

**BIS ECONOMIC PAPERS**

**N° 4 - May 1981**

**THEORIES OF THE GROWTH  
OF THE EURO-CURRENCY MARKET:  
A REVIEW OF THE EURO-CURRENCY  
DEPOSIT MULTIPLIER**

**by R.B. Johnston**

**BANK FOR INTERNATIONAL SETTLEMENTS**

**Monetary and Economic Department**

**BASLE**



## Table of Contents

Introduction . . . . .	5
I. Fixed coefficient models . . . . .	8
The multiplier hypothesis . . . . .	8
The analytical framework . . . . .	9
Multiplier estimates . . . . .	16
II. Portfolio approaches . . . . .	28
A. The rôle of reserve requirements . . . . .	29
B. Interest rate adjustments and general equilibrium portfolio models . . . . .	34
III. Interest rate effects and aggregation problems – some “new” views . . . . .	43
Summary and conclusions . . . . .	49
Technical note . . . . .	51



# **THEORIES OF THE GROWTH OF THE EURO-CURRENCY MARKET: A REVIEW OF THE EURO-CURRENCY DEPOSIT MULTIPLIER\***

## **Introduction**

One of the most controversial issues surrounding the development of Euro-currency banking concerns the ability of Euro-markets to expand autonomously the stock of money and credit outside the control of national authorities. The rapid expansion of international banking aggregates, which have grown by around 25 per cent. per annum, is said itself to provide evidence of monetary expansion in the Euro-markets. A short-hand name frequently used to describe this process is the Euro-currency credit or deposit multiplier.

Two important questions in this issue are: the ability of the Euro-currency banking system to expand because a proportion of the funds the banks lend out is redeposited with them – endogenous money or credit creation and the Euro-currency multiplier proper; and second, the rôle of the Euro-markets in increasing the credit-creating or multiplier potential of the banking system as a whole, i.e. the domestic and international banking systems combined. When these effects are large they are said to undermine national monetary policies, in the first case because the monetary expansion is beyond the direct control of domestic authorities (unlike, for example, domestic bank deposits in Germany and the United States, Euro-currency deposits are not subject to legally imposed reserve ratios or direct credit controls); in

\* The author would like to thank colleagues in Group II, International Division, Bank of England and in the BIS, particularly Helmut Mayer, for their helpful comments. The views expressed are, of course, the author's alone and do not necessarily reflect those of either of these institutions.

the second, because the relationship between the domestic control variable – the supply of domestic bank reserves – and the stock of money is weakened when deposits are placed in the Euro-currency market.

This paper reviews the models that have been used to estimate and explain the size of these “multiplier” effects, and their implications for the rate of expansion of the Euro-market. Two distinct approaches have been adopted: one characterises the depositing and redepositing process by fixed coefficients (discussed in Section I), the other suggests that the size of any multiplier is variable and reflects general portfolio considerations and interest rate adjustments (Section II). Both depend on making “plausible” guesses at the likely size of the coefficients and interest rate adjustments in order to estimate the size of the multiplier. As estimates are, however, based on *ex ante* guesses without any *ex post* verification, the size of the monetary influence of Euro-banking remains an untested hypothesis. Some new approaches have therefore evolved to explain the growth and influence of the Euro-market in terms of empirically observed “institutional” links between the Euro-markets and national banking systems (Section III). These suggest that it is completely inappropriate to treat the Euro-market as a closed or autonomous banking system and that the rôle of the Euro-markets in adding to the volume of credit can only be seen in the context of the world financial system as a whole. The paper concludes with a short summary of the main analytical conclusions.

Throughout, this paper, as with much of the literature on the subject, focuses on the rôle of Euro-banks in intermediating between private non-banks rather than between banks, although this latter activity is numerically the largest function of the Euro-market. The main issue of importance is the impact of the Euro-markets on the liquidity of the non-banking sector and whether this is significantly increased by the activities of Euro-banks outside the control of national authorities. By increasing the flow of liquidity between national money markets, Euro-markets might enhance the credit-creating ability of some national banking systems and thus the liquidity of the non-banking sector. The channelling of funds to domestic commercial

or central banks may also provide balance-of-payments finance which can be used to sustain the level of world activity. To that extent Euro-markets will have larger expansionary effects on the wealth and liquidity of private non-banks. But that is a separate issue and may be regarded as being caught by national policies. These effects would, however, be factors explaining any Euro-currency redepositing multiplier. Another issue which is briefly considered, because of its policy implications, is the rôle of central-bank deposits in explaining the size of any Euro-currency multiplier.

## I. Fixed coefficient models

### **The multiplier hypothesis**

There is widespread agreement that the act of financial intermediation can itself add to the stock of liabilities of financial intermediaries. Only two conditions are required for this to happen: that financial intermediation should have some net expansionary effect on the nominal levels of income and wealth, and that wealth-holders should have a propensity to hold part of nominal additions to wealth or income in the form of deposits with intermediaries. Multiplier theory, however, takes the view that the liquidity effects of groups of financial intermediaries and the redepositing of funds lent out by them with themselves can be characterised by fixed or predictable ratios, and that multiplier effects will generally tend to be positive and large. The underlying hypothesis is that some automatic process causes the loans of the banking system or group of intermediaries to be returned to it as new deposits. These models are most often applied to domestic banking systems where the liabilities of the intermediary act predominantly as a means of payment, deposits are subject to legally determined (or institutionally predictable) reserve ratios and the stock of bank reserves is exogenously determined by national monetary authorities. The automatic process which returns the loans of the banking system to it as new deposits is seen as the need to use the bank liabilities as a means of payment.

It is not usually possible to distinguish clearly other types of financial intermediaries, and Euro-banking in particular, from domestic banking systems. Although the foreign currency deposits of banks are not part of the domestic payments transmission mechanism, which is made up of domestic commercial-bank and central-bank clearing systems in domestic currencies, the operation of Euro-currency markets tends to link different domestic banking systems rather closely. A



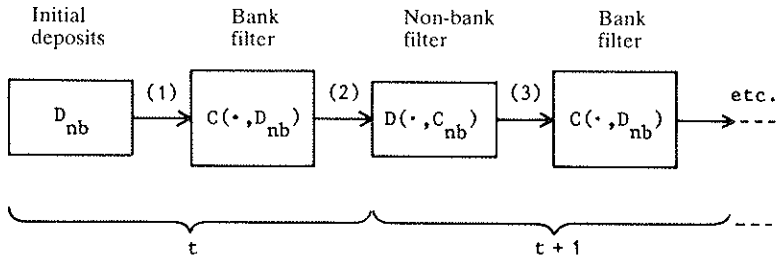
proportion of Euro-currency deposits may also substitute for domestic means of payment, for example, when Euro-currency balances are used to make foreign trade payments and held instead of making spot purchases of foreign currencies. Foreign currency balances may therefore play an integral rôle in the international payments transmission process between national economies. There are close institutional links between “Euro-banks” and domestic commercial banks, more so perhaps than between banks and other types of financial intermediaries; and although not subject to legal reserve ratios, Euro-banks hold some precautionary reserve balances, which might even be viewed by some as the reserve base of the Euro-currency system, to cover operating needs and the risk of withdrawal of deposits. The same multiplier framework has therefore frequently been used to explain the growth of the balance sheet of Euro-banks as is used for domestic banks. However, the wholesale nature of Euro-banking is not at all similar to domestic retail banking: the overwhelming majority of Euro-currency deposits are wholesale fixed-term time deposits (or negotiable time deposits in the case of Euro-dollar certificates of deposit) which are, most likely, closer substitutes for less liquid assets in the portfolios of wealth-holders than for balances held for use as a means of payment. The reflow of private funds to the Euro-market must therefore involve a range of factors and not just their use in making payments.

### **The analytical framework**

Multiplier theory is concerned with dynamic processes; there are initial inputs in the form of non-bank deposits and final outputs in the form of bank credits and new bank deposits. At least two agents are involved in this process — the banking system, and the non-bank public — and they interact one with another to produce the final outcome for credits and deposits. A third agent, which is also important, is the domestic central bank, but in these simple multiplier models central-bank activities can usually be assumed to be exogenous. Each

agent may be viewed as a filtering system through which the stocks of deposits and credits are passed. This is illustrated in Figure 1.

Figure 1



This diagram shows an initial stock of non-bank deposits  $D_{nb}$ , at time  $t$ ; this is passed to the banking system [flow (1)] which makes loans to the public. The size of the loans depends on the filter  $C(\cdot, D_{nb})$ , a function of the supply of bank deposits and other, as yet unspecified, factors. The action of making loans adds to non-bank liquidity [flow (2)] and this additional liquidity is passed through the non-banking sector and its filter  $D(\cdot, C_{nb})$ , a function of the size of bank loans,  $C_{nb}$ , and other factors, and a proportion is then returned to the banking system [flow (3)]. The process can then begin again until some final equilibrium is established, which depends on the values of the various filters, i.e. whether they dampen or amplify the deposit and loan flows.

The simplest approach to these filters is the fractional reserve or deposit multiplier. This specifies:

$C(\cdot, D_{nb}) = 1 - r$ , where  $r$  is the fraction of deposits sterilised as holdings of reserves by the banking system and

$D(\cdot, C_{nb}) = 1$ , all additions to non-bank liquidity are returned to the banking system.

The redepositing chain from the initial stock of non-bank deposits is then:

$$D_{nb}^F = D_{nb} + (1 - r) D_{nb} + \dots$$

and the final stock of bank deposits held by non-banks,  $D_{nb}^F$ , the sum of this series:

$$D_{nb}^F = \frac{D_{nb}}{r} = m_1 D_{nb} \quad (1)$$

Equation (1) becomes the simple fractional reserve multiplier formula when the initial deposit flow,  $D_{nb}$ , is taken to be the stock of reserves,  $R$ , supplied to the banking system by the authorities,  $D_{nb}^F = \frac{R}{r}$ .

In this model the only restrictions on the banking system expanding the stock of its deposits by a multiple of any initial flow is the sterilisation of deposits as reserve holdings, or the size of the exogenous supply of initial deposits or reserves to the banking system. The filtering system is, therefore, a very simple one.

A slightly more sophisticated approach is the leakage model which allows the non-bank sector to redeposit some net additions to liquidity outside the banking system. In terms of the filtering model:

$$C(\cdot, D_{nb}) = 1 - r$$

$D(\cdot, C_{nb}) = 1 - b$ , where  $b$ , the leakage coefficient, represents the fixed proportion of additions to non-bank liquidity held outside the Euro-market.

The redepositing chain is:

$$D_{nb}^F = D_{nb} + (1 - r) (1 - b) D_{nb} + \dots$$

giving the familiar multiplier formula:

$$D_{nb}^F = \frac{1}{1 \cdot (1 - r) (1 - b)} D_{nb} = m_2 D_{nb} \quad (2)$$

When  $D_{nb} = R$ , equation (2) can be interpreted as a reserve base multiplier. The size of the redepositing multiplier,  $m_2$ , now depends on the sterilisation of deposits as reserves and non-bank leakages to other assets. The larger these leakages the smaller the multiplier.

