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Money Creation in the Euro-Currency Market

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I. Introduction

The rapid expansion of the Euro-currency market--particularly since the late sixties--has attracted the attention of international financial experts and policymakers. Whether and to what extent money creation takes place in that market has been a question of central interest.

In a domestic economy, money creation is most frequently analyzed within the framework of the multiplier approach. According to this approach, an inflow of an initial deposit induces commercial banks to expand the volume of their activity. In the final equilibrium the volume of credits and deposits is a multiple of the injected volume of funds. Multipliers relating the stock of commercial banks' reserves to their deposits have also been calculated. Modern money supply theory has extended this approach to a framework where the domestic money stock is determined by the amount of base money in the economy and a money multiplier. The different multipliers are the outcome of the behavior of commercial banks and the general public. Empirical research indicates that the behavior pattern of economic entities is sufficiently stable so that the multipliers are also relatively stable.1/ Consequently, changes in commercial banks' reserves or in the total volume of base money lead to predictable changes in domestic monetary aggregates.

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1/ See for example, Milton Friedman and Anna J. Schwartz, A Monetary History of the United States 1867-1960, Princeton University Press, Princeton, 1963; Phillips Cagan, Determinants and Effects of Changes in the Stock of Money 1875-1960, Columbia University Press, New York, 1965; and Albert E. Burger, "The Relationship Between Monetary Base and Money: How Close?" Federal Reserve Bank of St. Louis Review, October 1975.

A number of economists have extended the domestic deposit and money multiplier concepts to an analysis of the Euro-currency market. Contrary to the results for domestic multipliers the computations lead to a wide range of different Euro-money multipliers depending on the approach and data base.

The purpose of this paper is: (1) to describe and compare alternative Euro-money multiplier concepts, (2) to estimate the multipliers under various approaches on a consistent data base, and (3) to examine whether or not the different concepts are appropriate. The paper is concerned only with money multiplier approaches in which the volume of Euro-deposits or the money stock of a country including Euro-deposits is related to alternative concepts of a reserve base.1/

The paper begins with a brief description of the characteristics of the Euro-currency market (Section II) and the reasons for its expansion (Section III). In the following sections four different multiplier concepts are discussed: (1) the initial deposit multiplier, (2) a bank reserve multiplier assuming a two-stage banking system, (3) a bank reserve multiplier assuming a three-stage banking system, and (4) the base money multiplier. A final section summarizes the results.

II. Characteristics of the Market2/

The Euro-currency market is an international financial market where banking transactions in currencies outside their countries of origin are carried out. Participants in the market are commercial banks, national and multinational companies, local authorities, governments, central banks, and international agencies. These economic entities either deposit funds with the Euro-banks or they take loans in different currency denominations from the Euro-banks.3/ The predominant currencies are U.S. dollars, German marks, and Swiss francs.

The market is dominated by large commercial banks. Many of these banks operate in the Euro-currency market through foreign branches. In particular, the large U.S. banks maintain branches in European financial centers such as London, Zurich, Frankfurt and Luxembourg, and also outside Europe in Singapore and the Bahamas. The market share of the U.S. banks and their branches is considerable.

1/ There have been attempts to utilize the portfolio approach for an examination of the Euro-dollar deposit multiplier. See for example, Charles Freedman, "A Model of the Eurodollar Market," Discussion Paper No. 25, Center for Economic Research, University of Minnesota, February 1973. John Hewson and Eisuke Sakakibara, "The Euro-Dollar Deposit Multiplier: A Portfolio Approach," IMF Staff Papers, Vol. XXI, July 1974, pp. 307-28. These approaches do not fall into our framework of analysis.

2/ For an excellent description of the structure of the market and the institutional mechanics see Geoffrey Bell, The Euro-Dollar Market and the International Financial System, Macmillan, London 1973.

3/ The term "Euro-bank" is not restricted to banks located in Europe. It refers to all banks dealing in nondomestic currencies.

The assets and liabilities of the Euro-banks are concentrated around the short end of the maturity structure. Data published by the Bank of England show that about 20 per cent of the foreign currency liabilities of U.K. banks have a maturity of less than eight days, and close to 50 per cent are in the range of between eight days and three months. Most of the liabilities of the Euro-banks are similar in maturity to time deposits and it may be appropriate for some purposes to consider Euro-deposits as money defined in the broader sense.

An important function of the Euro-currency market is the channelling of funds from areas of excess supply where interest rates are low to areas of excess demand where interest rates are high. The market is highly sensitive to international interest rate variations. Relatively small changes in interest rate differentials can lead to large flows of funds from one country to another.[1/]

The transfer of funds from the original lender in a low interest area to a final borrower in a high interest area would be associated with substantial information costs were it not for the inclusion of one or more Euro-banks into the financial intermediary chain. Additional Euro-banks enter the chain as long as they can realize a positive net return. Due to the existence of a highly competitive market and relatively low costs per unit of financial flow, many banks may be involved in channelling the funds from a lender in country X to a borrower in country Y. As a result, the Euro-currency market is to a large extent an interbank market.

III. Reasons for the Expansion of the Market

Over the last two decades the Euro-currency market has become one of the most important financial markets of the world. It gained a respectable size in comparison to all domestic financial markets and, by now, its volume exceeds the money stock of any of the European countries.

The most comprehensive estimates of the size of the Euro-currency market are provided by the Morgan Guaranty Trust Company.[2/] Based on foreign-currency liabilities of banks in major European countries, Canada, Japan, the Bahamas and Singapore, the gross market size was estimated at $350 billion at the end of 1974. The figures most widely used in the analysis of the Euro-currency market are the quarterly gross figures and the annual net figures of the eight reporting countries computed by the Bank

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1/ For empirical evidence on the relatively high interest rate elasticities in the Euro-dollar market see Malcolm Knight, "Eurodollars, Capital Mobility, and the Forward Exchange Market," unpublished paper, June 1975.

2/ Morgan Guaranty Trust Company, World Financial Markets.

for International Settlements.[1/] These data, together with figures for the eight countries plus Canada and Japan, are depicted in Chart 1. Chart 1 shows the rapid expansion of the Euro-currency market particularly since 1968. Annual growth rates in excess of 40 per cent have not been unusual. The highest growth rates for the gross size of the market for the eight reporting countries were realized in 1968 with 50 per cent, and in 1969 with 68 per cent. The greatest absolute increase in the volume occurred in 1973 with $60 billion. For the net size the highest growth rate of 63 per cent was realized in 1969. The average annual growth rate over the ten-year period between 1965 and 1974 was 34 per cent for both the gross and the net size of the market in the eight reporting countries. By the end of 1974, the net size of the Euro-currency market, as represented by the eight countries reporting to the BIS, totalled $177 billion, and the gross size was estimated at $220 billion.

Chart 2 presents a currency breakdown of the gross size of the market for the eight European countries. The chart clearly indicates the dominating role of the U.S. dollar. Between 1964 and 1969 the dollar component increased modestly, mainly at the expense of the British pound. Since 1969 the German mark has attained a more prominent position as Euro-marks were growing faster than Euro-dollars. The percentage share of the mark increased from 6.3 per cent in 1964 to 8.2 per cent in 1969 and 15.6 per cent in 1974. On the other hand, the share of the Swiss franc remained relatively unchanged.

What are the reasons for the rapid expansion of the Euro-currency market? The most important reason is the absence of regulations for Euro-bank operations. Banks frequently shift to the Euro-currency market in order to circumvent cost-increasing domestic monetary policy actions. Whenever a country imposes severe restrictions on the domestic currency transactions of its commercial banks, the banks increase their activity in the Euro-currency market.

For example, the introduction of stringent controls on nonresident sterling borrowing and lending in 1957 induced British banks to switch their operations from sterling into dollars. The controls imposed by the authorities on U.S. financial institutions in the sixties designed to cope with the increasing

