The Eurodollar Market[1] and the Money Supply

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Introduction

As is usually the case when new economic phenomena emerge, economists have tried to explain the phenomenon of the Eurodollar market by suitably adapting the pertaining text-book paradigm. These efforts resulted in numerous attempts, both theoretical and empirical, to analyse the money supply implications of the Eurodollar market in terms of the so-called "Eurodollar multiplier". More recently, however, the Eurodollar multiplier concept has been critized (*Niehans/Hewson* 1976, *Willms* 1976, *Swoboda* 1978) and the money supply paradigm has been adapted to the Eurodollar market in a different and more meaningful way. This paper adds to this recent development. Its main purpose is to bring out the money supply implications of the Eurodollar market as clearly as possible addressing questions such as:

— What is the correct analogy between domestic money supply and Eurodollar market money supply? What is the role of the Eurodollar market concerning the total mony supply and its linkage to the domestic money supply?

— What are the relevant behavioral parameters and their respective roles?

— What are the implications for pursuing monetary policies? Have the monetary authorities' capabilities to control the mony supply been impaired? If so, what measures would be necessary to improve their money supply controlling capabilities?

— Is the emergence of the Eurodollar market in any way responsible for the excessive money supply growth, i. e. for the world-wide inflation of the 1970s?

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[1] As in other studies, the term "Eurodollar market" here is used to mean the "Eurocurrency market".

In trying to answer these questions, section I briefly discusses the shortcomings of the concept of the Eurodollar multiplier and then points out the correct analogies between a domestic and a Eurodollar market money supply model. Subsequently it links the two together to yield a meaningful, easily understandable money supply function (which by the way is very much along the lines of *Willms* 1976). Section II addresses the question of whether the money supply role of the Eurodollar market analysed in section I also obtains in a general equilibrium framework in the *Tobin-Brainard* tradition. Section III summarizes the conclusions.

I. The Role of the Eurodollar Market in a Three-Stage Money Supply Model

1. The Model

1) Even though the serious deficiencies of the Eurodollar multiplier concept have increasingly been recognized (e. g. *Willms* 1976) — especially its disregard of the interrelationship between domestic demand deposits, Eurodollar demand deposits and the total money supply — the Eurodollar multiplier concept continues to be widely used and the true nature of the money supply role of the Eurodollar market is still somewhat nebulous in many of the pertaining studies. For example, one still finds misunderstandings as to the analogies between the money supply process on the domestic and on the Eurodollar market respectively and as to the interrelationship betwen the two markets. Therefore, rather than just setting up a set of equations to describe the money supply role of the Eurodollar market, I will first illustrate the analogies between the money supply process on the domestic and on the Eurodollar market respectively by translating a very simple two-stage money supply model (central bank, banking system) into a two-stage Eurodollar market money supply model (Eurobanks, domestic banking system). With this background, a three-stage money supply model capable of addressing the issues raised in the introduction is easily derived.

2) An extremely simple domestic two-stage money supply model is given by the following three equations

(1) $$B = R + C$$

(2) $$r = R/D$$

(3) $$c = C/D$$

(were B = Base, C = Currency, R = Reserves with central bank, and D = demand deposits). Equation (1) defines the monetary base, equation (2) describes the asset allocation by banks between base money and earning assets, and equation (3) captures the wealth allocation by non-banks between base money and money issued by the banking system. From a balance-sheet view the monetary base is defined as the central bank's total liabilities as composed of liabilities both against banks (R) and against non-banks (C). The banking system's money supply D is a multiple of its reserves, i. e.

$$D = \frac{1}{r} \cdot R = \frac{1}{r + c} \cdot B \tag{4}$$

and the total money supply is

$$M = D + C = \frac{1 + c}{r + c} B \ . \tag{5}$$

A change in non-banks' asset preferences c results in a change in the banking system's money supply as well as in the total money supply, as illustrated by equations (6) and (7)

$$\frac{dD}{dc} = -\frac{1}{(r + c)^2} B < 0 \tag{6}$$

$$\frac{dM}{dc} = -\frac{1 - r}{(r + c)^2} B < 0 \ . \tag{7}$$

3) How is this very simplistic two-stage money supply model translated into a Eurodollar money supply model?