A third type of model, the multi-stage banking model, views the Euro-currency market as part of a larger financial system made up of Euro-banks and domestic banks. Non-banks disperse their deposits between the two markets, depending on some decision rule, and

Euro-banks hold their reserves with the domestic banking system. This model recognises somewhat more explicitly than the previous leakage model that the Euro-currency market is an open banking system and that the precautionary reserve balances of Euro-banks are held with domestic commercial banks rather than central banks. There is, therefore, a feedback from expanding Euro-banking activity to the size of domestic-bank deposits, which reduces the overall reserve leakage from the banking system. The general influence of the Euro-market is seen in terms of the volume of credit made available by the banking or financial system as a whole. The theoretical model examines, however, the influence of one currency segment of the Euro-market on the total stock of credit made available in that currency, e.g. the influence of the Euro-dollar market on dollar credit availability, and does not therefore examine the overall influence of the Euro-market. An assumption of the analysis is that if deposits were not held in the Euro-market they would be held automatically in the same currency with domestic banks, and subject to domestic reserve requirement regulations. Such an assumption will be unwarranted if Euro-markets change the currency preference of depositors. The general theoretical approach can also be applied to other types of non-bank financial intermediaries. The process is illustrated in Figure 2.

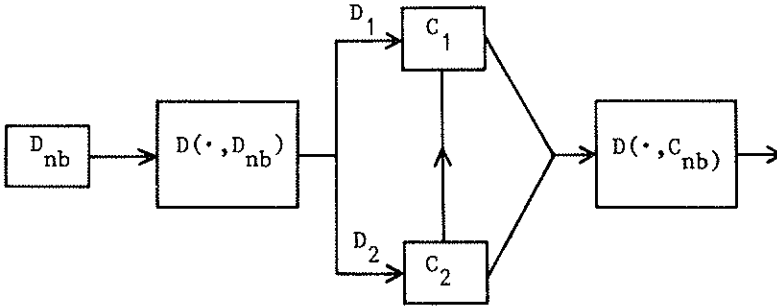
Non-banks have an initial stock of deposits  $D_{nb}$ ; the holding of these in the domestic market,  $D_1$ , or the Euro-currency market,  $D_2$ , is determined by the dispersion filter  $D(.,D_{nb})$  which depends on the amount of deposits and some other factors. This is normally specified simply as:

$$D(.,D_{nb}): D_2 = (1 - b)D_{nb},$$

a fixed portion  $(1 - b)$  of initial deposits,  $D_{nb}$ , being held in Euro-banks. These two deposit flows pass through different banking filters,  $C_1$  and  $C_2$ , which depend on the different reserve ratios held by each banking system:

$C_1 = 1 - r_1$ , where  $r_1$  is the proportion of deposits placed with the domestic banking system which is sterilised by legally imposed domestic reserve requirements; and

Figure 2



$C_2 = 1 - r_2$ , where  $r_2$  is the precautionary reserve ratio held by Euro-banks, against their deposits, with domestic banks.

The redepositing chain for the combined non-bank holdings of deposits in the domestic and Euro-currency market then becomes:

$D_{nb}^F = D_{nb} + \{ [bD_{nb} + r_2(1-b)D_{nb}] (1 - r_1) + (1 - b)D_{nb}(1 - r_2) \} + \dots$   
 where the first square bracketed term shows the amount of domestic bank deposits at the end of the first depositing stage ( $bD_{nb}$  of non-bank deposits and  $r_2(1-b)D_{nb}$  of Euro-bank precautionary reserves).

Simplifying this formula gives the total non-bank redepositing multiplier as:

$$D_{nb}^F = \frac{1}{r_1[1 - (1-r_2)(1-b)]} D_{nb} = m_3 D_{nb} \quad (3)$$

If the initial deposits,  $D_{nb}$ , reflect the reserves supplied to domestic banks by domestic monetary authorities,  $R$ , and  $D_{nb}^F$ , the total money stock, then formula (3) can also be taken to explain the impact of a change in national bank reserves on total money stock and the influence of Euro-markets on this process. It is immediately apparent from equation (3) that the larger the proportion of total deposits held in the Euro-currency market ( $1 - b$ ) and the smaller the Euro-currency reserve ratio, the larger will be the total money multiplier( $m_3$ ).

All three fixed coefficient models have been used to estimate the liquidity creating effect of the Euro-market by making guesses at the size of the various coefficients,  $r$ ,  $b$ , etc. Certain assumptions are, however, needed before this is possible. Firstly, none of the models say anything about the *demand* for loans from the banking system, and the non-banking sector is assumed to accommodate any increase in lending that the banks wish to undertake. In other words the  $C(.,D_{nb})$  filters do not contain any arguments on the demand side which may limit the ability of the banking system to expand its balance sheet. The state of the world must, therefore, be such either that there is very buoyant loan demand or that the supply of loans, perhaps by depressing the level of loan rates and expanding the level of nominal incomes, creates its own demand. Indeed, it is through such nominal income effects that multiplier theorists might see the dynamics of the feedback process working as expanding bank credit adds to inflation or real income levels and thus to a demand for new bank deposits. To isolate the multiplier it is necessary, however, to be able to distinguish between such bank-lending-induced depositing and other sources of funds to the Euro-market which have nothing to do with credit expansion in the market. (The attached technical note outlines the multiplier hypothesis in more detail.) In practice this is not easily done and therefore the analysis has to make *a priori* guesses about the size of leakages from the market. Rapid Euro-market expansion does not necessarily imply endogenous multiple credit creation. A second assumption is that banks are willing to *supply* loans by the amount of new deposits and thus take on new lending risks, possibly at lower rates of return. In other words the  $C(.,D_{nb})$  filters do not contain any elements which explain the rôle of banks as financial intermediaries. There are other constraints on banking activity – the supply of equity and risk capital and management services – which must be assumed not to be binding. These factors are also scarce resources and indeed much of the concern about the ability of Euro-markets to recycle OPEC funds reflects the comparative scarcity of intermediary services relative to the initial supplies of funds to and demand for funds from the banking system.

Thirdly, the various reserve and redepositing ratios, i.e. the filters, must be assumed to be reasonably stable or predictable. If this is not so the economic value of estimated multipliers is limited and can at most be taken as an explanation of *ex post* behaviour, rather than as a structural forecast of future developments. From what has been said about assumptions one and two, this is very unlikely to be the case. Different constraints influence the willingness of the banking system to lend, and of non-banks to borrow, at different times and thus the  $C(. , D_{nb})$  filter is very likely to be highly unstable. Certainly, it will not be characterised by a simple sterilisation of deposits through reserve holdings. Similarly, the willingness of non-banks to redeposit funds in the Euro-currency banking system, the  $D(. , C_{nb})$  filter, varies sharply over time, depending on the structure of national controls on capital movements, banking regulations, the varying degree of risk of Euro-currency deposits, relative Euro-currency and domestic interest rates and whether any liquidity effects which occur in the Euro-market are sterilised by national central banks. For example, in 1978 and 1979, at a time of high US domestic interest rates and non-interest-bearing reserve requirements, there was a very large interest rate incentive for non-banks to hold dollar deposits in the Euro-market rather than the United States, and the flow and reflow of dollar deposits to Euro-banks could have been fairly large. At other times the interest rate incentive for holding offshore dollar deposits has been much smaller and thus leakages from the Euro-currency system larger. An example was the Herstatt banking crisis of 1974, when there was a temporary, but serious, loss of confidence in the Euro-currency system. The assumption of a fixed leakage coefficient can, therefore, at most be an average approximation to reality; and even the average multiplier will be impossible to identify without knowledge of or assumptions about the underlying structural relationships. Finally, initial deposit flows or the stock of reserves made available to the banking system must be assumed to be exogenous, if they are to impose an effective constraint on the lending activity of banks. With these qualifications in mind, we proceed to discuss the various estimates of the multiplier that have been made.

## Multiplier estimates

*Fractional reserve estimates.* The simplest, but intellectually most unsatisfactory, approach is to attempt to estimate the reserve stock held by Euro-banks,  $R_E$ , and then to use equation (1) to calculate the multiplier as the *ex post* ratio of Euro-currency deposits,  $D_{nb}^F$ , to the reserve stock, under the assumption that the only restriction on Euro-banks' balance sheets is the exogenously given reserve base. The multiplier,  $m_1$ , is then:

$$m_1 = \frac{j}{r} = \frac{D_{nb}^F}{R_E}$$

A fundamental problem with this approach is, however, the assumption that the reserve base of the Euro-currency system is an exogenous variable and that causality runs from the supply of reserves to the stock of bank liabilities and assets. As balances with domestic commercial banks, which make up only a small fraction of domestic banks' total deposit liabilities, there is no reason why the reserves of the Euro-currency market should be exogenously determined. It is much more likely that causality runs from the supply of deposits to the Euro-currency market to their holdings of precautionary balances and not the other way around. Thus there is no reason why the supply of reserves to the Euro-market should impose *any* constraint on Euro-banks expanding their balance sheets as fractional reserve theory suggests. Consequently, the expansion of the Euro-currency system should be able to proceed virtually without limit (or until Euro-banks had absorbed the complete stock of liabilities of the US and indeed other national banking systems as precautionary balances). The fact that it has not must imply that the expansionary process is limited by factors other than the reserve holdings of Euro-banks, which should be seen as only one of a number of leakages of deposits from the Euro-currency banking system.

There is also a major statistical difficulty with this approach: that of measuring  $D_{nb}^F$  and  $R_E$ . Indeed, several attempts have been made at this; most assume that  $D_{nb}^F$ , the stock of non-bank deposits, can be approximated to the net size of the Euro-dollar market and  $R_E$  to some aggregate of the liquid liabilities of US domestic banks to



foreign commercial banks. Any estimates derived from this approach, however, tend to be very diverse depending on the exact definition of the reserve base, ranging from 3.7<sup>1</sup> to 18.5<sup>2</sup>. Willms<sup>3</sup> has undertaken several simulations to show in fact how diverse and unstable these multiplier estimates can be, concluding that “this type of multiplier approach is not a very meaningful concept”.

However, the point is not whether reserve holdings are unstable, but rather whether the instability can be systematically explained by movements in some independent variables. Makin<sup>4</sup> has attempted to estimate a model to explain the precautionary reserve holdings of Euro-banks. He does this in terms of the opportunity cost of holding precautionary reserves (measured by the three-month Euro-dollar rate), the cost of running out of reserves (measured by the US three-month certificate of deposit rate), the variance of the change in Euro-banks' total assets, Euro-banks' total assets and a time trend. The variables with the largest explanatory power in his equation are trend variables – the time trend and Euro-banks' total assets – which suggest to him that there have been large economies of scale in the management of precautionary balances as the volume of receipts and disbursements of the financial intermediaries rose over time. This may explain the instability observed by Willms.

