direct investment claims, private claims on the rest of the world by Japan and Canada have been negative over the period of floating rates since 1973. However, some preliminary reduced-form regression equations for the dollar exchange rates of these two countries do not support the implications of the portfolio balance model in the debtor case. On the other hand, an equation for a composite of Western European currencies (by our calculations, this group of countries is a net creditor) gives more promising results.

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I. Introduction

The purpose of this paper is to consider in detail the theoretical properties of a model of exchange rate determination that appears increasingly in the literature, and to subject it to some empirical tests. The motivation for the development of this general class of models, which broadly-speaking can be described as portfolio balance models, is the increasing importance in the post-war years of capital flows compared to trade flows, aided by such factors as the return to convertibility of European currencies in the nineteen-fifties and the more recent enormous growth of Euro-currency markets, and the recognition that capital flows should be modelled via the underlying asset demands rather than as independent entities. In consequence, the exchange rate has come to be seen as an asset price rather than a goods price, and exchange rate determination to be inextricably linked to portfolio allocation among assets denominated in home and foreign currencies.

Portfolio balance models of the exchange rate are also a natural development of closed economy portfolio allocation models most closely associated with the work of James Tobin and others of the Yale School. As such they enforce consistency across asset demand equations and do not focus on only a restricted set of assets (e.g. monies), but rather consider the whole menu of assets to which wealth can be allocated (albeit in a necessarily aggregative fashion). Consequently, such portfolio balance models have great theoretical appeal when one is trying to explain exchange rate movements.

However, it is argued here that there are some theoretical features of such models that have not been widely recognized, and that these features have considerable empirical significance. They relate to the sign of a country's net position in assets denominated in foreign currency. If it is negative, that is, the country is a net debtor in foreign currency assets, then the signs of most comparative statics results are reversed. Whereas in the net creditor case an increase in the home money supply, or a purchase of foreign currency in the exchange market, will tend to depreciate the home currency, the opposite is true for a net debtor country.[1] Even more disturbing, in the net debtor case the comparative statics positions are not stable equilibria; shocks to the exchange rate will be self-reinforcing rather than bringing about a return to the initial position.

The above-mentioned properties, both because they conflict with intuition and because they have such major implications for policy, must necessarily induce a certain wariness about use of portfolio balance models for exchange rate determination until they have been subjected to considerable empirical testing. On the one hand one may be tempted to reject such models out of hand, at least for net debtor countries (which, as we shall see below, are numerically important). On the other hand, one may find some heuristic support for such models in observed exchange rate volatility for countries like Canada which are clearly net debtors in foreign currency. Neither reaction is a satisfactory substitute for careful testing of the model, which we attempt to do below.

The plan of the paper is as follows. Section II generalizes the portfolio balance model to a multi-country framework in order to make it empirically relevant and derives comparative static and stability results. The model ascribes a special role to the U.S. dollar; all international claims and liabilities are assumed denominated in that currency. Section III gathers together what data exist for testing the model, which requires bilateral net claims on the United States by other countries: exchange rate equations are tested for Canada, Japan, and a Western Europe composite currency, corresponding to available bilateral asset stocks. It happens that

(1) See, for instance, Boyer (1976) and Henderson (1977).

the first two countries are net debtors, thus pointing up the empirical importance of this case. Regression results are reported, and they prove generally unfavourable to the model. Section IV sketches a few conclusions.

II. Portfolio Balance Models of the Open Economy

What is meant here by portfolio balance models (and this term will be used henceforth in the restricted sense as a shorthand) is an extension of a closed-economy asset allocation model (see, for instance, Tobin (1969)) to include holdings of assets denominated in foreign currencies. What we view as essential characteristics of such models are as follows:

(1) wealth-owners in a given country translate their foreign assets (or the relevant part of their foreign assets, such as fixed price bonds) into domestic currency using the prevailing exchange rate, and

(2) with unchanged interest rates and risk, there is some determinate proportion of national wealth that investors desire to hold in each of the domestic and foreign assets(1) (the latter after translation into domestic currency).

The model presented and tested in this paper possesses the above characteristics, and shares other features with portfolio balance models appearing in the literature: assets considered are money, domestic bonds and a foreign bond; real output and income, prices and the current account balance are assumed exogenous. The model does not assume, however, that one of the countries is "small", i.e. that it has no effect on financial conditions abroad and hence can be taken as exogenous to it (this was the assumption in, for instance, Branson, Halttunen, and Masson (1977) and Flood (1976)). Furthermore, it considers the effect of intervention on domestic asset markets and the exchange rate, as do Girton and Henderson (1977)

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(1) The proportions may vary with wealth if demand functions are not homogeneous.

in their theoretical model.

An innovation here is the attempt to account in a consistent way for developments in many countries. A shortcoming of much modelling work is that only two countries - or one country and an exogenous "rest of the world" - are considered, and a bilateral spot rate is then related to the developments in each of the two countries. Other countries are ignored or ad hoc assumptions are made in order to yield the result desired, namely the independence of the spot rate considered from third-country effects. Empirical testing of the portfolio balance model of exchange rate determination requires, on the contrary, that it be formulated in a form consistent with the data available. It must account for the realities of a multi-country world if it is in fact true that rebalancing of portfolios by the residents of each country in response to an exchange rate change is a significant and predictable force - as the portfolio balance model assumes. This is not to say that there do not exist consistent multi-country exchange rate models - examples are the IMF MERM model (Artus and Rhomberg (1973)) and that of Armington (1979) - but the primary mechanism by which exchange rates get determined is not through the rebalancing of national portfolios of financial assets.[1]

A conceptual framework exists for examining in complete generality the effects on exchange rates of asset holdings[2]: ideally one should look at a three-dimensional matrix of claims, with an index for the borrowing country, the lending country, and the currency of denomination. In practice such data are simply not available. Even if one excludes direct investment, where there are notorious problems in measuring the market value of the underlying stock, the remaining assets are so diverse and their statistical coverage so fragmentary

(1) The MERM model determines exchange rates to equilibrate trade flows, while Armington's model assumes that it is the global portfolio that is relevant, not the portfolios of individual countries.

(2) See Basevi (1973).

as to make an attempt at empirical verification of a fully general model fruitless.

Fortunately the preeminent role of the dollar in world financial markets makes possible a major simplification which does not do too great violence to reality, namely that current account deficits and surpluses lead to decumulations and accumulations of assets that are denominated in U.S. dollars, excluding the portion corresponding to direct investment. This is consistent with both the size of non-U.S. borrowing and lending in the Eurodollar and domestic United States market, and the fact that a vast majority of official intervention takes place in dollars. The assumption of the primary role of the dollar also has the realistic implication that the United States must be treated differently from other countries in a portfolio balance model. It is such a model that we develop below, considering first comparative statics and then dynamic stability.

(a) Comparative Statics Results

We consider a world where only country 1, the United States, issues fixed-price bonds (F) which are held internationally; its money (M_1) is not traded. Other countries (i=2,...,n) issue non-traded money (M_i) and bonds (B_i), the latter held only by private domestic residents (BP_i) or the central bank (BG_i); but US bonds are also held by private residents (FP_i) and by i's central bank (FG_i), which keeps all its foreign exchange reserves in US bonds. The United States central bank is assumed not to intervene in foreign exchange markets, and it does not appear explicitly in the model.