First of all, in the context of a Eurodollar model, the two stages "central bank" and "commercial banks" correspond to the two stages "domestic banks" and "Eurobanks". In other words, the role of the banking system in a Eurodollar model is being played by the Eurobanks, and the role of the central bank by the domestic banking system, respectively. Thus, the liabilities which serve as "base" for the Eurobanks' money supply, B^E (I call it "Eurobase"), are the domestic banks' liabilities as composed of liabilities against Eurobanks, R^E, and against non-banks, D^H (where D^H stands for *d*emand deposits with *h*ome banks), i. e.

$$B^E = R^E + D^H \ . \tag{1'}$$

Next, the allocation of Eurobanks' assets between "Eurobase money", R^E, and earning assets may be described by an allocation parameter r^E

(2′) $$r^E = R^E/D^E$$

(where D^E = demand deposits with Eurobanks), while the allocation of non-banks' assets between demand deposits with domestic banks ("Eurobase money"), D^H, and demand deposits with Eurobanks, D^E, may be described by an allocation parameter c^E

(3′) $$c^E = D^H/D^E \ .$$

Then, of course, the Eurobanks' money supply likewise is a multiple of its reserves, i. e.

(4′) $$D^E = \frac{1}{r^E} R^E = \frac{1}{r^E + c^E} B^E$$

(5′) $$M^E = D^H + D^E = \frac{1 + c^E}{r^E + c^E} B^E \ .$$

A change in non-banks' asset preferences c^E results in a change in Eurobanks' money supply as well as in the total money supply, as illustrated by equations (6′) and (7′)

(6′) $$\frac{dD^E}{dc^E} = -\frac{1}{(r^E + c^E)^2} B^E < 0$$

(7′) $$\frac{dM^E}{dc^E} = -\frac{1 - r^E}{(r^E + c^E)^2} B^E < 0 \ .$$

This translation of a domestic two-stage money supply model into a Eurodollar money supply model, despite its simplicity, provides useful insights:

— First, it demonstrates the analogies between the money supply process on the domestic and on the Eurodollar market. It illustrates e. g. that the equivalent of the monetary base in a Eurodollar money supply context (i. e. the "Eurobase"), is the total of the domestic banks' liabilities as against Eurobanks, R^E, and against non-banks, D^H, or put differently, is the total of non-banks' and Eurobanks' deposits with the domestic banking system. It is *not* as sometimes asserted, the domestic money supply. Further, it illustrates that the crucial allocation parameters for describing the money supply process on the Eurodollar market are r^E and c^E. While the role of r^E has been clearly recognized in the pertaining literature, this is true to a much lesser extent for the role of c^E.

— Second, it demonstrates that a shift in demand deposits from domestic to Eurobanks has to be analysed exactly the same way as a

shift from cash to demand deposits, i. e. as a change in non-banks' asset preferences. Put differently: a shift from deposits with domestic banks to deposits with Eurobanks in this context has the same (expansive) effect as a shift from cash to demand deposits.

4) Based on this translation of a domestic two-stage money supply model into a Eurodollar market money supply model, a suitable three-stage money supply is set up easily and its working and implications are understood readily. To that purpose we start with the two equations defining the monetary base and the money supply, respectively. While the monetary base definition remains the same (equation (1)), the money supply, in a three-stage scenario, encompasses three different monies: currency, demand deposits with domestic banks, and demand deposits with Eurobanks. Thus, we have

$$B = R + C \tag{1}$$

$$M = C + D^H + D^E \ . \tag{8}$$

Because there are three assets, the asset allocation behavior by non-banks is described by two allocation parameters. We define one parameter as reflecting the allocation of money between currency and demand deposits and the other one as reflecting the allocation of demand deposits between domestic and Eurobanks, i. e.

$$c = C/\,(D^H + D^E) \tag{9}$$

$$e = c^E = D^H/D^E \ . \tag{3'}$$

The allocation behavior by domestic banks is described by two reserve ratios — there are two different kinds of deposits — i. e.

$$R = r^H D^H + r^D R^E \tag{10}$$

(where r^H = reserve ratio applicable for non-banks' deposits and r^D = reserve ratio applicable for Eurobanks' deposits).

