EUROBANKING, OPEN MARKET OPERATIONS AND THE MONETARY BASE

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N° 81/01

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Dépôt légal : 3ème Trimestre 1980

Imprimé par l'INSEAD, Fontainebleau
France.

EUROBANKING, OPEN MARKET OPERATIONS AND THE MONETARY BASE

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August 1980

This paper examines the non-stochastic structure determining, in the short run, the monetary base of a small open economy under a regime of fixed exchange rates with less than perfect substitution between currency denomination of assets but unrestricted domestic financial intermediation in "Eurocurrency" assets. It demonstrates that such intermediation reinforces the impact of open market operations on the monetary base by alleviating the connection between short term international capital flows and covered interest rate arbitrage. Euroasset financial intermediation absorbs some of the financial and monetary shocks from shifting preferences for the currency denomination of assets.

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* This paper, prepared with financial support from INSEAD, benefited from discussions at the E.I.A.S.M., Brussels, the Centrum voor Economische Studien, K.U. Leuven, and the Constanz Seminar in Monetary Theory and policy, and from comments by E. Baltensperger, M. Fratianni and C. Wyplosz.

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I. INTRODUCTION

Monetary authorities, domestic and international, often contend that the existence of Eurobanking creates a new problem for monetary control (e.g. Larre, 1980). They then advocate imposition of quantity constraints on bank Euro assets and liabilities to restore domestic monetary autonomy. This paper examines a simple model describing, under less than Mundellian conditions, yet, under fixed exchange rates, a domestic banking system granting credit in both domestic and foreign currency to both residents and non-residents.

Under Mundellian conditions, traditional foreign exchange banking (TFEB) and Eurobanking are, except for minor details, indistinguishable and the authorities are correct. Their contention reduces to the traditional argument in favor of foreign exchange controls and limited convertibility. It is an old solution to an old problem.

But what if assets denominated in home currency are less than perfect substitutes for assets valued in foreign exchange? Several reasons for this can be thought of: transaction costs, exchange domain, information costs, higher than zero probability of parity change. Suppose, that under such circumstances the domestic banking system starts granting credit and issuing deposits in foreign exchange to residents and non-residents. Does such an innovation (Eurobanking) attenuate, as claimed by the authorities, the effectiveness of monetary policy compared with a situation in which credit was granted and deposits issued to non-residents in domestic currency (TFEB) and none of these in foreign exchange neither to non-residents nor to residents?

The model in this paper is designed to critically examine this claim of the authorities. The authorities contention is analysed within the context of official views on money stock determination. But it is well known that in fact, the base is the key determinant of bank credit and the money stock (Brunner, (1973), Fourçans, (1978), Fratianni, (1976), and Korteweg, (1977)). If the base escapes potential control by the monetary authorities, their policy actions remain inconsequential to the money stock and bank credit. The authorities can steer these variables only if the prerequisite for base controllability is satisfied. That is, their actions may not be fully offset by the total feedback on the base of the responses of the banking system, the public and the rest of the world to the use of a policy instrument.

The paper focuses on the impact of Eurobanking on this offset in the context of open market operations. Its implications show that Eurocurrency financial intermediation strengthens the effect of open market operation. Intuitively, this results from the fact that with Eurobanking arbitrage between the domestic rate and the covered foreign rate takes also place within the home country, through shifts in currency denomination of existing assets and liabilities of the domestic banking system. Through this mechanism, covered interest arbitrage, to run its course, necessitates less actual international capital flows and changes less the monetary base than in the pure case of TFEB.

This paper is divided in three parts. Section 2 describes the scope, specification and solution of the model. The policy implications of the findings are discussed in Section 3.

2. THE MODEL

2.1 SPECIFICATION

The determination of the base is summarized by the model presented in Table 1. Its variables are defined in Appendix 1.

Equation 1 specifies the supply of base money by banks borrowing from the central bank A^m, from non-residents in domestic currency A^n, and foreign exchange FA^n, by government borrowing from the central bank S^m and in foreign exchange FS and by the public's net international borrowing IA and the cumulative current account surplus CCAB.

Along the lines of Black (1973), total net indebtedness of banks to non-residents is disaggregated into its domestic currency component A^n, defined in 2, and its foreign exchange component FA^n, defined in 4. A^n and FA^n have no direct behavioral content. They are derived magnitudes determined simultaneously by the behavior of banks, non-residents and the public in the relevant markets. This leads to the explication of the market for domestic currency bank credit (7 through 10) and of the domestic market for Eurocurrency credit (11 through 14) to single out the determination of EA_n and FEA_n, variables entering directly the supply of base money. This construction contrasts with the contributions of others who consider international refinancing, like that with the central bank, in perfectly elastic supply to the banking system. The joint construct of net refinancing from the rest of the world occurring partly in domestic currency, and of an endogenous domestic credit market interest rate i requires the integration of these international refinancing activities in the domestic bank credit market for i to be determinable.