Even these statistical estimates raise problems. All studies have used the BIS measure of the net size of the Euro-currency market, or some variant of it, as the proxy of Euro-banks' liabilities for the calculation of the multiplier. However, this includes not only sources of

<sup>1</sup> Michele Fratianni and Paolo Savona, “International liquidity: an analytical and empirical reinterpretation”, *A debate on the Euro-dollar market*, Ente per gli Studi Monetari, Bancari e Finanziari, Quaderni di Ricerche, N. 11, Roma, 1972. Proxy for reserves used, short-term liabilities of US banks vis-à-vis their foreign branches.

<sup>2</sup> John H. Makin, “Demand and supply functions for stocks of Euro-dollar deposits: an empirical study”, *The Review of Economics and Statistics*, Vol. 54, No. 2, November 1972. Proxy for reserves, demand deposits of foreign commercial banks, exclusive of claims on home offices of branch banks.

<sup>3</sup> Manfred Willms, “Money creation in the Euro-currency market”, *Weltwirtschaftliches Archiv*, Band 112, Heft 2, 1976.

<sup>4</sup> John H. Makin, “Identify a reserve base for the Euro-dollar market”, *The Journal of Finance*, Vol. 28, No. 3, June 1973, pp. 609–617.

funds from non-banks but also sources from banks outside the reporting area and within the reporting area, through switching of funds between domestic and foreign currencies, which should be netted out to arrive at an estimate of the direct impact of Euro-markets on non-banking liquidity. What is relevant is the amount of funds sterilised as reserves by the *banking system* in intermediating directly between non-banks. Interbank trading is part of and not an addition to this process and should be completely netted out of the estimates. Moreover, to the extent that banks are themselves net suppliers of Euro-

Table I

Estimated Euro-dollar fractional reserve multipliers and ratios

End of year	Estimated non-bank Euro-dollar holdings <sup>1</sup>		Demand deposit liabilities of US banks to banks abroad excluding foreign branches <sup>2</sup>		Estimated multiplier	Reserve ratio
	Total (1)	Annual change $\Delta(1)$	Total (2)	Annual change $\Delta(2)$	$\frac{(1)}{(2)}$	$\frac{\Delta(2)}{\Delta(1)}$
1971	12.20		3.40		3.6	
1972	15.13	2.93	4.66	1.26	3.2	0.43
1973	22.17	7.04	6.94	2.28	3.2	0.32
1974	31.23	9.06	8.24	1.30	3.8	0.14
1975	33.69	2.46	7.53	-0.71	4.5	-0.29
1976	40.21	6.52	9.10	1.57	4.4	0.24
1977	46.27	6.06	10.93	1.83	4.2	0.30
1978	58.47	12.20	11.24	0.31	5.2	0.03
1979	84.59	26.12	13.26	2.02	6.4	0.08

Note: Monetary magnitudes in billions of US dollars.

<sup>1</sup> With banks of the narrowly defined European reporting area, partly estimated.

<sup>2</sup> Source: US Treasury Bulletin. Figures also exclude liabilities of US agencies and branches of foreign banks to their head offices and foreign branches.

currency funds these presumably will have been caught within national money stocks and subject to national reserve requirements. They need not be counted again. The estimates of the multiplier based on the BIS net measure of the Euro-currency market therefore exaggerate the fractional reserve multiplier as applied to non-bank deposits. Table I provides some estimates of the stock of non-banks' Euro-dollar holdings in the narrowly defined European reporting area and compares this with the demand deposit liabilities of US banks to banks abroad, excluding foreign branches. In some of the years the build-up of non-bank Euro-dollar balances and the changes in reserve holdings were somewhat erratic but these can largely be accounted for by special factors. As mentioned above, the very rapid growth of dollar balances in 1978 and 1979 reflected the structure of US domestic reserve requirements, which encouraged round-tripping of non-bank deposits through the Euro-market, and the absolute fall in foreign-bank demand deposits in 1975 may reflect a delayed response to the Herstatt banking crisis. The unusually small rise in foreign banks' demand deposits with US banks in 1978 may also have reflected the weakness of the dollar in that year. Ignoring these years, a picture of a reasonably stable and small Euro-currency multiplier of around 3.7 emerges. What is more interesting is that if these figures are representative, they imply that Euro-banks hold fairly large working or precautionary reserves relative to the stock of non-bank deposits (see column 6, Table I). Over the total ten years 1971–1979 foreign commercial banks increased their demand deposits at US banks by 13 per cent. of the increase in Euro-dollar deposits. This ratio rises to 22 per cent. when the years 1978 and 1979 are excluded. Some US demand deposits of foreign banks may, however, be held as normal working balances which have nothing directly to do with Euro-currency business, or as a form of compensating balance against lines of credit with US banks, but even so they may be used as precautionary reserve balances for Euro-currency activities. Assuming even that working balances grew by 100 per cent. of the initial demand deposit holdings of foreign banks (i.e. from \$3.4 billion to \$6.8 billion), over the total period the marginal Euro-dollar reserve ratio comes out at about 9 per

cent.\* The conclusion is that it is not obvious that the precautionary reserve holdings of Euro-banks are negligible, as has frequently been asserted.

*Leakage model estimates.* The second approach to estimating the Euro-currency multiplier is to use the leakage model, equation (2), and make guesses at the size of the reserve ratio  $r$  and the leakage coefficient  $b$ . The redepositing multiplier then derived is:

$$m_2 = \frac{1}{1 - (1 - r)(1 - b)} = \frac{1}{r + b - rb}$$

Table II

Leakage model multipliers for various leakage and reserve ratios

Leakage coefficient (b)	Reserve ratio (r)			
	.2	.1	.05	.0
	Euro-deposit multiplier			
1.0	1	1	1	1
.8	1.19	1.22	1.23	1.25
.6	1.47	1.56	1.61	1.67
.4	1.92	2.17	2.33	2.50
.2	2.78	3.57	4.17	5
.0	5	10	20	∞

\* These figures may tend to overstate the precautionary reserve holdings of Euro-banks since the stock of demand deposits at US banks refers to those due to all foreign banks, excluding branches, while the estimated Euro-dollar balances are only those with European banks. Adding in Euro-dollars held with banks in Canada and Japan raises the size of non-bank Euro-dollar holdings to \$114.5 billion at end-1979 and the non-bank multiplier to 8.6. However, this still implies that Euro-banks held an average reserve ratio of 11 per cent., i.e.  $13.26/114.5$ . Even if holdings by official monetary institutions are also counted as reservable Euro-dollar balances the precautionary reserve ratio comes out at around 7 per cent. On the other hand, these calculations may also understate the stock of Euro-banks' precautionary reserves. Only demand deposit holdings of foreign banks have been counted. It is also possible that Euro-banks hold reserves in less liquid but marketable assets — e.g. time deposits or certificates of deposit.

Clearly the larger is  $b$ , the leakage of additions to non-bank liquidity out of Euro-currency deposits to other assets, the smaller will be the multiplier. Indeed, for a reasonably large value of  $b$  it does not really matter what size  $r$  is, as the multiplier will still be small. Table II provides the calculations. The interesting question is: what determines the size of  $b$ ?

Analysts usually proceed by defining a group of Euro-currency, or more usually Euro-dollar, assets or asset holders and then use the *ex post* ratio of Euro-currency (or Euro-dollar) holdings to the total (or dollar) assets of the group as the estimate of  $1-b$ . The assumption is that average holdings of assets are a good proxy for marginal disbursements. Lee, for example, defines the asset group as the short-term dollar claims of foreigners including central banks and derives a Euro-currency multiplier of 1.27 in 1963 and 1.92 in 1969<sup>1</sup>. However, the fact that this estimate of the multiplier has risen suggests that average behaviour is not a good proxy for marginal behaviour and that the multiplier has been understated. But it is impossible to judge how much of the increase reflects bank-lending-induced redepositing rather than an exogenous change in preferences of Euro-currency depositors. Swoboda compares total Euro-dollar holdings of non-banks with different definitions of US money supply<sup>2</sup>. This gives very high leakage coefficients of between 92 per cent. and 98 per cent. Assuming a Euro-currency reserve ratio of  $r = 0.01$  gives a multiplier in the range of 1.02 to 1.09. Similar estimates about the size of the multiplier have been derived by Mayer<sup>3</sup>. The conclusion from these models is, therefore, that any Euro-currency multiplier is very small indeed. Clearly, however, these estimates depend on the choice of

<sup>1</sup> Boyden E. Lee, "The Euro-dollar multiplier", *The Journal of Finance* 28, No. 4, September 1973, pp. 867-874.

<sup>2</sup> Alexander K. Swoboda, "Credit creation in the Euro-market: alternative theories and implications for control", Occasional Paper No. 2, *Group of Thirty*, New York, 1980.

<sup>3</sup> Helmut Mayer, "Credit and liquidity creation in the international banking sector", *Bank for International Settlements, Economic Papers*, No. 1, November 1979. This paper provides a helpful analogy between the Euro-currency market and an inter-regional banking system, and discusses the possibility of a number of leakages out of the Euro-market reflecting its international character.

asset stock for comparison with Euro-currency holdings, and the assumption that average behaviour is a good proxy for marginal behaviour is not a very good one when Euro-currency holdings have tended to expand more rapidly than domestic money stocks. Under these assumptions the multiplier would be gradually increasing over time. Comparing the annual change in non-bank Euro-dollar holdings with the annual change in US  $M_2$  in 1980 would give a somewhat smaller leakage ratio of 87 per cent. and a multiplier of 1.15. Thus, even allowing for marginal changes, the leakage model multiplier, although larger, is still small.

*The rôle of central-bank deposits.* Somewhat different conclusions are, however, said to occur when consideration is given to the asset-holding behaviour of one particular group of investors – central banks. Lee attributes 69 per cent. of the rise in his estimated multipliers to the increasing preference of central banks for holding dollars in the Euro-currency market. The story runs as follows: say all non-bank leakages out of the Euro-dollar market,  $b$ , are to national money markets other than the United States, and that central banks fix their exchange rates against the dollar so that these leakages result in international reserve gains. If central banks reinvest a proportion, say  $c$ , of their dollar reserves in the Euro-market, the overall leakage of funds out of the market, taking non-banks and central banks together, is reduced and the multiplier will then be larger. The formula is:

$$m_2^1 = \frac{1}{1 - (1 - r)[1 - b + cb]}$$

When  $c = 1$ , i.e. central banks hold all marginal increases in reserves as Euro-currencies, this formula collapses to the simple fractional reserve multiplier,  $m_1$  (equation (1)), and the fractional reserve multiplier estimates become relevant. More generally we would expect leakages out of the Euro-dollar market both to the United States (say this leakage is  $b_1$ ) and to other national markets ( $b_2$ ) and the revised multiplier formula is then:

$$m_2^{11} = \frac{1}{1 - (1 - r)[1 - b_1 - b_2(1 - c)]}$$

Only leakages to national markets, other than the United States,  $b_2$ , will add to central-bank reserves and can be reinvested in the market. Now, if in the extreme  $c = 1$  the revised formula  $m_2^{11}$  collapses to the original leakage multiplier,  $m_2$ , but with  $b$  replaced by  $b_1$ , how does this revised multiplier differ from the non-bank leakage estimates reported by Swoboda? Not at all: his multiplier was based on an estimate of the leakage of non-bank Euro-dollar deposits to the United States only and not to other national markets. Effectively Swoboda assumed  $b_2 = 0$ , i.e. there are no leakages to markets other than the United States. If  $b_2$  is greater than zero, the non-bank Euro-dollar redepositing multiplier is actually *smaller* than the estimates derived by Swoboda, since the leakage ratio would then also have to take account of the possibility of such leakages, and is at most only as large when central banks redeposit the complete non-bank Euro-dollar leakage into non-dollar currencies in the Euro-market. In the context of the purely non-bank leakage model the central-bank redepositing argument would therefore appear something of a red herring.