And finally, the allocation behavior by Eurobanks again is described by parameter r^E, i. e.

$$R^E = r^E D^E \ . \tag{2'}$$

This set of equations captures the money supply role of the Eurodollar market comprehensively, yielding the money supply function

$$M = \frac{(1 + c)\,(1 + e)}{r^H e + r^D r^E + c\,(1 + e)}\,B \ . \tag{11}$$

This money supply equation is very similar to *Willms'* (1976) and it also does not differ very much from the usual two-stage money supply functions. What can it tell us concerning the money supply role of the Eurodollar market, and how does it relate to the issues raised in the introduction?

2. *Meaning and Implications of the Model*

1) First, it answers the question which underlies the whole Eurodollar multiplier literature: how does a change in non-banks' asset preferences, in the sense of a permanent shift of dollar demand deposits from domestic to Eurobanks, affect the money supply? Differentiating equation (11), we obtain

$$\frac{dM}{de} = \frac{r^D r^E - r^H}{\Delta} (1 + c) B \ , \tag{12}$$

the sign of which is, unless r^H is extremely small (considerably smaller than both r^D and r^E), negative. Just to get an idea of how remote the possibility of a positive sign is, assume that $r^D = r^E = .1$. Then, r^H would have to fall short of .01, or put differently, r^H would have to fall short of both r^D and r^E by more than ten times to make equation (12) yield a positive sign.

This possibility may safely be excluded, and one may even argue that r^H is very likely to exceed r^E, since Eurobanks are not subject to minimum reserve requirements. (In fact, the inequality $r^E < r^H$ has sometimes been made the centerpoint to argue that holding Eurodollar deposits rather than domestic deposits raises the money supply.) Thus, we find that the sign of equation (12) for all practical purposes is negative, i. e. a permanent shift of demand deposits from domestic to Eurobanks increases the money supply.

2) Second, this model makes intuitively clear why a shift in asset preferences towards more Eurodollar deposits increases the money supply. As equation (12) shows, this expansive effect occurs if $r^D r^E < r^H$. The rationale is straightforward: Reserves held against deposits with domestic banks amount to $r^H D$ while reserves held against deposits held with Eurobanks amount to $r^E D$. However, only reserves held by domestic banks, $r^H D$, are held with the central bank and constitute therefore a "leakage". Reserves held by Eurobanks, $r^E D$, because they are held with domestic banks, may be, and in fact are, used as source for the

domestic banks' money supply. Only that proportion of Eurobanks' reserves which domestic banks hold as reserves with the central bank, i. e. $r^D\, r^E\, D$, actually "leaks" from the system. Thus, the "effective" reserve ratio in the sense of reserves being held with the central bank amounts to r^H for deposits held with domestic banks, and to $r^D\, r^E$ for deposits held with Eurobanks. Therefore, the result of equation (12) according to which a shift in parameter e increases the money supply if $r^D\, r^E < r^H$, is intuitively very easily understood. This verbal reasoning also illustrates why the argument sometimes encountered that the expansive nature of the Eurodollar market stems from its not being subject to minimum reserve requirements (which means $r^E < r^H$) completely misses the point. Even with $r^E > r^H$ the Eurodollar market is very likely to be of expansive nature because even with $r^E > r^H$, it is very likely that $r^E\, r^D < r^H$.

3) Third, this model illustrates clearly what the crucial parameters are in the context of the money supply role of the Eurodollar market. They are parameter e, which is a relationship describing how non-banks allocate their deposits between domestic and Eurobanks, and parameter r^E, which describes the allocation behavior of Eurobanks concerning their dollar liabilities. These two variables comprehensively capture the money supply role of the Eurodollar market and the extent to which the Eurodollar market contributes to an increased money supply. Other variables like e. g. the balance of payments of the United States are irrelevant in this context. Only if the balance of payments deficit were to affect either parameter e or parameter r^E, it would have any bearing on the Eurodollar market's money supply.