TABLE I

The Simultaneous Equation Determination of the Base

The base money market

1.	$B = A^m + A^n + FA^n + S^m + FS + IA + CCAB$	Supply of base money
2.	$A^n \equiv D^n - EA_n$	Definition bank borrowing in home currency from non-residents
3.	$A^m = A^m \underset{+}{(i,} \underset{+}{y;.})$	Bank borrowing from monetary authorities
4.	$FA^n \equiv FD^n - FEA_n$	Definition bank borrowing in foreign exchange from non-residents
5.	$B^p = B^p \underset{-}{(i;} \underset{+}{NFW,.})$	Public demand for base money
6.	$B = R + B^p$	Equilibrium condition base money market

The market for domestic currency bank credit

7.	$EA = EA \underset{+}{(i,} \underset{-}{y;.})$	Banks' demand for home currency earning assets
8.	$EA_p = EA_p \underset{-}{(i,} \underset{+}{y;} \underset{+}{NFW,.}) + S$	Public's supply of home currency earning assets
9.	$EA_n = EA_n \underset{-}{(i,} \underset{+}{y;.})$	Non-residents' supply of home currency earning assets
10.	$EA = EA_p + EA_n$	Equilibrium condition in domestic currency loan market

TABLE I (cont'd)

The domestic market for Eurocurrency credit

11.	$FEA = FEA^{b}\ (\overset{-}{i},\ \overset{+}{y};.)$	Banks' demand for foreign currency assets
12.	$FEA_p = FEA_p\ (\overset{+}{i},\ \overset{-}{y};.)$	Public's supply of foreign currency earning assets
13.	$FEA_n = FEA_n\ (\overset{+}{i},\ \overset{-}{y};.) + FS$	Non-residents' supply of foreign currency earning assets
14.	$FEA = FEA_p + FEA_n$	Equilibrium condition foreign currency loan market

The market for bank deposits

15.	$D^n = D^n\ (\overset{-}{y};.)$	Foreign demand for bank deposits
16.	$D = D^p + D^n$	Equilibrium condition bank deposit market

The domestic market for Eurocurrency deposits

17.	$FD = FD\ (\overset{+}{i},\ \overset{-}{y};.)$	Banks' supply of foreign currency deposits

The balance-sheet identities

18.	$R + EA + FEA = A^m + D + FD$	Banks' balance-sheet
19.	$B^p + D^p + FD^p = EA_p + FEA_p + IA + NFW$	Public's balance-sheet

The distinction is further made between net bank indebtedness in foreign exchange to non-residents, FA^n, which has a direct impact on the base, and net bank indebtedness in foreign exchange to residents, $FD^p - FEA_p$, which has no direct impact on the base. The distinction between items affecting the foreign exchange markets without directly affecting the base was first pointed out by Basevi (1973).

The unit of account is the domestic currency in which all financial instruments in foreign exchange are valued. Speculation is eliminated from the model. Transactors in the foreign exchange market, domestic non-bank public and non-residents contracting forward contracts with the commercial banking system, cover systematically a spot position by a forward transaction in the opposite direction. The market for forward foreign exchange contracts is implicitly cleared through equilibrium in the spot domestic market for Eurocurrency credit and deposits.

In addition to the endogeneity of y, the model has in common with Dornbusch (1977) the existence of one non-tradeable security S, domestic currency denominated government securities. But the Dornbusch "domestic assets and the small country model" and "forward market and asset market equilibrium model" do not examine the substitutability in commercial bank portfolios between domestic assets, EA, and foreign assets, FEA. To focus on this substitutability, unintermediated international capital flows of the non-bank public IA are kept exogenous whereas the interaction of the banking system with non-residents and the non-bank public is fully disaggregated and endogenized with the introduction of the EA_n, FEA_n, D^n and FEA_p variables and their corresponding behavorial specifications (9, 13, 15, 12).

Two interest rates are "proximately" determined in two markets: i in the market for domestic currency bank credit (7 through 10) and y in the domestic Eurocurrency market (11 through 14). In two other markets, the rates are given: in the one for base money (1 through 6) the rate is zero, and in the one for bank deposits (15 through 16) the rate i_d is determined outside the model.

Following relationships are implicit: international reserves IR and the Balance-of-Payments constraint in 1, the government budget constraint and the accumulated deficit CDEF in 19.[1] Market clearing conditions for domestic currency government securities S and foreign exchange government securities FS are implied in 8 and 13. Net financial wealth of the public, NFW, equals S^m + FS + CCAB.[2]

The market for domestic currency bank credit

Domestic currency bank credit equals earning assets the banking system has in its portfolio EA, determined in 7. For banks in supplying EA residents and non-residents are perfect substitutes.

Demand for EA consists of the public EA_p 8 and of non-residents EA_n 9, each partially responding to different forces. EA_n is a negative component of A^n and, consequently, of the supply of base money.

Equilibrium condition 10 determines the domestic credit interest rate i. Mundell (1963, 1964) makes i exogenously equal to the foreign rate of interest i_e, with EA_n being perfectly interest elastic and y equal to zero. Here, as previously explained, we analyse the short-run endogeneity of i with the implication that, residents and non-residents being perfect substitutes in bank portfolios, the assumption of perfectly interest elastic demand for credit by non-residents from the domestic banking system be dropped.

The domestic markets for Eurocurrency credit and Eurocurrency deposits

The endogeneity of the forward premium y identifies a domestic market for Eurocurrency credit by endogenizing the covered return from holding assets denominated in foreign exchange. For banks in the supply of FEA, determined in 11, residents and non-residents are perfect subsititutes. The public and non-residents partially respond to different forces in their demand for Eurocurrency credit from the domestic market (12 and 13). Equilibrium condition 14 proximately determines y.[3]

The structure of the domestic market for Eurocurrency deposits is analogous to the market for Eurocurrency bank credit, but FD^p is left determined by the balance sheet of the non-bank public, and the demand for Eurocurrency deposits by non-residents FD^n is exogenously given. That is, there is no feedback of i on this demand and the response of FD^n to y is, 'a priori', only of second order. Walras Law ensures that, the banking system supply of Eurocurrency deposits FD equals their demand $FD^p + FD^n$.