The situation is, however, somewhat different if the relevant asset group for the calculation of the leakage coefficient is not just dollars held by non-banks, but also those held by central banks. This would be reasonable if central-bank deposits in the market are important factors explaining the supply of Euro-currency credits and thus additions of liquidity to non-banks and, through international borrowing, the reserve holdings of central banks. In this case the calculated leakage coefficient should take account of this to obtain the overall – non-bank plus central-bank – redepositing multiplier. If this is done (see Table III) the multiplier rises somewhat to 1.11 from 1.07 in the absence of central-bank Euro-dollar holdings (i.e. by about 4 per cent.). This is, however, an over-estimate as it makes no allowance for leakages of non-bank Euro-dollars into non-dollar currencies which would tend to increase the overall non-bank leakage ratio. Even if it were assumed that all dollar reserves were held in the Euro-market the redepositing multiplier would rise only to 1.22 because these total holdings are still small in comparison to the stock of domestic dollar deposits and the estimated leakage coefficient of non-bank funds out

Table III

Leakage estimate of Euro-dollar redepositing ratios and multipliers  
with and without central-bank redepositing

---

1) Non-bank holdings of domestic dollars (proxied by US $M_2$ )	1,500
2) Non-bank holdings of Euro-dollars	114
3) Central-bank holdings of domestic dollars	143
4) Central-bank holdings of Euro-dollars	73
5) Non-bank redepositing ratio, $(1 - b_1) = 2 / [(1) + 2]$	0.07
Multiplier based on 5) and assuming $r = 0.01$	1.07
6) Overall redepositing ratio, $(1 - b) = [2) + 4) / [(1) + 2) + 3) + 4)]$	0.10
Multiplier based on 6) and assuming $r = 0.01$	1.11
7) Redepositing ratio assuming all dollar reserves are held in the Euro-currency market $[2) + 3) + 4) / [(1) + 2) + 3) + 4)]$	0.18
Multiplier based on 7) and assuming $r = 0.01$	1.22

---

Note: Monetary magnitudes in billions of US dollars.

of the Euro-market to the US domestic market continues to be large. Based on these various estimates about the size of the leakages the conclusion from the fixed coefficient leakage models remains: the multiplier is not very great.

In addition to the various qualifications that have already been made, a further problem with this approach is the assumption that central banks rigidly fix their exchange rates against the dollar. If exchange rates are freely floating, international reserves will be unaffected by any switches by non-banks out of dollars into domestic currencies and no secondary reflow of funds to the Euro-market will occur from central banks. Similarly, flexibility in exchange rate policy will also reduce the impact of inflows from the Euro-dollar market on domestic liquidity and thus reflows to the market from non-banks.



Interest rate adjustments and other effects described in Section III may also limit the potential influence of central-bank deposits on the Euro-currency multiplier. Indeed, when there are very high interest rate responses, central-bank depositing may have a very limited influence on Euro-market liquidity. More generally, they would be expected to have some influence on overall Euro-market expansion.

*Multi-stage banking system estimates.* Multi-stage banking system estimates are concerned with a somewhat different question from the previous two and specifically with the contribution of the Euro-currency market to the total – domestic and Euro-currency – liquidity or money holdings of the non-banking sector. The overall redepositing multiplier in a particular currency,  $m_3$ , is derived as (equation (3)):

$$m_3 = \frac{1}{r_1[1 - (1 - r_2)(1 - b)]}$$

To isolate more clearly the influence of the Euro-currency market this can be written simply as:

$$m_3 = m_d m_2$$

where  $m_d$  is the size the domestic fractional reserve multiplier would be in the absence of a Euro-currency market,  $1/r_1$ , and  $m_2$  is the Euro-currency multiplier obtained from the previous leakage model. The contribution of the Euro-markets to overall credit availability is then:

$$\begin{aligned} \Delta m_3 &= m_d m_2 - m_d \\ &= (m_2 - 1) m_d \\ &= (1 - r_2) (1 - b) m_2 m_d \end{aligned}$$

which is the product of the Euro-currency multiplier derived from the leakage model, the domestic fractional reserve multiplier in the absence of the Euro-currency market, and the factors  $(1 - r_2) (1 - b)$ , which represent the proportion of funds not leaked out of the Euro-market to the national banking system. We have already reported “guestimates” of  $m_2$ ,  $b$  and  $r_2$  and using these, excluding central-bank holdings, would yield approximately:

$$\Delta m = 0.07 m_d$$

i.e. the Euro-currency markets have increased the overall redepositing multiplier by about 7 per cent.

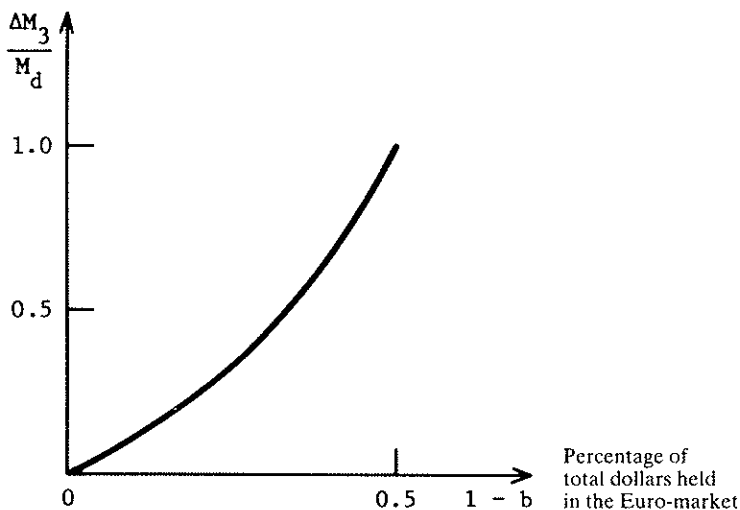
This model can be simplified even further by assuming that Euro-bank reserve holdings are zero. The change in the domestic multiplier is then:

$$\Delta m_3 = \frac{(1-b)}{b} m_d$$

This is illustrated in Figure 3 which plots  $\frac{\Delta m_3}{m_d}$ , the rate of increase of the overall multiplier, against  $1-b$ , the volume of deposits held in the Euro-dollar market. When the dollar deposits are shifted to the Euro-currency market the overall rate of liquidity creation of the banking system and the velocity of circulation of domestically defined monetary aggregates will increase. This will tend to complicate somewhat the conduct of national monetary policy unless the authorities take offsetting action to reduce the domestic stock of reserves available to the banking system. But for this to have a major impact there have to be rather large shifts of funds between the domestic and

Rate of increase  
in the overall  
credit multiplier

Figure 3



Euro-currency markets. Comparing the stock of Euro-dollars held by non-banks with US  $M_2$  gives a value of 0.07 for 1-b, and an increase in the overall multiplier,  $m_3$ , of 7.5 per cent. To double this value to 15 per cent. would involve a further shift out of the US market to the Euro-dollar market of nearly \$100 billion!

At certain times, particularly during periods of restrictive national monetary policy, deposit flows may be disintermediated to the Euro-currency market and this will tend to mean that domestic monetary policy will seem more restrictive than it actually is, if the authorities target only on the domestic money market. But in terms of the size of such flows the influence on national policy must be regarded as relatively minor. They have not caused the authorities to lose control over their national monetary policies.

## II. Portfolio approaches

The main critique of fixed coefficient multiplier models is provided by the portfolio or "new" view of money.\* According to this approach the function of intermediaries is to satisfy simultaneously the preferences of borrowers and lenders by issuing direct claims upon themselves in the form of deposits, which can be held in the portfolios of wealth-holders, and purchasing claims directly from borrowers. It observes that financial intermediaries, be they commercial banks or other non-bank financial intermediaries, expand the overall size of their balance sheets in a market environment in which there is competition between different types of financial intermediaries and "primary" security markets for both deposits and loans; and that the increase in the stock of assets or liabilities of any intermediary depends ultimately on the portfolio preferences of wealth-holders. These in turn are affected by the relative level of interest rates an intermediary offers and any particular attributes, such as the perceived riskiness of different assets, or advantages of the liabilities of one intermediary over another. In the Euro-market there might be the advantages of geographical location or convenience to European residents in holding a dollar deposit in Europe. In order to encourage wealth-holders to alter the structure of their portfolios either relative interest rates or the attributes of intermediaries' deposits must change.

This approach notes, in particular, that it is misleading to believe that banks have any special ability to create their own liabilities simply because they are a means of payment since this ignores the ultimate portfolio preferences of wealth-holders. For non-banks to be willing to hold additional volumes of bank deposits created at a given level of wealth or income they must be made more attractive relative to other

\* For a statement of the approach see J. Tobin, "Commercial banks as creators of 'money'" in *Banking and monetary studies*, ed. Deane Carson, Homewood, Ill., Richard D. Irwin, 1963, pp. 408-419. For an application of the analysis to the Euro-currency system see Andrew D. Crockett, "The Euro-currency market: an attempt to clarify some basic issues". *IMF Staff Papers*, Vol. 23, No. 2, July 1976, pp. 375-386.

assets. If this does not occur there is no reason for the proportion of bank deposits to exceed previously established levels (a basis for more simple leakage models).<sup>\*</sup> In terms of the models in Section I, the various filters involve not only the interest rates and attributes offered by the particular intermediary under investigation but those of all other intermediaries, as well as a range of other arguments such as a wealth constraint on the portfolios of non-banks. Because of the emphasis in these models of relative returns on other assets they provide a powerful framework for analysing an open system such as the Euro-currency market.