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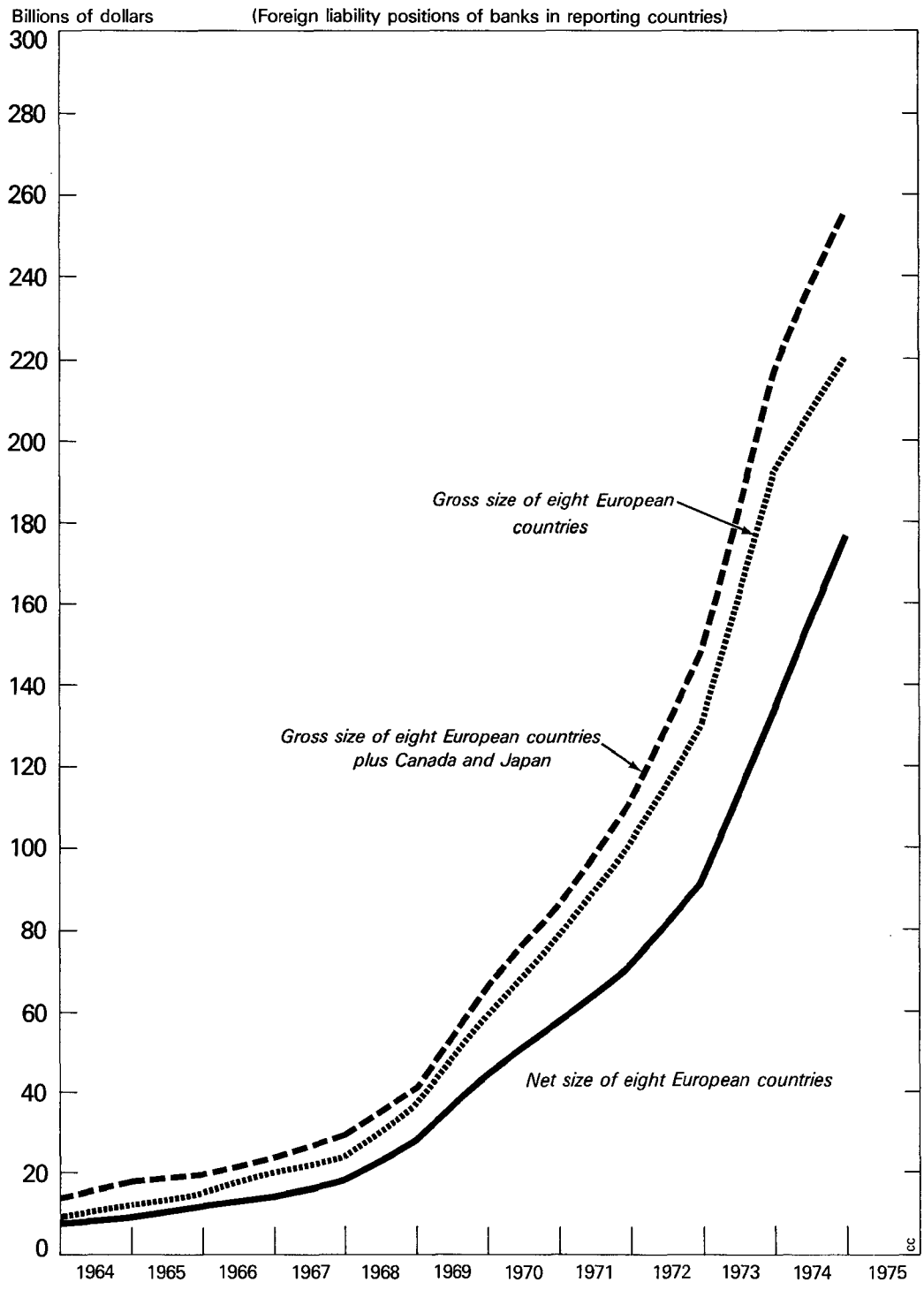
1/ The gross data include all foreign currency positions of banks vis-a-vis nonresidents in the reporting countries regardless of whether they are held with banks or with nonbanks. The net data are adjusted for interbank positions of banks within the eight country area. Further corrections are made with respect to foreign currency positions vis-a-vis nonbank residents, conversions of foreign currency positions into domestic currency, positions of official monetary institutions, etc. However, they do not exclude positions vis-a-vis banks outside the reporting area. These positions can be substantial. Therefore, it must be pointed out that the net size of the Euro-currency market as calculated by the Bank for International Settlements is not equal to the loans of Euro-banks to final borrowers or to the deposits held by nonbank economic units.

CHART 1

SIZE OF THE EURO-CURRENCY MARKET

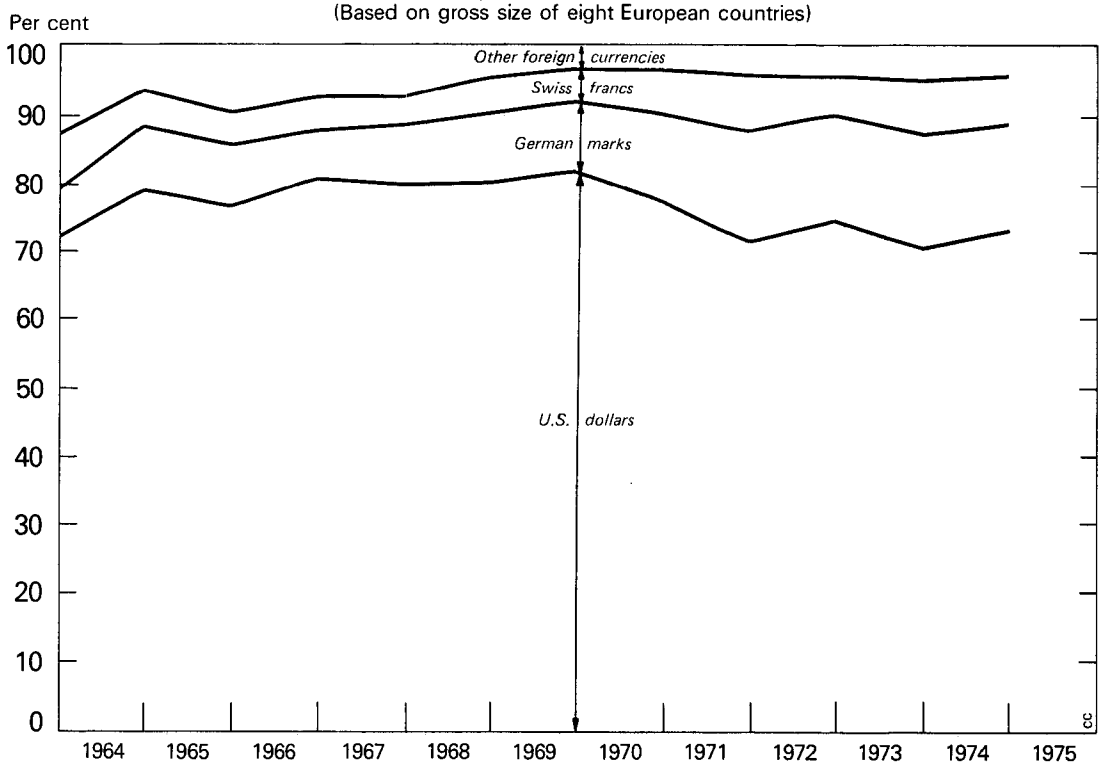


Source: Bank for International Settlements, Annual Reports.

CHART 2

CURRENCY COMPONENTS IN THE EURO-CURRENCY MARKET

(Based on gross size of eight European countries)



Source: Bank for International Settlements, Annual Reports.

balance of payments deficit, shifted a large part of the market from the United States to other financial centers. The existence of ceiling rates for time deposits in the United States (Regulation Q) contributed further to the expansion of the Euro-currency market. Whenever the market rate exceeded the ceiling rate a movement of dollar deposits from the U.S. market to the Euro-currency market occurred.

Different national policies with respect to legal reserve requirements can also constitute substantial incentives for domestic banks to expand their activity in the Euro-currency market. Legal reserve requirements force commercial banks to hold part of their assets in the form of noninterest bearing deposits at the central bank. As a result, commercial banks lose revenue. On the other hand, monetary authorities in many countries tend to be very reluctant to impose reserve requirements on the deposits of Euro-banks. Therefore, commercial banks shift to the Euro-currency market in order to avoid the costs of domestic legal reserve policies.

Furthermore, the trend towards increased diversification of currency portfolios has undoubtedly contributed to the expansion of the Euro-currency market. Multinational corporations and financial intermediaries which try to reduce the political and exchange rate risks by diversifying their portfolios find it convenient to hold accounts in different currencies at their commercial bank. Also, money managers of central banks and governments discovered the advantages of Euro-banks in that they could provide services in various international currencies. It is well known that central banks--and most recently including those of the OPEC countries--have sometimes redeposited part of their foreign reserves at Euro-banks and that this has accelerated the growth of the market.[1/]

Another argument has been put forward concerning the relation between the Euro-dollar market and the U.S. balance of payments. It has been argued that the rapid growth of the Euro-dollar market was predicated on the existence of the U.S. balance of payments deficit. A brief lock at the growth of the Euro-mark and Euro-Swiss franc market indicates that this statement is not necessarily correct. The volume of these Euro-currencies increased rapidly despite huge balance of payments surpluses of both countries. Obviously, the market develops quite independently of the balance of payments situation of the country which issues the currency.

Of course, one important factor in the growth of the Euro-currency market has been the increase in the demand for credit on an international scale. In particular, large borrowings of balance of payments deficit countries had a substantial impact on the expansion of the market in recent years. The existence of the Euro-currency market enabled many countries to adjust either more smoothly or to delay an adjustment to rapidly changing conditions in the world market caused by the deterioration and final breakdown of the fixed exchange rate system, the world-wide stagflation, and the increase in oil prices.

1/ Identified official holdings of Euro-currencies amounted to SDR 38 billion at the end of 1974. Of this, SDR 32.7 billion were Euro-dollars. See International Monetary Fund, Annual Report, 1975, p. 39.

IV. Initial Deposit Multiplier

When discussing money creation in the Euro-currency market, many analysts apply the familiar initial deposit multiplier framework which has been originally developed for the domestic banking system. The central concept behind this multiplier approach is that a Euro-bank which receives an additional primary deposit[1/] will--after making provisions for precautionary reserve holdings--lend the money to a customer who may use it in such a way that part of it is redeposited in the same currency in another Euro-bank. This bank will also hold a fraction of the deposit as reserves while lending the rest to a customer. Again, a part of the funds is redeposited within the Euro-banking system. The process continues until the entire initial deposit is transferred into precautionary reserves of the Euro-banking system. The final amount of Euro-deposits and Euro-credits is a multiple of the initial deposit.

The equilibrium amount of additional Euro-deposits of nonbanks, ΔED, that can be created on the basis of an additional primary deposit, ΔED_o, is determined by the well-known multiplier relationship.[2/]

$$(1) \quad \Delta ED = \frac{1}{1 - (1-r)(1-q)} \Delta ED_o$$

where r is the reserve-deposit ratio and q the leakage coefficient.