4) Fourth, this model illustrates that to understand the money supply role of the Eurodollar market, one has to think of the crucial behavior parameters as "equilibrium" parameters, in the sense of "desired" or "average" magnitudes, i. e. magnitudes which are responsive to variations in economic variables (especially interest rates). Only then has equation (11) a meaningful interpretation and is more than just a definitional relationship, and only then does one clearly differentiate between economic (equilibrium) effects and mere bookkeeping transactions. The failure to clearly draw this distinction was one of the serious deficiencies of the traditional Eurodollar multiplier studies where much of the work was directed towards tracing out all conceivable transactions following a shift of deposits from domestic to Eurobanks, rather than trying to explain what happens "on average". Also this

failure certainly contributed to the confusion surrounding the money supply role of the Eurodollar market. To take an example, the discussion of which proportion of outstanding Eurodollar deposits are "primary" and which are "derivative" clearly reflects the thinking within the bounds of *T*-accounts. In an equilibrium context, there is no way to meaningfully divorce primary from derivative deposits.

5) Fifth, this model illustrates that while in fact the emergence of the Eurodollar market is very likely to have caused the U.S. money supply to rise, this effect does not mean at all that the Eurodollar market is able to create money beyond the control of the monetary authorities. Rather, the money supply is still a function of the monetary base (equation (11)) and thus absolutely controllable by the central bank. The only effect of the Eurodollar market is to increase the monetary multiplier, but a higher multiplier per se does not impair the money controlling capabilities of the central bank. In view of this result, present efforts by the central banks of the Group of Ten to get the Eurodollar market under their control for the sake of improving their capabilities to check the money supply rise, are unnecessary and reflect the central banks' lack of understanding the Eurodollar market's money supply role.

6) Finally, the model illustrates that efforts by some central banks (foremost the U.S. monetary authorities) to pressure a majority of central banks into subjecting Eurodollar deposits to minimum reserve requirements are ill-conceived on the grounds that such an imposition would not necessarily eliminate the expansive nature of the Eurodollar market. This is readily seen by inspection of equation (12). To impose the same minimum reserve requirements on Eurodollar deposits as are applied to domestic deposits means that $r^E = r^H$ so that

$$\frac{dM}{de} = \frac{r^D r^H - r^H}{\Delta} = \frac{r^H (r^D - 1)}{\Delta} < 0 \; . \tag{12'}$$

Thus, a permanent shift of dollar deposits to Eurobanks *still* increases the U.S. money supply. Only if Eurobanks were required to hold their reserves with the respective central banks, rather than with U.S. commercial banks, would the imposition of minimum reserve requirements eliminate the expansive nature of the Eurodollar market.

7) In concluding the discussion of this money supply model, we may note that the model, while being very useful, is also severely limited, as it completely disregards the price mechanism on the financial markets.

Therefore, in the next section two alternative, though similar, general equilibrium models will be set up to analyse the response of the money supply to changing asset preferences by non-banks. But before that, the three-stage money supply model is generalized to include time deposits with domestic as well as with Eurobanks. Such a generalization is of interest because in fact the bulk of Eurodollar deposits consists of time rather than demand deposits.

3. A Generalized Three-Stage Money Supply Model

1) To generalize the three-stage money supply model in the mentioned manner means to further widen the spectrum of non-banks' portfolio choices. Allocation behavior by non-banks now is to be described by four allocation parameters (five assets and one wealth identity) which we define as follows: parameter c is suitably extended to include both kinds of time deposits, i. e. $c = C/(D^H + D^E + T^H + T^E)$; parameter e is defined as perviously ($e = D^H / D^E$), and a similar parameter pertaining to time deposits is defined, namely $f = T^H / T^E$; and finally, the usual time deposit ratio is suitably modified as $t = (T^H + T^E)/(D^H + D^E)$. As to the behavior of domestic and Eurobanks, we assume for simplicity that the same reserve ratios apply for demand and time deposits. The obtaining generalized money supply model then is described by eight equations

(1) $$B = R + C$$

(13) $$M = C + D^H + D^E + T^H + T^E$$

(9) $$c = C/(D^H + D^E + T^H + T^E)$$

(3′) $$e = D^H / D^E$$

(14) $$f = T^H / T^E$$

(15) $$t = (T^H + T^E) / (D^H + D^E)$$

(16) $$R = r^H (D^H + T^H) + r^D R^E$$

(17) $$R^E = r^E (D^E + T^E)$$

to yield the nicely structured money supply function

(18) $$M = \frac{(1 + c)(1 + t)}{\left(\frac{r^H e + r^D r^E}{1 + e} + c\right) + t\left(\frac{r^H f + r^D r^E}{1 + f} + c\right)} \cdot B \ .$$

Which conclusions may be drawn from this generalized money supply model and how does it relate to the issues discussed so far?