The portfolios of each country can thus be written schematically as follows, assuming demand functions are homogeneous in wealth:

United States Private Sector

Money: $M_1 = m_1 (r_1) W_1$

Dollar bonds held domestically: $F_1 = f_1 (r_1) W_1$

Wealth: $M_1 + F_1 = W_1$

Non-U.S. Country i

Private Sector

$M_i = m_i(r_1, r_i) W_i$

$BP_i = b_i (r_1, r_i) W_i$

$FP_i/e_i = f_i (r_1, r_i) W_i$

$W_i = M_i + BP_i + FP_i/e_i$

Central Bank

$M_i = BG_i + FG_i/e_i^*$

where r_i is the interest rate on the bond issued by country i, e_i is the spot exchange rate expressed as dollars per unit of currency i, e_i^* is some fixed exchange rate used by the central bank to value its foreign exchange reserves (arbitrarily set at 1, as is the initial value of e) so that capital gains or losses are not reflected in the money supply.

Asset holders are assumed to have static expectations, that is, their expectation of the relevant future rate is just this period's rate. In general, however, demand functions should include the U.S. interest rate minus the expected rate of change of the exchange rate; the difficulty in modelling expectations of the exchange rate and some partial evidence that it may follow a random walk have led us to omit this term.

As the model is a short-run financial model which abstracts from the influence of conditions in flow markets, the current account is taken as exogenous (in terms of dollars). This means that each country's holdings (F_i) of dollar bonds (except for the U.S.) are predetermined as the sum of past current account (CA) surpluses, that is, $F_i = FP_i + FG_i = \int_{-\infty}^{0} CA_i(t)dt$ or alternatively that

$$dF_i = dFP_i + dFG_i = CA_i \qquad (i=2,\ldots,n)$$

Similarly,

$$dF_1 = dF + CA_1 = dF - \sum_2^n CA_i$$

where F is the net supply of dollar bonds by the United States (other countries can issue dollar bonds, but their net holdings are each still limited by their cumulated current accounts(1)).

We are interested in the effect on exchange rates e_2 to e_n and incidentally on interest rates r_1 to r_n, of changes in the asset stocks: money supplies, U.S. issue of dollar bonds, other countries' supplies of non-traded bonds, current account surpluses, and foreign exchange market intervention. It should be noted that the latter cannot change the net wealth of the private sector, but rather affects the shares of dollar bonds held by the private sector and the central bank, with offsetting changes to private sector holdings of domestic bonds (if there is complete sterilisation) or domestic bonds and money (if sterilisation is incomplete). Intervention is thus best viewed as an open-market swap of foreign bonds for domestic bonds (and perhaps money), just as domestic monetary policy is an open market swap of domestic bonds for domestic money.

We thus differentiate the market clearing conditions, of which we have 2n, only 2n-1 of which are independent (we eliminate that for U.S. bonds), after noting that with e_i=1 initially, the change in wealth can be simplified to

$$dW_1 = dM_1 + dF - \sum_2^n dF_i$$

$$dW_i = dB_i + dF_i - FP_i de_i \quad (i=2,\ldots,n),$$

to yield

(1) Net of direct investment outflows. This will be discussed more fully below, in the empirical section.

$$dM_1 = W_1 m_{11}\, dr_1 + m_1\, (dM_1 + dF - \sum_{2}^{n} dF_i)$$

$$dM_i = W_i\, (m_{i1}\, dr_1 + m_{ii}\, dr_i) + m_i\, (dB_i + dF_i - FP_i\, de_i)$$

$$dB_i - dBG_i \equiv dB_i + dFG_i - dM_i$$

$$= W_i\, (b_{i1}\, dr_1 + b_{ii}\, dr_i) + b_i\, (dB_i + dF_i - FP_i\, de_i)$$

where $m_{ij} = \partial m_i / \partial r_j$, $b_{ij} = \partial b_i / \partial r_j$, $f_{ij} = \partial f_i / \partial r_j$, etc., and $m_{ij} < 0$ for all i, j; $b_{i1} < 0$, $b_{ii} > 0$, $f_{ii} < 0$ all $i > 1$, $f_{i1} > 0$ for all i.

In matrix terms, the system of 2n-1 equations can be written in the form $Ady = Bdx$, (see page 10).

After inverting the matrix on the left and multiplying by the matrix B, one can derive the following:

$$\frac{de_i}{dM_1} = \frac{\psi_i\, W_i\, (1-m_1)}{\phi_i\, FP_i\, m_{11}\, W_1}$$

a money financed budget deficit in U.S.

$$\frac{de_i}{dF} = \frac{-\psi_i\, W_i\, m_1}{\phi_i\, FP_i\, m_{11}\, W_1}$$

a bond financed budget deficit in U.S.

$$\frac{de_i}{dM_i}\bigg|_{dBG_i = dM_i} = \frac{-f_{ii}}{\phi_i\, FP_i}$$

an open market purchase of bonds

$$\frac{de_i}{dB_i} = \frac{f_{ii}\, m_i - m_{ii}\, f_i}{\phi_i\, FP_i}$$

a bond financed budget deficit

$$\frac{de_i}{dB_j} = \frac{de_i}{dM_j} = \frac{de_i}{dFG_j} = 0 \text{ if } j \neq i$$

cross effects

$$\frac{de_i}{dF_i} = \frac{1}{FP_i} \left(\frac{\psi_i\, W_i\, m_1}{\phi_i\, m_{11}\, W_1} + 1\right)$$

a current account surplus with U.S.

$$\frac{de_i}{dF_j} = \frac{\psi_i\, W_i\, m_1}{\phi_i\, FP_i\, m_{11}\, W_1} \quad j \neq i$$

a current account surplus of a third country with U.S.

