Two-Tier Exchange Rates and Monetary Autonomy in a Portfolio-Balance Model

By Nancy Peregrim Marion*

Small open economies that wish to peg their currencies to those of their major trading partners often find themselves hampered by interest-sensitive and speculative capital flows that undermine their ability both to maintain fixed exchange rates and to pursue an independent monetary policy. Some countries, notably the Belgo-Luxembourg Economic Union, France and Italy, have experimented with the two-tier exchange market in the hopes of insulating their economies from international capital flows and restoring some autonomy to domestic monetary policy. Such an exchange regime involves the formal establishment of separate exchange markets for current and capital transactions. The commercial exchange rate, determined in the market for current transactions, is frequently pegged by the authorities; the financial exchange rate, determined in the market for capital transactions, is usually free to fluctuate.

The purpose of this paper is to examine the impact effects of certain disturbances and changes in policies on a small open economy maintaining a two-tier exchange market. The task at hand is really twofold: first, to develop a portfolio-balance model of a two-tier exchange market and second, to determine whether the two-tier exchange market permits a country to gain some autonomy over its monetary policy when financial assets are either imperfectly or perfectly substitutable. For the purpose of this paper, monetary autonomy is defined to mean that the authorities can regulate net capital flows independently of the relative rates of return at home and abroad and thus have some control over the domestic interest rate.

The two-tier exchange market model is described below and is solved in Appendix I. A second version of the two-tier exchange regime, one which involves a different segmentation of the exchange market, is presented and solved in Appendix II. In order to compare

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these models with more familiar exchange-rate systems, the solutions for both the unitary flexible and unitary fixed exchange rate are presented in Appendix III and IV; they serve as backdrops to the discussion of two-tier exchange rates.

While the models can generate much fruitful analysis and comparison, both in respect of short-run behavior and steady state properties, and can be extended in a number of ways,[1] this paper will focus on impact effects in the asset markets of the two-tier exchange system. It will examine the short-run determination of the domestic interest rate and the financial exchange rate and will then examine their responses to various disturbances. It will show that the authorities have some control over the domestic interest rate, even in the case of perfect substitutability between domestic and foreign bonds, when interest income, a current-account item, is repatriated at the commercial exchange rate, but that they lose control over the interest rate when interest income is channeled through the financial exchange market.

Description of the Model

The model presented below extends to the regime of two-tier exchange rates the portfolio balance theory developed by *James Tobin* (1969) *et. al.* in which wealth holders decide how to distribute net worth among available assets based on relative rates of return and the size of the total portfolio. It assumes that demands for assets are stock rather than flow demands and are realized instantaneously so that actual holdings of assets always reflect the desired composition of the portfolio. Disturbances to portfolio equilibrium create stock adjustments as portfolios are rebalanced, causing instantaneous changes in the domestic interest rate and the financial exchange rate. In addition, disturbances alter the rate of accumulation of financial assets.

In the model, the financial exchange rate is treated as a relative asset price. It is among the variables that equilibrate asset markets and it is determined in the short run in those asset markets.[2]

[1] For example, the financial sector of the two-tier model can be extended by adding a domestic asset which is traded, by adding expectations and by allowing for leakages between the two exchange markets. The complete two-tier exchange market would include a goods sector and one could assume a fixed commercial exchange rate or a commercial rate that floated in its own tier. One can argue that neglecting the goods market in this exercise is not a serious omission since the model is constructed so that the financial markets are unaffected on impact by disturbances in the goods market.

[2] When a Keynesian goods market (fixed prices, adjustable output) is added to the financial sector and the steady-state solutions are examined, one discovers that the financial exchange rate is responsive to events in the goods market as well as to financial disturbances.

Private Wealth and Demands for Financial Assets

The model contains three financial assets — a bond issued by the government of the small country and held only by its own residents, a stock of money issued by its central bank and held internally, and a bond issued in the outside world and available to the small country in perfectly elastic supply. Foreign money is not held domestically but its existence is implied by the exchange rate.

Assuming fixed prices and no physical capital stock, the wealth of private households can be written as the nominal (= real) domestic-currency value of the money and bonds they currently hold:

$$W^h = L^h + B^h + eF^h \tag{1}$$

where L^h is the actual stock of money held by households, B^h is the number of domestic bonds held, F^h is the number of foreign bonds held and e is the spot financial exchange rate (the price of foreign currency in terms of domestic currency).[3] For simplicity, it is assumed that all bonds are short-term, with fixed prices in units of the currency of the issuer and variable interest rates.

The interest rate on the foreign bond is determined in the world market and given exogenously to the small open economy ($r' = \bar{r}'$). The interest rate on the domestic bond, r, can vary independently of the foreign rate since private wealth holders in the small country regard the two types of bonds as imperfect substitutes.[4]

Wealth holders base their nominal (= real) demands for assets in terms of domestic currency. The fraction of the wealth they wish to hold in each of the three assets is assumed to depend on the effective rates of return on domestic and foreign bonds but not on income.[5] In a two-tier exchange-rate system where the principal on bonds must be acquired at the financial exchange rate, e, but the interest income must be repatriated at the fixed commercial exchange rate, $\bar{e}$, the effective rate of return on foreign bonds perceived by domestic wealth

[3] While I am aware of the argument that domestic bonds issued by the domestic government are not wealth (*Barro*, 1974), I choose here to follow the other tradition.