The money market

Base money is supplied through domestic and international bank borrowing (2 through 4), predetermined international borrowing of the public IA, the discretionary actions of the government and the monetary authorities FS and S^m and finally through the predetermined amount of the accumulated trade surplus CCAB. On the demand side for base money, the relevant behavior is that of the banking system in its demand for reserves and that of the public in its desired holdings of base money. The interest rate on base money being

Semi-reduced in i, y, B, the model looks like:

$$(20) \quad EA\ (i, y;.) - EA_p\ (i, y; NFW,.) - S - EA_n\ (i, y;.) = 0$$

$$(21) \quad FEA\ (i, y;.) - FEA_p\ (i, y; NFW,.) - FEA_n\ (i, y;.) - FS = 0$$

$$(22) \quad D^n\ (y;.) - EA_n\ (i, y;.) + A^m\ (i, y;.) + FD^n - FEA_n\ (i,y;.) + S^m + CCAB + IA - B = 0$$

Domestic currency credit excess supply, equation 20, summarizes 7 through 10. Foreign exchange excess supply of credit, in 21, summarizes equations 11 through 14. The base is recursively determined from the supply side in 22. Solution values of i and y, substituted in 22, determine the base. Given the base, all other monetary aggregates are also recursively determined from the remaining expressions in the model (5, 6, 16, 17, 18, and 19).[4]

The cash constraints of the base on the credit aggregates, and thereby also its second order effects on the equilibrium stock of base money, has been fully relaxed. At the given discount rate or foreign interest rate, the central banks' supply of base money fully accomodates reestablishment of equilibrium in the two credit markets after any disturbance of the initial equilibrium.

In fact, base money supply is largely determined by the credit markets. Bank reserves are a residual variable, balancing bank credit and the public's demand for notes and coin. The monetary aggregates are directly determined by their counterparts without accounting for the process through which this occurs (multiple and fractional reserve banking). Essentially, this modelization reflects

official doctrines of central banks, such as the Bank of England, the Banque de France and the Nationale Bank van België, on money stock determination. To sum up, official views on the impact of Eurocredit markets on monetary control are analyzed within the context of official views on money stock determination.

The interaction between the domestic currency credit market CM, the foreign exchange credit market FCM and the base BM is illustrated in Figure 1. The first quadrant portrays combinations of i and y which are consistent with equilibrium in the CM and FCM markets and which determine BM. The additional structure to achieve these results is discussed in Appendix 2. The slope of the CM curve is positive and smaller than 1:

$$\frac{di}{dy}\Big|_{CM} \rightarrow 0 < -\frac{a_{12}}{a_{11}} < 1.$$

The slope of the FCM curve is larger than one:

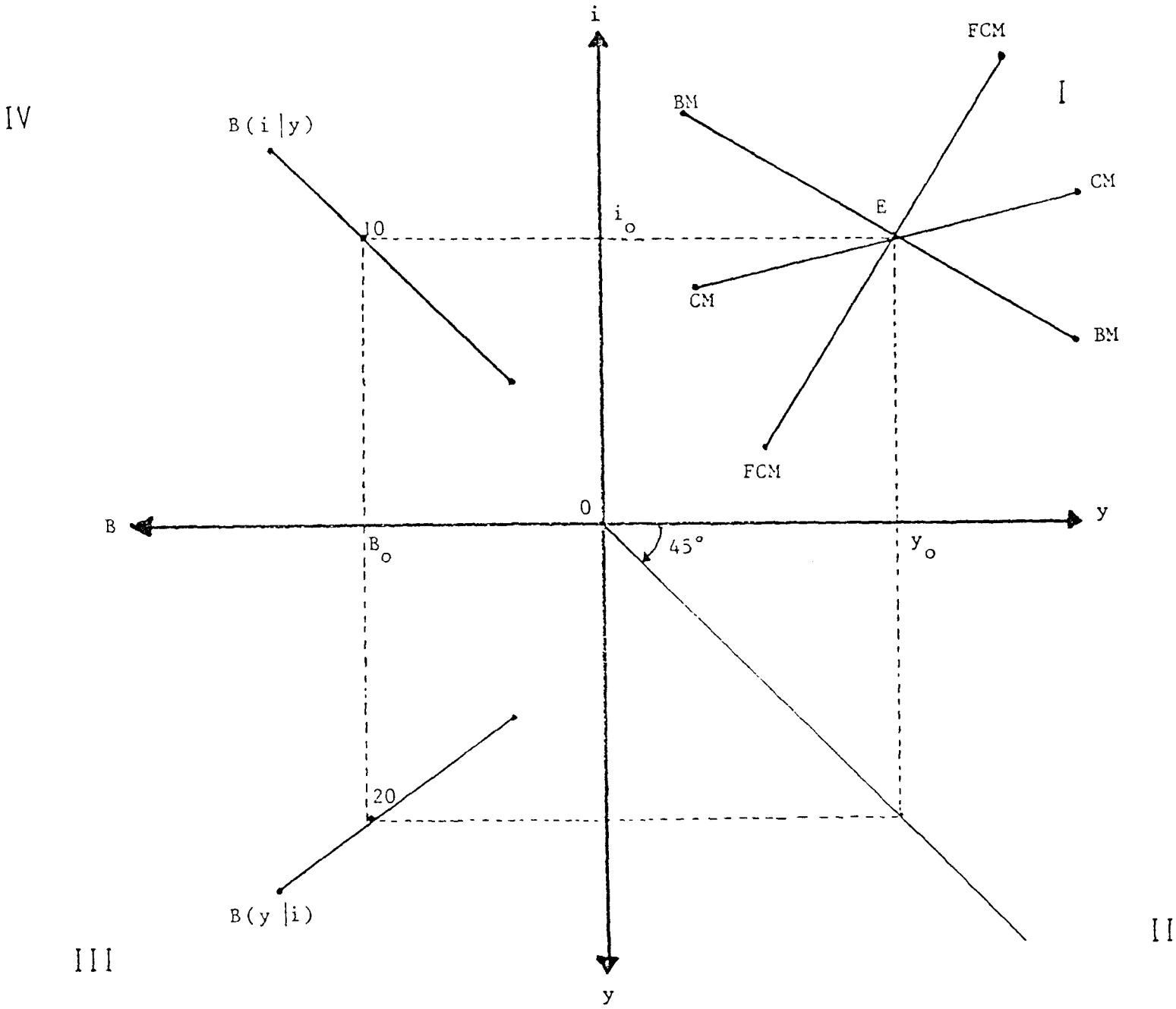
$$\frac{di}{dy}\Big|_{FCM} \rightarrow \quad -\frac{a_{22}}{a_{21}} > 1.$$