$$\frac{de_i}{dFG_i} = -\frac{m_{ii}}{\phi_i\, FP_i};$$

purchase of foreign exchange

$$
\left[\begin{array}{cccc|ccc}
m_{11}W_1 & 0 & \cdots & 0 & 0 & \cdots & 0 \\
\hline
m_{21}W_2 & m_{22}W_2 & & 0 & -m_2FP_2 & & 0 \\
\vdots & & \ddots & & & \ddots & \\
m_{n1}W_n & & & m_{nn}W_n & 0 & & -m_nFP_n \\
\hline
b_{21}W_2 & b_{22}W_2 & & 0 & -b_2FP_2 & & 0 \\
\vdots & & \ddots & & & \ddots & \\
b_{n1}W_n & & & b_{nn}W_n & 0 & & -b_nFP_n
\end{array}\right]
\left[\begin{array}{c}
dr_1 \\ \hline dr_2 \\ \vdots \\ dr_n \\ \hline de_2 \\ \vdots \\ de_n
\end{array}\right]
=
\left[\begin{array}{c|c|ccc|ccc|ccc|ccc}
(1-m_1) & -m_1 & 0 & \cdots & 0 & 0 & \cdots & 0 & m_1 & \cdots & m_1 & 0 & \cdots & 0 \\
\hline
0 & 0 & 1 & & 0 & -m_2 & & 0 & -m_2 & & 0 & & & \\
\vdots & \vdots & & \ddots & & & \ddots & & & \ddots & & & 0 & \\
0 & 0 & 0 & & 1 & 0 & & -m_n & 0 & & -m_n & & & \\
\hline
0 & 0 & -1 & & 0 & (1-b_2) & & 0 & -b_2 & & 0 & 1 & & 0 \\
\vdots & \vdots & & \ddots & & & \ddots & & & \ddots & & & \ddots & \\
0 & 0 & 0 & & -1 & 0 & & (1-b_n) & 0 & & -b_n & 0 & & 1
\end{array}\right]
\left[\begin{array}{c}
dM_1 \\ \hline dF \\ \hline dM_2 \\ \vdots \\ dM_n \\ \hline dB_2 \\ \vdots \\ dB_n \\ \hline dF_2 \\ \vdots \\ dF_n \\ \hline dFG_2 \\ \vdots \\ dFG_n
\end{array}\right]
$$

where $\psi_i = (b_{i1}\ m_{ii} - m_{i1}\ b_{ii}) > 0$

$\phi_i = (m_{ii}\ b_i - b_{ii}\ m_i) < 0.$

The changes in current balances and budget deficits being considered are assumed to be the result of autonomous shifts in savings (in the first case) and in investment (in the second case) which are not induced by either interest rates or exchange rates. This is not to deny that these linkages do exist, just that the lags involved are long relative to the short run time frame of exchange rate determination. Since they thus do not pose simultaneity problems for estimation, these linkages need not be considered here.

The derivatives de_i/dF_i and de_i/dF_j give results for the case where the current account surplus run by i or j is solely at the expense of the United States; furthermore as F is being kept constant, the U.S. authorities are assumed not to issue bonds in response to the increased foreign demand for dollar bonds. Other cases are also of interest, however, and can easily be calculated from the above derivatives. In particular, (1) if i's current account is at the expense of a third country k:

$$\left.\frac{de_i}{dF_i}\right|_{dF_k = -dF_i} = \frac{1}{FP_i}$$

(2) if j's current account is at the expense of a third country k ($k\neq 1$, $k\neq i$):

$$\left.\frac{de_i}{dF_j}\right|_{dF_k = -dF_j} = 0$$

(3) if the U.S. issues bonds equal to the increased demand for dollar bonds due to surpluses by i or j at the expense of the U.S.:

$$\left.\frac{de_i}{dF_i}\right|_{dF=dF_i} = \frac{1}{FP_i}$$

$$\left.\frac{de_i}{dF_j}\right|_{dF=dF_j} = 0$$

(4) if the authorities in country i absorb the current account surplus with the U.S. by intervening in the foreign exchange market:

$$\left.\frac{de_i}{dF_i}\right| dFG_i = dF_i \quad = \frac{1}{FP_i} \times \left[\frac{\psi_i \; W_i \; m_1}{\phi_i \; m_{11} \; W_1} + \frac{m_i \; f_{ii} - f_i \; m_{ii}}{\phi_i} \right]$$

(5) if the authorities of i absorb the current account surplus with a third country k by intervening:

$$\left.\frac{de_i}{dF_i}\right| \begin{matrix} dF_k = -dF_i \\ dFG_i = dF_i \end{matrix} \quad = \frac{1}{FP_i} \times \left[\frac{f_{ii} \; m_i - f_i \; m_{ii}}{\phi_i} \right] = \frac{de_i}{dB_i}$$

(6) if the U.S. increases the money supply by open-market operations rather than a budget deficit:

$$\left.\frac{de_i}{dM_1}\right| \quad dF = -dM_1 \quad = \frac{1}{FP_i} \times \left[\frac{\psi_1 \; W_i}{\phi_i \; m_{11} \; W_1} \right]$$

The latter impact must be worked out separately because the U.S. central bank does not appear explicitly, so that F_1, the stock of bonds held by the private sector, was implicitly held constant for de_i/dM_1 given above.

Given the pattern of signs of the partial derivatives of asset demand functions, one can in most cases determine the direction of the comparative statics results. One knows in addition that

$$m_i + b_i + f_i = 1 \qquad i = (2,\ldots,n)$$

and that money and bond stocks have to be positive. However, f_i is the ratio of a <u>net</u> stock of dollar bonds (resulting from all past current account surpluses and deficits minus central bank interventions) and hence need not be positive. In particular, there is no reason to exclude borrowing in dollars to finance a current account deficit, either from the United States or from third countries, and there is no reason to exclude the possibility of a country's private sector being a net debtor internationally.

The implication for our comparative statics results is major, as each of the derivatives changes signs as FP_i (and hence f_i) moves from positive to negative. We therefore present the comparative statics results below for two cases, first where country i is a net creditor internationally, second where it is a net debtor (see Table 1).

It is striking that if the portfolio balance model holds (and abstracting from possible additional feedbacks through expectations, and price and output changes), the effect of the exogenous variables is completely opposite depending on the sign of the net foreign asset position.(1) This is a strong and radical implication of the model, for it implies that intervention is perverse if a country's private sector is a net debtor: purchase of foreign exchange drives up the value of one's currency! This and other implications of the model will be tested below in the empirical section.

(b) Short-Run Dynamic Stability

It is of interest to determine under what conditions the portfolio balance model presented above will be stable, that is, will return to its equilibrium position when shocked. We postulate a simple adjustment process in which each country's interest rate responds positively to excess demand for money and its exchange rate negatively to excess demand for foreign currency assets on the part of its residents. Writing this as

$$\dot{r}_1 = c_1 (m_1 (r_1) W_1 - M_1)$$

$$\dot{r}_i = c_i (m_i (r_1, r_i) W_i - M_i)$$

$$\dot{e}_i = -d_i (f_i (r_1, r_i) W_i - FP_i/e_i) \qquad i=2,\dots,n$$

(1) Except for those cases where a positive net position does not permit the sign of the derivatives to be determined.

Table 1

Effect on the Dollar Price of i's Currency

of:	Sign of i's Private Net Foreign Asset Stock: +	-
1. Increase in U.S. money through open market operation	+	-
2. Increase in i's money through open market operation	-	+
3. Increase in the stock of dollar bonds	-	+
4. Increase in the stock of i's bonds	?*	-
5. Bilateral current account surplus with U.S.	+	-
6. Bilateral current account surplus with a third country	+ (less than 5. in absolute value)	-
7. Bilateral current account surplus with U.S., financed by an increase in U.S. bonds)	+ (magnitude equal to 6.)	-
8. Intervention (Purchase of dollars) by central bank i	-	+
9. Bilateral current account surplus with U.S. with an equal central bank purchase of dollars	?**	-
10. Bilateral current account surplus with a third country with an equal central bank purchase of dollar	?* (equal to line 4., smaller in magnitude than 9.)	-

* This is positive if and only if dollar bonds are better substitutes for domestic bonds than is domestic money, in terms of demand elasticities.