[4] Why are the two bonds considered imperfect substitutes and why, if there are no transactions costs, would anyone hold money? Wealth holders would want to hold both domestic and foreign bonds because of exchange risks and they would want to hold money as well as short-term bonds, even if there were no transactions costs, if they perceived a default risk on bonds.

[5] The rationale for excluding income in a model that assumes instantaneous portfolio adjustment can be found in *Allen* (1976), *Hellwig* (1975) and *Allen-Kenen* (forthcoming).

holders is $\frac{\overline{e}r'}{e}$, which I shall call u.[6] A change in the differential between the commercial and financial exchange rates can thus influence capital movements directly through a rate-of-return motive.

The demand functions can be written as:

$$B^d = b\,(r, u)\,W^h \tag{2}$$

$$L^d = l\,(r, u)\,W^h \tag{3}$$

$$eF^d = f\,(r, u)\,W^h \tag{4}$$

$$\text{where } u = \frac{\overline{e}r'}{e}\,.$$

The balance-sheet constraint for private wealth holders requires that the sum of their demands for all assets must be equal to the wealth they currently hold. This constraint means that:

$$b + l + f = 1$$
$$b_r + l_r + f_r = 0$$
$$b_u + l_u + f_u = 0$$

It is assumed that the three assets are gross substitutes, so that desired holdings of a bond increase when the return on that bond rises, while the desired holdings of the other bond and of money decline:

$$b_r > 0 \qquad f_r\,,\; l_r < 0$$
$$f_u > 0 \qquad b_u\,,\; l_u < 0$$

If all partials are non-zero, it can be deduced that each own partial must be larger in absolute value than either cross partial:

$$b_r > |f_r| \quad b_r > |l_r| \quad \text{where } b_r, f_r, l_r \neq 0$$
$$f_u > |b_u| \quad f_u > |l_u| \quad \text{where } f_u, b_u, l_u \neq 0$$

Furthermore, with instantaneous adjustment, the quantities demanded, B^d, L^d, F^d, are equal to the amounts actually held, B^h, L^h and F^h in (1). For this reason, any one of the demand equations is satisfied when the other two are satisfied.

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[6] In the general case, the effective rate of return on foreign bonds perceived by domestic residents would be:

$$(1 + \overline{\pi})\,\frac{\overline{e}r'}{e} + \pi$$

where $\overline{\pi}$ is equal to the expected depreciation in the fixed commercial exchange rate and π is the expected depreciation in the financial rate. In this paper, it is assumed that wealth holders expect the commercial rate to remain fixed ($\overline{\pi} = 0$). It is also assumed that the expected depreciation of the financial rate is the same for all wealth holders and has a probability distribution around mean zero, so that $\pi = 0$. In a more general model, expectations should be made explicit.

The markets for the three assets are assumed to be perfectly competitive and clear at all times.

The market-clearing equation for domestic bonds is:

$$B - B^c - B^h = 0 \tag{5}$$

where B is the fixed supply and B^c is the amount held by the central bank.

The market-clearing equation for domestic money is:

$$L - L^h = 0 \tag{6}$$

where L is the supply of money determined by the banking system.

The market-clearing equation for foreign bonds is:

$$eF - eF^h = 0 \tag{7}$$

where F is the perfectly elastic supply of foreign bonds available to domestic wealth holders. (7) will be true when (5) and (6) are satisfied.

It should be stressed here that the omission of income from the asset demand functions has an important analytical property: it permits the partitionability of the financial markets from the goods market. It provides strong justification for studying, in isolation, the impact effects of financial disturbances on the asset markets. When income is excluded from the asset demand functions, the financial sector is unaffected on impact by events in the goods market.

If one were to contrast the dynamics and long-run properties of two-tier and unitary exchange rates in the face of financial disturbances, the results would differ from the impact effects in part because of feedback effects from the goods market. On impact, however, the effects of financial disturbances on the asset markets are the same whether or not a goods market is included. A short-run analysis of just the financial markets can be undertaken. Additionally, once the impact effect of any financial disturbance on the domestic interest rate is determined, one can infer the change in output, provided that the change in the domestic interest rate is the dominant financial disturbance in the goods market.

The Banking Sector

The banking sector consists of one central bank. There are no commercial banks. The liabilities of the central bank are equal to the stock of money held by the private sector, L^h; its assets are its holdings of domestic bonds, B^c, and the domestic-currency value of its foreign-currency reserves, $\bar{e}R$. The central bank balance sheet is:

(8) $$L^h = B^c + \bar{e}R - W^c$$

where W^c represents the central bank's net worth; W^c changes to reflect capital gains and losses resulting from changes in the commercial exchange rate, by which the central bank is assumed to value its reserves. The central bank's holdings of domestic bonds, B^c, is an exogenous policy instrument. The interest income of the central bank is rB^c.