Two specific propositions of portfolio theory concern the rôle of reserve requirements and interest rate adjustments. The first states that the existence of reserve requirements causes the credit-creating process to conform to a multiplier framework. In an attempt to clarify this issue it is looked at in sub-section A below. This is not, however, of importance in the Euro-markets, which are not subject to reserve requirements, and is therefore by way of a slight digression. The second proposition is that movements in Euro-currency interest rates will tend to limit any multiplier process in the Euro-currency market. This is of some importance to estimates of the Euro-currency multiplier. The types of portfolio models which use this effect in the Euro-markets are described in sub-section B. Some of the analysis in sub-section B draws upon the result obtained in sub-section A.

### **A. The rôle of reserve requirements**

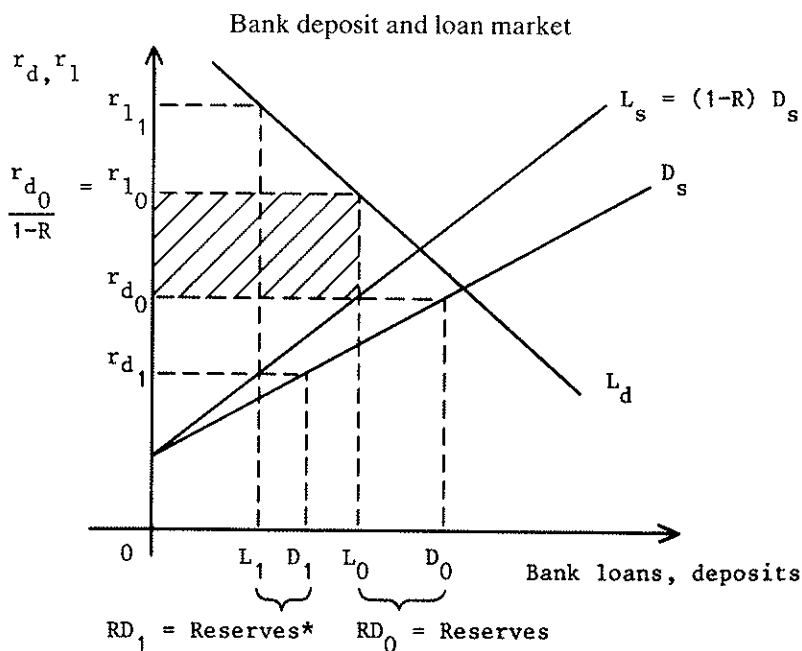
In elaborating on Tobin's analysis Crockett emphasises the rôle of reserve requirements in explaining the usefulness of multiplier analysis, which makes credit creation conform to a multiplier framework. The argument runs as follows: the existence of legal reserve requirements higher than the level of reserves desired by banks on precau-

<sup>\*</sup> To paraphrase Tobin, when bank deposits are only a small fraction of total private wealth, other things being equal, savers cannot be expected greatly to exceed this proportion in allocating new savings. So if all new saving is to take the form of bank deposits, other things cannot stay equal. Yields and other advantages of competing assets will have to fall. Consequently there is a natural economic limit to the size of the banking system.

tionary grounds imposes a direct restraint on the banking system which prevents it equalising the marginal cost of deposits with the marginal yield on loans. As soon as the authorities remove this direct constraint by supplying more reserves, or by reducing reserve requirements, banks can thus be counted on to respond by expanding their balance sheets. In the Euro-currency market there are no legal reserve requirements and thus there is no constraint on Euro-banks equating the marginal cost of deposits (including some precautionary holding of reserve balances) with the marginal return on loans. A marginal increase in the supply of reserves to the Euro-market (say from a shift of deposits) cannot therefore be counted on to automatically expand the volume of Euro-currency lending. Another way of putting this argument is that an increase in the supply of reserves to domestic banks allows them to move towards their optimal portfolio position and thus can be counted upon to expand the volume of bank lending. However, because Euro-banks are not constrained by reserve requirements, they are already at their optimal portfolio positions and thus inflows of new deposits to the Euro-market have a much smaller effect on their lending, which only expands if the relative return on deposits and loans alters.

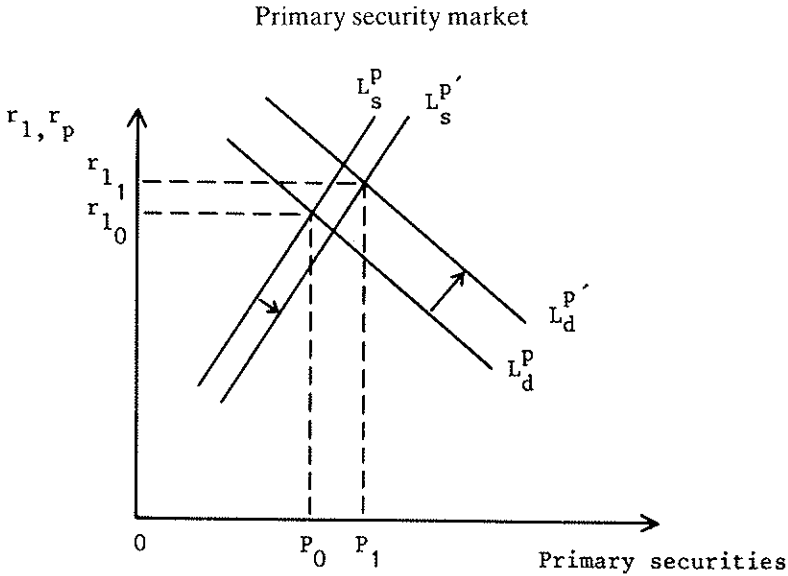
This argument is elaborated using some diagrams. Figure 4 illustrates the situation for a competitive banking system subject to a legal reserve requirement,  $R$ . Bank deposit and loan rates are shown on the vertical axis and volumes on the horizontal axis.  $D_s$  is the stock of deposits supplied to the banking system, which slopes upward, being positively related to the deposit rate  $r_d$ ;  $L_d$ , the stock demand for bank loans slopes downward, being negatively related to the loan rate  $r_l$ . The supply of loans by the banking system,  $L_s$ , depends on the supply of bank deposits and the legal reserve ratio  $R$ . This can be written as  $L_s = (1-R) D_s$  since a proportion  $R$  of bank deposits is sterilised by the reserve ratio and is therefore unavailable for lending by the banking system. The banking system will determine its optimal loan portfolio by attempting to equalise the marginal cost and the marginal return on loans. The question is whether it is prevented from doing this by the imposition of legal reserve requirements.

Figure 4



The marginal effective cost of deposits to the banking system is not just the nominal deposit rate,  $r_d$ , but rather  $\frac{r_d}{1-R}$  since a fraction  $R$  of any marginal bank deposits is sterilised as reserves. The relevant interest rate for marginal lending behaviour of the banking system is therefore this effective deposit rate and not the nominal rate  $r_d$ . In equilibrium banks would seek to equate this effective rate with the loan rate (assuming bank lending margins are zero), setting  $r_l = \frac{r_d}{1-R}$ . This is illustrated in Figure 4. The deposit rate is set at  $r_{d0}$ , the loan rate at  $r_{l0}$ , and the bank borrows deposits  $D_0$ , holds  $RD_0$  as reserves and makes  $L_0$  loans, and *the equilibrium marginal conditions for the banking system are met*. The effect of the legal reserve requirements is to place a wedge between nominal deposit and loan rates but not between the banking system's marginal effective deposit and loan rates. The result

Figure 5



holds because it is assumed that the supply of reserves  $RD_0$  is determined by the demands of the banking system. But, as drawn, any expansion in the reserves made available to the banking system by the authorities beyond  $RD_0$  would not lead to an automatic increase in bank lending. The existence of legal reserve ratios is therefore not on its own a sufficient condition for multiplier effects.

If, however, the reserves available to the banking system were constrained to  $RD_1 = \text{Reserves}^*$  (see Figure 4), then the banking system could no longer equate the marginal effective cost of deposits with the marginal return on loans, deposit rates would fall to  $r_{d1}$ , and loan rates would rise to  $r_{l1}$ . In this case an expansion in the volume of reserves beyond  $RD_1$  would lead to an automatic expansion in bank loans. But this analysis assumes that as the authorities restrict the volume of reserves, by, for example, open-market sales of Treasury bills,



deposit rates fall relative to loan rates. This need not generally be the case as restrictive policy on the part of the authorities normally causes a rise in *all* interest rates. The reserve ratio argument is misleading because it is only a partial equilibrium approach. General portfolio theory, however, suggests that the rise in bank loan rates will encourage borrowers to issue more securities in the primary security market, shifting the demand curve for primary loans from  $L_d^0$  to  $L_d^{p1}$  (see Figure 5) and raising interest rates on primary securities. Together with the fall in bank deposit rates this will encourage a portfolio shift by wealth-holders as previous holders of bank deposits purchase more primary securities, thus shifting their supply curve to  $L_s^{p1}$  from  $L_s^0$  (see Figure 5). The effect of this on the market for bank deposits and loans would be to cause upward movements in the  $D_s$  schedule and thus bank deposit rates, and downward shifts in the  $L_d$  schedule and bank loan rates in Figure 4 (not shown). Such shifts may well re-establish the marginal equilibrium conditions of the banking system when the banking system can once again equate the marginal effective cost of deposits with the marginal return on loans, but with smaller totals for the stock of bank deposits and loans. The contraction of bank loans, following the action by the authorities to restrict the supply of reserves, occurs because of the portfolio shift out of bank deposits and loans to other security markets and not primarily because of the existence of reserve requirements or the discontinuity between the marginal effective cost of bank deposits and the marginal return on bank loans. Such effects occur in the absence of legal reserve ratios. The presence of reserve requirements does, however, provide a lever for the operation of monetary policy, which may mean that the effects of restricting bank reserves through security sales by the authorities is more quickly transmitted to the market for bank deposits and loans.

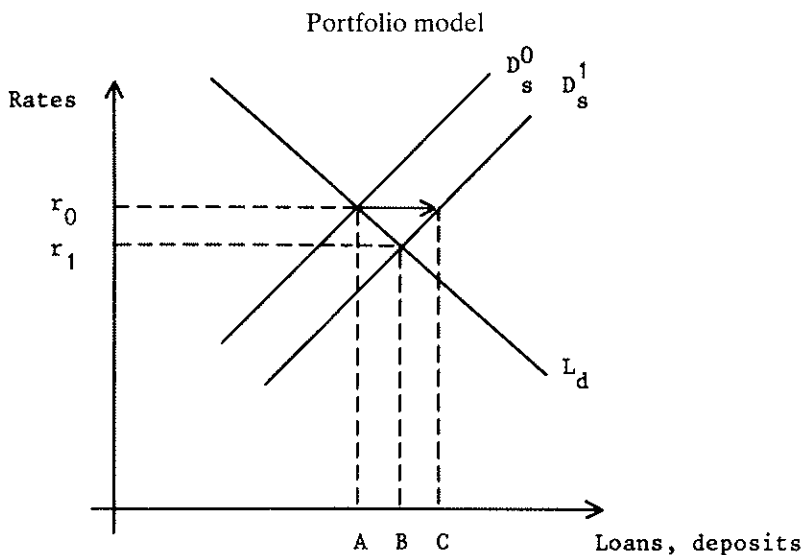
The situation is somewhat different if the stock of deposit liabilities of the banking system is insensitive to interest rate movements in other markets. In that case the supply of loans will be constrained by the supply of reserves rather than the supply of deposits. But if that is the basis for the argument that multiplier theory is appropriate when there are legal reserve ratios it is not very different from the standard

multiplier argument, i.e. the liabilities of the banking system are insensitive to the movements in the relative price of other assets and are therefore automatically returned to banks in fixed proportions. The conclusion from portfolio theory is that fixed coefficient multiplier analysis is only appropriate if bank deposits are interest rate insensitive, and in such circumstances it will hold whether or not there are legal reserve ratios. We therefore reject Crockett's argument that it is the absence of legal reserve ratios in the Euro-market which makes fixed coefficient multiplier theory inapplicable in that market.