** This is positive if, but not only if, dollar bonds are better substitutes for domestic bonds than is domestic money.

where c_i, d_i are (positive) speeds of adjustment, and a dot over a variable indicates a time derivative.

The adjustment equations can be linearised about the equilibrium values $y^o = (r_1{}^o,\ldots,r_n{}^o,e_2{}^o,\ldots e_n{}^o)$ to yield a system of equations of the form

$$\dot{y} = B(y-y^o)$$

Stability requires that the characteristic roots of B have negative real parts, **and a necessary condition for this to be true, for all positive speeds of adjustment, is for leading principal minors to alternate in sign, starting with negative (see Gandolfo (1971), Part II, Chapter 9).**

It can easily be shown, however, that the principal minors of B are equal to those of A (given above in section II(a)) since B can be transformed into A by subtracting row j from row 2j+1 (for j=2,...,n), leaving the values of the relevant determinants unchanged. Therefore we shall discuss stability in terms of the properties of matrix A.

Consider the first n principal minors (call them P_1 to P_n). Since the determinant of a triangular matrix is the product of its diagonal elements

$$P_i = \prod_{j=1}^{i} m_{jj}\, W_j = (-1)^i \prod_{j=1}^{i} \left| m_{jj}\, W_j \right|$$

for i = 1,...,n and these minors satisfy the stability conditions.

The value of principal minors P_{n+i-1} (i=2,...,n) can be found through partitioning the relevant matrix (call it A_{n+i-1}) into

$$A_{n+i-1} = \begin{array}{c} \\ n \\ i-1 \end{array} \begin{array}{c} \begin{array}{cc} n & i-1 \end{array} \\ \begin{bmatrix} S & T_i \\ U_i & V_i \end{bmatrix} \end{array}$$

and recalling that by Schur's formula (see Dhrymes (1970), p.571) if V_i is non-singular then

$$P_{n+i-1} = \det (A_{n+i-1}) = \det V_i \; . \; \det (S-T_i V_i^{-1} U_i),$$

from which it can be shown that

$$P_{n+i-1} = (-1)^{n+i-1} \prod_{j=2}^{i} FP_j \left| \prod_{j=2}^{i} W_j (b_{jj} m_j - b_j m_{jj}) m_{11} W_1 \prod_{k=i+1}^{n} m_{kk} W_k \right|$$

It is clear that the only way all principal minors P_i can have sign $(-1)^i$ is for all $FP_j > 0$, $j > 1$.

Thus it is necessary **for stability in this short-run asset market model that all countries be net creditors in dollars (except the United** States): if any country is a net debtor in foreign currency (because it has a cumulated deficit on its current account forcing it to issue dollar bonds), then its currency will not return to its initial value when subject to a random shock.

The reason for this surprising result can best be understood by comparing the portfolio rebalancing induced by an exchange rate shock in the net debtor case with the net creditor case. Suppose a country is a net creditor in foreign currency assets. A fall in its exchange rate will induce a rise in the value of those assets and hence in wealth, but it will not in general be desired to hold the increase in wealth solely in dollar bonds; the attempt to shift out of dollar bonds into domestic assets (causing an incipient capital inflow) will tend to appreciate the currency and re-establish the initial exchange rate.

In the case of the net debtor country, on the other hand, a fall in the exchange rate will increase its foreign currency liabilities and hence decrease wealth. The consequence of the decrease in wealth will be the desire to scale down all assets and liabilities; however, its dollar liabilities have increased. The attempt to decrease foreign currency liabilities leads to an incipient capital outflow and hence a further weakening of the exchange rate, driving the rate even further from the initial value and again lowering wealth. It could be argued that the creditor and debtor cases are not necessarily symmetric, especially if the assets concerned are of longer term to maturity than just one period. In the latter case, debtors may not be concerned with the current value of their liabilities as they cannot repay them before maturity, while creditors can dispose of their assets. However, if, as we assume here, the relevant securities are marketable, debtors can repay their debts by repurchasing them in the market.

The unstable process described above would only come to an end when forces not captured in the model (expectations, output and price changes) dominated the portfolio balance effects detailed here. For instance, if exchange rate expectations are strongly regressive, and investors use a "normal" exchange rate to value their liabilities, a change in the exchange rate will not induce a perverse wealth effect. The argument suggests, therefore, that the comparative static results in the net debtor case may have limited applicability, as the observed values for exchange rates and asset stocks may not reflect so much the expected change in the exchange rate produced by the exogenous variables as the effect of those stabilizing forces. Alternatively, observed data may correspond to disequilibrium positions that are only transitory. As the states which are present in the comparative static results are not stable equilibrium states, there is no presumption that they are likely to be observed.

Nonetheless, it is significant that under some conditions an exchange rate model with eminently reasonable assumptions about portfolio behaviour produces instability, without the assumption of destabilizing expectations. Recent periods have witnessed a number of episodes in a number of currencies where observers have talked of exchange rate movements feeding upon themselves. These are usually ascribed to expectional forces extrapolating past changes. More recently, the "vicious circle hypothesis" has linked falls in exchange rates to the cumulated effect of import price increases, domestic inflation and further depreciation.(1) In addition, a literature on "overshooting" has sprung up (see e.g. Dornbusch (1976)) where the faster adjustment of financial markets than goods markets causes the exchange rate to overshoot its equilibrium value in the short run, though eventually to return to it. Another possible explanation of observed volatility in exchange markets then emerges from the analysis of this paper, namely perverse wealth effects making exchange rate shocks self-reinforcing, at least in the short run where real variables are constant.

III. Empirical Results

In this section we apply the theoretical framework developed above to monthly data on three spot exchange rates against the U.S. dollar: the Canadian dollar, the Japanese yen and a weighted average exchange rate for Western Europe.(2) The choice of these particular bilateral exchange rates was dictated by the availability of bilateral data on current accounts and direct investment vis-à-vis the U.S. From these data we were able to calculate bilateral net claims or liabilities on the U.S. by cumulating the balance of payments flows

(1) See Basevi and De Grauwe (1977).

(2) For this exercise Western Europe comprises Belgium, France, Germany, Italy, the Netherlands, Sweden, Switzerland and the United Kingdom.

from benchmark values.[1] The time period for estimation purposes runs from April, 1973, the beginning of the managed floating regime, to April, 1978, the latest observation available for certain series at the time of estimation.

(i) Asset Stock Measures

Three different measures of the bilateral foreign asset stock vis-à-vis the U.S. were calculated: (1) the cumulated bilateral current account (henceforth called FTB); (2) the cumulated overall current account excluding direct foreign investment claims (CBBM); and (3) the cumulated bilateral current account excluding direct foreign investment claims (FTED). The latter two measures have strong intuitive appeal since long-term direct investment flows are not related to the exchange rate in the same way as short-term financial flows, as expected future earnings will to some extent offset exchange rate movements. Clearly decisions about direct investment may be influenced by long-term judgements concerning movements in real exchange rates. However, they do not depend on current spot exchange rates to the same extent as short-term capital flows.[2] In addition, the theoretical discussion dealt with the portfolio behaviour of the private sector. Thus, corresponding to each of the three measures of the bilateral foreign asset stock, we calculated the net private stock as the difference between total national net claims on the U.S. and the authorities' holdings of foreign exchange reserves.