Replacing L with (8) and L^h with (3), the market-clearing equation for domestic money (6) can be rewritten as:

(9) $$B^c + \bar{e}R - W^c - l\,(r, u)\,W^h = 0$$

Replacing B^h with (2), the market-clearing equation for domestic bonds (5) can be rewritten as:

(10) $$B - B^c - b\,(r, u)\,W^h = 0$$

Saving

Wealth can be altered in two ways — by saving out of current income and by capital gains or losses due to changes in the financial exchange rate. Following *Allen-Kenen* (forthcoming), the totality of wealth accumulated through time as a consequence of saving will be defined as:

(11) $$W^{hs} = \int_0^T S\,dt = \int_0^T (\dot{L}^h + \dot{B}^h + e\dot{F}^h)\,dt$$

where $\dot{L}^h$, $\dot{B}^h$ and $\dot{F}^h$ represent time rates of change.

Substituting (8) into (11) and recalling that $B^h = B - B^c$ yields:

(12) $$W^{hs} = \int_0^T S\,dt = \int_0^T (\dot{B} + \bar{e}\dot{R} + e\dot{F}^h)\,dt$$

W^{hs} changes only gradually through time. It is therefore exogenous to the analysis of impact effects although important in the dynamics.

Total wealth, a history of saving and of capital gains and losses, can be written as:

(13) $$W^h = W^{hs} + \int_0^T F^h\,\dot{e}\,dt$$

Its time derivative is:

(14) $$\dot{W}^h = \dot{W}^{hs} + F^h\,\dot{e}\,dt$$

The stock of total wealth can change instantaneously since movements in the financial exchange rate bring about immediate capital gains or losses.

Domestic holdings of foreign bonds

In this model, the small country cannot accumulate foreign bonds either in the short-run or over time. The central bank does not supply foreign currency to satisfy an excess demand for foreign bonds, so that any excess demand merely bids up the financial exchange rate in the short-run.

The small country can accumulate foreign assets (reserves) over time by running a current-account surplus. In fact, if the government budget is balanced at all times, which implies $B = \bar{B}$, the only way the country *can* save is through a current-account surplus. But private households cannot use a current-account surplus to accumulate foreign bonds. They must channel their current-account transactions through the commercial exchange market and turn any net proceeds over to the central bank in exchange for domestic money.[7] (The central bank, in turn, can use the proceeds to acquire reserves). If households *now* want to acquire foreign bonds, they must go through the financial exchange market. Doing so merely bids up the financial exchange rate. Thus the two-tier exchange market, as modeled above, prevents households from accumulating foreign bonds at any point in time or over time. The dynamic equation of the model can be expressed as:

$$\dot{W}^{hs} = S = \bar{e}\dot{R} \qquad (15)$$

when the government budget is balanced and a two-tier exchange-rate system is in effect.

The market-clearing equations for domestic bonds and money (10) and (9) can be solved for changes in the domestic interest rate and the financial exchange rate, given the exogenous variable $\bar{r}'$, the policy-determined variables B^c and $\bar{e}$, and the history of household saving, W^{hs}.

The standard two-tier exchange-rate model, henceforth called Model I, is solved in Appendix I. In Appendix II, a permutation of the two-tier exchange regime is presented and solved (Model II). In that permutation, interest income as well as all capital account transactions are channeled through the financial exchange market. As a result, the effective yield on domestic residents' foreign bond holdings is equivalent to $\bar{r}'$ rather than $\frac{\overline{er'}}{e}$. A change in the differential between com-

[7] Institutionally, residents' net foreign-exchange proceeds may be held in a special non-interest-bearing account to be used solely for future purchases of goods and services from the rest of the world. For simplicity, I ignore this option and assume that all net proceeds must be turned over to the central bank.

mercial and financial exchange rates can no longer influence capital movements directly by affecting the rate of return. In addition, repatriation of interest income cannot alter reserve holdings over time. Finally, the most interesting implication of this permutation is that residents are able — and indeed are obliged — to accumulate foreign assets over time using the interest-income proceeds earned from foreign holdings. As long as residents maintain some foreign assets in their portfolios and receive a positive yield, interest-income inflows to the financial market must be matched by continual capital outflows over time. The model cannot converge on a steady-state since the system cannot reach long-run stock equilibrium in the asset markets.

In order to compare the standard two-tier exchange system and its permutation to more familiar exchange-rate regimes, the model is converted to a unitary flexible exchange rate and solved in Appendix III. It is then converted to a unitary fixed exchange rate and solved in Appendix IV.