The slope of the BM schedule, which portrays i and y values for which dB = 0, is negative:

$$\frac{di}{dy}\Big|_{BM} \rightarrow \quad -1 < \frac{a_{32}}{a_{31}} < 0.$$

The base being recursively determined, the three schedules intersect at the same point E, which represent the pair of i and y values consistent with joint equilibrium in the domestic currency and foreign exchange markets. The BM schedule intersecting point E implies that at this combination of i and y no endogenous forces are at work to change the base: dB remains equal to zero. The constant level of B associated with E is portrayed in the other three quadrants.

FIGURE 1 JOINT EQUILIBRIUM OF THE DOMESTIC INTEREST RATE, THE FORWARD PREMIUM AND BASE DETERMINATION.



Quadrant III portrays the schedule of partial equilibrium values of y and B, keeping i constant $B(y|i)$. The slope of $B(y|i)$ is positive:

$$\frac{dB}{dy}\Big|_{di = 0} = a_{32} > 0$$

Keeping y constant, the schedule of partial equilibrium values for i and B, $B(i|y)$, is described graphically in quadrant IV. Its slope is also positive:

$$\frac{dB}{di}\Big|_{dy = 0} = a_{31} > 0$$

Considering again the relative sizes of a_{31} and a_{32}, it further follows that:

$$\frac{dB}{dy}\Big|_{di = 0} < \frac{dB}{di}\Big|_{dy = 0}$$

The equilibrium stock of B associated with E can be read from the graph of either the third or fourth quadrant.

2.2 THE IMPACT OF OPEN MARKET OPERATIONS

The model's implications are summarized in Table 2, describing the base multipliers of alternative open market operations.[5] Each multiplier consists of two components: (1) the direct response of the base to a purchase, expressed in the first component; (2) in brackets, the feedback on the base source components of the market responses to this purchase; this feedback is summarized in the second component. The first term of the feedback summarizes the indirect impact on the base of the Eurocurrency market response to a trigger exercised in the domestic currency bank credit market; the second term of the feedback summarizes the indirect impact on the base of the domestic currency bank credit market response to a trigger exercised in the foreign exchange market. The feedback through each market is the product of each market trigger ε, φ with the response for the home currency credit market ($B|CM$) and for the Eurocurrency credit market ($B|FCM$).

An open market operation is a change in the composition of government debt while the cumulative deficit remains constant. Formally, in terms of the government budget constraint:

$$dCDEF = 0 = dS^m + dS + dFS.$$

Any combination of dS^m, dS and dFS with their sum equal to zero is an open market operation. The three limiting cases in which dFS, dS and dS^m are alternatively set equal to zero are discussed.

TABLE 2

Open Market Operations Base Multipliers

Purchase of non-tradeable securities $(dS^m = -dS,\ dFS = 0)$

$$\frac{dB}{dS^m} - \frac{dB}{dS} = 1 + \left[\underset{-}{(\varepsilon - 1)} \quad \underset{+}{(B|FCM)} + \underset{+}{\varphi} \quad \underset{+}{(B|CM)} \right] > 0$$

Purchase of tradeable securities $(dS^m = -dFS,\ dS = 0)$

$$\frac{dB}{dS^m} - \frac{dB}{dFS} = 1 + \left[- \quad \underset{+}{(B|CM)} \right]$$

Swap Operation $(dFS = -dS,\ dS^m = 0)$

$$\frac{dB}{dFS} - \frac{dB}{dS} = \left[\underset{-}{(\varepsilon - 1)} \quad \underset{+}{(B|FCM)} + \underset{>1}{(\varphi + 1)} \quad \underset{+}{(B|CM)} \right]$$

The direct impact on the base of a purchase of non-tradeable securities ($dS^p = -dFS = 0$) is one. Such a purchase produces two simultaneaous and opposing indirect effects on the domestic currency bank credit market. Net financial wealth of the public increases, producing an upward shift in EA_p, represented by ε. Simultaneously, EA_p decreases by a factor of one representing the securities the authorities remove from circulation. Assuming that the wealth effect is smaller than the transfer effect, i tends to decrease. Will this indirect effect be strong enough to offset the unit impact of the direct effect? The answer is unambiguously no:

$$\varepsilon > 0 \quad \text{and} \quad 0 < (B|FCM) < 1.$$

At once, this implies that an open market operation in non-tradeable securities has a net expansionary impact on the base. There is no perfect offset between the purchase and the reactions of the domestic currency bank credit market. The stronger the wealth effect ε, the smaller the offset. Even if ε would be zero, the offset would be less than perfect, provided that the own interest rate effects of the demand and excess demand functions are stronger than the cross rate effects.

Furthermore, the wealth effect, through the increase in S^m, expands FEA_p, triggering the Eurocurrency credit market and reinforcing the direct impulse on the base due to the upward movement of y. Whether the reinforcement induced through the Eurocurrency market dominates the attenuation brought about by the domestic currency market is an empirical matter.