Thus, in two respects our empirical analysis of the role of the foreign asset stock represents an extension of Branson and Halttunen (1979). First, we have calculated bilateral net foreign asset stocks whereas they used both

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(1) See Appendix for sources of data.

(2) The case of long-term portfolio investment is more ambiguous. On the one hand, as such assets may be held for a short period, they may respond to the exchange rate in the same way as short-term assets. On the other hand, portfolio investment will include equity holdings the investment motive for which is very similar to direct investment.

countries' foreign asset stocks in the equation determining the bilateral rate. Second, we also restrict the definition of the foreign asset stock to exclude capital flows taking the form of direct investment.

(ii) Net Creditor and Debtor Positions

The theoretical analysis in Section II also highlighted the importance of establishing whether the home country is a net creditor or debtor in its foreign asset position vis-à-vis the U.S. Since the properties of the model are so crucially dependent on the sign of the net position, we have considered alternative definitions and been diligent in searching for reliable stock data. However, we are aware that it may be possible to construct other measures giving quite a different picture, and that these could conceivably change the interpretation of the regression results.

The positions for Canada, Japan and Western Europe for the three definitions of the total and private foreign asset stocks are set out in Table 2. Canada, as would be expected, is a net debtor with the U.S. on all definitions. The cases of Japan and Western Europe are less clearcut. Japan is always a net debtor for the private asset stock but switches during the time period in question from a net debtor to a net creditor position on all definitions of the total foreign asset stock though with the CBBM measure this only holds for the last observation. Western Europe, on the other hand, is always a net creditor for the total foreign asset stock but switches during the period from a net creditor to a net debtor on the private asset stock.

(iii) Estimating Equation for the Exchange Rate

In our empirical specification of an exchange rate equation, the main focus is on the impact of shifts in the bilateral money, bond and foreign asset stocks on the home country exchange rate vis-à-vis the U.S. dollar. Thus,

Table 2: Net Creditor and Debtor Positions for Canada, Japan and Western Europe vis-à-vis the U.S. for Alternative Definitions of the Stock of Foreign Assets, Sample Period 1973:4-1978:4

	Foreign Asset Stock (U.S. Dollars)					
	CBBM	$CBBM^P$	FTB	FTB^P	FTED	$FTED^P$
Canada	Net Debtor	Net Debtor	Net Debtor	Net Debtor	Net Debtor	Net Debtor
Japan	Net Debtor except for 1978:4	Net Debtor	Net Debtor through 1976:1; Net Creditor since	Net Debtor	Net Debtor through 1974:6; Net Creditor since	Net Debtor
Western Europe	n.a.	n.a.	Net Creditor	Net Creditor through 1975:1; Net Debtor since	Net Creditor	Net Creditor through 1977:9; Net Debtor since

Notes: n.a. = not available
CBBM = interpolated total current account + interpolated direct foreign investment (cumulated)
FTB = bilateral trade balance + interpolated services (cumulated)
FTED = interpolated bilateral current account + interpolated direct investment (cumulated)
The superscript "P" indicates the private foreign asset stock i.e., CBBM, FTB and FTED minus foreign exchange reserves.

the typical equation to be estimated specifies the home country exchange rate against the U.S. dollar, e($/Home) as a function of the home and U.S. money and bond stocks and the bilateral net foreign asset position: (1)

$$e\{\$/Home\} = f\{M_H, M_U, B_H, B_U, F_{HU}\} \tag{1}$$

where the subscripts "H" and "U" stand for home country and the U.S, respectively; and F_{HU} = bilateral net foreign asset position with the U.S.

(iv) A Reaction Function for Intervention

Public sector decisions, in so far as they affect the asset stocks of the private sector, will have repercussions on the exchange rate. In an attempt to model the systematic part of the authorities' behaviour, we assumed that the reaction function might (in its most general manifestation) have three components: (i) a desire to smooth changes in the exchange rate; (ii) an attempt to hit a target exchange rate level depending on purchasing power parity and capacity output relative to actual output; and (iii) a target level of foreign exchange reserves whose level might be expected to grow with nominal income. (2)

Symbolically, it is assumed that

$$\Delta\, FXR = a\{e-e_{-1}\} + b\{e^*-e_{-1}\} + c\{FXR^* - FXR_{-1}\} \tag{2}$$

with the target levels of the exchange rate and reserves given as:

$$e^* = \alpha\{CPI_H/CPI_U\} + \beta\{\gamma t - \log IP\} \tag{3}$$

$$FXR^* = \ell + \rho IP^* \; CPI \tag{4}$$

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(1) In addition to estimating such an equation with the home and U.S money and bond stocks entering as separate regressors, we also experimented with an alternative specification where the money and bond stocks were constrained to enter the equation in ratio form. However, this specification never produced better results.

(2) A more thorough discussion of such a reaction function is presented in Branson, Halttunen and Masson (1977).

The reaction functions, thus, include the current exchange rate so that a reduced-form exchange rate equation such as equation (1) above, if estimated by ordinary least squares (OLS), would produce biased estimates of the coefficients. To correct for this bias we also used a consistent estimating technique, two-stage least squares (2SLS), for the exchange rate equation and the reaction function.

(v) Data Set for the Regressions

We used monthly series on M1 and M3 as alternative measures of the money stocks having no prior opinion as to which was the more suitable monetary aggregate. The bond stocks were proxied by monthly data on the public debt (measured in domestic currency).(1)

The list of variables used in the regressions is as follows:

(suffix - indicated by a dot - can take the string "US", "CAN", "JAP", or "EUR", except for the CBBM variables for which CBBMEUR does not exist. The U.S. variables exist only for money and bond stocks).

M1.		money stocks
M3.		
DB.	-	government bond stock outstanding (data on M1, M3, DB all measured in local currency units).
FTB.	-	cumulated bilateral current account vis-à-vis U.S.
FTED.	-	cumulated bilateral current account excluding direct investment vis-à-vis U.S.
CBBM.	-	cumulated overall current account excluding direct investment.
FXR.	-	foreign exchange reserves (data on FTB, FTED, CBBM and FXR all

(1) Further details on the data and sources are to be found in the appendix.

in U.S. $).

ERI. - exchange rates, indices Dec. 1971 = 1, U.S.$/Home.

IP. - industrial production.

RCP. - ratio of a country's consumer price index (CPI) to that of the U.S.

Y. - a proxy for nominal income, the product of CPI and IP.

QUEDUM - a dummy variable with value 0 before Nov. 1976 and 1 since.

The equations were first estimated by OLS but in every regression run low values of the Durbin-Watson statistic indicated positive serial correlation of the residuals. The equations were then reestimated using the Cochrane-Orcutt iterative process and only the latter results are reported here.