The signs of all impact effects contained in all appendices are displayed below in Table I:

Table I

Table I.1

Two-Tier Exchange Model (Model I)

Disturbance	Effect ∂r	Effect ∂e
∂B^c	−	+
$\partial \bar{r}'$	?	+
$\partial \bar{e}$	?	+

Table I.2

Two-Tier Exchange Model (Model II)

Disturbance	Effect ∂r	Effect ∂e
∂B^c	−	+
$\partial \bar{r}'$	?	+
$\partial \bar{e}$	0	0

Table I.3

Flexible Exchange Rate

Disturbance	Effect ∂r	Effect ∂e
∂B^c	−	+
$\partial \bar{r}'$	?	+
$\partial \bar{e}$	0	0

Table I.4

Fixed Exchange Rate

Disturbance	Effect ∂r	Effect $\bar{e}\,\partial R$
∂B^c	−	−
$\partial \bar{r}'$	+	−
$\partial \bar{e}$	−	+

Solution of Model I

In a two-tier exchange regime with interest income repatriated at the commercial exchange rate, an open-market purchase of bonds, ∂B^c

causes the financial exchange rate to depreciate and the domestic interest rate to fall.[8]

An exogenous increase in the foreign interest rate also causes the financial exchange rate to depreciate, but its impact on the domestic interest rate is ambiguous since wealth and substitution effects work in opposite directions.

Devaluation of the commercial exchange rate, like a rise in the foreign interest rate, instantaneously increases the effective return on foreign bonds, forcing the financial exchange rate to depreciate but having an uncertain impact on the domestic interest rate.

The financial sector and the effects of the various disturbances can be illustrated diagrammatically as well as algebraically.

In figure 1 below, three schedules are plotted which show pairs of r and e which are compatible with equilibrium in each of the three financial asset markets. Minus (plus) signs near each schedule indicate

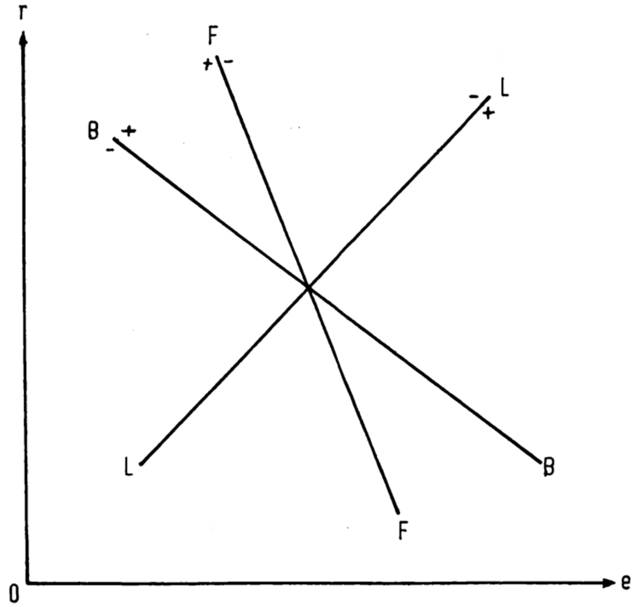

Fig. 1

[8] *Decaluwe-Steinherr* (1976) use a portfolio-balance approach and get the same signs on their impact effects. However, they include income in the demand for money, ignore short-run wealth effects, and do not include exchange rates in the effective yield on bonds, even though they assume interest income is repatriated at the commercial exchange rate.

that the interest rate-exchange rate pairs in that region result in excess supply (demand) in that market.

The curve labeled BB gives the combinations of r and e for which the private demand for domestic bonds is equal to the fixed supply minus the holdings of the central bank. The curve is negatively sloped since an increase in the domestic interest rate requires an appreciation of the financial exchange rate to increase the effective return on foreign bonds and hold the demand for domestic bonds constant. The appreciation of the financial exchange rate also creates a wealth effect, but the wealth effect is reflected in a shift of the schedule.

The LL curve represents the interest rate-exchange rate combinations for which the demand for money is equal to the supply. The curve is positively sloped since an increase in the domestic interest rate which reduces the demand for money requires a depreciation of the financial exchange rate to reduce the effective return on foreign bonds and increase the demand for money.

The FF curve represents interest rate-exchange rate pairs for which the domestic demand for foreign bonds is equal to the supply. It is negatively sloped since an increase in the domestic interest rate which reduces the demand for foreign bonds must be offset by an appreciation in the financial rate which increases the effective return on foreign bonds and stimulates the demand for the bonds.

Any two schedules determine the intersection point and the equilibrium values of r and e. The wealth constraint guarantees that the third schedule must also pass through that point.

The assumption that the three assets are gross substitutes insures that the slope of the FF curve must be greater than the slope of the BB curve. The balance-sheet constraint implies that the sum of the excess supplies for all assets must be zero, so at no point in the diagram can there be excess supplies of both domestic and foreign bonds and domestic money.

Impact effects of various exogenous or policy disturbances can be studied with the aid of diagrams. In figure 2, let the initial equilibrium be at a, determined by the intersection of the BB_0 and LL_0 curves. An open-market operation by the central bank shifts down LL_0 and BB_0, At a there would be an excess demand for domestic bonds and an excess supply of money.