2) The first question which arises, of course, is whether a permanent shift of time deposits from domestic to Eurobanks has the same or a similar effect on the money supply, as has a shift of demand deposits. Suitably differentiating equation (18) yields

$$\frac{dM}{df} = \frac{r^D r^E - r^H}{\Delta} \cdot \frac{(1+c)(1+e)(1+t)\,t}{(1+f)} B < 0 \,, \tag{19}$$

i. e. a shift in non-banks' asset preferences in favor of the Eurodollar market again raises the money supply, if $r^D r^E < r^H$. The rationale is of course the same as before.

3) The effect on the money supply of variations in the (extended) time deposit ratio again is derived by suitable differentiation of equation (18) yielding

$$\frac{dM}{dt} = \frac{\dfrac{r^H e + r^D r^E}{1+e} - \dfrac{r^H f + r^D r^E}{1+f}}{\Delta} \cdot (1+c) \cdot B \begin{matrix} < 0 & \text{if} & f > e \\ > 0 & \text{if} & f < e \,. \end{matrix} \tag{20}$$

The interpretation of this result is straightforward: if a shift from demand to time deposits occurs, and if the proportion held with Eurobanks is higher for time than for demand deposits (i. e. $e > f$), then such a shift is tantamount to a shift of deposits from domestic to Eurobanks. This means that the money supply will increase ($dM/dt > 0$).

4) In concluding this section, we note that both results are what one would intuitively expect and no further comments are necessary. The conclusions drawn earlier apply here as well.

II. A General Equilibrium Model

1) As mentioned the principal weakness of the previous money supply model is its neglect of the response of interest rates to variations in one of the parameters. More specifically, one would expect the expansive effect of a shift in parameter e to be at least partly offset by the ensuing adjustment processes. The question which therefore will be addressed in this section is whether it is possible or even likely that the expansive money supply effect is not only partly, but totally or even more than totally offset. In setting up a suitable model, I will be guided by two considerations:

— First, the model should tend to overstate rather than to understate the interest rate effects, the reasoning being that if in such a setting the expansive effect were to prevail, the case for the expansive nature of the Eurodollar market would be very strong.

— Second, the model should resemble as closely as possible the previously used money supply model.

2) To set up that kind of model means to construct a model in which there is an equilibrium condition for each financial instrument equalizing the demand for and the supply of that instrument. Regarding the domestic financial instruments which are relevant in a money supply context, there are three instruments we have to take into consideration: deposits, loans, and base money. This requires three prices but because the calculations would become extremely messy with three prices, we will do with only two, namely the interest rate for deposits and the interest rate for loans. This means that we have to skip

— either the supply function for base money (implying completely accomodative monetary policies),

— or the demand function for cash.

While the first variant (completely demand determined monetary base) is not realistic, it has the advantage of containing a demand function for both cash and reserves which can be viewed as counterpart to the allocation parameters c and r which played such a crucial role in the previous money supply model.

Rather than choosing one variant, I will analyse both, beginning with the one that contains demand functions for both cash and reserves. Then the three domestic financial markets at issue are described by the following equations:

$$D^S = D^S(i_L, i_D) \tag{21}$$

$$D^D = D^D(i_L, i_D) \tag{22}$$

$$D^S = D^D \tag{23}$$

$$L^S = L^S(i_L, i_D) \tag{24}$$

$$L^D = L^D(i_L, i_D) \tag{25}$$

$$L^S = L^D \tag{26}$$

$$C^D(i_L, i_D) + R^D(i_L, i_D) = B^D(i_L, i_D) \tag{27}$$

$$B^S = B^D \tag{28}$$

(where superscripts denote demand and supply respectively and where L = Loans, i_L = interest rate on loans, i_D = interest rate on deposits; other symbols as previously).