(vi) Results for the e(U.S.$/Can$)

The OLS estimates are set out in Table 3(a) while the consistent 2SLS estimates are reported in Table 3(b).[1] Inspection of the residuals from the early regression runs revealed that the Quebec election in late 1976 was accompanied by a sharp depreciation of the CAN$ and the negative effect persisted. Accordingly, we added a (0,1) dummy variable to the regression equation to capture this effect.

Canada was a net debtor throughout the sample period on all definitions of the net private foreign asset stock (see Table 2). This implies a particular pattern of expected coefficient signs for the money, bond and foreign asset stock which are set out in Table 1. In particular, the bilateral net foreign asset stock variable should have a negative coefficient in this situation. However, in all three equations reported in Table 3(a) the foreign asset stock

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(1) For Canada the M1 measure of the money stock consistently outperformed the M3 measure so only the results for the regressions including the former are reported.

Table 3(a): OLS Estimates for e(U.S.$/CAN$)

Equation Number	CON	M1CAN	M1US	DBCAN	DBUS	QUEDUM	FTBCAN	FTEDCAN	CBBMCAN	R^2	RHO	D.W.
1.	1.375 (4.15)	0.012 (1.84)	-0.0002 (0.24)	-0.0002 (0.13)	-0.0003 (1.05)	-0.059 (5.69)	0.009 (1.46)			0.95	0.957 (25.59)	1.57
2.	1.016 (3.76)	0.013 (1.79)	-0.0002 (0.14)	0.0001 (0.06)	-0.0002 (0.62)	-0.061 (5.93)		0.004 (0.53)		0.95	0.946 (22.25)	1.61
3.	0.824 (2.34)	0.013 (1.89)	0.0002 (0.22)	0.0001 (0.09)	-0.0000 (0.02)	-0.060 (5.78)			0.009 (0.99)	0.95	0.946 (22.70)	1.63

Notes: The symbols are as follows:
R^2=squared coefficient of multiple determination; RHO=first-order serial correlation coefficient; D.W. = Durbin-Watson statistic; t-statistics are given in parentheses.

Table 3(b): 2SLS Estimates for e(U.S.$/CAN$)

Equation Number	CON	M1CAN	M1US	DBCAN	DBUS	QUEDUM	FXRCAN	FTBCAN	FTEDCAN	CBBMCAN	R^2	RHO	DW
1.	1.054 (5.89)	0.005 (1.10)	-0.002 (2.67)	-0.0003 (0.26)	0.0001 (0.71)	-0.035 (4.26)	0.035 (6.27)	-0.003 (0.84)			0.98	0.882 (14.51)	1.58
2.	1.196 (7.00)	0.006 (1.27)	-0.001 (1.90)	-0.0003 (0.28)	0.00004 (0.15)	-0.038 (4.61)	0.030 (5.57)		-0.0006 (0.11)		0.98	0.928 (19.34)	1.61
3.	1.006 (4.09)	0.008 (1.73)	-0.0007 (0.85)	-0.0002 (0.14)	0.0002 (0.58)	-0.041 (5.12)	0.025 (4.95)			0.007 (1.07)	0.98	0.952 (24.13)	1.63

variable has a positive coefficient and is never significant at conventional significance levels. The two money stock variables (those for Canada and the United States), on the other hand, have the expected positive and negative coefficients and the Canadian money stock is significant at the 10 per cent level. The latter coefficient suggests a perverse result in that an expansion of the Canadian money supply will, cet. par. appreciate the Canadian dollar. The bond variables tend to have the wrong coefficient signs and are never significant. The Quebec dummy is always highly significant with a negative coefficient.

When the policy reaction function is estimated with the exchange rate equation by 2SLS, the results in Table 3(b) show that two of the foreign asset stock variables, FTBCAN and FTEDCAN, now have the predicted negative coefficients but neither estimate is significant. The other foreign asset stock measure, CBBMCAN, is also insignificant. Both the money stocks and the bond stocks have the expected pattern of coefficients though the bond stock variables are always insignificant.(1) One difference from the results in Table 3(a) is that the Canadian M1 variable tends to decline in significance while the U.S. M1 variable becomes significant at the 1 per cent level with the FTBCAN measure and is also significant at the 10 per cent level with the FTEDCAN measure. The intervention variable, FXRCAN, is highly significant in all three regressions with the expected positive coefficient. This result, if taken on face value, implies that intervention in the foreign exchange market by the Canadian authorities produced perverse results over the sample period! However, this conclusion can only be regarded as tentative for our specification

(1) In the net debtor case it is possible to sign the de_i/dB_i variable (see Table 1) whereas it is not possible to do this in the net creditor case.

of the reaction function is over-simplified and may not have served to entirely eliminate the simultaneity bias.

One additional result deserves to be noted. The underlying model stresses that third-country asset stocks should also be included in the regression equation. To test this we constructed a measure of the third-country asset stock as the difference between the total cumulated current account excluding direct investment (CBBMCAN) and the cumulated Canadian-U.S. bilateral current account excluding direct investment (FTEDCAN). When such a proxy for the third-country net foreign asset stock was added to the exchange rate equation e.g., equation 2 of Table 3(a), both the net foreign asset stock variables were insignificant.

(vii) Results for the e(U.S.$/Japanese Yen)

The OLS and 2SLS estimates are set out in Tables 4(a) and 4(b), respectively. The regression results revealed no grounds for selecting between the two alternative money stock measures so we only present results with the M1 variables.

The key point to remember in interpreting the results is that while Japan changes from a net debtor to a net creditor on its total net foreign asset position with the U.S., the private sector is always a net debtor on all measures. It also hardly needs stressing that the yen strongly appreciated against the U.S.$ over the sample period.

The OLS results seem at first sight to be very satisfactory in that all three foreign asset stock measures are highly significant with a positive coefficient. This result implies that a Japanese current account surplus with the U.S. should, cet. par., appreciate the yen exchange rate. However, as Japan is a net debtor on a private basis, on our measures, the expected coefficient on the bilateral foreign asset variable is negative and

Table 4(a): OLS Estimates for e(U.S.$/JAP Yen)

Equation Number	CON	M1JAP	M1US	DBJAP	DBUS	FTBJAP	FTEDJAP	CBBMJAP	R^2	RHO	D.W.
1.	4.179	-0.0000004	-0.010	0.000008	-0.0005	0.041			0.95	0.479	1.85
	(9.77)	(0.09)	(5.21)	(1.98)	(1.25)	(7.71)				(4.23)	
2.	3.571	-0.0000004	-0.009	0.000007	-0.000001		0.040		0.95	0.513	1.82
	(9.18)	(0.09)	(4.84)	(1.68)	(0.00)		(7.84)			(4.63)	
3.	1.645	0.00001	-0.002	0.000007	-0.0006			0.017	0.96	0.435	1.85
	(5.20)	(2.25)	(1.45)	(2.07)	(1.83)			(9.78)		(3.74)	

Table 4(b): 2SLS Estimates for e(U.S.$/JAP Yen)