**B. Interest rate adjustments and general equilibrium portfolio models**

A specific proposition of portfolio theory is that adjustments in Euro-currency deposit rates will generally tend to limit the size of any Euro-currency multiplier. A movement of funds into the Euro-market will tend to depress interest rates there, and raise interest rates

Figure 6



elsewhere, causing some marginal holders of Euro-currency deposits to shift their funds out of the Euro-market, partly offsetting the initial inflow. This is illustrated in Figure 6. An initial inflow of new deposits to the Euro-currency market of AC, at interest rate  $r_0$ , shifts the supply of deposit curve from  $D_s^0$  to  $D_s^1$  and causes the equilibrium Euro-currency interest rate to fall to  $r_1$  and the equilibrium size of the Euro-market to expand from A to B. The initial deposit multiplier is then  $\frac{AB}{AC}$ , which is clearly less than unity, the fraction BC of the initial deposit inflow being lost to the Euro-currency market because of the induced fall in Euro-currency deposit rates.

An analysis of this effect on the Euro-currency multiplier, and perhaps more importantly of the interactions of Euro-markets with national banking systems and monetary policies, has been made by constructing small general equilibrium models of the world's financial system.\* Within these the Euro-banking system is highlighted and the size of the multiplier determined by examining the impact of a shift of deposits to the Euro-market on its final size. These models treat the economic system as one of short-run equilibrium in which the sum of world assets and liabilities is given and the only question is one of allocation. They abstract from the impact of financial markets on real variables and do not generally allow feedbacks from financial intermediaries to wealth, income, or the price level. The type of dynamic feedback processes from bank lending to nominal incomes which multiplier theorists implicitly hypothesise are not part of the analysis. Indeed, in most models, the Euro-currency banking system could be dropped out without very much loss to the final equilibrium. As such they suffer from the same defect as fixed coefficient models in that they do not allow for policy decisions of financial intermediaries themselves as regards their lending strategies. These decisions can, however, be very important for the world economy and thus the final equilibrium of the system. The willingness of Euro-banks to expand

\* Charles Freedman, "A model of the Euro-dollar market", *Journal of Monetary Economics* 3, No. 2, April 1977, pp. 139–161; J. Hewson and E. Sakakibara, "A general equilibrium approach to the Euro-dollar market", *Journal of Money, Credit and Banking* 8, No. 33, August 1976, pp. 297–323.

lending for balance-of-payments finance can maintain the level of world activity at higher levels and this may feed back on the stock of Euro-currency deposits.

The main conclusion from these models of asset distribution for the Euro-currency multiplier is that “the leakage caused by changes in interest rates is probably larger than any other leakage”<sup>1</sup> or “the interest rate leakage effect on the Euro-dollar market would be the key feature in reducing the value of the Euro-dollar multiplier”.<sup>2</sup> To outline the derivation of these types of conclusion, a small general equilibrium model is described below and then iterated through the various stages which follow a shift of deposits to the Euro-currency market.

*A general equilibrium model.* General equilibrium models involve the specification of a consolidated balance sheet for each sector, market clearing conditions for each asset and certain behavioural assumptions about the substitutability between assets in the portfolios of transactors. Table IV illustrates the type of balance-sheet constraints and market clearing conditions hypothesised. To simplify, a number of restrictions are imposed on the sectoral holdings of assets.

The titles across the top of Table IV identify six sectors – US and European non-banks, commercial banks and central banks; the titles down the left-hand column the assets – US and European government securities, bank deposits and loans, and reserves, together with Euro-dollar bank deposits and loans (assumed to be issued by European banks). The right-hand column tables the interest rates on each asset and the bottom row the sectoral balance-sheet constraint. Entries in the body of Table IV indicate which sectors hold or issue which assets. A “1” identifies an asset of the sector and a “-1” a liability. Market clearing conditions are obtained by summing across the appropriate row for each asset (these determine the interest rates), and the sectoral balance sheet by summing the appropriate

<sup>1</sup> Freedman, *op. cit.*

<sup>2</sup> Hewson and Sakakibara, *op. cit.*

Table IV  
Balance-sheet constraints and market clearing conditions in a simplified general equilibrium model

Assets	Sectors						Interest rates
	US non-banks (1)	European non-banks (2)	US banks (3)	European banks (4)	US central bank (5)	European central bank (6)	
US government securities ( $S_{us}$ )	1				-1	1	$r_{us}^{gbs}$
European government securities ( $S_e$ )		1				-1	$r_e^g$
US bank deposits ( $D_{us}$ )	1		-1	1			$r_{us}^d$
US bank loans ( $L_{us}$ )	-1		1				$r_{us}^l$
Euro-dollar bank deposits ( $D_{es}$ )	1	1		-1			$r_{es}^d$
Euro-dollar bank loans ( $L_{es}$ )	-1	-1		1			$r_{es}^l$
European bank deposits ( $D_e$ )		1		-1			$r_e^d$
European bank loans ( $L_e$ )		-1		1			$r_e^l$
US reserves ( $R_{us}$ )			1		-1		$r_{us}^r$
European reserves ( $R_e$ )				1		-1	$r_e^r$
Totals	US private wealth = $W_{us}$	European private wealth = $W_e$	0	0	US government deficit = $G_{us}$	European government deficit plus balance of payments = $G_e + BOP_e$	

column for each sector. Thus the first row of the table shows that the US central bank “issues” government securities and these are held by US non-banks and European central banks. The first column shows that the sum of US non-banks’ holdings of US government securities, US and Euro-dollar bank deposits plus their borrowing from US and European banks, adds to US private wealth, etc. The general complexity of these models can be greatly increased by introducing additional entries in the table – US non-banks might, for example, be assumed to hold US reserves, i.e. currency – or by introducing specific assumptions about the dollar/European currency exchange rate (assumed fixed), but these make the models more difficult to handle.

A further preliminary is to specify certain behavioural assumptions for each sector. These can be written in the general form:

$$F_i(B, \mathbf{r}) = 0, \quad i = 1, 2 \dots 6$$

where B is the balance-sheet constraint of sector i and  $\mathbf{r}$  the vector of relevant interest rates. For US non-banks this would be written as

$$F_1(W_{US}, r_{US}^s, r_{US}^d, r_{US}^l, r_{ES}^d, r_{ES}^l) = 0$$

and the demand for each asset derived under certain assumptions about the substitutability between assets. The usual assumption is that assets are gross substitutes and that a rise in the interest rate on, say, Euro-dollars will lead at least to a rise in holdings of Euro-dollars and a fall in the holding of one or all other assets.

For example the demand for Euro-dollars by US non-banks could then be written as:

$$D_{ES}^{(1)} = g_{(1)}(W_{US}, \bar{r}_{US}^s, \bar{r}_{US}^d, \bar{r}_{US}^l, \bar{r}_{ES}^d, \bar{r}_{ES}^l)$$

where the signs over the variables are the partial derivatives of the demand for Euro-dollars by the various variables. Rises in wealth or the Euro-dollar interest rate cause US non-banks to increase – and rises in all other interest rates to reduce – their holdings of Euro-dollars. Etc. for other sectors and assets.

Using this system of sectoral balance-sheet identities, market-clearing conditions and behavioural assumptions, the financial system can then be “solved” to determine the volume of each asset held by each sector. In practice, however, algebraic analysis of the system

proceeds by considering the final impact of an exogenous shock — for example, a shift of dollars from the US to the Euro-dollar market — on the structure of interest rates and size of each sector. In this way, the Euro-dollar multiplier can be determined. Clearly, this model is considerably more complicated than the simple filter system described in Section I, but it can be viewed as such a system, only that now explicit account is taken of the balance-sheet constraints on each sector and the impact of a deposit shift between markets on the structure of interest rates and reactions of agents in all markets. This is illustrated by considering the effect of a deposit shift from the US domestic banking system to the Euro-currency market by US non-banks using the balance-sheet identities outlined in Table IV.

Initially, the deposit shift from the US to the Euro-dollar market will put downward pressure on Euro-dollar deposit and loan rates and upward pressure on US domestic deposit and loan rates.\* This will entice some Euro-dollar holders to shift funds to the US market to take advantage of the higher deposit rates available there, and to European deposit and security markets since Euro-dollar rates will have fallen relative to European currency interest rates. There will also be some leakage to the US market if European banks hold some precautionary reserves against their now larger stock of Euro-dollar deposits. At the same time US and European borrowers will switch to the Euro-dollar market because Euro-dollar loan rates are now lower

\* It is frequently observed that shifts of deposits from US banks to Euro-banks would not affect US domestic deposit and loan rates since Euro-banks would initially hold new dollar placements as US bank deposits. The deposit shift would simply be a book-keeping operation for the US banking system, which would not alter the overall supply of domestic bank deposits. While this may be the instantaneous result of the shift of deposits to the Euro-market, it is very unlikely to be a longer-term response in a portfolio theory which allows for competition between intermediaries and variable responses of wealth-holders and other transactors. It assumes that deposits are automatically returned — indeed completely returned — to the US banking system in fixed proportions following the deposit shift to the Euro-market. However, portfolio theory is as relevant for US banks as for other types of intermediaries. There is no necessary reason why all dollar deposits have to stay in the US banking system. When US banks lose deposits they will, like everyone else, have to bid to replace them, pushing up domestic deposit and loan rates. Other considerations may, however, limit these interest rate adjustments, such as particular institutional links between the domestic and Euro-currency markets. These effects are discussed below in the text and in the next section.

relative to national markets. As a first-round effect the stock of Euro-dollar deposits and loans will expand, but by something less than the initial deposit inflow as a portion is leaked to the US and European national markets (stopping the interactive process at this stage would be analogous to the fixed coefficient leakage model). In the United States the transfer of dollar deposits and the demand for dollar loans to the Euro-market will cause the credit extended by the US banking system to contract somewhat and, assuming that US banks were initially "loaned up", excess reserves will become available to the US banking system equal to the legal reserve ratio times the net shift of deposits by non-banks from the US to the Euro-dollar market less the increase in precautionary reserves held by Euro-banks with US banks. Initially, any contraction in lending by US banks will partly offset the expansion of Euro-dollar lending; the offset will only be partial, however, because the increase in deposits available for lending by Euro-banks will be larger than the loss of deposits available for lending by US banks (the analogy is with the multi-stage banking model).\* In Europe, assuming the European central bank fixes its exchange rate against the dollar, the shift of borrowing to the Euro-dollar market and of deposits out of Euro-dollars into domestic bank deposits will ease monetary conditions and add to the dollar reserves of the European central bank.