The excess demand for domestic bonds puts downward pressure on the domestic interest rate; the excess supply of money puts upward

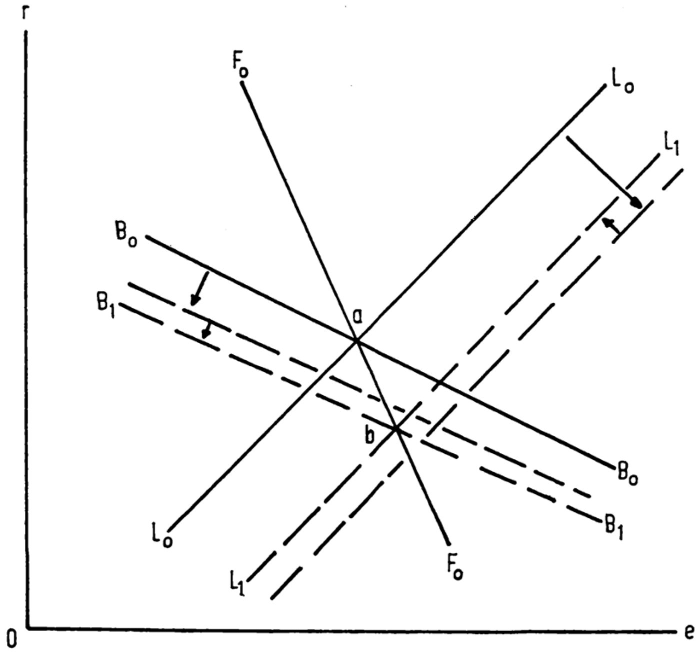

Fig. 2

pressure on the financial rate (lowering the relative value of domestic money). In addition, the depreciation of the financial exchange rate stimulates demand for domestic bonds and money since it reduces the effective rate of return on foreign bonds and increases household wealth. (The wealth increase is completely in the form of a higher domestic-currency value for foreign bond holdings, so that households desire more domestic-currency assets). *BB* shifts down still further, while *LL* moves up slightly. The new equilibrium values of r and e will be at a point like b, the intersection of the BB_1 and LL_1 curves (and the old FF_0 curve). The expansionary open-market operation lowers the domestic interest rate and depreciates the financial exchange rate, but leaves the quantity of foreign bonds held by domestic residents unchanged.

Solution of Model II

When interest income is repatriated at the financial exchange rate, the impact effects of various disturbances on the domestic interest rate and the financial rate are similar to those in Model I. The main difference is that since the effective yield on foreign bonds is merely $\bar{r}'$, changes in the commercial exchange rate have no effect on the asset markets in Model II.

While the signs of the impact effects are the same in both models, the magnitudes differ.

In Model II, changes in monetary policy and the foreign interest rate lead to larger movements in the financial rate. This characteristic may be undesirable, since large exchange-rate differentials increase the incentives to evade the controls of the two-tier system and may also lead to speculative pressures on the commercial exchange rate.[9]

While changes in the foreign interest rate have an ambiguous effect on the domestic interest rate in both models, the higher the substitutability between domestic and foreign bonds in the portfolios of domestic residents, the more likely it is that an increase in the foreign interest rate will raise the domestic interest rate, and this effect will be transmitted more powerfully in Model II than in Model I. Again, this may make the segmentation in II undesirable; a country has less monetary autonomy in setting its domestic interest rate.

When $|b_u l| > |l_u b|$, so that the demand for money is more wealth-elastic relative to the demand for home bonds and less interest-elastic relative to the demand for home bonds, an open-market purchase has a greater influence on the domestic interest rate in the standard two-tier exchange regime than in the permutation. When $|b_u l| < |l_u b|$, the reverse is the case.

Perfect Substitutability Between Domestic and Foreign Bonds

The impact of various disturbances on the domestic interest rate and the financial exchange rate can also be analyzed when there is perfect substitutability within the economy between domestic and foreign bonds. Perfect substitutability can be introduced into the models by letting $b_u \to -\infty$ *and* $f_r \to -\infty$ in the demand functions of wealth holders. It has the effect of keeping the interest-rate spread between the two bonds constant, assuming that wealth holders continue to deal in both bonds.

The signs of the impact effects on the interest rate and the financial exchange rate under perfect bond substitutability are shown below in Table II.

[9] This characteristic of a two-tier exchange market with interest income repatriated at the financial rate has also been noted by *Salin* (1971) and *Swoboda* (1974).

Table II

Disturbance	Effect			
	∂r		∂e	
	Model I	Model II	Model I	Model II
∂B^c	$-$	0	$+$	$++$
$\partial \bar{r}'$	$0<+<1$	1	$+$	$++$
$\partial \bar{e}$	$+$	0	$+$	0

Model I with Perfect Substitutability

In Model I, an expansionary open-market operation leads to an excess demand for domestic bonds and an excess supply of money at unchanged values for r and e. As a result, there is downward pressure on the domestic interest rate and upward pressure on the financial exchange rate. Any decline in the return on domestic bonds causes wealth holders to switch their demand from domestic to foreign bonds, putting some upward pressure on the interest rate and further bidding up the financial rate until effective rates of return to home residents from home and foreign investments are again equalized. The net result is a lowered domestic interest rate and a depreciated financial rate.

Since an open-market operation allows the authorities to vary the nominal domestic interest rate independently of the foreign rate, the two-tier exchange system with interest income repatriated at the commercial exchange rate permits some autonomy in interest-rate policy, even in the case of perfect bond substitutability.