Equation Number	CON	M1JAP	M1US	DBJAP	DBUS	FXRJAP	FTBJAP	FTEDJAP	CBBMJAP	R^2	RHO	D.W.
1.	1.218	-0.000004	-0.0004	0.0000002	-0.0004	0.028	0.006			0.95	0.771	2.02
	(1.41)	(0.72)	(0.15)	(0.05)	(0.76)	(3.44)	(0.57)				(9.38)	
2.	2.509	-0.000005	-0.005	0.000005	0.00007	0.014		0.023		0.96	0.519	1.88
	(4.23)	(1.03)	(2.17)	(1.24)	(0.21)	(2.19)		(2.55)			(4.70)	
3.	1.475	0.000005	-0.002	0.000006	-0.004	0.009			0.013	0.97	0.389	1.86
	(5.22)	(1.01)	(1.16)	(1.70)	(1.28)	(2.15)			(5.39)		(3.27)	

not positive. The coefficients on the two bond stocks and the Japanese money stock in equations (1) and (2) also have the wrong signs though the U.S. money stock has the expected negative coefficient and is significant at the 1 per cent level. In equation (3), however, the Japanese money stock has the expected positive coefficient which is significant at the 5 per cent level while the U.S. money stock loses significance.

The 2SLS estimates do not produce much change in this picture. The foreign asset stock variables tend to be less significant than in the OLS regressions; indeed, the FTBJAP variable is now insignificant. However, they still have positive coefficients in all cases. The intervention variable, FXRJAP, has the expected positive coefficient and is always significant. Thus, just as in the Canadian case, the results suggest that official exchange market intervention tends to produce perverse results on the exchange rate. The money and bond stocks tend to be insignificant in almost all cases.(1)

Thus, the comparative static properties of the model when the home country is a net debtor in foreign currency, are not supported by these results with the sole exceptions of the intervention variable and the U.S. money stock. Two possible explanations may account for these dismal econometric results. First, the portfolio balance model is unsatisfactory in the case of a net debtor country; the model does not allow any role to expectations and it abstracts from conditions in flow markets.(2) Second, our three proxies for the bilateral asset position of the Japanese private sector may all be defective. Clearly there are difficulties in (i) delimiting the

(1) When the third-country foreign asset stock, FTCJAP (defined as CBBMJAP minus FTEDJAP), was added to equation 2 in Tables 4(a) and (b) and the equations reestimated, the FTEDJAP variable became insignificant in both cases but the FTCJAP variable was highly significant with the wrong (i.e., positive) coefficient.

(2) Following the terminology in Isard (1978), this is a "point in time" model.

appropriate set of short-run financial flows and (ii) in computing appropriate asset stock measures on a monthly basis. Thus, a different set of criteria might turn the Japanese private sector into a net creditor in foreign currency over some or all of the sample period. In that event, the positive coefficients on the foreign asset stocks would be consistent with the predictions of the portfolio balance model.

(viii) Results for the e(U.S.$/Western European Basket)

Tables 5(a) and 5(b) set out the results of selected regressions for the composite Western Europe exchange rate against the U.S. dollar. As there was little to choose between the M1 and M3 money stocks, only the results for the latter are presented. To interpret these results, we once again return to Table 2. On both measures of the total bilateral foreign asset position - FTBEUR and FTEDEUR - Western Europe is a net creditor over the entire sample period. However, if one only considers the bilateral private asset stock, Western Europe switches from a net creditor to a net debtor position over the sample period.

The OLS estimates show both foreign asset stock measures have the expected coefficient i.e., if Western Europe runs a current account surplus with the U.S., this should, *cet. par.*, appreciate its exchange rate against the dollar. However, only the FTB measure is significant and then only at the 10 percent level. Neither the money nor the bond stocks are significant. When the exchange rate equation is reestimated by 2SLS, both foreign asset stocks become insignificant. In this case, the only significant variable is the intervention variable with a positive coefficient. A positive coefficient on the foreign exchange reserves variable would be expected in the net debtor case but as this is not true throughout our sample period one has no prior

Table 5(a): OLS Estimates for e(U.S.$/Western Europe Basket)

tion ber	CON	M3EUR	M3US	DBEUR	DBUS	FTBEUR	FTEDEUR	FXREUR	R^2	RHO	D.W.
.	-0.389 (0.39)	0.0005 (0.58)	0.0006 (0.61)	-0.0008 (0.51)	0.0005 (0.47)	0.016 (1.67)			0.83	0.842 (12.09)	1.49
.	0.072 (0.06)	0.0006 (0.74)	0.0004 (0.35)	-0.001 (0.87)	0.0004 (0.34)		0.010 (0.82)		0.82	0.898 (15.78)	1.46

Table 5(b): 2SLS Estimates for e(U.S.$/Western Europe Basket)

tion ber	CON	M3EUR	M3US	DBEUR	DBUS	FTBEUR	FTEDEUR	FXREUR	R^2	RHO	D.W.
.	0.966 (0.97)	0.0004 (0.65)	-0.00002 (0.03)	-0.001 (0.87)	0.00003 (0.39)	0.001 (0.11)		0.006 (2.30)	0.88	0.805 (10.51)	1.45
.	0.919 (0.93)	0.0004 (0.62)	-0.000004 (0.01)	-0.001 (0.87)	0.00005 (0.55)		0.002 (0.17)	0.006 (3.20)	0.88	0.803 (10.45)	1.44

expectation as to sign.

To cope with this case we split the sample period in two at January 1975 when, on the FTB measure, Western Europe moved into a net debtor position and reestimated the equations separately over the two sub-periods. The aim was to establish whether the estimated coefficients switched signs between the two sub-periods in accordance with the predictions of the model. The OLS and 2SLS results (not shown) were very disappointing. For instance, the foreign asset stock variable was mildly significant in both sub-periods but always with the wrong sign.

IV. Summary and Conclusions

In this paper we specify a portfolio balance model of short-run exchange rate determination and test it against monthly data on selected exchange rate movements over the floating rate period.

Our specification of the portfolio balance model attempts to give greater generality by incorporating portfolio shifts in a multi-country framework. In order to make the model tractable, we postulate that all current account deficits and surpluses are settled via transactions in U.S. dollar-denominated assets. Thus, our version of the model assigns a pivotal role to the U.S. dollar and the bilateral international investment position of individual countries vis-à-vis the U.S. In particular, the model allows for the possibility of the private sector being either a net creditor or net debtor in U.S. dollars on its foreign asset stock.[1]

Whether the private sector is a net debtor or creditor internationally is shown to be crucial for the comparative static properties of the model. Indeed, the effects of changes in the exogenous asset stocks on the exchange rate are reversed as the private sector moves from a net creditor to a net

(1) If the country is in a zero position in its net international lending, the model is indeterminate.

debtor position. If the private sector is a net debtor on its foreign asset stock, the short-run behaviour of the exchange rate is shown to be unstable. This result arises solely because of wealth effects due to the net liability position and does not depend on extrapolative exchange rate expectations.