Accordingly, a credit multiplier measuring the creation of additional Euro-credit to nonbanks, ΔEC, can be derived as:

$$(2) \quad \Delta EC = \frac{1 - r}{1 - (1-r)(1-q)} \Delta ED_o$$

Analytically, these Euro-deposit and Euro-credit multipliers are the same as those applying to a domestic banking system. However, the analysts who adopt the initial deposit multiplier approach to the investigation of the Euro-currency market are aware of the fact that there are some basic economic differences between the Euro-banking system and a domestic banking system.[3/]

One difference is that Euro-banks do not directly hold reserves in the form of base money at the central bank as do domestic commercial banks. Instead, they hold precautionary reserves in the form of short-term deposits at commercial banks mainly in the country of issue. Only these reserves are

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1/ A primary dollar deposit is created when (1) the nonbank public transfers dollar deposits from U.S. banks to Euro-banks; (2) Euro-banks borrow from U.S. banks; and (3) central banks or the nonbank public deposit dollar currency holdings with a Euro-bank.

2/ For an elaboration of this and other initial Euro-deposit multipliers see Klaus Friedrich, "The Euro-Dollar System and International Liquidity," Journal of Money, Credit and Banking, Vol. II, August 1970, pp. 337-47.

3/ See, for example, Alexander K. Swoboda, "The Euro-Dollar Market: An Interpretation," Essays in International Finance, No. 64, Princeton University, 1968.

considered in the initial deposit multiplier approach. Because Euro-banks match the time structure of their assets and liabilities fairly well most Euro-currency experts agree that these reserves are rather small in relation to their deposits.

Another difference between the Euro-banking system and a domestic banking system is related to the leakages. In a domestic banking system, leakages occur into domestic currency holdings of the nonbank public. In the Euro-banking system, leakages occur into other banking systems. Because the domestic banking system can be considered a closed banking system, redepositing is usually high. As a result, the leakage coefficient is small. In contrast, the Euro-currency system is an open system where funds can shift easily into a national banking system. Therefore, there is widespread agreement that the leakage coefficient for the Euro-banking system is relatively large in comparison to the coefficient for a domestic banking system. But how large is it in fact? Those who assume that the rapid expansion of the Euro-currency market has been to a large extent the result of a multiple credit and deposit creation process feel that redepositing has been a significant factor. Other economists believe that the leakages of funds from the Euro-currency market are so large that multiple deposit and credit creation have had only a minor impact on the growth of the market.

The calculations of the multipliers range between .50 and 2.00. The smallest estimate has been made by Klopstock. According to Klopstock the "Euro-bank multiplier is very low, lying probably in the approximate range of 0.50 and 0.90".1/ Obviously, what Klopstock has in mind is a Euro-credit multiplier. In contrast to the deposit multiplier only the Euro-credit multiplier can become smaller than unity. Klopstock gets his estimate on the assumption of fairly large leakages out of the Euro-banking system. A similar view with respect to leakages is held by Mayer. On the basis of the same underlying assumptions, Mayer obtains a Euro-deposit multiplier of 1.05 to 1.09.2/ Based on plausible guesses of the reserve ratio and the leakage coefficient, Swoboda's estimate of the deposit multiplier is between 1.25 and 1.75.3/ Machlup tries to solve the estimation problem by a somewhat different procedure.4/ He distinguishes three ways in which dollar deposits with Euro-banks come into existence: inflows of dollars from abroad, conversion of dollars from domestic currencies, or creation of dollar deposits through the expansion of credit by the Euro-banking system. Machlup calls all dollars that cannot be attributed to inflows or conversions of dollars "made in Europe". He then estimates these inflows and conversions at about 50 per cent of the total increase in Euro-dollar

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1/ Fred H. Klopstock, "The Euro-Dollar Market: Some Unresolved Issues," Essays in International Finance, No. 65, Princeton University, 1968, p. 8.

2/ Helmut Mayer, "Multiplier Effects and Credit Creation in the Euro-Dollar Market," Banca Nazionale del Lavoro Quarterly Review, No.98, September 1971, p. 236.

3/ Alexander K. Swoboda, "The Eurodollar Market: An Economist's Point of View," The Eurodollar, (ed. Herbert V. Prochmore) Ran McNally, Chicago, 1970, p. 305.

4/ Fritz Machlup, "The Magicians and Their Rabbits," The Morgan Guaranty Survey, May 1971, pp. 3-13.

deposits during 1964 and 1969.[1/] If this result is translated into the above multiplier framework a Euro-dollar deposit multiplier of two is derived.

Thus the available calculations for the Euro-credit multiplier in the above specification are below unity and for the Euro-deposit multiplier are in the range between slightly above unity and two. The estimates depend very much on the underlying assumptions. A precise empirical test of the multipliers cannot be performed because the leakage coefficient cannot be measured. Statistics cannot distinguish between primary and derivative bank deposits. However, it is possible to get an idea on the size of the multipliers by assuming hypothetical values for the leakage coefficients and reserve ratios.

Table 1 shows the magnitude of some Euro-deposits and Euro-credit multipliers related to alternative leakage coefficients and reserve ratios.

Table 1. Hypothetical Euro-currency Multipliers

(Excluding interbank transactions)

Leakage coefficient	Reserve Ratio .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	∞
	Euro-credit Multiplier			
1.0	.8	.9	.95	1
.8	.95	1.10	1.17	1.25
.6	1.18	1.41	1.53	1.67
.4	1.54	1.96	2.21	2.50
.2	2.22	3.21	3.96	5
.0	4	9	19	∞

According to Table 1, the hypothetical Euro-deposit multipliers lie in the range between unity and infinity. Making plausible guesses on the size of the parameters, i.e., assuming low reserve ratios and high leakage coefficients, the deposit multiplier will hardly be greater than two. Implausibly small leakage coefficients have to prevail in order to get a substantially greater multiplier.

1/ Ibid., p. 10.

The Euro-credit multipliers can vary from values well below unity to infinity. Under reasonable assumptions on the size of the parameters the Euro-credit multiplier will hardly be greater than two. Multipliers between .50 and .90 as suggested by Klopstock are very unlikely to occur in reality. It takes a rather large leakage coefficient and reserve ratio in order to get a credit multiplier substantially below unity. For example, the credit multiplier will be .50, if the reserve ratio is .50 and the leakage coefficient is unity, that is, no redepositing takes place at all.

In the preceding analysis interbank transactions have not been considered. However, interbank business is of great importance in the Euro-currency market. It influences not only the gross size of the market but also the net size. The net size is influenced if banks hold reserves against interbank deposits. Reserve holdings against these deposits reduce the potential expansion of the market for a given initial deposit.

The multiplier which measures the maximal amount of additional Euro-deposits to nonbanks that can be created on the basis of an additional initial deposit taking into account reserves for interbank transactions is described by the following relationship:

$$(3) \quad \Delta ED = \frac{1}{1-(1-b)^{h}(1-r)(1-q)} \Delta ED_{o}$$

with the new symbol b being the reserve coefficient against interbank deposits and h the number of interbank transactions.

The corresponding relation for Euro-credit made to nonbank borrowers is given by:

$$(4) \quad \Delta EC = \frac{(1-b)^{h}(1-r)}{1-(1-b)^{h}(1-r)(1-q)} \Delta ED_{o}$$

If we assume that average reserves of Euro-banks against interbank deposits are 2.5 per cent[1/] and that three banks are involved in channelling the funds from the original lender to the final borrower (h=3) the hypothetical Euro-deposit and Euro-credit multipliers shown in Table 2 can be calculated.

1/ Reserves on interbank deposits are relatively small because banks adjust the maturity structure of claims and liabilities of interbank transactions fairly well.

Table 2. Hypothetical Euro-currency Multipliers

(Including interbank transactions)

Leakage coefficient	Reserve Ratio .2	.1	.05	.0
	Euro-deposit Multiplier			
1.0	1	1	1	1
.8	1.18	1.20	1.22	1.23
.6	1.43	1.49	1.54	1.59
.4	1.79	2.00	2.13	2.27
.2	2.44	3.03	3.33	3.85
.0	3.85	5.88	8.33	14.29
	Euro-credit Multiplier			
1.0	.74	.83	.88	.93
.8	.87	1.00	1.07	1.14
.6	1.05	1.25	1.36	1.47
.4	1.34	1.67	1.87	2.09
.2	1.82	2.51	2.98	3.59
.0	2.87	5.04	7.38	12.70

A comparison of the results of Table 2 with those of Table 1 indicates that, for given values of nonbank reserve ratios and leakage coefficients, the multipliers are always smaller when allowance of interbank transactions is made than without such transactions. It also shows that for lower leakage coefficients the multipliers which allow for interbank transactions become increasingly smaller in comparison to the other multipliers. However, for large leakage coefficients, which are more likely in the Euro-currency market, the difference is rather small. Thus, for realistic values of the parameters we find that reserve holdings on interbank transactions do hardly affect the size of the Euro-credit and Euro-deposit multipliers.