In the second round it is necessary to consider the reaction of each of the sectors to what is now a state of disequilibrium in asset markets. In the United States the rise in interest rates on bank deposits will encourage US non-banks to sell securities; some may be purchased by the European central bank, which has now larger dollar reserves, thus returning deposits to the US banking system. The US central bank may also intervene to fix the price of US securities, buying the net amount of securities offered by US non-banks. If it does, additional deposits will be made available to the US banking system, US bank

\* If the net deposit shift is  $D$ , and  $R$  and  $R_E$  are respectively the US legal and Euro-banks' precautionary reserve ratios, the net amount of deposits released by the deposit shift is

$$RD - R_E D + (1-R)R_E D = R(1-R_E)D$$



deposit and loan rates will fall, the volume of US bank lending will expand towards previous levels and the impact of the deposit shift to the Euro-currency market on the overall availability of credit will be larger. Even if the US central bank does not fix security prices the availability of free reserves may allow US banks to expand their lending, but only if this is profitable and the marginal equilibrium conditions for US banks (discussed in sub-section A above) are not met. In Europe, the fall in deposit rates will entice European non-banks to buy securities. If the European central bank intervenes to fix the price of securities this will sterilise the impact of the dollar inflow from the Euro-market and prevent European monetary conditions from easing, and the overall expansionary impact of the shift of dollars to the Euro-market will be reduced.

There will be third-round effects from the increased availability of credit but these depend on the reaction of the central banks in their national security markets. If the US central bank does, but the European central bank does not, fix security prices the overall expansion in credit will be greatest and this will feed back to the Euro-markets allowing some net multiplier effects to occur. If, however, the US central bank does not intervene in its national security market while the European central bank does, the effects of the deposit shift will largely be sterilised and the impact of the deposit shift will be similar to that discussed in the first round. In this case, the Euro-currency multiplier will certainly be less than unity and the overall impact on credit availability will depend on how US banks react to the availability of free reserves. If they find it unprofitable to expand their lending (i.e. the marginal conditions described in sub-section A are met), then the increase in Euro-dollar lending will be partly compensated by a reduction in US bank lending and the overall impact on credit availability will be *smaller* than the expansion of lending in the Euro-currency market. If, however, they find it profitable to expand their lending by the full amount of free reserves available, the upper limit to the impact of the Euro-markets on overall credit availability is given by the estimates derived from the fixed coefficient multi-stage banking model.

The size of the Euro-currency multiplier will then be larger when:

(a) interest rate adjustments in the Euro-currency market and the response of US non-banks to these are small;

(b) US banks find it profitable to expand their lending by the full amount of free reserves released by any deposit shift to the Euro-market;

(c) the US central bank intervenes to sterilise the effects of the shift on interest rates in the United States;

(d) European central banks accept any easing in monetary conditions following a decline in Euro-dollar interest rates and European non-banks are responsive to this decline.

Abstracting from condition (a) (see the next section), the major influence on the credit-creating ability of the Euro-markets will depend crucially on the reaction of national central banks. If both target only on their domestic markets and sterilise liquidity influences on their own markets, shifts of deposits to the Euro-market will most probably have small expansionary effects. The size of these is impossible to judge *a priori*, but the estimates from the multi-stage banking model suggest that even in the extreme they will be fairly small.

### III. Interest rate effects and aggregation problems — some “new” views

An assumption of portfolio model estimates of the Euro-currency multiplier is that Euro-currency interest rates adjust to non-bank deposit flows and that this leads to large leakages from the Euro-markets back to national money markets. While wealth-holders will be sensitive to the relative movement in Euro-dollar and US domestic interest rates, it is very difficult to find evidence that short-term Euro-currency interest rates adjust to non-bank deposit flows. Empirical analysis of the determination of Euro-currency interest rates has shown that, in the absence of restrictions on the free flow of capital, over long runs of data short-term Euro-dollar (and Deutsche Mark) interest rates have been tied within narrow margins to the level of short-term domestic interest rates by the arbitrage activity of domestic banks.\* Such analysis strongly suggests that movements in Euro-currency deposit rates are largely independent of the volume of non-bank deposits in the Euro-currency market and that by implication the type of interest rate effects hypothesised by portfolio models either do not normally occur or are very small. Estimates from portfolio theory would thus be an underestimate of the non-bank credit multiplier and, moreover, once the assumption of interest rate adjustments is dropped portfolio models are only marginally better than the simpler fixed coefficient leakage models. The main advantages are that they impose balance-sheet constraints on sectors and take specific account of the origin of deposit flows to the Euro-market and the reactions of central banks to shifts in deposits between markets.

However, the observation that relative interest rate movements do not generally occur is due to a more powerful arbitrage mechanism between the domestic and Euro-currency market which, at the margin, dominates the non-bank arbitrage process. That is interbank

\* For an analysis of the determination of Euro-currency interest rates see R.B. Johnston, “Some aspects of the determination of Euro-currency interest rates”, *Bank of England Quarterly Bulletin*, March 1979.

arbitrage. Such is the efficiency of interbank arbitrage that at the margin small changes in the liquidity in one market are rapidly transmitted to the other without there having to be a large movement in the relative structure of domestic and Euro-currency interest rates. Inflows of non-bank deposits to the Euro-market do not usually lead to sharp interest rate movements because they are arbitrated out by banks. In such a world it might also be reasonable to believe that inflows of non-bank (or central-bank) deposits would have little or no effect on the volume of Euro-market loans and that the concept of an independent Euro-currency multiplier is meaningless (the attached technical note provides a more detailed discussion of this point). The implication is that bank and non-bank flows to the Euro-market can be aggregated together and that Euro-banks, in their Euro-currency lending policy, do not specifically react to net increases in the volume of non-bank deposits placed with them.

Other conclusions for Euro-currency credit creation are drawn from the close links between domestic and Euro-currency interest rates. It has been suggested that they imply that the Euro-currency market is *demand* determined and that the market has a near infinite capacity to expand in response to an increase in the demand for Euro-currency loans.<sup>1</sup> Alternatively, using the same observed linkages it is also suggested that the growth of the Euro-currency market is mainly *supply* determined at the instigation of the banks themselves and that the expansion of Euro-dollar business by US banks is an attempt to reduce their overall holdings of reserves, determined by legal reserve ratios on domestic deposits, by expanding their reserve-free Euro-dollar business.<sup>2, 3</sup> The influence of the Euro-markets on credit

<sup>1</sup> R.H. Heller, "Why the market is demand-determined", *Euromoney*, February 1979.

<sup>2</sup> For example, Robert Z. Aliber, "The integration of the offshore and domestic banking system", *Journal of Monetary Economics* 6, 1980, pp. 509-526. Aliber does not make this point explicitly in his paper; however, it does seem to be at the heart of his analysis.

<sup>3</sup> Such approaches are not necessarily inconsistent. The demand-determined approach is concerned with *interbank* flows from the domestic market to the Euro-market which have already "paid" domestic reserve requirements. The supply-determined approach on the other hand is concerned with taking *non-bank* deposits offshore which avoid domestic reserve requirements.

availability then derives from reducing the effective reserve ratio on the banking system as a whole.

Such an analysis is intellectually appealing as there are very close links between the Euro-markets and the domestic banking system. Euro-banks are predominantly the foreign branches or the wholly or partly-owned subsidiaries of domestic commercial banks, and their overall lending policy may well be determined on a consolidated basis with their parent banks. However, it is hard to believe that this gives the management of Euro-banks *no scope* for independent decision-making, for example, on the level of spreads, maturities or size of loans to each borrower. It seems more likely that while parent organisations determine overall lending strategies and even limits on the total volume of lending to any one country, it will be left to local managers to implement this policy as best they can, given the prevailing circumstances, which may well depend on the extent of liquidity in the Euro-market.

In interbank dealing there is, for example, no single interbank deposit rate at which any individual Euro-bank can be assured of borrowing funds in the Euro-market; rather there is a whole spectrum of rates which vary with the particular Euro-bank's credit standing. Many Euro-banks, i.e. non-US banks, have no dollar deposit base in the United States, and thus their recourse to interbank borrowing of Euro-dollars depends on the balance between their non-bank deposits and non-bank loans. To the extent that borrowing in the interbank market influences a bank's credit standing, as it appears to, it will also influence the rates at which the bank can borrow funds in the interbank market. Banks which are typically large net placers of funds in the interbank market can normally be assured of better rates when they seek to borrow funds from other banks than those which are continuous net takers of interbank deposits. Inflows of non-bank deposits (and possibly central-bank funds) to the Euro-markets may then be an important influence explaining Euro-bank lending behaviour. They reduce the overall indebtedness of the Euro-market to national banking systems and the burden that offshore banking operations place on parent banks' funding operations. Euro-currency banking is a

response by the banking system to the desire by wealth-holders to place and borrow funds outside national banking systems; it has not grown up at the independent instigation of the banks themselves.

Other empirical factors also suggest that the supply of non-bank deposits to the Euro-market is important. Bank of England data on the degree of maturity mismatching by London Euro-banks show that while they largely match their interbank liabilities and claims with other London banks and banks abroad, there is a good degree of maturity transformation between non-bank liabilities and claims.<sup>1</sup> If there are calculable probabilities that private deposits will be replaced with the bank when they fall due for repayment, this is a reasonable outcome. When interbank deposits fall due, however, they are automatically withdrawn and in renewing these the bank has to accept the risk that interbank rates will have moved against it. There will be risks in taking deposits both from banks and from non-banks but the relative interest rate insensitivity of non-bank deposit flows suggests that the risk will be greater in the interbank market.<sup>2</sup> Evidence from the operation of some London Euro-banks suggests that it is possible to observe a stable "core" of non-bank deposits which acts as a base for Euro-market lending operations; when the "core" deposits expand so can the lending operations of the banks. Empirical analysis of the determination of spreads on syndicated medium-term Euro-credits has also shown that the volume of non-bank deposits relative to the total liabilities of London Euro-banks has been a statistically important factor.<sup>3</sup> These considerations suggest that independent Euro-currency liquidity, and thus multiplier effects, may occur, but that they would be the outcome of a complex process involving decisions by wealth-holders to redeposit funds in the market and by

<sup>1</sup> There are, however, difficulties in interpreting these data. There is no necessary reason why non-bank deposits have to be used to fund non-bank Euro-currency loans, rather than being placed at the same maturity in the interbank market.