Several measures of the net foreign asset position were constructed for Canada, Japan and Western Europe. Indeed, for Canada and Japan our calculations showed the private sector to be consistently in a net debtor position throughout the estimation period while Western Europe moved from a net creditor position at the beginning of the period to a net debtor midway during the period in question. It is, however, possible that applying a different set of criteria as to which financial flows should be included in the cumulation of current flows might change Japan from a net debtor to a net creditor over part of the sample period. This would certainly not be the case for Canada.

The empirical results for the exchange rates of the Canadian dollar, Japanese yen and a weighted average exchange rate for Western Europe against the U.S. dollar were very mediocre. The foreign asset stock variables tended to be insignificant in most cases except Japan and, in the latter case, the foreign asset stock variables always had signs opposite to those predicted by the model.(1) The coefficients on the money and bond stocks tended to match expectations in the net debtor cases though few of the coefficients were statistically significant. The results suggested that intervention by the authorities in the foreign exchange market produced perverse results. Thus, the empirical verdict on the utility of the portfolio balance model, at least on this data set, must be judged unfavourable.

(1) But in agreement with conventional beliefs about the effect on the exchange rate of a current account surplus.

APPENDIX: SOURCES OF DATA

Abbreviations:

BEQB: Bank of England Quarterly Bulletin

BOCR: Bank of Canada Review, monthly

BOJ: Bank of Japan, Economic Statistics Annual

IFS: International Monetary Fund International Financial Statistics, monthly

MEI: Organisation for Economic Cooperation and Development, Main Economic Indicators, monthly

SCB: United States Department of Commerce, Survey of Current Business, monthly

SFTA: OECD, Statistics of Foreign Trade, Series A, monthly

SNBMB: Swiss National Bank, Monthly Bulletin

1. Exchange rates

End-month spot rates against the U.S. dollar taken from MEI. West European rate against the dollar was calculated as a geometric average of spot rates, in the form of indices (December 1971=1), for France, Germany, Italy, U.K., Belgium, Netherlands, Sweden, and Switzerland. Weights were based on the relative size of the monetary base (average of the two end-years 1973 and 1977) for the countries concerned (IFS, line 14) after conversion to a common currency. These weights are (.176, .301, .215, .110, .050, .038, .029, .083) respectively.

2. Money stocks

End-month M1 and M3 (M1 + quasi-money) taken from MEI, and converted to billions of local currency units. Seasonally adjusted data were extracted directly from MEI for M1 (all countries) and for M3 in the cases of Canada, U.S., and Japan. The West Europe M3 aggregate was constructed as follows: non-seasonally adjusted M1 plus quasi-money figures were taken for France, Germany, Italy, U.K., Netherlands and Sweden. For Switzerland, the sum of M1 and savings deposits was used; for Belgium, M1 alone. The countries' money stocks were converted to U.S. dollars using a fixed exchange rate, namely that prevailing on average in 1974 and 1977. The resulting total was then seasonally-adjusted using the X-11 programme. Two numerical adjustment to the data were also made. MEI data for France omitted a value for March 1974: the average of February and April, namely 585 billion frances, was inserted. For Canada, data for October-December 1975 are distorted by a mail strike; they were replaced by figures of $ Canadian 17.3, 17.35, and 17.4 billions, respectively.

3. Bond stocks

Bond stocks refer to central government debt at month-end and are taken from IFS, line 88, except where not available. The latter were created as follows: France, IFS line 88b (government debt in francs), with missing data replaced by interpolations; Japan, IFS, line 88b (government debt in yen); Belgium, IFS, line 88a (government debt in francs); Netherlands, IFS, line 88b (government debt in guilders). For the U.K., quarterly data on "domestic borrowing" (IFS, line 84b) were cumulated and adjusted, where necessary, to match annual benchmark numbers for the national debt (excluding foreign currency debt) published in BEQB. These quarterly stocks were then interpolated to monthly. For Italy, monthly data for net borrowing in lira (IFS, line 84b) were cumulated from a benchmark figure for 1972 (IFS, line 88). For Switzerland quarterly data on "net domestic borrowing" (IFS, line 84a) and "other financing" (IFS, line 86c) were cumulated and adjusted, to match annual benchmark numbers for the national debt published in SNBMB. These quarterly stocks were then interpolated to monthly. The West European aggregate bond stock is a dollar total using the 1974, 1977 average exchange rate.

4. Foreign Asset Stocks

Net claims or liabilities on foreigners, calculated by cumulating balance of payments flows from benchmark values, were created for three different definitions:

(a) Cumulated Current Accounts: bilateral stocks vis-à-vis the United States

Monthly current account figures are not available on a bilateral basis. Monthly trade balance figures, on a seasonally adjusted customs basis, were taken from SFTA, for flows between the U.S., on the one hand, and Canada, Japan, and OECD Europe, on the other. The difference between the quarterly seasonally-adjusted current and trade accounts (to all countries: Source MEI) was allocated to Canada, Japan and Western Europe using the relative importance of those countries in the services balance for the year 1977 (namely .407, -.141, -.009): source SCB (march 1978). The services were interpolated and added to the monthly trade balance, and the resulting flows cumulated from benchmark figures for end-1975 of U.S. net international investment positions vis-à-vis Canada, Japan, and Western Europe (Source: SCB, August 1976), namely ($46.361, $0.805, $-41.027) billions, respectively.

(b) Cumulated Bilateral Current and Direct Investment Accounts

Quarterly flow data were taken from SCB ("International Investment Position of the United States", Table 10, various issues) for flows vis-à-vis Canada, Japan, and Western Europe. Before 1977, both current account and direct investment ignore reinvested earnings, and account for them since. However, the sum of current account and direct investment is consistent over time. Flows were interpolated to monthly and cumulated from end-1975 benchmark figures for the U.S. net international investment position excluding direct investment (source SCB, August 1976), namely ($20.352, $-1.665, $-74.115) billions for Canada, Japan and Western Europe, respectively. The negative of the resulting series are those countries' net positions with respect to the United States.

(c) Cumulated Overall Current and Direct Investment Accounts

For Canada and Japan only, series for their overall position vis-à-vis foreigners were calculated using monthly trade and quarterly current accounts, seasonally-adjusted from MEI the difference between the two plus direct investment (source BOCR for Canada and IFS line 77 bad for Japan), being interpolated to monthly and added to the trade balance. The result was cumulated from benchmarks for overall net investment positions excludin direct investment at the end of 1975: $-12.99 billion for Canada (BOCR, July 1978, Table A15 converted to U.S. dollars) and $-16.54 for Japan (BOJ, 1977, table 123).

5. Foreign Exchange Reserves

Monetary authorities' reserves held in the form of foreign currencies were obtained from MEI, and converted to dollars using the SDR exchange rate at month-end (source: MEI). The Western European reserve total was calculated as the sum of figures for France, Germany, Italy, U.K., Belgium, Netherlands, Sweden and Switzerland.

6. Consumer Prices and Industrial Production

These variables were used as instruments in the exchange rate equation as they were assumed to affect target exchange rates. Consumer price indices, all items, and industrial production, seasonally adjusted, were taken from MEI for each of the following: United States, Canada, Japan, and OECD Europe. The latter grouping weights together the component countries using 1975 final consumption and 1975 gross domestic product originating in industry, respectively.

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