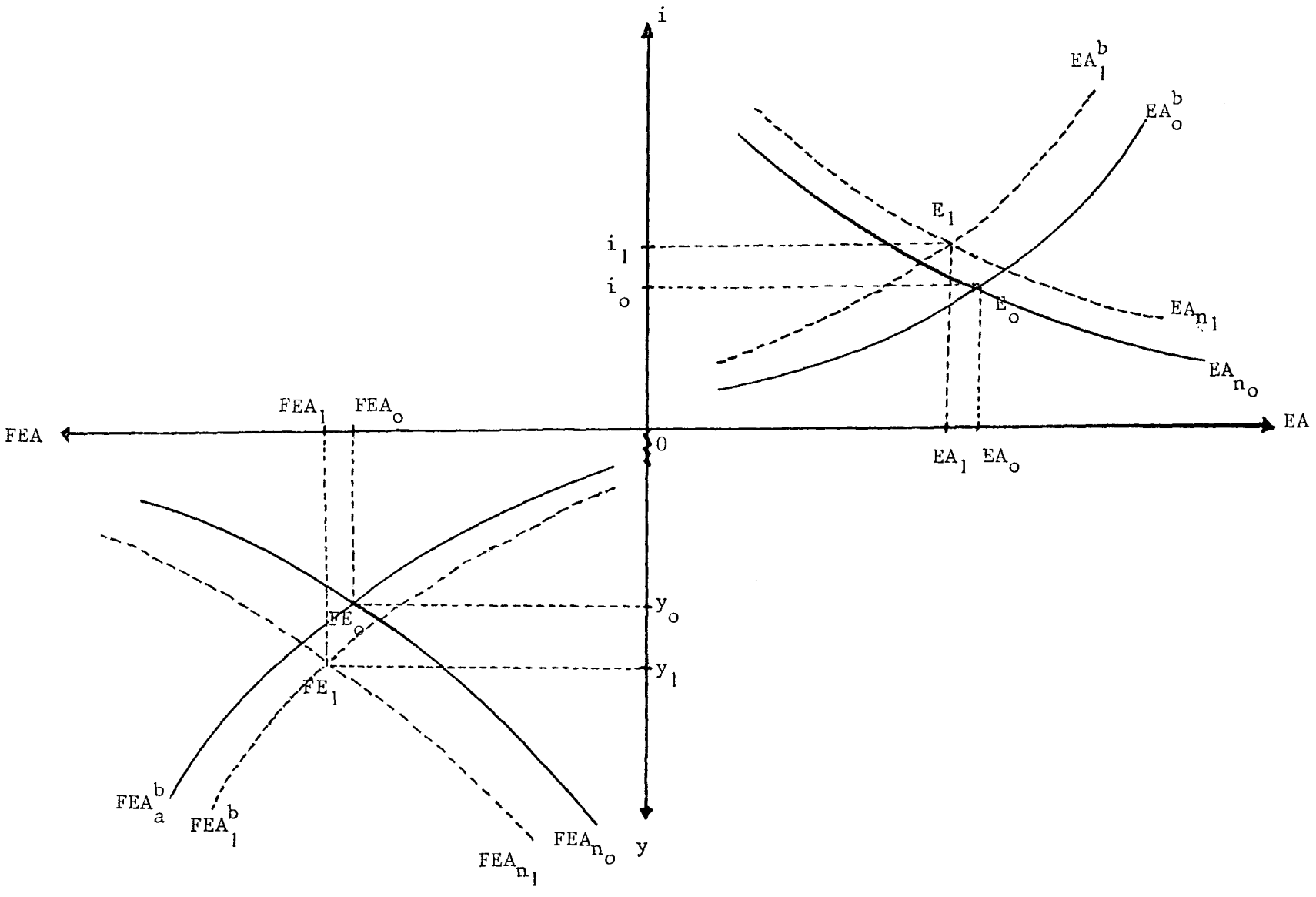
Importantly and unambiguously: the readiness of the banking system to extend Eurocurrency credit to the domestic public adds strength to open market operations in the non-tradeable security proportional

to the strength of the wealth effect in the non-bank public's demand for this credit. Domestic Eurocurrency intermediation reinforces, rather than weakens, the impact of this open market operation on the monetary base.

Note that the financial wealth effect makes the total impact of a purchase of non-tradeable securities on i and y ambiguous. In the absence of the wealth effect, the hypothesis yields the standard result that both i and y decrease, with i more than y. The ambiguous result of this particular open market operation on i and y and its definite positive impact on the base suggest that the openness of an economy reinforces the argument in favor of base targeting and against interest rate or forward premium targeting.

A purchase of tradeable securities, ($dS^m = -dFS$, $dS = 0$), lowers the domestic rate and the forward premium, and the latter more so than the former. Interestingly enough, its impact on the base is ambiguous, whatever the financial wealth effects are. There will certainly be an offset: the decrease in i and y makes both bank domestic borrowing and indebtedness toward non-residents smaller than what it otherwise would have been. But whether the offset is smaller, equal or larger than one is an empirical matter. In general, there is no perfect offset. $(B|CM)$ will be smaller that one, yielding a less that perfect offset, if the excess supply response of Eurocurrency bank credit with respect to the forward premium (a_{22}) and the cross rate responses of EA_n, FEA_n and D^n are large enough. In the latter case, net induced capital flows will be limited. In the extreme case they may be nil and be replaced by a one to one shift in the currency denomination of non-residents liabilities to the banking system. The ability of the banking system to lend to non-residents with contracts denominated in either home or foreign currency, avoids the

FIGURE 2 - INTERNATIONAL ARBITRAGE WITHOUT CAPITAL FLOWS



Turning now to a swap operation, ($dFS = -dS$, $dS^m = 0$), its interest rate, forward premium and base multipliers are ambiguous. For $\varepsilon = \varphi = 0$, the interest rate would drop and the forward premium would increase. In this case, the base multiplier remains ambiguous: the interest rate decrease destroys base money, the increase in the premium makes domestic borrowing and international indebtedness larger than what it otherwise would have been. From a monetary policy point of view, a swap operation is the worst of the three alternative open market operations to the extent that both the base and the rate impacts are uncertain.