Analogously, there are three financial markets on the Eurodollar market which are relevant in a money supply context, namely a market for Eurodollar deposits, a market for Eurodollar loans, and a market for Eurobanks' dollar reserves. Again, we postulate only two prices and skip the supply function for the "Eurobase", i. e. for Eurobanks' reserves. Contrary to the domestic markets, this assumption is straightforward because here the reserves are supplied by the domestic banks (as opposed to the central bank), and the assumption that domestic banks passively accept dollar deposits by Eurobanks is plausible. Thus, the financial markets for Eurodollars are described by the following equations:

(29) $$D_e^S = D_e^S\,(i_{eL}, i_{eD})$$

(30) $$D_e^D = D_e^D\,(i_{eL}, i_{eD})$$

(31) $$D_e^S = D_e^D$$

(32) $$L_e^S = L_e^S\,(i_{eL}, i_{eD})$$

(33) $$L_e^D = L_e^D\,(i_{eL}, i_{eD})$$

(34) $$L_e^S = L_e^D$$

(35) $$R_e^D = R_e^D\,(i_{eL}, i_{eD})$$

(36) $$R_e^S = R_e^D$$

(where the subscript e denotes "Euro").

The next step is to integrate these two systems which means that demand and supply functions in both systems become functions of all four prices (i_L, i_D, i_{eL}, i_{eD}). Then, adding the balance sheet identities for both the domestic and the Eurobanking system

(37) $$L^D + R^D = D^S + R_e^S$$

(38) $$L_e^D + R_e^D = D_e^S$$

makes one equation in each subset redundant. We drop equations (25) and (33) and then simplify by describing the banks' supply behavior on the demand deposit market by means of a price-setting function, i. e.

(21′) $$i_D = i_D\,(i_L)$$

(29′) $$i_{eD} = i_{eD}\,(i_{eL})\ .$$

Plugging these two equations in all other equations and compressing the obtaining equations yields the following system:

$$L^S(i_L, i_{eL}) + R^D(i_L) = D^D(i_L, i_{eL}, \beta) + R_e^D(i_{eL}) \tag{39}$$
$$(-,+) \quad (-) \quad (+,-,+) \quad (-)$$

$$L_e^S(i_L, i_{eL}) + R_e^D(i_{eL}) = D_e^D(i_L, i_{eL}, \alpha) \tag{40}$$
$$(+,-) \quad (-) \quad (-,+,+)$$

$$C^D(i_L, i_{eL}) + R^D(i_L) = B \tag{41}$$
$$(-,-) \quad (-)$$

with the variables i_L, i_{eL} and B, and the parameters α and β (which describe the shape of the demand functions for demand deposits on both markets). The model is completed by adding an equation that defines the money supply

$$C^D(i_L, i_{eL}) + D^D(i_L, i_{eL}) + D_e^D(i_L, i_{eL}) = M \ . \tag{42}$$

To examine now the effect of the total money supply of a permanent shift in asset preferences from domestic demand deposits towards Eurodollar demand deposits, the model (39) - (42) has to be totally differentiated and solved for dM (with $d\alpha = -d\beta$). Assuming that the shape of the D^D-function and the D_e^D-function with respect to the parameters α and β respectively is the same (i. e. $D_3 = D_{e_3}$), the following equation obtains

$$\left.\frac{dM}{d\alpha}\right|_{d\alpha = -d\beta} = \frac{D_{e_3}(C_2 + D_2 + D_{e_2})(-(L_1 + L_{e_1}) + (D_1 + D_{e_1}) - (L_{e_1} - D_{e_1})(L_2 - D_2 - R_{e_2}) - R_1) + D_{e_3}(C_1 + D_1 + D_{e_1})(-(L_{e_2} + L_2) + (D_{e_2} + D_2))}{-(L_1 + R_1 - D_1)(L_{e_2} + R_{e_2} - D_{e_2})} \tag{43}$$

(where the subscript 1 denotes $\partial/\partial i_L$, subscript 2 $\partial/\partial i_{e_L}$, and subscript 3 $\partial/\partial\alpha$ and $\partial/\partial\beta$ respectively). While the denominator of this expression is unambigously negative, the numerator may be both positive and negative. However, looking more closely at the numerator reveals that under the following (plausible) order of magnitude conditions, the numerator also has a negative sign:

— The total money demand is a negative function of the pertaining interest rates, i. e. $M_1^D \equiv M_1 = C_1 + D_1 + D_{e_1} < 0$ and $M_2^D \equiv M_2 = C_2 + D_2 + D_{e_2} < 0$.