The result of the preceding analysis is that the initial deposit multiplier for Euro-deposits, although it cannot be measured statistically, seems to be hardly greater than two and probably lies more in the neighborhood of one. If such a small multiplier exists, the inflow of initial deposits into the Euro-currency market must have been substantial in order to explain the rapid growth of that market. This indeed seems to be the position of Klopstock, Mayer and Machlup. Clendenning, on the other hand, tries to solve the problem by assuming a lagged reflow of deposits to the Euro-currency market.1/ Such delayed redepositing implies a small short-run multiplier but a large long-run multiplier.

1/ E. Wayne Clendenning, "Euro-Dollars and Credit Creation," International Currency Review, March/April 1971, p. 19.

Evaluating the usefulness of the above multiplier approach for an analysis of money creation in the Euro-currency market one has to consider that this multiplier describes only the potential impact on Euro-deposits of a domestic deposit that has been shifted from a domestic bank to a Euro-bank. Such a shift does not imply a transfer of base money to the Euro-currency market. Therefore, its potential expansionary power is limited.

The fact that the above multiplier concept is concerned only with the impact of a deposit that has been shifted to the Euro-currency market without regarding its effect on domestic monetary aggregates is the main weakness of the approach. It demonstrates the multiple money expansion process only within a two-stage banking system, while an adequate analysis requires a framework of a three-stage system. In addition, the initial deposit multiplier has the disadvantage of not being empirically measurable.

Other analysts, particularly those who are interested in empirical results, apply a multiplier approach in which they assume that the observed reserves of Euro-banks are the remaining reserves which are held by the banks after the process of credit and deposit creation has taken place. This multiplier concept is analyzed in the next section.

V. Bank Reserve Multiplier: Two-Stage Banking System

The main difference between the initial deposit multiplier and the bank reserve multiplier is that the first is based on a flow approach while the latter is a stock approach. The bank reserve multiplier is a full equilibrium multiplier where interest rate effects have already worked themselves out. The observed reserves of commercial banks are the remaining reserves after the leakages have occurred. It is assumed that banks have expanded their credits and deposits such that their actual reserves are equal to their precautionary reserves. In that case, the volume of Euro-credit and Euro-deposits is determined by the stock of reserves and the ratio of reserves to deposits.

If Euro-bank reserves are indicated by ER and the reserve ratio for Euro-deposits is specified by r_E, the following relationship between Euro-bank reserves and Euro-deposits holds:

$$(5) \quad ED = \frac{1}{r_E} \; ER$$

$1/r_E$ is the Euro-deposit multiplier which measures the deposit expansion for given reserves of Euro-banks. Accordingly, a Euro-credit multiplier can be derived as $(1 - r_E)r_E$. These multipliers must be greater than the multipliers in (1) and (2) because the reserve base is smaller after the leakages have occurred from the initial deposits.

In order to measure the multiplier, the reserves of Euro-banks have to be specified. In most of the recent empirical studies on Euro-currency multipliers the deposits of Euro-banks with commercial banks in the country of issue have been defined as their reserves. For example, for Euro-dollars, the dollar deposits of Euro-banks with U.S. commercial banks have been treated as their reserves. The idea behind this approach is that these deposits form the precautionary reserves of the Euro-banks.

One of the first empirical studies along this line has been presented by Carli.1/ He uses data on the credits given by the Euro-banks to the United States as a proxy for the dollar reserves of Euro-banks, and the net size data for the Euro-dollar market published by the Bank for International Settlements. On this basis, Carli estimates Euro-dollar credit multipliers ranging in size between 2.3 and 5.5 for the period 1964 through 1970.2/

The most complete and rigorous analysis on Euro-dollar multipliers selecting the reserve holdings of Euro-banks with U.S. banks as their reserve base has been performed by Fratianni and Savona.3/ The authors integrate demand and supply functions for Euro-currencies into a broader framework of an international liquidity concept, where the equilibrium values of Euro-bank reserves, Euro-deposits and Euro-credits are simultaneously determined within the Euro-credit market.

In their empirical work, Fratianni and Savona estimate several types of multipliers applying two different definitions of Euro-banks' reserves and various specifications of the multipliers. As one proxy for reserves of Euro-banks they use short-term liabilities of U.S. banks vis-a-vis their foreign branches. On this basis they estimate an average Euro-dollar credit multiplier of 7.7 for the period 1964:IV through 1970:IV. This multiplier was derived by regression analysis and assuming a linear homogenous relationship between reserves and Euro-dollar credits. Under a nonlinear homogeneity hypothesis a multiplier equal to 3.7 was calculated.

Makin defined "demand deposits of foreign commercial banks at U.S. banks, exclusive of claims on home offices of branch banks" as the reserves of Euro-banks.4/ Estimating a distributed lag function of the Koyck type, he derived a short-run Euro-dollar deposit multiplier of 10.3 and a long-run multiplier of 18.5 for the period 1964:III through 1970:IV.

The large difference in size between the various Euro-dollar multipliers reported in this section can mainly be explained by the application of different definitions of Euro-bank reserves. The narrower the definition with respect to

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1/ Guido Carli, "Eurodollars: A Paper Pyramid?" Banca Nazionale del Lavoro Quarterly Review, No. 98, June 1971, pp. 95-109.

2/ See Guido Carli, Ibid., p. 107.

3/ Michele Fratianni and Paolo Savona, "International Liquidity: An Analytical and Empirical Reinterpretation," A Debate on the Eurodollar Market, Ente per gli Studi Monetari, Bancari e Finanziari, Quaderni di Ricerche, Numero 11, pp. 39-121, Rome, 1972.

4/ John H. Makin, "Demand and Supply Functions for Stocks of Euro-Dollar Deposits: An Empirical Study," Review of Economics and Statistics, Vol. LVI, November 1972, pp. 381-91.

the asset type and the inclusion or exclusion of foreign branches of U.S. banks the larger is the multiplier for a given net size of the Euro-dollar market. The reserve base used by Makin is much smaller than the various bases applied by the other analysts. Accordingly, the bank reserve multiplier for Euro-dollars estimated by Makin must be greater. In addition, the deviations may have to some extent been influenced by different estimation techniques.

The impact of the selection of a specific bank reserve base on the size of the Euro-dollar multiplier can best be demonstrated by comparing time series for different bank reserve multipliers. In Table 3 five different definitions of Euro-banks' dollar reserves have been used for estimating the size of Euro-dollar multipliers based on Euro-bank claims vis-a-vis U.S. commercial banks. The definitions of the reserves differ by the type of claims (demand deposits or other liquid assets) and by the type of banks (all foreign banks or only foreign branches of U.S. banks). All definitions have an economic justification. It can easily be argued that not only demand deposits of foreign commercial banks at U.S. banks serve as reserves of Euro-banks but also their short-term liabilities. There are also good reasons for either including or excluding claims of foreign branches of U.S. banks on their parent banks. A reason for including them in the definition of Euro-bank reserves is the fact that some of these claims fulfill the function of reserves. Another part of these claims consists of loans by the branches to the parent banks. These loans have no reserve function. However, because they cannot be separated from the total, one could argue that claims of foreign bank branches on their parent banks should not be included into the definition of Euro-bank reserves.

All multipliers in Table 3 show an increasing trend over the time period covered. The data also indicate that the size of the Euro-dollar multiplier not only varies substantially from one reserve definition to another but also that it varies for a given definition of reserves over time. For the period under consideration the smallest quarterly multiplier is calculated as .9 and the greatest as 98.1. Among the five categories, the smallest average multiplier of 2.5 is given if short-term liabilities of U.S. banks to foreign commercial banks including foreign branches of U.S. banks are defined as reserves. The highest average multiplier of 23.1 is derived for short-term liabilities of U.S. banks to their foreign branches in the United Kingdom.

The large fluctuations of the different multipliers over time are reflected in the standard deviations and the coefficients of variation. For three definitions of reserve-multipliers (columns 2, 4, and 5 in Table 3) the standard deviation is greater than the mean and, therefore, the coefficient of variation is greater than unity. These statistical characteristics indicate a very unstable relationship between Euro-banks' dollar reserves with U.S. commercial banks and the net size of the Euro-dollar market.1/ Only for demand deposits of foreign commercial banks with large U.S. banks and for short-term liabilities of U.S. banks to foreign commercial banks including foreign branches of U.S. banks, are the ratios more stable.

1/ It should be noted that the impact of interest rate changes has been abstracted from the analysis.