This finding can be illustrated clearly using figure 3. Normally, perfect substitutability between the domestic and foreign bond would make the FF curve horizontal at a point where $r = \bar{r}'$. With a two-tier exchange system modeled as in I, the FF curve is a rectangular hyperbola; it represents interest rate-exchange rate combinations that maintain $r = u$ and keep demand for foreign bonds equal to the available supply. All three curves are used to derive the equilibrium point.

When there is an expansionary open-market operation, the effect of the policy, given perfect substitutability, can be illustrated in figure 3 as follows: from an initial equilibrium point at a, the change in monetary policy shifts the original BB_0 and LL_0 curves downward. The decline in the domestic interest rate causes wealth holders to switch their demand from domestic to foreign bonds. The BB curve starts shifting up

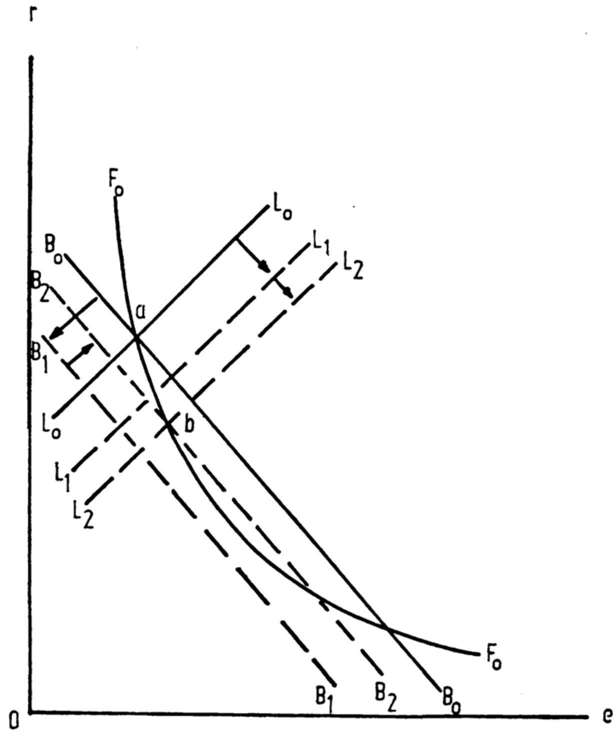

Fig. 3

in response to the excess supply of domestic bonds and the *LL* curve starts shifting down as households bid for foreign exchange to finance the purchase of foreign bonds. As the financial rate depreciates, the effective rate of return on foreign bonds begins to fall. Additionally, wealth holders experience capital gains on their foreign bond holdings which in turn increase their demand for domestic bonds (shifting *BB* downwards) and increase their demand for money (shifting *LL* upwards). But these shifts due to wealth effects are swamped by the shifts due to substitution effects. The process continues until effective rates of return are again equalized, which occurs at *b*.

If before the disturbance the return on foreign bonds was the same for domestic and foreign holders alike ($u = \bar{r}'$), then after the disturbance the change in the financial rate will have made the effective yield on foreign bonds lower for home residents than for foreigners.

When bonds are perfectly substitutable, an increase in the foreign interest rate, $\partial \bar{r}'$, no longer has an ambiguous impact on the domestic interest rate. Since the substitution effect dominates the wealth effect, the domestic interest rate will rise.

This result differs from that in flow models which show that two-tier exchange rates totally insulate the domestic interest rate from exogenous disturbances in the foreign rate when domestic and foreign bonds are perfectly substitutable.[10] The different results here should not be surprising. The fact that the small open economy cannot insulate itself completely from outside disturbances is inherent in the portfolio-balance approach of modeling the asset markets.

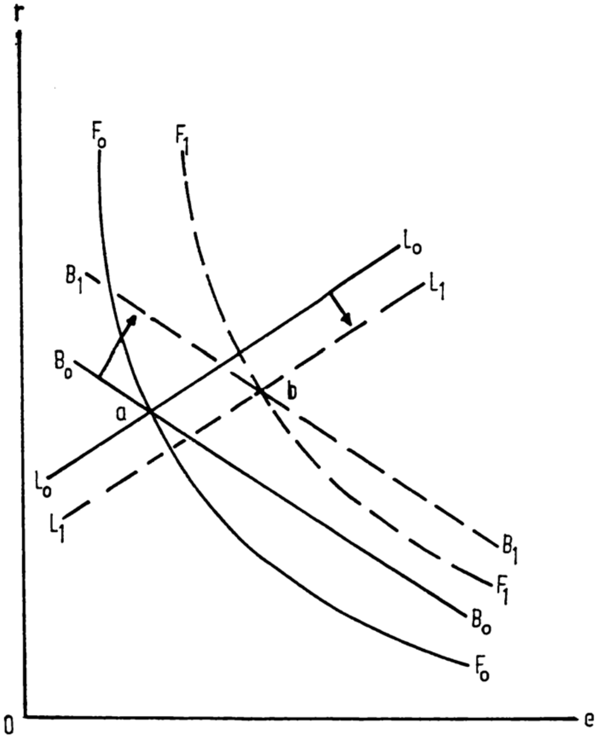

Fig. 4

Diagrammatically, an increase in the foreign interest rate can be shown as a rightward shift in the *FF* schedule. (See figure 4). As a result, wealth holders switch their demand from domestic bonds and money to foreign bonds, putting upward pressure on the interest rate and upward pressure on the financial exchange rate: the excess sup-