A further result clarifies the role of domestic Eurocurrency financial intermediation. The participation of the public in the domestic Eurocurrency market attenuates the impact of all three open market operations on the domestic interest rate and the forward premium. For $FEA_p = FD^p = 0$, each of the three open market operations decrease the domestic rate, the first two decrease the premium, and a swap operation increases it. The decrease in i and y due to the purchase of tradeable securities is less when domestic Eurocurrency intermediation takes place than when $FEA_p = FD^p = 0$. A swap operation and purchase of non-tradeable securities could have a positive effect on i and y in the case of domestic Eurocurrency intermediation if the wealth effect φ and/or the excess demand response of the domestic bank credit market to an increase in the forward premium would be sufficiently large.

To sum up, under perfect substitutability in bank portfolios between credit granted to non-residents and the public, and less than perfect substitutability in bank portfolios between credit granted in domestic

currency and foreign exchange, monetary policy, as measured by the ability of the authorities to affect the base through open market operations, is more effective with domestic Eurocurrency intermediation, than without it. This result is reinforced by the wealth effects in the domestic public's credit demands. The essential mechanism that explains these results is the fact that arbitrage between the domestic rate and the covered foreign rate takes also place within the home country, necessitating less actual international capital flows than in the pure case of TFEB.

3. SUMMARY AND IMPLICATIONS

Repeatedly, central banks have argued that substitutability in currency denominations of bank credit and deposits with both the public and non-residents necessitates the imposition of regulations restricting domestic Eurocurrency financial intermediation and rationing the banking system's international position to overcome market interference against the conduct of monetary policy. International interest rate arbitrage by commercial banks is the central market mechanism against which the policy makers raise the regulatory barriers to restore the power of monetary policy.

This paper examined the contention of the authorities that Eurocurrency financial intermediation attenuates the power of open market operations. Its task was to build a model in which covered interest rate arbitrage is the essential adjustment mechanism under conditions of full Eurocurrency financial integration but less than perfect capital mobility in the specific Mundellian sense. Perfect elasticity supply of funds from the rest of the world to the banking system is replaced by the simultaneous determination of the domestic rate and the forward premium in the markets for domestic bank credit denominated in the home currency and the one denominated in the foreign currency. Non-residents participate in the home currency credit market and the non-bank public in the domestic foreign currency credit market. Both these demands are characterized by less than perfect interest elasticity and the avoidance of foreign exchange risk by systematic covering an open spot position by a forward position in the opposite direction.

Particular attention was paid to the impact on the base of open market operations and to the concept of international bank borrowing.

This was redefined as domestic and foreign currency denominated net international bank indebtedness, magnitudes resulting from the interaction of banks, non-residents and the non-bank public on the market for domestic currency bank credit and the domestic market for Eurocurrency credit.

Following are the major findings. Traditional open market operations in a non-tradeable security regain their full strength in changing the base and the market mechanism, in which financial wealth plays a key role, could reinforce rather than weaken, the initial thrust exercised by the impulse. A purchase of tradeable securities or a swap operation are, in general, not ineffective and the issue of Eurobonds by the government adds an instrument to the policy conduct of base targeting.

Finally, and most importantly, the paper shows that domestic financial intermediation in Euro-assets and liabilities adds strength to base money targeting, rather than weakening it. The essential mechanism that explains these results is the fact that arbitrage between the domestic rate and the covered foreign rate can take place within the home country, necessitating less actual international flows than in the Mundellian world. If a rational is to be found for regulating commercial banks international position and for restricting domestic financial intermediation in Euro-assets and liabilities, it should not be searched for in the international behavior of the banking system.

The current paper does not settle the issue of Eurobanking and base determination in the long run or under stochastic conditions. Nonetheless, it sheds new light upon the interpretation made of Eurocurrency financial integration. Indeed, as Euro-assets become a

part of the domestic financial system, financial integration loses some of its impact on actual international short term capital flows and, therefore, on the difficulty of base targeting. The problems to be dealt with for money stock control become more similar to the ones associated with the existence of an additional domestic financial asset, and less similar to international gold flow type of phenomena of the fixed exchange gold standard regime which inspired the Mundellian characterisation of capital mobility and which still inspire the reaction of monetary authorities. As Hayek pointed out a long time ago, the nature of the system has changed.

APPENDIX 1: Definition of Symbols

20 variables determined by the model

18 quantities:

A^m = Banks' borrowing from monetary authorities

A^n = Banks' borrowing from non-residents in domestic currency

B = Monetary base

B^p = Monetary base held by public

D = Domestic bank deposits in domestic currency

D^n = Domestic bank deposits in home currency held by non-residents

D^p = Domestic bank deposits in home currency held by public

EA = Earning assets of banks in home currency

EA_n = Earning assets of banks in home currency supplied by non-residents

EA_p = Earning assets in home currency supplied by public

FA^n = Banks' borrowing from non-residents in foreign exchange

FD = Domestic currency value of bank deposits in foreign exchange

FD^p = Domestic currency value of bank doposits in foreign exchange held by public

FEA = Assets of banks in foreign currency

FEA_n = Assets of banks in foreign currency supplied by non-residents

FEA_p = Assets of banks in foreign exchange supplied by public

R = Reserves of banks in home currency with monetary authorities

2 interest rates:

i = Domestic bank credit interest rate

y = Forward premium of the foreign currency

Variables as given in the analysis

Policy variables:

FS = Stock of government securities issued in foreign exchange

S = Stock of government securities issued in home currency

S^m = Net government borrowing from monetary authorities

Predetermined values:

CCAB = Cumulative current account surplus

FD^n = Domestic currency value of bank deposits in foreign exchange held by non-residents