Table 3. Ratios of the Net Size of the Euro-dollar Market (NSED) to Alternative Definitions of Euro-bank Reserves

Quarter	(1) NSED over demand deposits of foreign commercial banks with large U.S. banks	(2) NSED over demand deposits of foreign commercial banks with all U.S. banks including foreign branches of U.S. banks	(3) NSED over short-term liabilities of U.S. banks to foreign commercial banks including foreign branches of U.S. banks	(4) NSED over short-term liabilities of U.S. banks to all their foreign branches	(5) NSED over short-term liabilities of U.S. banks to their foreign branches in the United Kingdom
1964 I	5.000	1.307	0.934	4.254	7.703
II	5.214	1.368	0.959	4.420	7.820
III	5.284	1.377	0.972	4.577	7.927
IV	6.135	1.464	1.042	5.294	8.988
1965 I	5.654	1.416	0.961	4.900	8.167
II	5.943	1.545	1.018	4.747	7.776
III	5.917	1.517	1.017	4.943	7.969
IV	6.806	1.737	1.175	5.846	8.604
1966 I	6.080	1.580	1.085	4.878	6.934
II	6.434	1.670	1.157	4.817	6.765
III	7.214	1.671	1.164	3.558	4.798
IV	8.208	1.738	1.182	3.160	4.221
1967 I	8.070	1.858	1.245	3.618	5.017
II	8.185	1.930	1.318	3.970	5.482
III	8.630	1.848	1.300	3.592	4.746
IV	9.119	1.822	1.290	3.519	4.589
1968 I	9.945	1.972	1.403	3.626	4.699
II	10.592	1.914	1.382	3.340	3.934
III	10.983	1.813	1.326	2.844	3.612
IV	11.497	1.978	1.458	3.116	4.049
1969 I	12.584	1.957	1.427	2.780	3.585
II	15.670	2.153	1.546	2.815	3.486
III	16.364	1.929	1.398	2.806	3.650
IV	16.333	2.057	1.482	2.779	3.777
1970 I	15.476	2.270	1.565	2.822	3.882
II	16.915	2.504	1.720	3.150	4.291
III	17.400	2.703	1.862	3.660	4.978
IV	19.760	3.417	2.408	5.449	7.472
1971 I	18.915	4.505	2.916	8.770	12.469
II	20.031	6.516	3.375	18.722	28.669
III	18.992	6.605	3.567	18.020	26.610
IV	21.152	6.490	4.635	17.076	23.687
1972 I	21.036	16.802	4.768	26.969	43.463
II	20.338	15.112	4.307	23.938	40.074
III	19.701	15.404	4.608	31.650	55.692
IV	21.208	16.290	4.733	32.978	59.158
1973 I	22.699	17.148	5.439	36.318	62.123
II	21.177	14.797	5.191	35.152	76.944
III	21.321	15.291	5.163	33.790	75.690
IV	22.743	15.099	5.499	41.228	98.141
1974 I	22.878	15.657	5.346	36.459	90.509
II	23.905	16.027	4.822	25.870	46.249
III	22.240	16.229	4.153	23.968	48.139
IV	23.814	16.937	4.376	32.345	68.579
Minimum value	5.000	1.307	0.934	2.779	3.486
Maximum value	23.905	17.148	5.499	41.228	98.141
Mean	14.172	6.078	2.493	12.558	23.071
Standard deviation	6.632	6.227	1.659	12.723	27.454
Coefficient of variation	0.468	1.025	0.665	1.013	1.190

Sources: Net size of the Euro-dollar market: Calculated by assuming that the percentage share of dollars in the total net size of the Euro-currency market is the same as for the gross Euro-currency liabilities of the eight reporting countries. Net and gross size of the Euro-currency market: Bank for International Settlements; (1), (2), (3) Federal Reserve Bulletins; (4), (5) Treasury Bulletins.

The empirical analysis of the Euro-dollar multipliers based on Euro-bank claims against U.S. commercial banks show that this type of multiplier approach is not a very meaningful concept. It is statistically extremely difficult to determine the precautionary reserves of Euro-banks. The multipliers derived are unstable and unpredictable.[1/] There are also some theoretical problems. The approach assumes that an increase in the claims of Euro-banks on U.S. banks leads to an expansion of Euro-banks' deposits.

Domestic commercial banks are seen as suppliers of reserves which form the base for the credit-and-deposit expansion process of commercial banks operating in the Euro-currency market. However, in reality these reserves are determined by the Euro-banks themselves in relation to the expansion of their deposits.

In addition, this multiplier like the initial deposit multiplier is derived from a two-stage banking system, consisting only of commercial banks and Euro-banks. It ignores the fact that Euro-banks cannot operate in isolation from a domestic banking system that has to include the central bank. Therefore, a thorough analysis of money creation in the Euro-currency market has to be performed within the framework of a three-stage banking system. Such an approach will be presented within the next section.

VI. Bank Reserve Multiplier: Three-Stage Banking System

The interdependence between the Euro-banking system and the various national systems has been underlined very clearly by Friedman.[2/] Obviously, by applying the analogy between the Euro-banking system and the Chicago banking system Friedman wanted to point out that the Euro-banks need a lender of last resort like the Chicago banks do. The main difference is that Chicago banks directly hold reserves in the form of base money while Euro-banks absorb cash reserves only indirectly in the country of issue. These indirect reserves are reserves which are held by domestic commercial banks against the deposits of Euro-banks.

The indirect absorption of base money reserves through the Euro-banks influences the expansion of domestic deposits and of total deposits defined as domestic deposits plus Euro-deposits. For example, if the amount of reserves in a country is given, the indirect absorption of a part of it by the Euro-banks leaves less reserves available for domestic deposit creation. As a result, the expansion of Euro-deposits reduces the creation of domestic deposits. However, the total volume of deposits which can be created on a given reserve base will increase.

1/ For the very same reason the applicability of this multiplier approach to an analysis of the Euro-currency market has been rejected by Rainer S. Masera, "Deposit Creation, Multiplication and the Euro-Dollar Market," A Debate on the Eurodollar Market, Ente per gli Studi Monetari, Bancari e Finanziari, Quaderni di Ricerche, Numero 11, pp. 158-75, Rome, 1972.

2/ See Milton Friedman, "The Euro-Dollar Market: Some First Principles," The Morgan Guaranty Survey, October 1969, pp. 4-14.

In order to demonstrate the interdependence between commercial banks' reserves, domestic deposits, Euro-deposits and total deposits we have to begin with two simple multiplier relationships: the relationship between domestic deposits (demand plus time deposits) and reserves which back these deposits:

$$(6) \quad D_{dt} = \frac{1}{r_{dt}} R_{dt}$$

and the relationship between Euro-deposits and the reserves which back them:[1/]

$$(7) \quad ED = \frac{1}{r_e r_E} R_e$$

D_{dt} = demand and time deposits of nonbank residents.

ED = Euro-deposits in domestic currency denomination.

ER = precautionary reserves of Euro-banks in the form of deposits with domestic banks.

R_{dt} = reserves of domestic banks on nonbank residents' deposits.

R_e = reserves of domestic banks on Euro-bank deposits.

$r_{dt} = R_{dt}/D_{dt}$ = average reserve ratio for demand and time deposits.

$r_e = R_e/ER$ = reserve ratio for deposits of Euro-banks at domestic banks.

r_E = ER/ED = ratio of Euro-bank deposit reserves at domestic banks to Euro-deposits.

Let us assume the following values of the parameters: $r_{dt} = .10$, $r_e = .20$, $r_E = .10$. In that case it is possible to create 10 units of domestic deposits or 50 units of Euro-deposits on each unit of base money reserves. If the commercial banking sector of a country has 100 units of reserves available of which 95 units are devoted to domestic deposits while 5 units are related to Euro-deposits, domestic deposits can increase to a volume of 950 and Euro-deposits to 250. The volume of total deposits would then amount to 1,200. In the absence of the Euro-currency market only 1,000 units of deposits could have been created.

1/ A bank reserve multiplier for a three-stage banking system which relates the total amount of deposits to the total amount of reserves is derived in Appendix B.

Thus, for a given amount of reserve money, the Euro-currency market enables the banking system to expand the total volume of deposits by 20 per cent.

The approach outlined will be utilized to calculate the volume of Euro-deposits which have been "created". "Created" Euro-deposits are defined as the difference between the total amount of Euro-deposits and the domestic deposits which could have been created on the volume of reserves indirectly absorbed by Euro-banks.1/ Returning to our previous example, we may conclude that 80 per cent of the Euro-deposits have been "created". This percentage is arrived at by taking the difference between the 250 units of Euro-deposits actually in existence and the 50 units of domestic deposits that could have been supported by the 5 units of base money and setting this net Euro-deposit "creation" of 200 units in relation to the total amount, 250 units, of Euro-deposits.

Empirical estimates of U.S. dollar and German mark "creation" in the Euro-currency market are shown in Table 4. Column 1 of this table presents the precautionary balances of Euro-banks. It is assumed that Euro-banks hold dollar demand deposits at U.S. banks as precautionary balances against their dollar liabilities and demand deposits denominated in German marks at banks in Germany as precautionary balances against their German mark liabilities.

In column 2 the required reserve ratios on foreign demand deposits are reported. With the exception of deposits of foreign branches of U.S. banks the Federal Reserve Bank applies the same reserve ratio to deposits of residents and nonresidents. Because Euro-banks and their correspondent banks in the United States are mainly large banks the reserve ratio for demand deposits of large reserve city banks has been chosen as the appropriate reserve ratio for the United States.

Reserve requirements on deposits of foreign branches of U.S. banks were imposed for the first time in October 1969. Since then the reserve ratio has been as high as 20 per cent.2/ However, many exemptions reduced the effective rate. A sizable impact on the total amount of reserves only occurred in 1969/70 and 1974 when interest rates were higher in the United States than in Europe. In these periods U.S. banks borrowed heavily from their foreign branches in order to circumvent a restrictive monetary policy. For example, in the 1969/70 period the largest monthly amount of required reserves that U.S. banks had to hold against deposits of their foreign branches was $424 million in October 1969. During the 1974 period the highest amount was $304 million in August of that year. On the other hand, when the reserve ratio of 20 per cent was imposed, foreign branches of U.S. banks held hardly any deposits with their parent banks and consequently the amount of required reserves dropped to a few million dollars.

1/ This approach was first used by Ann-Marie Meulendyke, Causes and Consequences of the Euro-Dollar Expansion, unpublished Ph.D. dissertation, Chicago, May 1975, pp. 21-29.