— The direct effects outweigh the indirect effects, i. e.

$$|L_1| > |L_{e_1}|$$
$$|D_1| > |D_{e_1}|$$
$$|L_{e_2}| > |L_2|$$
$$|D_{e_2}| > |D_2|$$

— The shape of the domestic demand and supply functions with respect to both interest rates is similar to the shape of the corresponding Eurodollar demand and supply functions, i. e.

$$L_1 \simeq L_{e_2}$$
$$L_2 \simeq L_{e_1}$$
$$D_1 \simeq D_{e_2}$$
$$D_2 \simeq D_{e_1}$$
$$R_1 \simeq R_{e_2}$$
$$C_1 \simeq C_2 \qquad \text{which implies } M_1 \simeq M_2 \ .$$

This last order of magnitude condition (which is quite restrictive) may be justified on the grounds that qualitatively domestic dollars and Eurodollars are essentially the same with the major distinction being their geographic location.

With these three assumptions, the numerator of equation (43) is dominated by the term $-R_1 M_1 D_{e_3}$ which is negative. Equation (43) therefore has a positive sign, illustrating that the expansive effect of a permanent shift of demand deposits from domestic to Eurobanks which was established in the three-stage money supply model also obtains in a general equilibrium set-up. However, the analysis of the money supply role of the Eurodollar market in a general equilibrium framework also makes clear that the findings of the previous money supply model must not be overemphasized. For one, each but one term in the numerator of equation (43) is offset by another term so that quantitatively the expression $dM/d\alpha$ is likely to be very small. This means that most of the expansive monetary effect of a change in parameter e is offset by the ensuing adjustment processes. For another, expression $dM/d\alpha$ is positive only if in fact the shape of corresponding demand and supply functions on the domestic and Eurodollar markets sufficiently resembles each other.

If this assumption does not hold in the real world, it might well be that a shift of deposits from domestic to Eurobanks ceases to have an

expansive effect. Despite this reservation, however, the analysis of the general equilibrium confirms and supports the principal result of the three-stage money supply model, so that the conclusions drawn there continue to be valid; however, they have to be interpreted with caution.

3) The main weakness of this general equilibrium model is that it implies a demand determined monetary base. One might wonder whether the finding arrived at in this model is in any way conditional upon this specific feature.

To demonstrate that this is not the case, we now assume the monetary base to be exogenously given and at the same time drop the demand function for cash. These modifications affect equations (41) and (42) but do not affect equations (39) and (40), so that the following model (which is essentially the same as in *Niehans/Hewson* 1976) obtains:

$$L^S(i_L, i_{eL}) + R^D(i_L, i_{eL}) = D^D(i_L, i_{eL}, \beta) + R_e^D(i_L, i_{eL}) \tag{39}$$

$$L_e^S(i_L, i_{eL}) + R_e^D(i_L, i_{eL}) = D_e^D(i_L, i_{eL}, \alpha) \tag{40}$$

$$M - D^D(i_L, i_{eL}) - D_e^D(i_L, i_{eL}) + R^D(i_L, i_{eL}) = \overline{B} \tag{44}$$

Totally differentiating and solving for dM yields

$$\left.\frac{dM}{d\alpha}\right|_{d\alpha = -d\beta} = \frac{D_{e_3}(-L_2 - L_{e_2})(-D_{e_1} - D_1 + R_1) - D_{e_3}(L_{e_1} + L_{e_1} - D_{e_1})(L_2 - D_2 - R_{e_2}) - (L_1 + R_1 - D_1)(L_{e_2} + L_1)(-D_2 - D_{e_2})}{+ R_{e_2} - D_{e_2})} \tag{45}$$

The denominator is the same as in equation (43) and the numerator again has both positive and negative terms. Assuming the same order of magnitude conditions as before to hold, equation (45) is dominated by the term $-R_1(L_2 + L_{e_2})D_{e_3}$ which again is negative so that $dM/d\alpha$ again has a positive sign. As before a change in non-banks' asset preferences towards more Eurodollar deposits is very likely to result in an increase of the money supply but again this increase is likely to be very small. This finding illustrates that the expansive nature of the Eurodollar market which was established in a three-stage money supply model and was found to prevail in a general equilibrium framework is not conditional upon the specific formulation of the employed model.