<sup>2</sup> Johnston, *op. cit.*, has argued that while banks are flow adjusters, non-banks are stock adjusters to changes in interest rates, which makes interbank flows much more interest rate sensitive.

<sup>3</sup> R.B. Johnston, "Banks' international lending decisions and the determination of spreads on syndicated medium-term Euro-credits", *Bank of England Discussion Paper* No. 12, September 1980.

intermediaries to expand their Euro-market lending. Effectively, the portfolio model and “institutional” banking approaches have to be combined to provide a more realistic theory of Euro-market expansion. The existence of close interest rate linkages nevertheless weakens the concept of an independent Euro-currency multiplier and focuses attention on banking behaviour and the influence of the disintermediation of money holdings to the Euro-market. This shift in emphasis is, in my opinion, correct, because, as described in the previous sections, all estimates of an independent Euro-currency multiplier contain a degree of arbitrariness. They cannot answer the question of whether multiplier effects occur or not.

Apart from the appropriate degree of aggregation in models of the Euro-currency market, the “new” approaches raise other problems and questions. It is difficult to believe that the Euro-market is purely demand determined over a broad range for its size or that it has an infinite capacity to expand at given interest rates. Even when Euro-dollar interest rates are tied to US domestic certificate of deposit rates within margins determined by the level of US domestic reserve requirements and interest rates, that does not mean that a rise in the demand for Euro-dollars has no effect on the *overall* level of deposit rates. When Euro-dollar interest rates rise above the arbitrage margins at which US domestic banks find it profitable to supply funds to the Euro-market, US domestic banks issue more domestic CDs to lend funds in the Euro-market. This action will tend to put upward pressure on US domestic and, through arbitrage, Euro-dollar interest rates. The supply of funds to the Euro-market, therefore, will not be infinitely elastic. The analysis may, however, be approximately valid if the Euro-market is small compared with the US domestic market and the amount of funds needed to arbitrage out any profitable interest rate differential has a negligible effect on the US domestic CD market. In such circumstances, the magnitude of concern about the growth of the Euro-market must also be small. Alternatively, the assumption that the Euro-market is purely demand determined may hold if the US authorities automatically intervene to fix the domestic CD rate. If, however, the Federal Reserve targets the domestic supply

of reserves, interest rates will rise as US domestic banks demand additional reserve balances to meet the reserve requirements on the new issues of domestic CDs. Even if the Federal Reserve targets interest rates it is unlikely to accommodate passively large new issues of CDs by domestic banks.

The second “new” explanation of the growth of the Euro-currency market – that it reflects attempts by banks to reduce overall reserve ratios by expanding “reserve-free” Euro-currency deposits – may be a factor explaining the expansion of Euro-dollar business by US banks. However, this approach is much less appropriate if applied to other nationalities of banks which are not subject to “burdensome” legal reserve ratios on domestic bank deposits – e.g. British, Swiss or Japanese banks. These banks are also important participants in the Euro-market and a theory of Euro-market expansion should also explain their behaviour. There are other regulatory constraints on bank lending behaviour and equally these could also be used to explain the expansion of a comparatively unregulated Euro-banking system. It may, for example, reflect attempts by banks to reduce their overall capital or equity ratios. Alternatively, however, Euro-market expansion may also be a response to non-regulatory or portfolio constraints on banks’ balance sheets – for example, it may reflect attempts to reduce overall portfolio risks by enlarging the geographical location of depositors and borrowers. The influence of domestic reserve requirements can be seen as part of banks’ broader portfolio considerations of which precautionary reserve holding is only one factor.

Other underlying factors are also important in explaining the expansion of Euro-currency lending and decisions by parent banks to set up branches and subsidiaries which operate in the Euro-market – the increasing integration of national economies through trade and multi-national investment, the structure of balance-of-payments surpluses and deficits, the changing portfolio preferences of wealth-holders and the needs of economic development, as well as the structure of national and international regulations. If this were not so, it would suggest that banks, and at that only certain nationalities of



banks, exercise a very large degree of monopoly power in financial markets — if business were not contracted “offshore” it would somehow automatically be done in the same banks onshore. A principal feature of international banking is, however, its highly competitive nature. The general arguments of portfolio theory outlined at the beginning of Section II apply equally to international and national banks. The portfolio preferences of wealth-holders and competition between financial intermediaries must therefore also be taken into account in explaining Euro-market growth.

### **Summary and conclusions**

There is a broad range of estimates about the size of the Euro-currency multiplier, particularly where a fractional reserve multiplier theory is concerned. Most, if not all, approaches which recognise that the Euro-market is an open banking system strongly indicate, however, that its endogenous credit-creating ability is very small. These conclusions are nevertheless based on plausible judgements about the size of leakages from the market into other assets. Once it is recognised that the Euro-market is part of a wider financial system the question arises as to its influence on the overall credit-creating potential of the world’s banking system. This depends equally on the estimates of the endogenous credit-creating potential of the Euro-currency market — the smaller this is, the smaller the impact on overall credit availability — and also, in an open system, on the response of a number of agents. Most important is the reaction of central banks to shifts of funds to the Euro-currency market and whether the domestic liquidity effects of these are sterilised. When they are, the Euro-market will have net expansionary effects on the world stock of credit, but from the estimates reported these need not be very large. What is relevant for policy is whether any expansionary effects are controllable. The portfolio and integrated-market approaches certainly suggest that they are as national interest rate movements will be rapidly transmitted to the Euro-market. Of course, the Euro-markets are not always the focus of national mone-

tary policy and thus at times developments in the market may be viewed in a sense as exogenous to – *but not independent of* – national monetary systems. However, even at such times the global credit expansionary effects of the markets appear to be limited.

Independent movements in Euro-currency interest rates may also have a rôle to play in limiting the endogenous multiplier process in the Euro-currency market, but the evidence for this is not great. Alternatively, near perfect interbank arbitrage between the domestic and Euro-currency may mean that the concept of an independent Euro-currency multiplier is meaningless and that distinct Euro-market liquidity effects do not occur. Other banking theories of the growth of the Euro-markets therefore emphasise the institutional links with national banking systems. It is difficult to believe, however, that the state of Euro-market liquidity has no influence on Euro-bank lending policy or the expansion of the Euro-currency system. Independent multiplier effects may, therefore, still occur. The institutional approaches underline, however, the weakness of multiplier theory when applied to the Euro-markets in isolation and they emphasise the need to take the behaviour of banks into account in explaining the expansion of the Euro-currency markets. Euro-currency banking is the response of a freely competitive banking system to a changing world environment. In this process the Euro-markets have undoubtedly exerted an expansionary influence on the world economy which may have led to feedbacks on the stock of Euro-currency deposits and the rate of growth of the Euro-currency banking system. The Euro-currency system has an endogenous credit-creating potential but one that is constrained by general portfolio considerations. Most important among these will be the decisions by the banks themselves, as institutional banking approaches suggest, and by wealth-holders, as outlined by the portfolio model approaches, to borrow and lend funds in external money markets. Combining these models brings one close to a general theory of Euro-market expansion.

### Technical note on the multiplier hypothesis

A basic assertion of multiplier analysis is that there exists a relationship between an *initial* inflow of deposits to the banking system, from non-bank wealth-holders, and the *final* stock of bank deposits held by wealth-holders, which is stable and predictable. Such an assertion can be decomposed into two propositions:

1. There is a stable and causal relationship between the volume of deposits placed with the banking system by non-banks and the volume of lending to non-banks by the banking system, written as:

$$C_{nb}^F = F(.) D_{nb}^0 \quad \text{prop. (1)}$$

where  $C_{nb}^F$  is the final volume of bank credits to non-banks generated by an initial inflow of non-bank deposits  $D_{nb}^0$  and  $F(.)$  some function which links the final credit volume to the initial deposits – an initial deposit/final credit transfer function.

2. There is a stable and causal relationship between an initial increase in the volume of bank loans or credits to non-banks,  $C_{nb}^0$ , and a final volume of bank deposits held by non-banks,  $D_{nb}^F$ , – i.e. an increase in bank lending leads to a predictable increase in the volume of bank deposits, written as:

$$D_{nb}^F = g(.) C_{nb}^0 \quad \text{prop. (2)}$$

where  $g(.)$  is an initial credit/final deposit transfer function.

Together the propositions are sufficient conditions for the existence of a stable bank deposit multiplier. They are also necessary conditions provided that instability in the initial deposit/final credit transfer function is not exactly compensated by instability in the initial credit/final deposit transfer function. Setting  $C_{nb}^0 = C_{nb}^F$ , the initial deposit/final deposit multiplier can be written as the product of  $g(.)$  and  $F(.)$ :

$$D_{nb}^F = g(.) F(.) D_{nb}^0 \quad \text{prop. (3)}$$

Proposition (3) relates the final volume of bank deposits held by non-banks,  $D_{nb}^F$ , to the initial volume of non-bank wealth-holders' deposits,  $D_{nb}^0$ . If proposition (1) holds but (2) does not, an initial inflow of bank deposits will lead to a predictable increase in bank lending but there will be no predictable reflow of bank deposits from the new bank credits and the multiplier assertion will be invalidated.

Similarly if proposition (2) holds but (1) does not, an increase in bank lending will lead to a predictable reflow of bank deposits but this will not generate any predictable secondary increase in bank lending and bank deposits. If both propositions hold there will be a stable function or multiplier link between the initial and final volume of bank deposits determined by the transfer functions  $F(\cdot)$  and  $g(\cdot)$ , the first transferring deposits into loans (in a predictable way) and the second loans into deposits (also in a predictable fashion).

It has been argued that the rate of growth of the Euro-currency market is purely demand determined. This assertion is based on the observation that there is nearly perfect substitutability between *interbank* deposits in the domestic and Euro-currency markets and thus that any increase in the demand for Euro-market loans can and will always be met by an increase in interbank borrowing by Euro-banks. The approach says that the volume of Euro-market lending has nothing to do with the volume of Euro-currency deposits held by non-banks and thus effectively rejects the first proposition. By implication it therefore also rejects multiplier analysis when applied to the Euro-market in isolation, the essence of which is the relationship between the initial and final volume of Euro-currency deposits held by non-banks.

A potentially useful feature of this decomposition is that it may provide one of the few methods of testing and measuring statistically the size of the Euro-currency multiplier. Attempts could be made to estimate each transfer function using time series statistical techniques, such as those developed by Box and Jenkins,\* under certain assumptions about the structure of the system, e.g. that it was recursive rather than truly simultaneous. At present long runs of data are not available and the series on the volume of non-bank Euro-dollar deposits and loans show that these are exponentially trended and very highly correlated. Such correlation does not necessarily imply causality but it would make it difficult to identify the system perhaps even after suitable differencing.

\* G.E.P. Box and G.M. Jenkins. "Time Series Analysis: forecasting and control", Holden-Day, San Francisco 1976.