2/ The required reserve ratio was 10 per cent originally. It was increased to 20 per cent in January 1970 and reduced to 8 per cent in June 1973. Since May 1975 it has been 4 per cent.

Table 4. U.S. Dollar and German Mark "Creation" in the Euro-currency Market

- Annual Averages of Quarterly Data -

Year	(1) Demand deposits of foreign commercial banks denominated in U.S. dollars and German marks	(2) Required reserve ratios for demand deposits of foreign commercial banks	(3) Required reserves for demand deposits of foreign commercial banks (1) x (2)	(4) Average reserve ratio for domestic deposits	(5) Euro-reserve divided by average reserve ratio for domestic deposits (3):(4)	(6) Net size of Euro-dollar and Euro-marks market	(7) Euro-money "created" (6) - (5)	(8) Ratio of Euro-money "created" to total Euro-money (7) : (6)
	U N I T E D S T A T E S - Billions of U.S. Dollars							
1964	1.198	.165	.198	.096	2.062	6.510	4.448	.683
1965	1.298	.165	.214	.093	2.301	7.900	5.599	.709
1966	1.427	.165	.235	.092	2.554	9.970	7.416	.744
1967	1.507	.165	.249	.089	2.798	12.820	10.022	.782
1968	1.733	.170	.295	.090	3.278	18.650	15.372	.824
1969	2.018	.175	.478	.093	5.140	30.830	25.690	.833
1970	2.243	.175	.552	.094	5.872	39.020	33.148	.850
1971	2.372	.175	.429	.088	4.875	46.920	42.045	.896
1972	2.821	.175	.511	.085	6.012	58.010	51.998	.896
1973	3.475	.175	.645	.077	8.377	76.510	68.133	.891
1974	4.910	.180	1.099	.077	14.272	114.020	99.748	.875
	G E R M A N Y - Billions of German Marks							
1964	1.693*	.081**	.137	.080	1.713	2.140	.427	.200
1965	1.786*	.102**	.182	.084	2.167	2.460	.293	.119
1966	1.798*	.100**	.180	.082	2.195	2.700	.505	.187
1967	1.788*	.121	.216	.063	3.429	4.840	1.411	.292
1968	3.001*	.103**	.310	.053	5.849	7.920	2.071	.261
1969	4.423	.154**	.681	.063	10.809	13.010	2.201	.169
1970	3.926	.114	.448	.071	6.310	17.260	10.950	.634
1971	4.936	.349	1.723	.092	18.728	30.390	11.662	.384
1972	6.442	.359	2.313	.097	23.845	38.900	15.055	.387
1973	7.834	.400	3.134	.126	24.873	52.620	27.747	.527
1974	7.161	.343	2.456	.110	22.327	65.280	42.953	.658

Sources: United States: (1), (2), (4) Federal Reserve Bulletins; (6) Bank for International Settlements. (Calculated by assuming that the percentage share of dollars in the total net size of the Euro-currency market is the same as for the gross Euro-currency liabilities of the eight reporting countries.) The annual averages of the monthly required reserves on deposits of the foreign branches of U.S. banks with their parent banks have been added to (3). 1969: $125 million; 1970: $159 million; 1971: $14 million; 1972: $17 million; 1973: $37 million; and 1974: $215 million.

Germany: (1), (2) Deutsche Bundesbank and Monthly Reports of the Deutsche Bundesbank (*Estimated by assuming that 40 per cent of total short-term liabilities of German commercial banks against foreign commercial banks are demand deposits denominated in German marks. ** Calculated by relating the absolute amounts of required reserves against foreign demand deposits to demand deposits of foreign commercial banks); (4) Monthly Reports of the Deutsche Bundesbank; (6) Bank for International Settlements. (Calculated by assuming that the percentage share of German marks in the total net size of the Euro-currency market is the same as for the gross Euro-currency liabilities of the eight reporting countries).

In Germany, legal reserve requirement changes were more often and more intensively used than in the United States as a policy tool. Special reserve ratios and marginal reserve requirements were introduced for deposits of nonresidents in order to dampen the impact of capital inflows on the domestic money supply. The legal reserve policy varied consideraly during the period under consideration. From 1961 to 1966 only liabilities of commercial banks vis-a-vis foreigners, which exceeded their own foreign assets, were subject to required reserve holdings. Marginal reserve ratios, often up to 100 per cent, were applied in 1968 and 1969. Due to the imposition of marginal reserve requirements vis-a-vis nonresidents the officially published reserve ratios against foreign demand deposits could not be utilized for some years in column 2 of Table 4. For these years the effective average ratio had to be estimated using available data on the total amount of required reserves against demand deposits of all nonresidents, banks and nonbanks.

The total volume of domestic bank reserves which are indirectly absorbed by the Euro-banks is calculated in column 3. Column 5 calculates how much domestic money could have been created on the basis of these reserves. The difference between the potential domestic money creation and the net size of the Euro-currency market is called Euro-money "created" (column 7). Column 8 shows the volume of Euro-money "created" as a percentage of the net size of the corresponding Euro-currency denomination. For Euro-dollars the "created" portion was always very high. On the average, 82 per cent of Euro-dollars have been "created" during the 1964-74 period. For the last five years the average was close to 90 per cent.

The large creation of Euro-dollars is the result of the fact that the Euro-dollar market only absorbs a small amount of base money reserves in the United States. This is mainly due to two reasons: First, a large part of Euro-dollar transactions goes through the foreign branches of U.S. banks for which the effective reserve ratio has been relatively small. Second, no special reserve requirements have been imposed on deposits of foreign commercial banks.

Foreign branch banking of German commercial banks is not as important as foreign branch banking of U.S. banks. Therefore, demand deposits of foreign commercial banks denominated in German marks are much higher in relation to the net size of the Euro-mark market than the corresponding data for the United States. Also, particularly high reserve requirements were sometimes imposed on deposits of nonresidents in Germany. Consequently, the percentage share of German marks "created" in the Euro-currency market is much smaller than the "creation" of Euro-dollars. During the 1964-74 period on average only 35 per cent of all Euro-marks were "created". However, the proportion of Euro-marks "created" varies considerably from year to year. This is, on the one hand, the result of large changes in the required reserve ratios and, on the other hand, a consequence of the irregular growth of the Euro-mark market. Nevertheless, the proportion of Euro-marks "created" showed an increasing tendency, with 52 per cent of all Euro-marks being "created" over the last five years.

In Switzerland, required reserves did not exist before September 1971. Until that time almost all of the expansion of Euro-Swiss francs was a net addition to the money stock. Unfortunately, no detailed data are available that would allow an estimate of the impact of reserve requirements on the creation of Swiss francs in the Euro-currency market since 1971.

The utilization of the three-stage framework has the advantage of showing simultaneously the relationship between base money reserves, Euro-deposits and domestic deposits. It takes into consideration that the Euro-currency market is connected to a domestic banking system. Conceptually, this is a very adequate approach. However, the economic meaning of the bank reserve multiplier for Euro-deposits is different from the domestic deposit multiplier. The domestic multiplier concept is based on the fact that an increase in reserves leads to a predictable increase in deposits. This is not the case for the Euro-currency market. The Euro-currency market absorbs domestic base money reserves as a result of the expansion of Euro-deposits. Despite this fact, it is interesting to know how many Euro-deposits are backed by one unit of reserve money and to what extent the existence of the Euro-currency market allows for additional money creation. These questions can be answered within the above approach.

Crucial for the empirical estimates is the identification of the base money reserves absorbed by the Euro-currency market. In the above analysis the estimates are based on demand deposits of foreign commercial banks. There are two problems associated with this variable: (1) it may be too small because time deposits with U.S. banks and other types of assets could also serve as precautionary balances of Euro-banks; and (2) the variable includes deposits of commercial banks from outside the Euro-banking system which cannot be separated. Considering these insufficiencies, demand deposits of foreign commercial banks should only be considered as a proxy for Euro-banks' precautionary reserves.

VII. Base Money Multiplier

In this section the traditional multiplier approach for a domestic economy relating the monetary base of a country to its money stock M_2 is expanded to incorporate Euro-currencies. Euro-currencies and the indirect reserve absorption of Euro-banks are easily integrated into the base money multiplier concept. If Euro-deposits denominated in domestic currency are added to the domestic money stock, the following multiplier relationship is derived:

$$(8) \quad M_E = m_E B$$

with

$$(9) \quad m_E = \frac{1 + c + t + e}{c + r_d + r_t t + r_e r_E e} \quad \underline{1}/$$

1/ For a derivation of the multiplier see Appendix B.

M_E = C + D + T + ED = total money stock

B = C + R = monetary base

C = currency

R = total reserves of domestic banks

R_d = reserves on demand deposits of residents

R_t = reserves on time deposits of residents

D = demand deposits of nonbank residents

T = time deposits of nonbank residents

c = C/D = currency ratio

t = T/D = time deposit ratio

e = ED/D = Euro-deposit ratio

r_d = R_d/D = reserve ratio for demand deposits of residents

r_t = R_t/T = reserve ratio for time deposits of residents

The size of the coefficients in the multiplier m_E cannot be determined on theoretical grounds but only by empirical observations. Estimates which have been computed for the United States, Germany and Switzerland show that all coefficients with the exception of t are positive but smaller than one. These constraints guarantee that the multiplier m_E is greater than one. In addition, they imply that changes in the coefficients have the following impact on the multiplier:

$$\frac{\partial m_E}{\partial c}, \quad \frac{\partial m_E}{\partial r_d}, \quad \frac{\partial m_E}{\partial r_t}, \quad \frac{\partial m_E}{\partial r_e}, \quad \frac{\partial m_E}{\partial r_E} < 0 \quad \frac{\partial m_E}{\partial t}, \quad \frac{\partial m_E}{\partial e} > 0$$

The above framework can be used to relate the volume of Euro-deposits to the monetary base by a multiplier m_e.

$$(10) \quad ED = m_e B$$

with $$(11) \quad m_e = \frac{\alpha - c - t - 1}{c + r_d + r_t t + r_e r_E e}$$

$\alpha = M_E/D$ = ratio of total money stock to demand deposits of residents.