[10] See, for example, *Argy-Porter* (1972), p. 515.

plies of domestic bonds and money shift the *BB* curve upwards and the *LL* curve downwards. The pressures stop only when the effective returns on both bonds are equalized. The new equilibrium occurs at a point like *b* in figure 4, at a higher interest rate and a depreciated financial exchange rate. As the financial rate depreciates, wealth holders experience capital gains on their foreign bond holdings so that they are inclined to increase their demands for domestic bonds and money, putting downward pressure on *BB* and some upward pressure on *LL*. But again, these shifts due to wealth effects are more than offset by the shifts due to substitution effects.

With perfect substitutability, an increase in the foreign interest rate leads to an increase in the domestic return on foreign bonds as well. But the effective return on foreign bonds will now be lower for domestic residents than for foreigners.

A devaluation of the commercial exchange rate, like an increase in the foreign interest rate, unambiguously increases the domestic interest rate, depreciates the financial rate, and keeps the effective rates of return on home and foreign bonds equalized for domestic wealth holders. After the devaluation, the effective rate of return on foreign bonds is greater for domestic residents than it is for foreigners.

Model II with Perfect Substitutability

In Model II, one discovers that with perfect substitutability between domestic and foreign bonds, an expansionary monetary policy depreciates the financial rate but cannot alter the domestic interest rate. Since effective rates of return for both bonds must remain equal at all times, r, the effective return on domestic bonds, cannot diverge from $\bar{r}'$, the effective return on foreign bonds. Diagrammatically, this statement means that the *FF* curve is horizontal at $r = \bar{r}'$.

Not only are the authorities unable to alter the domestic interest rate through an open-market operation, but they are unable to insulate the domestic interest rate, even minimally, from outside shocks, such as a change in the foreign interest rate. By implication, a two-tier exchange regime segmented as in Model II does not grant interest-rate autonomy when domestic and foreign bonds are perfect substitutes.

Moreover, neither a unitary flexible exchange rate nor a unitary fixed exchange rate gives any autonomy over the domestic interest rate when domestic and foreign bonds are perfect substitutes. (In fact, the impact effects for Model II and the unitary flexible exchange rate are identical).

A two-tier exchange market which channels interest income through the commercial market stands out as unique; it allows the authorities to regulate net capital flows independently of the relative rates of return at home and abroad and thus allows the authorities some short-run interest-rate autonomy, even in the case of perfect substitutability between domestic and foreign bonds.

Appendix I

Two-Tier Exchange Market — Model I
Impact Effects

Asset-Market Equations:

(1) $$B - B^c - b\,(r, u)\,W^h = 0$$

(2) $$B^c + \bar{e}R - W^c - l\,(r, u)\,W^h = 0$$

where

(a) $$W^h = (B - B^c) + (B^c + \bar{e}R - W^c) + eF^h = W^{hs} + \int_0^T F^h\,\dot{e}\,\partial\,t$$

(b) $$u = \frac{\bar{e}}{e}\,\bar{r}'$$

Differentiated:

$$\left\| \begin{vmatrix} -b_r W^h & b_u \bar{r}' W^h - bF^h \\ -l_r W^h & l_u \bar{r}' W^h - lF^h \end{vmatrix} \begin{vmatrix} \partial r \\ \partial e \end{vmatrix} = \begin{vmatrix} \partial B^c + W^h b_u \partial \bar{r}' + W^h b_u \bar{r}' \partial \bar{e} + b\,\partial R \\ -\partial B^c + W^h l_u \partial \bar{r}' + W^h l_u \bar{r}' \partial \bar{e} \\ -(1-l)\partial R \end{vmatrix} \right\|$$

$$\text{Determinant} = D_1 = -b_r W^h [l_u \bar{r}' W^h - lF^h] + l_r W^h [b_u \bar{r}' W^h - bF^h] > 0$$

$$\text{Trace} = -b_r W^h + l_u \bar{r}' W^h - lF^h < 0$$

$$D_1 \cdot \partial r = \partial B^c [l_u \bar{r}' W^h + b_u \bar{r}' W^h - lF^h - bF^h] + \partial \bar{r}' [W^h F^h (l_u b - b_u l)] + \partial \bar{e} [\bar{r}' W^h F^h (l_u b - b_u l)] + \partial R [-bF^h + b_u \bar{r}' W^h (1 - l) + l_u \bar{r}' W^h b]$$

$$D_1 \cdot \partial e = \partial B^c [(b_r + l_r) W^h] + \partial \bar{r}' [(l_r b_u - l_u b_r) W^h W^h] + \partial \bar{e} [(l_r b_u - l_u b_r) W^h W^h \bar{r}'] + \partial R [(1 - l)\, b_r W^h + l_r b\, W^h]$$