III. Conclusions

The conclusions of this paper may be summarized as follows:

1) A shift in non-banks' asset preferences in favor of Eurodollar deposits is very likely to result in an increase, though small, of the money supply. The crucial feature causing this expansive effect is the fact that Eurobanks hold their reserves with domestic banks (rather than with the central bank) which in turn hold only a small proportion of these deposits as reserves with the central bank.

2) The finding that the Eurodollar markets is of expansive nature does not mean, however, that the Eurodollar market may arbitrarily, i. e. beyond the monetary authorities' control, create money. Rather, the monetary base is still the "base" for the money supply, i. e. the money supply (inclusive of Eurodollar deposits) is still a direct function of the monetary base. The only effect of the Eurodollar market is to affect the monetary multiplier. This means that from a money supply view there is no need whatsoever to restrict or to control the Eurodollar market.

3) The view is widespread (not least among central banks) that the Eurodollar market should be subjected to minimum reserve requirements and other forms of regulation. The present analysis has illustrated that such reserve requirements would only eliminate the expansive nature of the Eurodollar market, if the Eurobanks were simultaneously required to hold all their reserves with the central bank rather than with the domestic banks. But this analysis has also illustrated that from a money supply perspective there is no need for imposing minimum reserve requirements into Eurodollar deposits.

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Zusammenfassung

Der Eurodollarmarkt und das Geldangebot

Im vorliegenden Beitrag wird die geldangebotstheoretische Rolle des Eurodollarmarktes analysiert. Zugrundegelegt wird dabei zuerst ein entsprechend erweitertes Geldangebotsmodell und anschließend ein relativ allgemeines Portfoliomodell. Die Analyse zeigt, daß der Eurodollarmarkt grundsätzlich expansiven Charakter hat. Gleichzeitig wird klar, welche ökonomischen Zusammenhänge im Rahmen dieses expansiven Effektes eine entscheidende Rolle spielen. Geldpolitisch macht die Analyse deutlich, daß trotz des expansiven Charakters des Eurodollarmarktes die Kontrolle über das Geldangebot den Zentralbanken keineswegs entglitten ist, und daß Mindestreservevorschriften für Eurodollardepositen den expansiven Charakter des Eurodollarmarktes nicht notwendigerweise eliminieren würden.

Summary

The Eurodollar Market and the Money Supply

The present article analyses the role of the Eurodollar market from the standpoint of money supply theory. First, a suitably extended money supply model is set up as a basis and then a relatively general portfolio model. The analysis shows that fundamentally the Eurodollar market is of an expansive nature. At the same time, it becomes clear what economic interrelationships play a decisive role in that expansive effect. With regard to monetary policy, the analysis makes it clear that for all the expansive nature of the Eurodollar market the central banks have lost control over the money supply and that minimum reserve requirements for Eurodollar deposits would not necessarily eliminate the expansive character of the Eurodollar market.

Résumé

Le marché de l'eurodollar et l'offre monétaire

La présente contribution analyse le rôle théorique de l'offre monétaire du marché de l'eurodollar. On s'est à cet effet servi d'abord d'un modèle correspondant d'offre monétaire élargi et ensuite d'un modèle de portefeuille relativement général. L'analyse démontre que le marché de l'eurodollar a fondamentalement un caractère expansif. L'on clarifie simultanément les relations économiques qui jouent un rôle déterminant dans le cadre de cet effet d'expansion. En matière de politique monétaire, l'analyse établit que malgré le caractère expansif du marché de l'eurodollar, le contrôle de l'offre de monnaie n'a nullement échappé aux banques centrales et que des prescriptions de réserves minimales pour les dépôts en eurodollar n'élimineraient pas forcément le caractère expansif du marché de l'eurodollar.