There are no nonnegative size constraints on this multiplier. m_e can be greater than one or smaller than one. Its value depends very much on the relative magnitude of the coefficients, α, c, and t. Changes in these coefficients affect the multiplier in the following way:

$$\frac{\partial m_e}{\partial c}, \frac{\partial m_e}{\partial r_d}, \frac{\partial m_e}{\partial r_t}, \frac{\partial m_e}{\partial r_e}, \frac{\partial m_e}{\partial r_E}, \frac{\partial m_e}{\partial e} < 0 \quad \frac{\partial m_e}{\partial t}, \frac{\partial m_e}{\partial \alpha} > 0$$

Estimates of the two multipliers for U.S. dollars, German marks and Swiss francs show that the values of m_E are very similar in the different countries, while the values for m_e deviate considerably from country to country. For the 1964-74 period the average multiplier m_E was 5.9 for U.S. dollars, 5.1 for German marks, and 5.7 for Swiss francs. For the same period the average value of m_e was .44 for Euro-dollars, .26 for Euro-marks and .70 for Euro-Swiss francs.

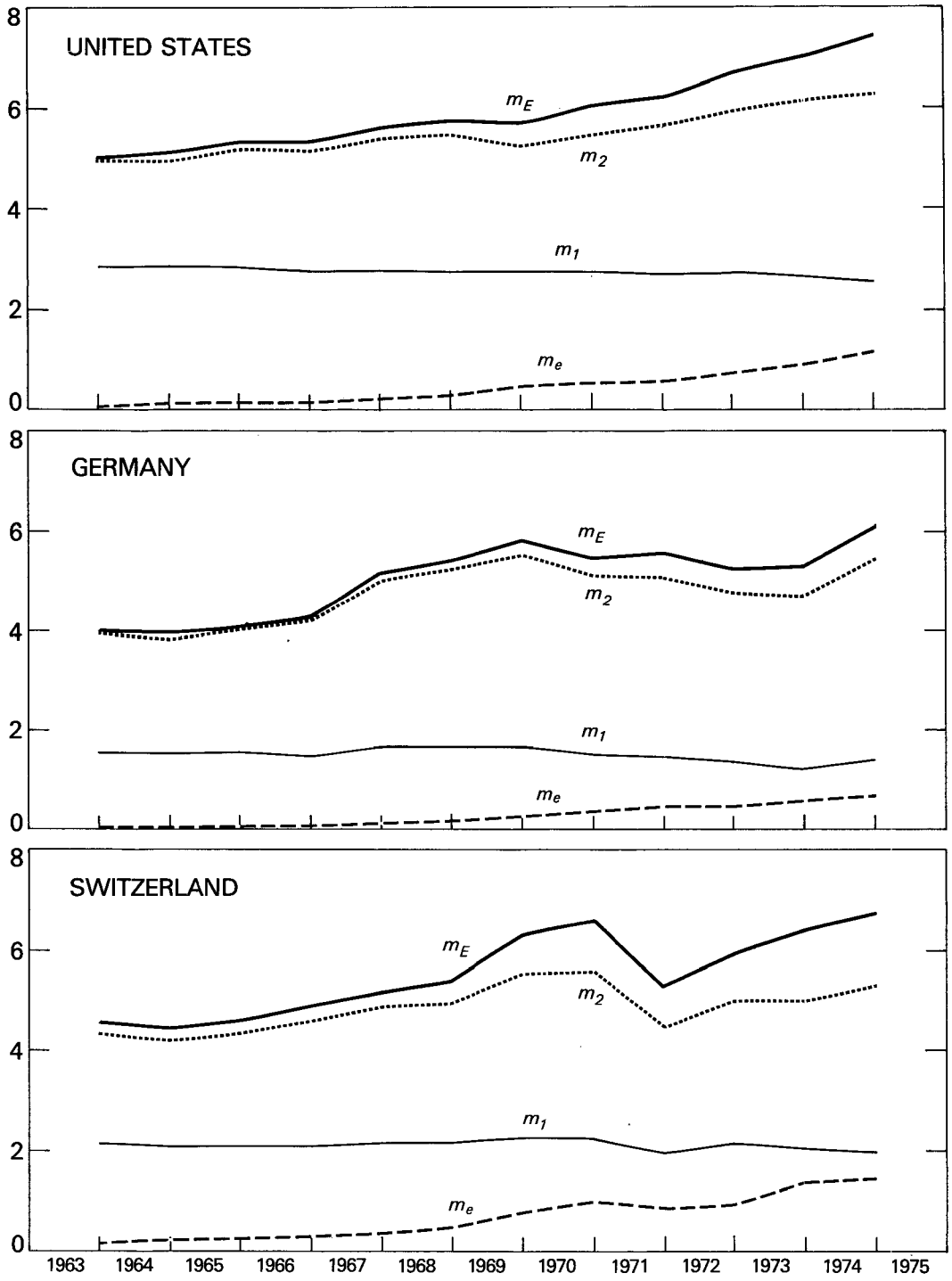
In Chart 3 the multipliers m_E and m_e are plotted together with two domestic money multipliers. m_1 is the money multiplier for currency plus demand deposits and m_2 the multiplier for the broader definition of money including time deposits. According to the underlying definitions the following relationships hold: $m_E > m_2 > m_1$. For m_e such a constraint does not exist. Of course, m_e cannot be greater than m_E. However, it can be greater than m_1 or even greater than m_2.

Chart 3 clearly indicates that in all three countries the relationship between the monetary base and the money stock in the narrow definition is the most stable. The relationship between base money and the broader definitions of money M_2 and M_E is characterized by less stability and a modest upward trend movement is apparent. A strong upward trend movement is observed for the Euro-currency multiplier m_e. This multiplier increased from .14 to 1.17 for U.S. dollars, from .06 to .68 for German marks and from .22 to 1.46 for Swiss francs during the period from 1964 through 1974.

The development of the Euro-money multiplier m_e shows that there is no systematic and stable relationship between base money and Euro-currencies for any of the three countries. Contrary to the domestic monetary aggregates the growth of Euro-dollars, Euro-marks, and Euro-Swiss francs is relatively independent of the growth of the monetary base in the respective countries. These results are confirmed if the relationship between changes in base money, Euro-money and other monetary aggregates is considered. The outcome of such an investigation in the form of simple correlations between first differences of the monetary base and various monetary aggregates is reported in Table 5.

Chart 3

ALTERNATIVE BASE MONEY MULTIPLIERS



Sources: Monetary base, M1, M2: International Monetary Fund, *International Financial Statistics:* Net size of Euro-deposits: *Bank for International Settlements. Annual Reports.* (Calculated by assuming that the percentage share of the different currencies in the total net size of the Euro-currency market is the same as for the gross Euro-currency liabilities of the eight reporting countries).

Table 5. Correlation Coefficients for Base Money and Different Monetary Aggregates

- First Differences of Quarterly Data -
(1964:II-1974:IV)

Δ Base Money	ΔM_1	ΔM_2	ΔM_E	Δ Euro-Money
U.S. dollars	.649	.606	.628	.416
German marks	.891	.873	.873	.178
Swiss francs	.567	.248	.087	-.055

Table 5 shows that for the three countries the strongest correlation exists between changes in the monetary base and changes in M_1. For the United States and Germany a fairly strong correlation also exists between base money and M_2 as well as base money and M_E. On the other hand, for all three countries the correlations between changes in base money and changes in the corresponding Euro-currencies are very poor.

The above multiplier framework can be used to measure the impact on Euro-money and the total money stock of a shift of deposits from the domestic market to the Euro-currency market. Because Euro-deposits absorb less base money reserves than domestic deposits such a shift frees reserves and, therefore, has an expansionary effect on monetary aggregates. In order to quantify this effect it has to be assumed that the coefficients in the multipliers are constant. For the very short run such an assumption might be acceptable.

For U.S. dollars and German marks the calculations are presented in Table 6. In this table the shift coefficients derived from the base money multipliers for Euro-money and the total money stock are estimated using ratios based on quarterly average data for 1974. As expected, the calculations show that the shift of one unit of domestic deposits to the Euro-currency market has a much stronger impact on the total money stock than on Euro-money. This is due to the fact that the multiplier for total money is much greater than the Euro-money multiplier. In addition, a shift of one unit of demand deposits affects the total money stock and Euro-money more than a shift of one unit of time deposits. This is the result of the different reserve ratios imposed on demand and time deposits. The central banks apply greater reserve ratios on demand deposits than on time deposits. Consequently, a shift of a unit of demand deposit frees more reserves and thus has a stronger impact than a shift of a unit of time deposits.