Note: $\partial W^{hs} = \bar{e}\,\partial R$

Appendix II

Two-Tier Exchange Market — Model II

Asset-Market Equations:

(1) $$B - B^c - b\,(r, u)\,W^h = 0$$

(2) $$B^c + \bar{e}R - W^c - l\,(r, u)\,W^h = 0$$

where

(a) $$W^h = W^{hs} + \int_0^T F^h \dot{e}\,\partial t$$

(b) $$u = \bar{r}'$$

Differentiated:

$$\begin{vmatrix} -b_r W^h & -bF^h \\ -l_r W^h & -\ lF^h \end{vmatrix} \begin{vmatrix} \partial r \\ \partial e \end{vmatrix} = \begin{vmatrix} \partial B^c + b_u W^h \partial \bar{r}' + b\,\partial R + b\,\partial F^h \\ -\partial B^c + l_u W^h \partial \bar{r}' + (-1 + l)\,\partial R + l\,\partial F^h \end{vmatrix}$$

Determinant $= D_2 = (b_r l - l_r b)\,F^h W^h > 0$

Trace $= -b_r W^h - lF^h < 0$

$$D_2 \cdot \partial r = \partial B^c\,[-(b + l)\,F^h] + \partial \bar{r}'\,[(bl_u - lb_u)\,F^h W^h] + \partial R\,[-bF^h] + \partial F^h\,[0]$$

$$D_2 \,.\, \partial e = \partial B^c\,[(b_r + l_r)\,W^h] + \partial \bar{r}'\,[(l_r b_u - b_r l_u)\,W^h W^h] + \partial R\,[f + b)\,b_r W^h + bl_r W^h] + \partial F^h\,[(l_r b - b_r l)\,W^h]$$

Note: $\partial W^{hs} = \bar{e}\,\partial R + e\,\partial F^h$

Appendix III

Unitary Flexible Exchange Rate

Asset-Market Equations

(1) $$B - B^c - b\,(r, u)\,W^h = 0$$

(2) $$B^c + eR - W^c - l\,(r, u)\,W^h = 0$$

where

(a) $$W^h = (B - B^c) + (B^c + eR - W^c) + eF^h$$

(b) $$u = \bar{r}'$$

Differentiated:

$$\begin{vmatrix} -b_r W^h - bF^h \\ -l_r W^h - lF^h \end{vmatrix} \begin{vmatrix} \partial r \\ \partial e \end{vmatrix} = \begin{vmatrix} \partial B^c + b_u W^h \partial \bar{r}' + b \partial W^{hs} \\ -\partial R + l_u W^h \partial \bar{r} + l \partial W^{hs} \end{vmatrix}$$

Determinant $= D_3 = (b_r l - l_r b) F^h W^h > 0$

Trace $= -b_r W^h - lF^h < 0$

$$D_3 \cdot \partial r = \partial B^c [-(b + l) F^h] + \partial \bar{r}' [(bl_u - lb_u) F^h W^h] + \partial W^{hs} [0]$$

$$D_3 \cdot \partial e = \partial B^c [(b_r + l_r) W^h] + \partial \bar{r}' [(l_r b_u - b_r l_u) W^h W^h] + \partial W^{hs} [(-b_r l + l_r b) W^h]$$

Note: $\partial W^{hs} = e \partial F^h$

Appendix IV
Unitary Fixed Exchange Rate

Asset-Market Equations

(1) $B - B^c - b(r, u) W^h = 0$

(2) $B^c + \bar{e}R - W^c - l(r, u) W^h = 0$

where

(a) $W^h = (B - B^c) + (B^c + \bar{e}R - W^c) + \bar{e}F^h$

(b) $u = \bar{r}'$

Differentiated:

$$\begin{vmatrix} -b_r W^h & 0 \\ -l_r W^h & -1 \end{vmatrix} = \begin{vmatrix} \partial r \\ -\bar{e} \partial R \end{vmatrix} \cdot \begin{vmatrix} \partial B^c + b_u W^h \partial \bar{r}' + b \partial W^{hs} + bF^h \partial \bar{e} \\ -\partial B^c + l_u W^h \partial \bar{r}' + \partial W^{hs} + lF^h \partial \bar{e} \end{vmatrix}$$

Determinant $= D_4 = b_r W^h > 0$

Trace $= -b_r W^h - 1 < 0$

$$D_4 \cdot \partial r = \partial B^c [-1] + \partial \bar{r}' [-b_u W^h] + \partial \bar{e} [-bF^h] + \partial W^{hs} [-b]$$

$$D_4 \cdot \bar{e} \partial R = \partial B^c [-(b + l_r) W^h] + \partial \bar{r}' [(b_r l_u - b_u l_r) W^h W^h] + \partial \bar{e} [(b_r l - l_r b) F^h W^h] + \partial W^h [(b_r l - l_r b) W^h]$$

Note: $\partial W^{hs} = \bar{e} \partial R$

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