IA = Net international borrowing of public

APPENDIX 2: Higher order sign constraints

The sign constraints characterizing the response behavior of the three sectors discussed in Section 2, are not sufficient to yield determinate results for the multipliers. Second and third order sign constraints are imposed upon the A.n = B.X system, in which:

$$A = \begin{bmatrix} a_{11} & a_{12} & 0 \\ a_{21} & a_{22} & 0 \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \qquad B = \begin{bmatrix} b_{11} & b_{12} & b_{13} \\ b_{21} & b_{22} & b_{23} \\ b_{31} & b_{32} & b_{33} \end{bmatrix}$$

$$n^T = \begin{bmatrix} di & dy & dB \end{bmatrix} \qquad X^T = \begin{bmatrix} dS^m & dFS & dS \end{bmatrix}$$

Table A1 summarizes the sign constraints on the partial endogenous responses of each market sector. The signs of a_{31} and a_{32} are not clear a priori.

The proximate impact on the endogenous base of an increase in the domestic credit interest rate a_{31} is constrained to be positive on grounds of substitutibility:

$$\left| \frac{\delta EA_n}{\delta i} \right| > \frac{\delta FEA_n}{\delta i}$$

The proximate response of the endogenous base to an increase in the forward premium a_{32} is more complex to assess a priori. Banks' borrowing A^m increases since y is both the cost of a substitute to borrowing and an asset yield. But the direct influence of y through

TABLE A1

Partial Endogenous Responses

Market for domestic currency bank credit

$$a_{11} = \overset{+}{\frac{\delta EA}{\delta i}} - \overset{-}{\frac{\delta EA_p}{\delta i}} - \overset{-}{\frac{\delta EA_n}{\delta i}} > 0$$

$$a_{12} = \overset{-}{\frac{\delta EA}{\delta y}} - \overset{+}{\frac{\delta EA_p}{\delta y}} - \overset{+}{\frac{\delta EA_n}{\delta y}} < 0$$

Domestic market for Eurocurrency bank credit

$$a_{21} = \overset{-}{\frac{\delta FEA}{\delta i}} - \overset{+}{\frac{\delta FEA_p}{\delta i}} - \overset{+}{\frac{\delta FEA_n}{\delta i}} < 0$$

$$a_{22} = \overset{+}{\frac{\delta FEA}{\delta y}} - \overset{-}{\frac{\delta FEA_p}{\delta y}} - \overset{-}{\frac{\delta FEA_n}{\delta y}} > 0$$

Base money market

$$a_{31} = \overset{+}{\frac{\delta A^m}{\delta i}} - \left(\overset{-}{\frac{\delta EA_n}{\delta i}} + \overset{+}{\frac{\delta FEA_n}{\delta i}} \right) > 0 \quad \text{imposed}$$

$$a_{32} = \overset{+}{\frac{\delta A^m}{\delta y}} - \left(\overset{+}{\frac{\delta EA_n}{\delta y}} + \overset{-}{\frac{\delta FEA_n}{\delta y}} \right) + \overset{-}{\frac{\delta D^n}{\delta y}} > o \quad \text{imposed}$$

$$a_{33} = -\frac{\delta B}{\delta B} = -1$$

the behavior of non-residents is negative, since y for non-residents is comparable with a component of the "own" yield on instruments denominated in home currency:

$$\frac{\delta EA_n}{\delta y} > \left| \frac{\delta FEA_n}{y} \right| .$$

That is, desired holdings of domestic currency deposits diminish with the result that capital inflows decrease. The increase in non-residents' demand for domestic currency credit is stronger than the decrease in their demand for foreign currency credit, thereby augmenting capital outflows. Non-residents' behavior in the credit markets reinforces their behavior in the deposit market and a net drain on the base results from it. Substitutibility considerations leave the sign of a_{32} unresolved. The question to be answered then is whether base creation through the reaction of the banking system dominates base destruction through the reaction of non-residents or vice versa. In the former case, a_{32} would be positive while in the latter, a_{32} would be negative. If non-residents were mainly non-bank public, one could argue that the domestic banks' reaction would be stronger since these banks would be relatively better informed. However, the non-resident sector is likely to comprise a considerable component of foreign banks which should be considered as well-informed as the domestic banks.

In the absence of theory or a priori empirical knowledge, it is postulated that $a_{32} > 0$. In other words, the further analysis rests upon the assumption that the partial response of the base to an increase in y through banks' domestic borrowing A^m is stronger than its partial negative response to y through non-residents' increased demand for credit FEA_n plus EA_n.

Table A2 summarizes the signs of the B matrix. The signs of S^m are self-explanatory. The automatic impact of an increase in FS in the base is zero as:

$$FEA_n = FL_n + FS - FS^b \quad \text{so that} \quad \frac{\delta FEA_n}{\delta FS} = 1.0$$

Noting the equalities, define:

$\varepsilon = b_{11} = b_{12}$ the domestic credit market wealth effect and,

$\varphi = b_{21} =$ the Eurocurrency credit market wealth effect.

Note further that $b_{22} = \varphi + 1$.

The signs of the relative responses of the markets to the own rates and the cross rates are as follows:

1. $a_{11} > |a_{21}|$: excess domestic credit supply responds stronger to an increase in the domestic rate than excess Eurocurrency credit demand does;

2. $a_{22} > |a_{12}|$: excess Eurocurrency credit supply responds stronger to an increase in the forward premium that excess domestic credit demand does;

3. $a_{11} > |a_{12}|$: excess domestic credit supply induced by a domestic rate increase is larger that excess domestic credit demand induced by an increase in the premium;

4. $a_{22} > |a_{21}|$: excess foreign credit supply induced by an increase in the forward rate is larger than excess foreign credit demand induced by an increase in the domestic rate.