The empirical results may only give an approximate estimate of the magnitudes involved. However, they clearly indicate that the existence of the Euro-currency market leads to an expansion of monetary aggregates. They also indicate that the

Table 6. Short-run Impact on Total Money Stock and Euro-Money of a Shift of Domestic Deposits to the Euro-Currency Market

Shift of	Shift Coefficient	Impact on 1/ U. S. Dollars Total Money Stock	Impact on 1/ German Marks 2/ Total Money Stock
1. Demand deposits	$\frac{(r - r_e r_E e)(1+c+t+e)}{c+r_d+r_t t+r_e r_E e}$	$\frac{(.18-.18x.043x.564)(1+.316+1.914+.564)}{.316+.18+.06x1.914+.18x.043x.564}=1.47$	$\frac{(.18-.343x.043x.772)(1+.572+4.713+.772)}{.572+.18+.13x4.713+.343x.043x.772}=.86$
2. Time deposits	$\frac{(r_t - e_e r_E e)(1+c+t+c)}{c+rd+r_t t+r_e r_E e}$	$\frac{(.06-.18x.043x.564)(1+.316+1.914+.564)}{.316+.18+.06\ 1.914+.18x.043x.564}=.47$	$\frac{(.13-.343x.043x.772)(1+.572+4.713+.772)}{.572+.18+.13+4.713+.343x.043x.772}=.61$
	Euro - Money		
3. Demand deposits	$\frac{(r_d - e r_E e)(\alpha-1-c-t)}{c+r_d+r_t t+r_e r_E e}$	$\frac{(.18-.18x.043x.564)(3.794-1-.316-1.914)}{.316+.18x.06x1.914+.18x.043x.564}=.22$	$\frac{(.18-.343x.043x.772)(7.062-1-.572-4.713)}{.572+.18+.13+4.713+.343x.043x.772}=.10$
4. Time deposits	$\frac{(r_t - r_e r_E e)(\alpha-1-c-t)}{c+r_d+r_t t+r_e r_E e}$	$\frac{(.06-.18x.043x.564)(3.794-1-.316-1.914)}{.316+.18x.06x1.914+.18x.043x.564}=.07$	$\frac{(.13-.343x.043x.772)(7.062-1-.572-4.713)}{.572+.18+.13+4.713+.343x.043x.772}=.07$

1/ Coefficients calculated by using quarterly averages of data for 1974.
2/ Because of lack of data for Germany the U.S. coefficient is used as a proxy for r_E.

expansionary effect of a deposit shift on Euro-money itself is not what matters. What matters is the impact of the Euro-currency market on the total money stock. And this impact seems to be substantial.

One advantage of the application of the base money multiplier approach to an analysis of the Euro-currency market is that it provides a framework for measuring the relationship between the monetary aggregates involved. This advantage still holds even if the calculations show that there is no stable and predictable linkage. Another advantage is that the investigation is performed within a three-stage banking system. A clear disadvantage is that the approach does not show by which mechanism the Euro-currency market affects the monetary base and the other monetary aggregates. A further problem is that all Euro-deposits are treated as net additions to the domestic money stock.

VIII. Conclusion

The study has shown that the key to the understanding of money creation in the Euro-currency market does not lie in the existence of a high or low multiplier relationship between a variable identified as the reserves of Euro-banks and Euro-money. What matters is the impact of the Euro-currency market on the expansion of the total money stock. This impact may be large while the Euro-money multiplier which measures the effect of a shift of domestic deposits to the Euro-currency market is small.

For instance, dollar deposits shifted from a U.S. bank account into a Euro-dollar account may result in an initial deposit multiplier only slightly larger than one. However, one cannot conclude from this that the existence of the Euro-dollar market has only a small impact on the creation of additional dollar deposits. Because of the fact that the U.S. reserve base maintained on Euro-deposits is much smaller than on domestic deposits, reserve money in the United States is set free. These reserves in the U.S. banking system can then serve as the base for additional money creation in the United States. As a result of such additional money creation in the United States, together with the expansion of Euro-deposits, the total world money stock will increase.

A realistic approach to money creation in the Euro-currency market cannot neglect these interrelationships. Such an approach requires an analysis within a three-stage banking system where the interdependence between Euro-deposits, domestic deposits and bank reserves is considered. Some of the multiplier concepts examined in this paper do not do this and thus are inadequate for an investigation of money creation in the Euro-currency market.

The main shortcoming of the initial deposit multiplier is that it describes only the potential increase in Euro-deposits resulting from a shift of domestic deposits to the Euro-currency market. The effect of this shift on the reserve base of banks and the domestic money stock is not analyzed.

The bank reserve multiplier for a two-stage banking system has basically the same weakness. In addition, the statistical identification of the reserve base causes substantial problems. The size of the multiplier varies considerably, depending on the definition of the reserve base.

The bank reserve multiplier for a three-stage banking system has the clear advantage of showing the interrelationship between Euro-deposits, domestic deposits and the base money reserves of commercial banks. It makes the net addition of money which is related to the existence of the Euro-currency market measurable. Critical problems arise, however, in any attempt to identify the amount of base money reserves indirectly absorbed by the Euro-banks, and in judging the extent to which Euro-deposits may simply be added to the domestic money stock. As long as these problems cannot be resolved satisfactorily, a calculation of the net addition of deposits due to the existence of the Euro-currency market is possible by this method only with a due amount of caution.

The general results of the study can be summarized as follows:

1. All multiplier relationships involving the Euro-currency market are much more variable than domestic money multipliers.

2. The volume of Euro-currencies is demand determined. Because Euro-banks absorb only a relatively small proportion of domestic reserves the supply side adjusts easily to an expansion of demand.

3. The existence of the Euro-currency market increases the world-wide money stock, if the latter is defined inclusive of Euro-deposits.

APPENDIX A

List of Symbols

B	Monetary base
C	Currency
c	Currency ratio
D	Demand deposits of residents
D_{dt}	Total deposits of residents
EC	Euro-credits
ED	Euro-deposits
ER	Precautionary reserves of Euro-banks in the form of deposits with domestic banks.
e	Euro-deposit ratio
M_E	Total money stock
m_e	Euro-money multiplier
m_E	Total money multiplier
R	Total reserves of domestic banks
R_d	Reserves on demand deposits of residents
R_t	Reserves on time deposits of residents
R_{dt}	Reserves on deposits of residents
R_e	Reserves of domestic banks on Euro-bank deposits
r_d	Reserve ratio for demand deposits of residents
r_t	Reserve ratio for time deposits of residents
r_e	Reserve ratio for deposits of Euro-banks with domestic banks.

r_E Ratio of Euro-bank deposit reserves at domestic banks to Euro-deposits.

T Time deposits of residents

t Time deposit ratio

α Ratio of total money stock to demand deposits of residents.

APPENDIX B

1. Derivation of the Bank Reserve Multiplier for a Three-Stage Banking System.

This multiplier relates the total amount of deposit, i.e., domestic demand and time deposits plus Euro-deposits to the total amount of base money reserves of the domestic commercial banking system. Total deposits are defined as:

$$(A1) \qquad D_E = D_{dt} + ED$$

If the relationship between Euro-deposits and domestic deposits is expressed by the coefficient e ($e = ED/D_{dt}$) the above equation becomes:

$$(A2) \qquad D_E = (1 + e)\, D_{dt}$$

Total reserves are given by:

$$(A3) \qquad R = R_{dt} + R_e$$

Utilizing the different reserve ratios and the coefficient e equation (A3) can be transformed to:

$$(A4) \qquad R = (r_{dt} + r_e r_E e)\, D_{dt}$$

Combining (A2) with (A4) gives the following multiplier relationship:

$$(A5) \qquad D_E = \frac{1 + e}{r_{dt} + r_e r_E e} R$$

2. Derivation of the Base Money Multiplier for Total Money Stock.

In this approach the money stock of a country is defined to include currency, demand deposits, time deposits and Euro-deposits denominated in the domestic currency.

$$(A6) \qquad M_E = C + D + T + ED$$

Substitution of the currency ratio, the time deposit ratio and the Euro-deposit ratio into (A6) gives:

$$(A7) \qquad M_E = (1 + c + t + e)\, D$$

The monetary base consists of currency in circulation, bank reserves on demand and time deposits of residents and bank reserves on deposits of Euro-banks.

$$(A8) \qquad B = C + R_d + R_t + R_e$$

Equation (A8) can be transformed into:

$$(A9) \quad B = cD + r_d D + r_t tD + r_e r_E eD$$

which gives:

$$(A10) \quad B = (c + r_d + r_t t + r_e r_E e)\, D$$

The base money multiplier:

$$(A11) \quad m_E = \frac{1 + c + t + e}{c + r_d + r_t t + r_e r_E e}$$

is obtained from (A7) and (A10).

3. Derivation of the Base Money Multiplier for Euro-Deposits

A relationship between Euro-deposits and the monetary base can be constructed in a similar way as the relationship between the total money stock and the stock of base money. For this purpose, Euro-deposits are defined from equation (A6).

$$(A12) \quad ED = M_E - C - T - D$$

If the total money stock M_E is related to domestic demand deposits by a coefficient α ($\alpha = M_E/D$) equation (A12) becomes:

$$(A13) \quad ED = (\alpha - c - t - 1)\, D$$

Combining (A13) with (A10) gives the base money multiplier for Euro-deposits:

$$(A14) \quad m_e = \frac{\alpha - c - t - 1}{c + r_d + r_t t + r_e r_E e}$$