TABLE A2

Sign Constraints on Exogenous Impulses

Government borrowing from the monetary authorities S^m

$$b_{11} = \underset{+}{\frac{\delta EA_p}{\delta NFW}} \cdot \underset{1}{\frac{\delta NFW}{\delta S^m}} \qquad > \quad 0$$

$$b_{21} = \underset{+}{\frac{\delta FEA_p}{\delta NFW}} \cdot \underset{1}{\frac{\delta NFW}{\delta S^m}} \qquad > \quad 0$$

$$b_{31} = -\frac{\delta S^m}{\delta S^m} \qquad - \quad 1.0$$

Issuance of securities in foreign exchange FS

$$b_{12} = \underset{+}{\frac{\delta EA_p}{\delta NFW}} \cdot \underset{1}{\frac{\delta NFW}{\delta FS}} \qquad > \quad 0$$

$$b_{22} = \underset{+}{\frac{\delta FEA_p}{\delta NFW}} \cdot \underset{1}{\frac{\delta NFW}{\delta FS}} + \underset{1}{\frac{\delta FEA_n}{\delta FS}} \qquad > \quad 1$$

$$b_{32} = \underset{1}{\frac{\delta FEA_n}{\delta FS}} - \underset{1}{\frac{\delta FS}{\delta FS}} \qquad 0$$

Additional structure is imposed. First, $a_{11} > a_{31}$. A sufficient condition for this is that EA^b responds more strongly to i than A_b^m does:

$$\frac{\delta EA^b}{\delta i} > \frac{\delta A_b^m}{\delta i}$$

Second, it is easy to see that $a_{22} > a_{32}$ as FEA responds more strongly than A^m to y:

$$\frac{\delta FEA}{\delta y} > \frac{\delta A_b^m}{\delta y}$$

Third, it is reasonable to impose: $(a_{12} - a_{32}) > (a_{31} - a_{11})$. For this inequality to hold, it is sufficient to assume that:

$$\frac{\delta EA^b}{\delta i} > \frac{\delta A_b^m}{\delta i} + \frac{\delta A_b^m}{\delta y}$$

Lastly, the constraint $a_{31} > a_{32}$ is imposed. In a_{31}, all terms are positive. Non-residents' portfolio behavior reinforces that of banks. In a_{32}, however, the effect on the base of bank borrowing from the central bank is attenuated by deposit decisions of non-residents.

Define $(B|FCM) \equiv \dfrac{a_{31}^{+}\ a_{22}^{+} - a_{32}^{+}\ a_{21}^{-}}{a_{11}^{+}\ a_{22}^{+} - a_{12}^{-}\ a_{21}^{-}}$ and $(B|CM) \equiv \dfrac{a_{11}^{+}\ a_{32}^{+} - a_{12}^{-}\ a_{31}^{+}}{a_{11}^{+-}\ a_{22}^{+} - a_{12}^{-}\ a_{21}^{-}}$

$(B|FCM)$ and $(B|CM)$ represent the cross interest rate effects on the base of the Eurocurrency, respectively domestic currency, credit market adjustments through interest rate, forward premium and asset movements brought about by disturbance of the initial equilibriums.

From the previous discussion, it follows that $1 > (B|FCM) > 0$ and that $(B|CM) > 0$.

Notes

1. The implicit incorporation of these relationships follows from the following specifications.

   The government budget constraint: $CDEF - S^m = S + FS$ with CDEF = the cumulative government cash flow deficit; ownership decomposition of non-tradeable government securities: $S = S^b + S^p$ with S^b = securities held by banks and S^p = securities held by the public: ownership decomposition of tradeable securities $FS = FS^b + FS^n$, with FS^b = securities held by banks and FS^n = securities held by non-residents; bank domestic currency earning assets: $EA^b = EA_p + EA_n$, $EA_p = L_p^b + S^b$ with L_p^b = domestic currency bank loans to the public: $FEA_n = FL_n + FS^b$ with FL_n = banks Eurocurrency loans to non-residents. These specifications assume perfect substitutability in bank portfolios between commercial loans and government securities (see Brunner, K., 1973).

2. The definition of NFW implies that CDEF is the liability of a public without tax illusion. The component $S^m + FS$ represents the amount of base money created at the discretion of the government in the process of financing the deficit and, in the case of FS, surrendering the foreign exchange to the central bank. CCAB represents the amount of goods and services (capital) the public has given up for consumption to the rest of the world and has replaced with net financial claims.

3. As noted earlier, equilibrium in the spot domestic market for Eurocurrency credit and deposits clears, in the absence of speculation and with a fixed exchange rate, implicity the market for forward foreign exchange contracts held by the commercial banking system. Implied excess demand for forward contracts FF is a positive function of i and negative function of y and i_e yielding the standard equilibrium schedule for a given i_e:

$$\frac{di}{dy} = - \frac{FF'_y}{FF'_i} > 0$$

4. The public's holdings of Eurocurrency deposits with the domestic banking system FD^p is recursively determined by:

$$(23) \quad FD\,(i, y;.) + D^n\,(y;.) + A^m\,(i, y;.) + EA_p\,(i, y;.) + S - EA\,(i, y;.)$$
$$+ FEA_p\,(i, y;.) - FEA\,(i, y;.) + IA + NFW - B - FD^p = 0$$

Determination of FD^p reflects the equilibrium conditions of the base money (6) and deposit (16) markets as well as the implicit supply of bank deposits D by the balance sheet identity of the banking system (18) and the balance-sheet identity of the public itself (19). The semi-reduced system (20) through (23) takes all behavioral specification, balance-sheets identities, definitions and equilibrium conditions of the system fully into account.

5. The i and y multipliers are not shown in the paper, but can easily be obtained from solving for them.

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